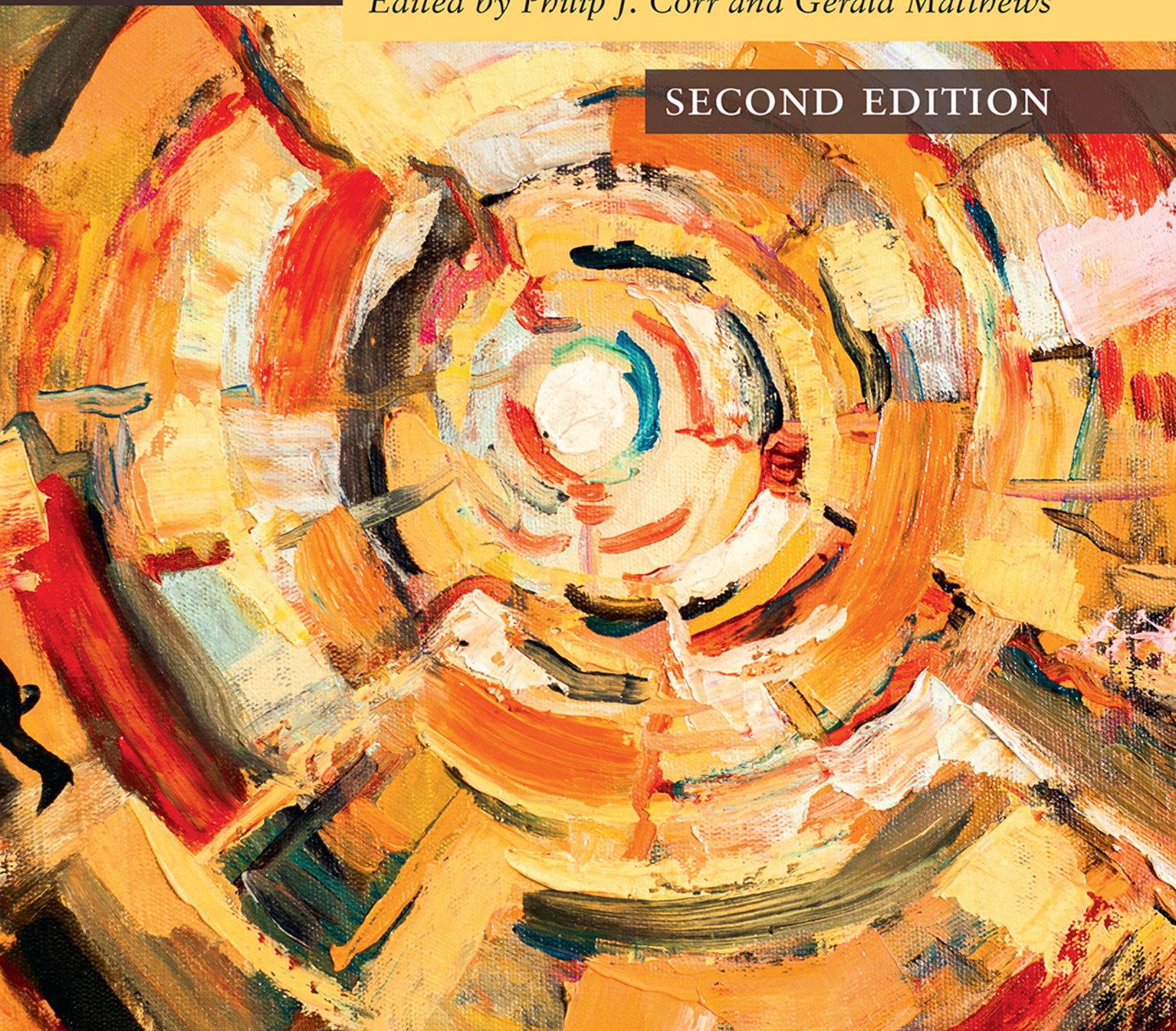


THE CAMBRIDGE HANDBOOK OF
**PERSONALITY
PSYCHOLOGY**

Edited by Philip J. Corr and Gerald Matthews

SECOND EDITION



THE CAMBRIDGE HANDBOOK OF PERSONALITY PSYCHOLOGY

Second Edition

Research in personality psychology is making important contributions to psychological science and applied psychology. This second edition of *The Cambridge Handbook of Personality Psychology* offers a one-stop resource for scientific personality psychologists. It summarizes cutting-edge personality research in all its forms, including genetics, psychometrics, social-cognitive psychology, and real-world expressions, with informative and lively chapters. The team of renowned international authors, led by two esteemed editors, ensures quality and a wide range of theoretical perspectives that characterise the whole field of personality psychology. Each area is discussed in terms of scientific foundations, main theories and findings, and future directions for research. The handbook features advances in technology, such as molecular genetics and functional neuroimaging, as well as contemporary statistical approaches. An invaluable aid to understanding the central role played by personality in psychology, it will appeal to students, researchers, and practitioners in psychology, behavioral science/neuroscience and the social sciences more broadly.

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Preface

The second edition of *The Cambridge Handbook of Personality Psychology* is a major update of the 2009 first edition. It is different in a number of crucial respects. First, and most importantly, chapters are longer, more detailed and pitched at a higher level, which will better meet the needs of graduate students, researchers and more seasoned academics. Second, there is now a more even and adequate coverage of the whole of personality psychology – not only compared to the first edition but, we believe, to similar handbooks on the market. Third, the first edition had separate chapters on a number of psychopathological disorders; for conceptual depth and clarity, the second edition has fewer chapters of a more integrative and comprehensive character. They focus on the relationships between personality and clinical psychology, models of mental health, and anxiety, depression and cognitive dysfunction – there is also a related chapter on models of physical health. Lastly, some new topics have been added: accuracy in person perception, the unconscious, needs, goals and motivation, and social and economic behavior. In addition, recognizing its growing prominence, the Appendix contains a chapter on statistical analysis and computer programming.

We continue to believe that the study of personality requires an unusual feat of scientific vision. Those of us working in the field need to focus narrowly on one or a few topics, while simultaneously maintaining a wide-angle view of the broader psychological landscape. This is not easy. For this reason, a handbook of this nature yields a special value in reminding us of what exists beyond our own, necessarily narrow, field – we hope this serves to foster collaborative effort, leading to greater integration across theoretical and applied psychology. In pursuit of this, the handbook aims to balance a comprehensive account of the current state of the science with perspectives on how the field has evolved since the first edition, along with its likely future trajectories.

The line-up of contributors to the handbook is outstanding. All are internationally renowned scholars with a wealth of expertise, knowledge and authority. The quality of this handbook could not have been achieved without them. We appreciate especially their willingness to strive for consistency between chapters, adhering as far as possible to the [following chapter](#) structure: (1) introduction, including historical developments and how their topic is positioned in relation to personality psychology more generally; (2) a thorough review of the seminal studies in the field, with discussion of methodologies and statistical procedures typically used; (3) critically appropriate presentation of the state of play of the literature with discussion of the crucial problems that dominate; (4) delineation of emerging issues for present/future research; and (5) summary of major findings, challenges and limitations.

We are grateful to Cambridge University Press who encouraged the second edition, and especially to the Commissioning Editor, Janka Romero, for her unfailing guidance and support throughout.

Philip J. Corr
Gerald Matthews

General Introduction

PHILIP J. CORR AND GERALD MATTHEWS

In the Editors' General Introduction to the first (2009) edition of this handbook, we acclaimed the success of the trait approach to personality (Matthews, Deary & Whiteman, 2009). Since that time, this approach has been boosted by growing consensus among researchers on the nature and measurement of the major traits, by remarkable advances in genetics and neuroscience, by increasing integration with various fields of mainstream psychology, and by applied utility – the maturity of the field is attested by the establishment of new journals, notably *Personality Neuroscience* (published by Cambridge University Press; see Corr & Mobbs, 2018). Such has been progress, trait researchers now pursue “normal science” (Kuhn, 1962): Common core assumptions are shared about the nature of personality and former vexatious positions are seen as far less relevant. There is a reasonable agreement on dimensional models, the importance of both biological and social factors, and the dependence of behavior on person $\times$ situation interaction. Within this consensus, a variety of still-burning questions remain (Fajkowska & Kreitler, 2018); for example, on the causal status of traits, sources of stability and change in personality over the lifespan, and the respective roles of trait and state factors in behavior.

We must also acknowledge advances in alternative conceptual models for personality that build on the social-cognitive, humanistic and idiographic traditions of the field (Cloninger, Chapter 1). Historically, proponents of different schools of personality research tended to talk past – sometimes even over – each other. Concomitantly, debate often devolved into forced choices between rigidly dichotomous alternatives: genes versus environment, brain processes versus social learning, trait versus situation, nomothetic vs. idiographic, conscious versus unconscious, fixed versus changing. The accumulation of empirical evidence has demonstrated the sterility of these choices – “all of the above” are required for a full account of personality.

The existence of multiple perspectives on personality does not necessarily imply that we can or should aim for a grand, integrated theory, although some have tried (for a special issue on this topic, see Corr, 2020). Some theories

may diverge so much from trait models in their basic assumptions that no conceptual integration is possible, or indeed desirable. For example, “Viewed through the constructionist lens, the person ceases to be a unified ensemble of stable psychological structures and traits and becomes a fluid, fractured, and changeable assemblage, distributed across and produced through social interactions and relationships” (Burr, 2018, p. 1). It is difficult to anticipate productive dialogue between trait theorists and radical constructionists.

However, the growing convergence of trait theory with traditionally divergent perspectives is a cause for optimism. Unconscious elements of personality – previously the deep and dark preserve of psychoanalysis – are now studied rigorously as implicit traits (De Cuyper et al., 2017). McAdams (2015) suggests integration of trait perspectives on personality development with two others. He points to individuals as motivated agents who develop a stable theory of mind, goals and values; and cognitive and motivational perspectives (e.g., Carver, Chapter 22) illustrate how this perspective adds to the explanatory value of traits. McAdams (2015) also emphasizes that people are autobiographic authors who construct and share life stories, or narrative identities – past research recognizes stability in life stories. Hence, this perspective provides a departure point for regarding the narrative approach as complementary rather than opposed to trait theory – it may also provide a meeting point between trait models and both qualitative and idiographic approaches.

Trait theory may never satisfy those seeking to understand the individual person or the intimacy of the person-situation relationship, or the humanists that want to help humankind. However, while different schools of personality research may be traveling to different destinations, they are increasingly willing and able to communicate with one another. For example, Poropat and Corr (2015) proposed a “Cronbachian” approach to integrative personality theory that goes beyond typical trait models in accommodating multiple sources of variance, including contextual factors, observers' perceptions of the individuals and intra-individual differences.

This second edition of the handbook has been thoroughly updated, with expanded chapters of those that were included in the first edition and with the addition of chapters of central relevance to personality psychology. As would be appropriate, the foundational issues are retained from the first edition and the Applications section (Part VII) has been systematized to reflect the broad range of domains. There is also a statistical analysis and computer programming appendix which reflects the increasingly analytical sophistication of the field. As a comparison of both editions will show, this second handbook is representative of the entire field of personality as it is today. The quality of chapters is assured by the status of the contributors who are leading researchers in their respective fields.

FOUNDATIONAL ISSUES

Part I of the present handbook introduces some of the basic conceptual issues that have shaped inquiries into personality. In this Introduction, we highlight: (1) the psychological meaning of measures of personality; (2) the coherence of personality in a holistic sense; and (3) the role of personality in predicting behavior. Prediction of behavior has often been a primary selling point for the trait approach, demonstrating that quantitative trait measurement has “added value” beyond a superficial description of self-evaluations (Costa & McCrae, 1992). However, meaning and coherence have proved more challenging, especially if we want a psychological understanding of traits that goes beyond a simple identification between the trait and individual differences in a specified brain system (Matthews, 2016).

A strictly constrained neuroscience of personality has the advantage of conceptual clarity and an ever-increasing methodological sophistication. If traits are direct expressions of activity in brain systems for arousal (Eysenck, 1967) or motivation (Gray, 1981), both meaning and coherence are defined by theories of the brain systems concerned. However, this perspective on traits is only satisfactory if we are willing to commit to strong neural (or “greedy”) reductionism (Lilienfeld, 2007; Smillie, Zhao & Barford, 2014). While such a commitment is necessarily anathema to cognitively oriented researchers, contemporary neurobiological researchers increasingly incorporate abstract knowledge representations into theory. For example, the goal conflict resolution approach central to Gray’s (1981) account of the Behavioral Inhibition System implies some representation of approach and avoidance goals (McNaughton & Corr, 2004; see Corr & Krupic, 2017). Conversely, cognitive-social accounts of personality that ignore the neurological substrate are incomplete. That is, whatever the researcher’s initial starting point for theory, a satisfactory account of personality requires reference to multiple conceptual frameworks.

Alternative conceptual frameworks can be defined and integrated within the trilevel explanatory framework of

the “classical theory” of cognitive science (Pylyshyn, 1999). Complex, “intelligent” systems are organized at three different levels: biophysical, symbolic and semantic. The biological or physical level describes the physical and chemical processes that support the functional properties of symbolic information-processing and corresponds to neuroscience. The intermediate symbolic or syntactic level refers to a formal algorithm for computing representation-based problems, corresponding to computational cognitive psychology. The semantic or knowledge level refers to relationships between abstract representations, including but not limited to declarative beliefs. It may also be construed as an account of system operation in terms of rational principles, including system goals (Newell, 1982). The trilevel framework distinguishes different strands of personality research, relating to neurological bases, formal information-processing models and high-level accounts of the self and personal motivations (Matthews, 2004a, 2018).

The trilevel framework also provides a basis for an explanatory pluralism (Lilienfeld, 2007) in personality theory that recognizes the value of theories at different levels of explanation. Higher levels are emergent from lower levels, but emergent cognitive phenomena are diverse and complex (Sloman, 2009), so that multiple layers of theory are not directly commensurate with each other. We can, nevertheless, pursue a “patchy reductionism” (Lilienfeld, 2007) that might, for example, map cognitive to neural constructs within some limited domain. Such an approach may not satisfy social constructivists and humanistic theorists, but it does bring a diversity of scientific approaches to personality into a common arena.

The cognitive science perspective also implies that meaning and coherence may look different at different levels. We can variously attribute traits to individual differences in the calibration of brain systems shaped by evolution, in biases in the functional cognitive architecture that controls information-processing, and in the person’s high-level understanding of their place in the world. For example, anxiety might be variously attributed to high sensitivity of a brain punishment system, cognitive biases in selecting and interpreting possible threat stimuli, and understanding oneself as vulnerable to a dangerous world (Matthews, 2004b). Similarly, the coherence of traits may be derived from the unified nature of major brain systems, the importance of cognitive systems for attention and memory, or the person’s core goals and strategies for adaptation to the major challenges of life (Matthews, 2008).

A multi-leveled perspective also requires rethinking the role of personality in the prediction of behavior. Recent years have seen an explosion of studies demonstrating that traits are associated with a range of important real-life outcomes (Matthews et al., 2009). In line with interactionism, the role of situational moderators in enhancing prediction is also well-documented (Judge & Zapata, 2015). However, theoretical accounts for trait-outcome

associations have lagged the data, and a focus on the appropriate level of explanation for the empirical findings would be welcome. Explanations should also accommodate temporal factors, given that real-world outcomes often unfold over periods of months or years. We need both a fine-grained understanding of how personality factors bias the dynamic interaction between the individual and the environment in some given social encounter, as well as a longer-term understanding of how personality and situation interact developmentally over periods of years, or even decades (e.g., Roberts, 2018).

These and other foundational issues are covered in the first section of the book. Cloninger (Chapter 1) reviews the historical arc that has seen trait psychology go in and out of favor. The underlying dialectic is that of contrasting scientific and humanistic approaches. In Cloninger's view, there is a healthy tension between these perspectives that stimulates theory and research. A hypothesis-testing approach modeled on the physical sciences risks sterility and neglect of the roles of qualitative personal experience, intention and choice, and the grounding of personality in life history. Cloninger also suggests that eclecticism remains of value until such time as we have a satisfactory unified theory.

Weiss and Deary's (Chapter 2) review of the trait approach affirms its success in measuring and validating key dimensions of personality. They also highlight that some of the fundamental questions posed by Gordon Allport in his foundational account of traits have yet to be answered satisfactorily. There is still no consensus on what is the basic unit of personality or on explanatory, causal models linking traits to behaviors. A particular challenge is the highly polygenic nature of the genetic bases for traits demonstrated in Genome Wide Association Studies (GWAS), implying that neurobiological theories must accommodate a high level of complexity.

A longstanding research question is the extent to which self- and observer-perceptions of personality attributes converge. As Biesanz and Wallace (Chapter 3) discuss, historical concerns about the validity of self-perceptions have been, at least, partially allayed by theoretical and methodological advances that support demonstrations of convergence. Deeper questions concern the nature of interpersonal perception, and recent work has provided a range of insights into the factors that influence accuracy and bias in evaluating the personality of others.

The replacement of simple-minded trait and situationist assumptions by interactionism is a necessary step, but simple acknowledgement of interaction does not take us very far. Asendorpf and Rauthmann (Chapter 4) review contemporary understanding of interactions between stable factors (traits, environmental characteristics) and fluctuating factors (states, situations). Modern data-analytic techniques illuminate the different forms of dynamic interactions that take place between the individual and the environment. People can shape their

environments in different ways, but over time, environments can also shape personality.

The unconscious tends to bring to mind the qualitative and idiographic (not to say idiosyncratic) contributions of traditional psychoanalysis. However, contemporary work reviewed by Perugini, Richetin and Costantini (Chapter 5) brings unconscious personality attributes into the realm of quantitative science. The validity of tests such as the Implicit Association Test is increasingly supported by data, though various issues remain for future research. These include optimizing test methodology and procedures and understanding convergences and divergences between explicit and implicit measures.

As with personality, research on emotion has provided an arena for integrating multiple psychological disciplines. Reisenzein, Hildebrandt and Weber (Chapter 6) review relevant research, covering individual differences in emotional dispositions, styles of emotional regulation, and nonverbal emotional communication, and their relationships with major traits. Such efforts may contribute to the overarching goal of cognitive science of creating a unified theory of the human mind.

DESCRIPTION AND MEASUREMENT

Quantitative assessment of dimensions of personality is at the heart of the trait approach. Not only is the number of measures available to the personality researcher ever-increasing (Boyle, Saklofske & Matthews, 2015), but so too is the range and diversity of measurable constructs, encompassing idiographic traits, the unconscious, and aspects of personal narratives as previously noted. Personality assessment may seem a rather settled methodology, buttressed by the availability of standard instruments such as the NEO-PI-R (Costa & McCrae, 2008), widespread use of latent factor modeling (Ullman, 2006), and explicit standards for test validity (AERA, APA, NCME, 2014). Against this rosy picture, there is still no universal consensus among researchers on a definitive dimensional model of personality, especially at more granular levels, and significant controversies over leading scales remain (Boyle, 2008). There are also those who challenge the fundamental assumptions of psychometrics (Barrett, 2005), and the question of whether self-report scales should be treated as representational or operational remains unresolved (Matthews, De Winter & Hancock, 2019). Contributions to this section illustrate both the accomplishments and uncertainties of personality measurement.

Boyle and Helmes (Chapter 7) review leading multidimensional personality scales, including clinically focused instruments. In addition to a comparative review, these authors highlight various scale-design, procedural, and statistical issues that can profoundly influence measurement, and point out some of the pitfalls awaiting the would-be psychometrician. They emphasize the importance of advances in methodology for improving evidence-based assessment procedures. They also

highlight the unfulfilled potential of objective personality assessments as a target for future measurement efforts.

De Raad and Barelds' (Chapter 8) review of personality structure begins by differentiating the two principal strategies for developing dimensional models. The first is a top-down theoretically inspired approach exemplified by the psychobiological model of Hans Eysenck. The alternative, taxonomic approach is more data-driven and empirical, and can be traced to the initial work of Allport and Cattell. It also encompasses the lexical approach to personality, and its best known expression, the Five-Factor Model (FFM). De Raad and Barelds also explore additional structural approaches including hierarchical and circumplex models.

The FFM is characterized by McCrae (Chapter 9) as the dominant paradigm in personality research. His chapter covers both the accomplishments of research based on the FFM and critiques of the model. One objection is that the dimensions are descriptive rather than explanatory; McCrae's rebuttal refers to the biological bases for traits. A second class of objection comes from researchers who propose alternate dimensional models; a source of disagreement that may be resolved by hierarchical models. The chapter also reviews cross-cultural studies of the FFM.

Another longstanding measurement issue is the relationship between dimensions of personality and of cognitive ability, traditionally seen as separate domains. Schermer and Saklofske (Chapter 10) examine relationships between personality and intelligence. They review the modest linear associations found between aspects of the two types of construct, evidence from developmental studies, and the hypothesis that personality structure varies with intelligence. The chapter also considers explanatory models that may integrate personality and intelligence factors in the etiology of psychological disorders.

DEVELOPMENT, HEALTH AND CHANGE

Another fundamental issue is personality development over the lifespan. How do our personalities originate? How do they change over time? What psychological processes support development? Can we predict and shape individual differences in major life outcomes, such as physical and mental health?

Broadly, two rather different perspectives have been adopted historically. An essentialist position (see Haslam, Bastian & Bissett, 2004) supposes that individuals have a rather stable nature, evident early in childhood, which is perpetuated, with minor changes, throughout the lifespan. This position is compatible with a strong hereditary component to personality and a view that biology is destiny. Conversely, in the spirit of J. B. Watson, we may see personality as accumulating over time through significant learning experiences. Theories as various as psychoanalysis, traditional learning theory and modern social-

cognitive theory have seen learning as central to personality development – accordingly, such approaches tend to suggest a more malleable view of personality. Understanding development breaks down into a number of discrete research issues, including measurement models for the lifespan, identifying qualitative differences between child and adult personality, modeling the processes that contribute to development, and linking personality development to the person's broader experience of life, wellbeing and health. Contributors to this volume address some of the key issues involved in stability and change.

The development of temperament and neural network is discussed in Rothbart, Posner and Sheese's (Chapter 11) review. Temperament is defined as individual differences in emotional and motor reactivity and attentional self-regulation. Studies of brain-imaging and molecular genetics are uncovering the individual differences in brain function that provide a platform for building on longitudinal studies of the development of temperament. This research may also inform network training interventions for attentional enhancement.

Atherton, Donnellan and Robins (Chapter 12) review evidence on stability and change in major traits across the lifespan. Beyond simple demonstrations of test-retest stability, the challenge is that personality development reflects dynamic transactions between the individual and social situations, rather than changes in isolated traits. Meeting this challenge requires several conceptually distinct types of stability and change, which may require different statistical approaches to analysis of longitudinal data. At a process level, three unique but complementary perspectives refer to intrinsic maturation, the social environment and self-reflection.

A critical issue for development is whether personality is associated with level of vulnerability to mental disorder or whether personality change is simply a concomitant of illness. Hakulinen, Jokela, Kivimäki and Elovainio (Chapter 13) address such issues in their review of personality traits and disorders. They find that traits, especially neuroticism, may, indeed, act as vulnerability factors for a range of disorders. However, there is also evidence for additional causal relationships between traits and symptoms of disorder, including the existence of common factors influencing personality and mental health, and personality change that represents a scar of the disorder.

Heilmayr and Friedman's (Chapter 14) review of personality and physical health complements the previous chapter, and arrives at similar conclusions. As for mental disorder, there is evidence from prospective data that traits are predictive of future health. In this case, the most salient trait is conscientiousness; its associations with better health appear to reflect multiple causal pathways, including individual differences in health behaviors. The authors recommend a dynamic biopsychosocial approach to better understand the various pathways influencing the interplay between personality and health across the lifespan.

The final chapter in this section, by Mikulincer and Shaver ([Chapter 15](#)), reviews attachment theory as an integrative approach that combines psychoanalytic, evolutionary, developmental, social-cognitive and personality trait constructs. The theory has generated validation of scales for measurement of attachment style, insights into how attachment style shapes adaptive and maladaptive social behaviors, and evidence on continuity of attachment patterns from infancy to adulthood. Future work may further integrate attachment theory with other theoretical perspectives in psychology, as well as investigating the gene-environment interactions associated with attachment style.

BIOLOGICAL PERSPECTIVES

According to the biological perspective, personality is a window on the brain. In their various ways, Hans Eysenck ([1967](#)) and Jeffrey Gray ([1981](#)) articulated the influential view that individual differences in simple but critical brain parameters, such as arousability and sensitivity to reinforcing stimuli, drive far-reaching personality changes, expressed in traits, such as extraversion and neuroticism. These theories emphasize the role of polymorphisms in genes for brain development in generating personality variation (in conjunction with environmental factors). As a broad research project, biological theory emphasizes studies of behavior and molecular genetics, psychophysiology, and the linkage between neuroscience and real-world behavioral functioning, including clinical disorder. It is also compatible with recent interest in how evolutionary genetic mechanisms may produce variation in traits across individuals (Penke & Jokela, [2016](#)).

Both genetic and neuroscience studies of personality are advancing rapidly, especially with enhancements in measurement technology. The conclusion from conventional behavior genetic studies that around 50 percent of the variance in major personality traits is heritable is no longer controversial (Johnson, Vernon & Mackie, [2008](#)). Current research focuses on important but subtler issues such as non-additive effects of genes, gene-environment interaction and epigenetic mechanisms (e.g., Gescher et al., [2018](#)). Molecular genetic research demonstrates that polymorphisms of individual genes make only small contributions, but recent work is now demonstrating the potential of GWAS studies conducted on large data sets (Sanchez-Roige et al., [2018](#)). At the same time, the likely complexity of mappings between genes, brain systems and behavior may present a barrier to future progress (Turkheimer, Pettersson & Horn, [2014](#)) – or it may be seen as just another scientific problem to be addressed, and solved.

Contemporary brain-imaging methods are transforming personality neuroscience (Kennis, Rademaker & Geuze, [2013](#)). Improving temporal and spatial resolution together with more powerful methods for modelling neural activity are likely to maintain the impetus. However, it remains to be seen whether the psychometric trait models based on

questionnaire data will prove adequate to capture personality variation seen at the neural level. “Endophenotypes” – highly specific traits that are shaped by the genes – might provide a better or at least complementary unit of analysis for neuroscience theory (Smillie, [2008](#)).

In the first chapter in this section, Lewis, Al-Shawaf and Buss ([Chapter 16](#)) make the case for evolutionary psychology as the foundational meta-theory for both personality and the broader field of psychology. They explain how a universal human nature shaped by evolution can produce individual differences. They identify multiple selective and non-selective evolutionary processes that may be responsible for personality trait variation. For future progress, they advocate studies of the computational architecture of evolved psychological mechanisms that control how individuals process situational cues when faced with an adaptive problem. Longitudinal studies are necessary to investigate how evolved mechanisms control personality stability and change.

From an evolutionary perspective, it would be surprising if personality was a uniquely human characteristic. Bell and Bensky ([Chapter 17](#)) review the evidence for personality variation in nonhuman animals. An advantage of studying animals is that genetic and environmental factors can be systematically manipulated in ways that are impossible in human personality studies. Researchers have overcome the challenges of working with nonhuman subjects to investigate dimensions of behavioral variation, their relationships with individual differences in cognition and social behaviors, and the developmental process. As with human research, molecular genetic studies may contribute to understanding the roots of inter-individual variation.

Current work on behavior and molecular genetics is reviewed by Sallis, Davey Smith and Munafò ([Chapter 18](#)). Although the heritability of personality traits is well-established, progress in specifying the genes responsible for personality has been slow. Heritability estimates from traditional twin studies have been complemented by alternative methods, such as analyses based on single nucleotide polymorphisms from GWAS studies of unrelated individuals. Somewhat provocatively, these analyses provide lower heritability estimates than traditional methods. GWAS studies also suggest that trait variation results from the combined small-magnitude effects of many individual genes. Future research may be able to use techniques including Mendelian randomization to test causal models.

The leading broad theoretical framework for the neuroscience of personality is provided by the family of approach-avoidance theories, reviewed by Corr and Krupić ([Chapter 19](#)). They describe the roots of these theories of personality in philosophy, psychology and neuroscience, as well as Reinforcement Sensitivity Theory as a specific example. Individual differences in three major neuropsychological systems mediate response to attractor (“appetitive”) and repulsor (“aversive”) stimuli. Theories of this kind, supported by neurophysiological and

behavioral evidence, provide a path toward truly explanatory models of major personality traits.

Personality neuroscience has emerged as a distinctive subfield of research, fueled in part by the explosion of functional and structural MRI studies of personality, complemented by advances in traditional psychophysiology and molecular genetics. DeYoung and Blain (Chapter 20) review the state of the science, focusing initially on methodological issues. The field has advanced sufficiently that a neuroscience account of each of the Big Five traits can be presented. Studies at different levels of granularity may contribute to advancing explanatory models of traits based on neuroscience.

COGNITIVE AND MOTIVATIONAL PERSPECTIVES

Cognitive-psychological research on personality has traded quite successfully on the insights and methods of the “cognitive revolution” of the 1960s. Major themes include the importance of stable self-knowledge, studies of information-processing using objective performance indices, and self-regulation as an element of dynamic interaction between the person and the outside world (Matthews, 2008). Theoretical landmarks include schema theories of emotional pathology (Beck, Emery & Greenberg, 2005), information-processing accounts of anxiety and impulsivity (Eysenck & Derakshan, 2011; Revelle, 1993) and the cybernetics of self-regulation which integrates cognitive with motivational perspectives (Carver & Scheier, 1998).

As in other realms of personality, these well-established theories face new challenges, one of which is the extent to which elements of personality, including emotion, values, and unconscious processes can be reduced to cognition. Cognitive science theory (Matthews, 2004a, 2018) provides a possible resolution: “Cognition” has different meanings at different levels of explanation. The utility of cognitive and motivational approaches as explanatory models is also open to debate. Information-processing models typically establish correlations between traits and multifarious processing components (Matthews, 2008), but it remains unclear whether processing causes personality or vice versa. Recent work on anxiety (Grafton et al., 2017) establishes a causal role for processing: training participants to respond to threat stimuli appears to increase anxiety (stress vulnerability). At the same time, trait anxiety relates to processing biases and strategic preferences that influence cognitions of threat. Self-regulative theories may be usefully extended by specifying reciprocal relationships between personality traits and specific processing functions that support adaptation to external social environments (Matthews, 2016).

The common element of the chapters in this section is a concern with cognitive and motivational process models that complement structural models of personality. Matthews (Chapter 21) provides an overview of cognitive-process studies utilizing objective performance measures

for a variety of purposes. The chapter also outlines the Cognitive-Adaptive Theory of Traits that integrates the differing explanatory perspectives of cognitive science. Traits may derive coherence from their basis in multiple processes that support common adaptive goals.

Carver and Scheier (Chapter 22) review self-regulative theory and its relevance to personality. They specify control processes that support feedback-based regulation of goal-directed behavior and accompanying affect. Priority management as the person pursues multiple goals may be an important feature of personality. The chapter also considers self-regulative perspectives on impulsivity and self-control, and their neurological bases. Recent work suggests that individual differences in impulsive responses to emotion may underpin a transdiagnostic vulnerability factor for multiple forms of pathology.

Szalma (Chapter 23) addresses need theories and their contribution to understanding the inter-relationships of cognition, motivation and personality. Modern needs theories, especially self-determination theory, identify psychosocial needs that may vary across individuals, as both states and traits. Major personality traits may be associated with a “motivational patterning” of needs analogous to the cognitive patternings identified in performance studies. This perspective enhances the explanatory power of both cognitive science and self-regulative accounts of personality.

The self is a fundamental but protean construct that has come to psychology by way of philosophy, theology and introspection. Robinson and Sedikides (Chapter 24) describe the prospects for resolving the tension between social-psychological and trait-based perspectives on the self. Research has addressed generalized self-beliefs, processes including self-verification, and motives such as self-enhancement. A dynamic account of personality functioning that recognizes stability and change in motivational and cognitive processes may integrate the self and personality literatures.

Jayawickreme and Zachry (Chapter 25) also call attention to diverging structural and process-based perspectives. They review dynamic theories, including Whole Trait Theory, that focus on the origins of individual difference factors (e.g., in traits, goals, values), their manifestations in daily lives, and their personal, social, occupational and societal consequences. Such theories draw on both accounts of social-cognitive processes and the stabilities emphasized in trait theory, including the frequency with which individuals perform trait-relevant behaviors.

Eysenck and Holmes (Chapter 26) review relationships between anxiety, depression and cognitive dysfunction, drawing on research from both normal and clinical populations. Anxiety and depression are related to a range of biases in attention, memory and interpretation, varying somewhat with the affective condition concerned. Personality-cognition relationships are likely to be bidirectional. Deficits in executive control may, in part,

mediate associations between traits for negative emotions and cognitive bias. Conversely, mitigation of bias may alleviate emotional vulnerabilities, although the magnitude of effects has not been conclusively determined.

SOCIAL AND CULTURAL PROCESSES

Traditional social psychological interpretations of personality face the issue that seemingly uniquely social aspects of personality may, in fact, be understood in terms of trait constructs and the individual's mental representations. Many core attributes of the self, such as self-esteem and self-efficacy, may be represented as generalized self-knowledge (Matthews et al., 2000). Empirical work elucidates the impact of stable biases in social knowledge and processes on individual differences in social behaviors and relationships (e.g., Landis, 2016). Such research is enriched by new lines of research as diverse as social neuroscience (Tamir & Thornton, 2018) and the role of personality in social media use (Liu & Campbell, 2017).

Research increasingly explores the wider cultural context of personality. The traditional argument is that culture shapes the social interactions which, in turn, shape the self and personality. This view continues to inform cross-cultural studies (Matsumoto, 2007) that investigate how contrasting social values, such as individualism and collectivism, are expressed in personality in cultures such as the USA and East Asia. At the same time, the cultural relativism traditionally promoted by anthropology has been challenged by the new awareness of universal human nature supported by evolutionary psychology and empirical evidence for, at least, some generality of personality structure (Fetvadjev & van der Vijver, 2015). Chapters in this section review the convergence of personality and social-psychological perspectives on narrative identity, social functioning, cultural similarities and differences, and political psychology.

McLean, Syed, Haraldsson and Lowe (Chapter 27) explore recent work on narrative identity. Although narrative identity is more socially and culturally informed than traits, the sociocultural context can promote stability as well as malleability in identity. They describe master narratives derived from specific cultures that shape stability in individual storytelling. There may be individual differences in deviations from master narratives and in the extent to which narratives are internalized. Work on these issues may serve to marry a personality and cultural approach to narration.

Exploring the social expression of traits requires evidence that traits predict individual differences in social functioning. Austin, Knack, Jensen-Campbell and Rex-Lear (Chapter 28) begin their review of social relations and social support by presenting evidence of this kind. They go on to demonstrate that personality effects are not a one-way street. Relationships between personality, social relations and social support are bidirectional, and they are influenced by cultural context. New

methodologies may be needed to understand better the causal relationships between personality and social constructs over the course of the lifespan.

Cross-cultural perspectives on personality are addressed by Draguns and Junko Tanaka-Matsumi (Chapter 29). Recent research has further fortified the evidence for the cross-cultural validity of overarching theoretical models, such as the FFM and basic values. At the same time, there is also new evidence on cross-cultural variation in traits, values, and conceptions of the self. Advances in both psychometric and ethnographic methods have contributed to a growing understanding of cultural factors. Future research may focus especially on developmental processes influenced by cultural traditions and the contemporary context of globalization and population movements.

Caprara and Vecchione (Chapter 30) point out that personality traits and values may be more influential in political behavior than traditional sociodemographic characteristics. In the political arena, personality has been treated both as a self-regulatory agentic system and a set of habitual behavioral tendencies. From a theoretical standpoint, the former perspective has been the more useful in understanding how traits, needs, motives, values and self-beliefs are related to ideological orientation and political engagement. Individual difference constructs are also relevant for understanding variation in political engagement and participation. Social-cognitive analyses provide constructs, such as value preferences and political self-efficacy, that contribute to personality theory in this context.

APPLICATIONS OF PERSONALITY PSYCHOLOGY

On the basis of Kurt Lewin's claim that "nothing is as practical as a good theory," we should anticipate that the progressing science of personality feeds into increasing practical application. Historically, personality trait assessment in fields, such as clinical, organizational and educational psychology has been somewhat controversial, mirroring the waxing and waning of the trait concept in basic psychology. The relevance of traits is now well-established due to meta-analyses establishing that major traits are reliably correlated with a range of consequential outcomes, such as job performance (Salgado, Anderson & Tauriz, 2015), educational attainment (Poropat, 2009) and a variety of clinical disorders (Kotov, Gamez, Schmidt & Watson, 2010). Indeed, DSM-5 recognizes dimensional trait models of psychopathology in parallel with traditional categorical descriptions of disorders (Crego, Gore, Rojas & Widiger, 2015). Traits also moderate humans' interactions with new technologies, such as unmanned vehicle operation, leading to human factors applications (Lin et al., 2019). Consistent with interactionism, the need to assess situational moderators to attain reliable prediction in applied settings is also established (Judge & Zapata, 2015). The evidence on the validity of traits in applied contexts supports enhancements in real-world

decision making, such as personnel selection (Lievens & Sackett, 2017) and choice of therapy for clinical patients (Lengel et al., 2016).

The credibility of the applied use of personality assessments is further bolstered by increasing sophistication of theory, referencing both psychobiological and social-cognitive processes (Matthews, Zeidner & Roberts, 2006). Occupational psychologists are increasingly attentive to the theoretical interpretations of associations between traits and organizational outcomes (Judge et al., 2013), and to cognitive, motivational and affective process mediating personality effects (e.g., Barrick, Mount & Li, 2013). Clinicians can use trait assessments not only for individual treatment planning, but also for understanding the time course of pathology and recovery, and facilitating the therapeutic alliance and treatment compliance (Bagby, Gralnick, Al-Dajani & Uliaszek, 2016). The trait approach is also compatible with the search for transdiagnostic abnormalities in cognitive and metacognitive processing that increase vulnerability to multiple disorders (Wells & Matthews, 2014), and are treatable using transdiagnostic therapies (Capobianco, Reeves, Morrison & Wells, 2018). Indeed, evidence for personality trait change during therapy suggests that personality could be explicitly targeted for interventions (Roberts et al., 2017).

Contributions to this section cover the well-established domains of clinical, organizational and educational psychology, as well as applications to criminology and to understanding economic behavior.

Personality research and its applications to work and organizations are reviewed by Salgado, Anderson and Moscoso (Chapter 31). Recent empirical studies have widened the focus of research from job performance as the principal outcome to include personality correlates of other important criteria, including organizational citizenship, leadership, counterproductive work behaviors and occupational health. While there remains a gap between important research findings and practice, the research base supports a range of applications for personnel selection.

Applications to educational psychology are reviewed by Ben-Eliyahu and Zeidner (Chapter 32). Research in this area has focused on individual differences in student achievement, motivation, emotional competencies and affective outcomes. Applications, such as enhancing learning, mitigating anxiety and supporting social-emotional development, have been shaped by multiple theoretical orientations. These include achievement motivation theory, accounts of intra-individual processes and contributions from the learning sciences, such as studies of self-regulated learning and learning context.

Clinical perspectives on personality are addressed by Widiger and McCabe (Chapter 33). A large body of research, including longitudinal studies, demonstrates relationships between major traits and a variety of clinically significant outcomes, including measures of

psychopathology. The authors suggest that evaluating personality disorders on a dimensional basis, rather than as discrete categories, will improve diagnosis and treatment.

Lynam, Vize and Miller (Chapter 34) point out that criminology has rather neglected personality, to its detriment. They report a meta-analysis that identifies various FFM predictors of relevant criteria, including antisocial and aggressive behavior and sexual aggression. Different FFM profiles may characterize different types of antisocial behaviors associated with criminality. Research of this kind addresses broader criminological issues, such as the relative stability of offending, the role of personality in moderating situational influences on criminal behavior, and the psychological processes underpinning delinquency and criminal acts.

The final chapter by Ferguson, Zhao and Smillie (Chapter 35) addresses how personality can be integrated within the new field of behavioral economics. The authors review the role of traits in various economic processes and outcomes, including cooperation in micro-economic social interactions and macro-economic outcomes, such as job performance, entrepreneurialism and Gross Domestic Product. The emerging dialogue between personality psychologists and economists may support innovative perspectives on the links between personality traits, economic preferences and socioeconomics.

STATISTICS AND SOFTWARE FOR PERSONALITY RESEARCH

Personality researchers typically practice quantitative science and the data-processing methods available to them are rapidly advancing. Revelle, Elleman and Hall's Addendum reviews open source statistical software suitable for analysis of the large scale data sets common in contemporary research. They focus especially on the R package and programming language, and its use for modern analytic approaches to regression, latent factor modeling and tests for mediation and moderation. Less familiar analyses covered include within-subject analyses, computational modelling of processes, aggregation of data by geographic location and statistical learning algorithms. Their Appendix includes sample R code. We anticipate that it will provide a valuable resource for researchers.

CONCLUSION

We hope this handbook conveys the vigor and diversity of current personality research, expressed in its conceptual, methodological, theoretical and applied aspects. Together the chapters reinforce the message of the first edition of this book that understanding trait variation is essential across the various disciplines of psychological science, including neuroscience, cognitive psychology and social psychology. Many of the chapters support the value of personality traits as a focus for an integrated approach to assessment, theory and practice. However, an important

development is increased interest in integrating trait models with additional perspectives from approaches, such as evolutionary psychology, social-cognitive theory and personological accounts. Consistent with integrative goals, there is also growing recognition of the multilayered nature of personality, expressed in individual differences in neural functioning, in cognition and information-processing, and in social relationships. We believe that the chapters in this book point the way toward the objective of adopting a true synthesis of the multiple variants of personality theory.

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PART I

FOUNDATIONAL ISSUES: HISTORY AND APPROACHES TO PERSONALITY

1

Conceptual and Historical Perspectives

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INTRODUCTION

Personality, including abnormal as well as normal personality, is arguably the most emblematic psychological area for outsiders, but a consensual definition of the field is elusive. In attempting to study the whole functioning of individuals, personality draws from other areas of psychology: biological, cognitive, social and developmental, to list a few. It has close ties to nonpsychological areas: history and politics, literature and the arts, health sciences and others. Weaving this diversity into a coherent whole remains a conceptual challenge.

The exploration of personality draws on long traditions that predate modern psychology. A major theme is differences among individuals. The ancient Greek physician Galen described four well-known temperaments. Character types were presented in classic literary works by Chaucer and Shakespeare. Philosophers, including Locke and Descartes, offered their opinions. The rise of modern physical sciences inspired psychology to adopt the methods of science and to detach personality description from its historical legacies.

The separate psychological discipline of personality is typically traced back to the year 1937, when Gordon Allport published *Personality: A psychological interpretation*, Ross Stagner published *Psychology of personality*, and Henry Murray's 1938 book *Explorations in personality* was rising on the horizon. These American developments built upon earlier philosophical and psychiatric, as well as psychological, work in the USA (e.g., William James) and in Europe (e.g., Sigmund Freud, Pierre Janet & Kurt Lewin) (Lombardo & Foschi, 2002). As it developed, the field of personality encompassed diverse perspectives. Psychologists in other specialties and the public at large influenced and reacted to theoretical developments and research trends. As part of a larger intellectual dialogue, the worldviews of various theorists (Freud's pessimistic emphasis on repression and sexual conflict, Maslow's optimism about human potential, Skinner's emphasis on environmental determinism and the possibility of a Utopian community, to name a few), capture diverse positions that contribute to their acceptance or rejection, based on

their compatibility and perceived usefulness for individual lives (Koltko-Rivera, 2004).

The variety of approaches brings lack of consensus about how to define personality. Most definitions include theorized entities within a person: traits. But what are traits? For Raymond Cattell, a personality trait was simply that "which defines what a person will do when faced with a defined situation" (Cattell, 1979, p. 14). Behavioral definitions focus on habits formed by experience. In its early radical form, behaviorism avoided positing concepts that were not observable (Skinner, 1950), but later theoretical developments include expectations and other cognitions as component parts of personality that determine an individual's behavior (Bandura, 1986).

Some definitions emphasize integration of personality into a whole person. From his personological trait approach, Gordon Allport (1937) defined personality as "the dynamic organization within the individual of those psychophysical systems that determine his unique adjustments to the environment" (p. 48). A definition that gives a modern twist to personological integration is offered by McAdams and Pals (2006), who define personality as "an individual's unique variation on the general evolutionary design for human nature, expressed as a developing pattern of dispositional traits, characteristic adaptations, and integrative life stories complexly and differentially situated in culture" (p. 212). The emphasis on dynamics and development in these two personological definitions reminds us that some theories emphasize function and change, in contrast to the typically more static trait emphasis on description. If commonality is to be found among these diverse definitions, it may be a frequently shared assumption that an individual's personality begins with biologically innate components, both those shared with others and those that are distinct because of heredity or other influences; that over the life course, these innate tendencies are influenced by many factors, including family experience and culture; and that the resulting pattern of habitual behaviors, cognitions, emotional patterns and so on constitutes an individual's personality. Sometimes later developed, more rational, "cooler"

aspects of personality hold potentially dangerous primitive, more emotional, “hotter” forces in check. Sometimes they do not. If we accept Carl Jung’s argument, too much of the former (rational) aspects can even be devastating to the psyche. Regardless which prevails, the interplay of these levels can be found in thought about personality ranging from Plato and Aristotle to Schopenhauer to Freud and German stratification theorists in the early twentieth century (Gilbert, 1973). Cognitive behaviorists and neuroscientists have also commented on these hot and cold, emotional and rational, aspects of personality.

Whether framed as a definition of personality, or less explicitly assumed among theorists and researchers, conventions about what should be included and what does not fit the conceptual framework for the scientific study of personality have implications: guiding research, describing individuals, suggesting clinical treatment and social interventions, and setting the parameters both for discourse within the scholarly community and for contributing the unique insights of our discipline to the larger world.

PSYCHOLOGY’S TWO DISCIPLINES

Throughout the history of psychology, observers have noted a dichotomy between those who emphasize rigorous scientific methods, on the one hand, and those who retained the field’s historic emphasis on subjective experience and a holistic study of the person: what William James (1907) called the “tough-minded” and the “tender-minded.” This dichotomy has been variously called the “two disciplines of scientific psychology,” experimental and correlational (Cronbach, 1957) and the “two cultures,” scientific and humanistic (Kimbale, 1984). It reflects a broader intellectual rift between science and humanism, impacting both the content and methods of personality theory and research. As James indicated, the two poles arguably reflect the personalities of those on each side of the dichotomy (Conway, 1992; Feist, 2006). Eysenck (1997) suggests that the split between these two approaches has impeded the progress of psychology in general, and personality in particular.

The founder of American psychology, William James (1890), included “tender-minded” topics such as consciousness and religion from a viewpoint that embraced both psychology and philosophy. Gordon Allport, often credited with the founding of personality as a separate field, himself “found a way to exploit the value in each [of these] perspective[s],” the science and the art of psychology (Gifford, 2004). The “tough-minded” pole, well represented in experimental laboratories modeled after that of Wilhelm Wundt, found its influence in personality through behaviorism, with the work of John B. Watson and, later, B. F. Skinner. The other pole, the tender-minded or humanistic, persisted as well. For example, during the 1950s, Gardner Murphy took a more integrative stance, and a humanistic psychology movement grew,

marking its entry by the establishment of the Association for Humanistic Psychology in 1962, with Abraham Maslow, Carl Rogers and Rollo May among the founding members. Today, we feel the tension between those who would emphasize the physical basis of personality and those who tend toward thoughts and consciousness. Bridges are being forged, however, as theorists and researchers try to apply rigorous empirical methods to the “big picture” issues like consciousness, religion and free will that early psychology left to the tender-minded (e.g., Greenberg, Koole & Pyszczynski, 2004; Rychlak, 1997).

While the beginning of psychology as a scientific enterprise is often traced to Wilhelm Wundt’s laboratory in 1879, the field of personality has no such consensual date of origin. William James’s classic *Principles of psychology* in 1890, which included discussion of personality-related issues such as the self, provides evidence that the field of personality had begun, as did Sigmund Freud’s writing on dreams (1900). Historically, personality courses were often taught from a “grand theorist” approach in which selected theories proposed by individuals were presented separately. Many of these theorists (Sigmund Freud, Alfred Adler, Gordon Allport, Carl Rogers, to name a few) have become well known and are cited in most introductory psychology texts. (See Table 1.1.) This telling of the discipline’s history has the advantage of presenting comprehensive theories that have an internal logic, but the disadvantage of omitting or understating recent advances that seldom fit this model, and of accentuating the differences among theories instead of attempting an integrated view. The classical grand theories often reflected the professional and life experience of their originators (Monte, 1977), and their fundamental assumptions (Skinner’s belief in environmental determination; Maslow’s optimism; Freud’s assumption of conflict) are not universally shared. This particularity fosters fragmentation in the discipline of personality.

A DIVERSITY OF PERSONALITY PERSPECTIVES

Throughout history, diverse approaches to the study of personality have competed. Among the approaches that have distinct histories are the psychodynamic, trait, behavioral, humanistic, cognitive and biological perspectives. (See Table 1.2.) While sometimes influencing one another, each approach has taken a different tactic toward a global theory of personality, guiding researchers’ observations and practitioners’ interventions.

The *psychodynamic* viewpoint, attributed to Sigmund Freud as its founder, attributes psychological malfunction to unconscious psychological conflict over the expression of instincts. Revisionists, including Alfred Adler, Erik Erikson, Karen Horney, Heinz Hartmann, Erich Fromm, Ronald Fairbairn and Heinz Kohut emphasized the more social and adaptive aspects of psychodynamics and the sense of self. Psychodynamic approaches to attachment

Table 1.1 Milestones in the history of personality

1890 William James publishes <i>Principles of psychology</i> (with sections on the self and other personality-related issues)
1900 Sigmund Freud publishes <i>The interpretation of dreams</i>
1907 Alfred Adler publishes <i>A study of organic inferiority and its psychical compensation</i>
1908 Mary Calkins describes the self (in several papers)
1910 Carl Jung publishes <i>The association method (research on complexes)</i>
1913 John Watson publishes his behaviorist manifesto: <i>Psychology as the behaviorist views it</i>
1923 Sigmund Freud publishes <i>The ego and the id</i> (structures of personality)
1927 Gordon Allport publishes <i>Concepts of trait and personality</i>
1935 Henry Murray publishes the Thematic Apperception Test (TAT)
1936 Anna Freud publishes <i>The ego and the mechanisms of defense</i>
1937 Gordon Allport publishes <i>Personality: A psychological interpretation</i>
1937 Karen Horney publishes <i>The neurotic personality of our time</i>
1938 B. F. Skinner publishes <i>The behavior of organisms: An experimental analysis</i>
1938 Henry Murray and colleagues publish <i>Explorations in personality</i>
1939 John Dollard and Neal Miller publish <i>Frustration and aggression</i>
1943 Abraham Maslow publishes <i>A theory of human motivation</i>
1950 Erik Erikson publishes <i>Childhood and society</i>
1951 Carl Rogers publishes <i>Client-centered therapy</i>
1952 Hans Eysenck publishes <i>The structure of human personality</i>
1954 Abraham Maslow publishes <i>Motivation and personality</i>
1955 Lee Cronbach and Paul Meehl publish <i>Construct validity in psychological tests</i>
1955 George Kelly publishes <i>The psychology of personal constructs</i>
1957 Lee Cronbach publishes <i>The two disciplines of scientific psychology</i>

Continued

Table 1.1 (cont.)

1961 The <i>Journal of Humanistic Psychology</i> begins
1961 Albert Bandura and collaborators describe learning of aggression through modeling (Bobo doll study)
1962 Founding of the Association for Humanistic Psychology
1967 Hans Eysenck publishes <i>The biological basis of personality</i>
1968 Abraham Maslow publishes <i>Toward a psychology of being</i>
1968 Walter Mischel challenges the trait model in <i>Personality and assessment</i>
1970 J. A. Gray proposes a biologically based Reinforcement Sensitivity Theory
1971 Rae Carlson asks 'Where is the person...?', calling for attention to a holistic approach
1971 B. F. Skinner publishes <i>Beyond freedom and dignity</i>
1973 Albert Bandura publishes <i>Aggression: A social learning analysis</i>
1976 Richard Dawkins publishes <i>The selfish gene</i>
1976 Loehlin and Nichols conclude, from twin research, that nearly all personality traits show moderate genetic influence
1978 Mary Ainsworth describes attachment in young children
1987 McCrae and Costa present data on the Five-Factor trait Model
1987 Daniel Schachter describes implicit memory (alternative view of unconscious cognition)
1989 David Buss describes cross-cultural universals in the evolution of mating behavior
1995 Mischel and Shoda propose a Cognitive-Affective Personality System (CAPS) model
2000 Martin Seligman and Mihaly Csikszentmihalyi publish <i>Positive psychology: An introduction</i>

and object relations interact with developmental and social psychological theories, both in clinical and nonclinical settings (Bornstein, Denckla & Chung, 2013; Greenberg & Mitchell, 1983; Westen, Gabbard & Ortigo, 2008). The Swiss analyst Carl Jung offered a concept of archetypes that, arguably, correspond to deep evolutionary levels of the human brain, and that has inspired experimental studies (Ivonin et al., 2015; Rosen & Luebbert, 1999).

The *behavioral* approach to personality sought a more rigorously scientific method patterned after a philosophy of science that guided the physical sciences. Early

Table 1.2 Major perspectives in personality

Perspective	Major concepts	Contributors
Psychodynamic	libido, conflict, id, ego, superego, defense mechanisms, Oedipal conflict, fixation, repression, attachment, object-relations	Freud, Jung, Adler, Erikson, Horney, Klein, Sullivan, Chodorow, Westen, Kohut, Kernberg
Behavioral	reinforcement, punishment, stimulus, response, conditioning, extinction, shaping, discrimination learning, generalization, situation, act frequency, basic behavioral repertoire, labeling, gradients of approach and avoidance	Skinner, Staats, Dollard and Miller
Cognitive	expectancy, self-efficacy, outcome expectation, schema, cognitive person variable, personal construct, reciprocal determinism, modeling, constructive alternativism, life narrative	Mischel, Bandura, Kelly, Beck
Humanistic	self-actualization, creativity, flow, spirituality, personal responsibility, freedom, choice, openness to experience, unconditional positive regard, acceptance, empathy, real self, hierarchy of needs, peak	Maslow, Rogers, Seligman, Csikszentmihalyi

Continued

Table 1.2 (cont.)

Perspective	Major concepts	Contributors
	experience, positive psychology	
Trait	trait, type, facet, factors, neuroticism/emotional stability, extraversion, Big Five	Allport, Cattell, McCrae and Costa
Biological	temperament, evolution, adaptation, altruism, sexual jealousy, heredity, neurotransmitter pathways, cerebral hemisphere function	D. Buss, H. J. Eysenck, J. A. Gray, C. R. Cloninger, J. Kagan

behaviorists, notably John Watson and B. F. Skinner, challenged “mentalism” and abandoned introspection, even the disciplined introspection used in Wundt’s experimental laboratories, as a valid source of data. Behaviorism was largely an American approach, appealing to the nation’s values of technology and control over nature, especially as Skinner was influenced by the ideas of philosopher Francis Bacon (Leahey, 2002; Smith, 2002). Behaviorists historically do not accept personality as a cause of behavior, but an effect that itself needs to be explained (Phelps, 2015).

The *cognitive* or *cognitive behavioral* approach reflects the development of cognitive science more generally and emphasizes individual differences in people’s thoughts, or personal constructs that have implications for behavior and adjustment. Adding cognition to behavioral theory made a research tradition that was rooted in animal studies more applicable to human personality. Cognitive mechanisms have also been proposed as alternatives to psychoanalytic theory to explain such phenomena as the forgetting of childhood traumatic memories (Hassin, Uleman & Bargh, 2005; Kihlstrom, 1987). Cognitive approaches, like behaviorism, have clinical applications (Shoda & Smith, 2004), and also implications for the social and political realms. George Kelly’s (1955) personal construct psychology inspired applications not only in personality and clinical areas, but also in business and politics. His term “personal constructs” continued in the work of influential theorists Walter Mischel (1968, 2009) and Albert Bandura (1986), whose theories identify the interpretations of situations, not the situations

themselves, as determinants of behavior. As the cognitive behavioral perspective developed, Bandura and his colleagues also described the ways that emotion (affect) function in this system.

The *humanistic* approach, which gained momentum in the 1960s with the establishment of the Association for Humanistic Psychology, returned to valuing the phenomenological and healthy aspects of personality that had been included in the contributions of William James at the turn of the twentieth century, but thereafter had been avoided by behaviorism and psychodynamic approaches. The holistic approach to the person, though diminished in American personality theory in the mid-twentieth century, remained strong in Europe (Taylor, 2009). Gordon Allport was an early member of the Association for Humanistic Psychology, though his later involvement in defense of traits has generally resulted in his being pigeonholed, misleadingly, as a trait theorist. Abraham Maslow asserted that humanism offered a different view of science that was more suitable for personality. While Carl Rogers and others attempted to conduct rigorous scientific research within a humanistic framework, many observers have faulted humanistic approaches for failure to adhere to scientific methods, until the more recent development of the positive psychology approach emerged as an outgrowth of humanistic theories, with greater scientific rigor. The contrast in methodological rigor is exaggerated by overlooking empirical foundations within early humanistic psychology that ought to be given more credit (Churchill & Mruk, 2014). Positive psychology has also been faulted for remaining too close to the methods and individualistic assumptions of mainstream psychology, rather than fulfilling the promise of the humanist movement (Richardson & Guignon, 2008).

The *trait* approach theorizes that individuals vary in the stable dimensions that constitute personality, determining their behavior and experience. First used by Francis Galton and Alfred Binet to understand intelligence in the nineteenth and early twentieth century, and then in clinical assessment with the Minnesota Multiphasic Personality Inventory, personality measures soon followed. Applying statistical analysis to language in the lexical approach to descriptors of people (John, Angleitner & Ostendorf, 1988), as well as in questionnaires developed from other strategies, has resulted in several factor analytic models of personality, including the Five-Factor Model, the HEXACO model, and Cattell's 16 factor model. Whether the resulting factors are simply a descriptive taxonomy of traits, or whether the emergent factors point to underlying universal, biologically based dimensions of personality has been a matter of controversy. The approach provides convenient self-report measures of individual differences, facilitating both applied uses and research to investigate cross-cultural comparisons, behavioral correlates of trait dimensions, and relationship to clinical diagnoses. For a time, the trait perspective was pitted against evidence from behaviorism and social

psychology that situations are more potent than static traits as predictors of behavior. Since then, the trait perspective has developed more sophisticated theories that integrate situational and developmental influences.

The *biological* approach in primitive form has been a theme throughout the history of the study of personality, centuries before psychology emerged as a discipline, with the well-known Greek model of humors. A biological basis for temperament as an early and pervasive manifestation of individual differences has been an enduring assumption of personality. Modern advances in understanding of genetics, application of evolutionary theory to individual differences in social behavior, and psychoneurological knowledge of brain circuits that informs models of the impact of rewarding and other experience on individuals have led to detailed biological models of personality functioning and individual differences.

MAJOR ISSUES IN PERSONALITY THEORIES

What questions should personality theory address? What data should be collected, using what methods? While the attempt to scientifically collect data is a recent development, the enduring questions that personality theorists grapple with can be traced back to thinkers centuries, even millennia, ago (Dumont, 2010).

Studying the Individual or Comparing People: Idiographic and Nomothetic Approaches

Should we emphasize intensive study of individuals, or comparisons between people? Personality from the individual point of view is a scientific version of a biography or autobiography, a life story. On the other hand, a compelling argument can be made for emphasizing comparisons among individuals, something we do in everyday life (Who is more assertive? Who is more responsible?), and which is useful for practical purposes such as deciding whom to hire for a particular job.

Idiographic approaches study individuals, while *nomothetic* approaches seek generalizations and make comparisons based on the study of many people. This distinction, proposed by the German philosopher Wilhelm Windelband in 1892, was discussed by American personality psychologist Gordon Allport (1937), who argued that idiographic traits that reside within individuals are the real causes of behavior and experience. Windelband's idiographic approach was what he called a "historical science" in that it emphasized the history of one person (Maher & Gottesman, 2005). European psychiatrists in the nineteenth century, whose work influenced later American personality psychology, reported individual case studies. Early publications in the *American Journal of Abnormal Psychology* also featured a majority of idiographic reports until its transformation to become the *Journal of Abnormal and Social Psychology* under the American Psychological Association, when nomothetic methods prevailed;

and from the 1920s to the 1930s, other publications reflected a rise in nomothetic trait research (Lombardo & Foschi, 2003). The nomothetic study of individual differences was favored by most researchers, despite Allport's reservations, while case studies of individuals were frequently reported in psychiatry and sociology publications (Barenbaum & Winter, 2003).

The nomological emphasis on measures of differences between people instead of the whole functioning individual prevailed, leading Rae Carlson (1971) to poignantly ask: "Where is the [study of the whole, integrated] person in personality research?" Affirming the importance of the idiographic approach, Lamiell (1981, 1997) offers a refined version that he terms *idiothetic*, with suggestions for appropriate research strategies, and asserts that differences between people (nomothetic findings) have no meaning at the level of individuals. Similarly, Molenaar (2004) demonstrates mathematically the inappropriateness of nonidiographic data analyses for understanding individuals and suggests a change in research methods to investigate psychological processes within individuals over time (Molenaar & Campbell, 2009).

Idiographic approaches are particularly useful for studying personality dynamics, that is, how motivated processes occur over time in an individual. We cannot assume, though, that what is found in one individual will also apply to others. Nomothetic approaches, in contrast, provide evidence for generality of concepts across the populations studied. The two approaches complement one another, and the study of personality needs both.

Individual Differences

Personality theory has been persistently concerned with the description of differences among individuals. In principle, if there are naturally existing categories, we may speak of these as *types*. Though the word "type" has been used to refer to types of temperament (Kagan, 1994), and attachment (Ainsworth, Blehar, Waters & Wall, 1978), for example, the underlying determinants (such as anxiety) that produce these categories are continuous. However convenient for descriptive and even analytical purposes, these are not types in the sense of discrete, natural categories; nor are the popular Jungian types, measured by the Myers-Briggs Type Indicator. Continuous dimensions (traits and factors) are far easier to find.

Gordon Allport (1937) argued that traits are a central concept in personality, building on European research and theory (Matthews & Deary, 1998), though he was more interested in how traits function as processes within an individual than in measuring differences between people, which has become a major focus since his time. The question "What units shall we employ?" had no easy answer when Allport (1958) asked it, and the choices have become even more bewildering since then (Ozer, 1996). Researchers have measured a variety of specific traits, such as field dependence, sensation-seeking and

achievement motivation, predicting specific behaviors from domain-specific personality tests. The trait concept suffered a setback when Walter Mischel (1968) reviewed research showing that situations were more influential than traits in predicting behavior. This *situational challenge* to the trait paradigm came with the rise of social psychology and decline of personality psychology, as subfields in psychology. But the issue itself, as the debate between situations and personality raged, was oversimplified. The impact of personality on behavior requires more sophisticated theory and analysis than a simple correlation (Epstein, 1980, 2007). After a lull in popularity in the aftermath of Mischel's challenge, personality programs and research experienced a comeback, often with more explicit ways of incorporating situations into their understanding of personality (Swann & Seyle, 2005). Mischel and other cognitive behaviorists (Bandura, 1986; Mischel & Shoda, 1995) emphasized a person's cognitions as refined trait concepts (sometimes called "person variables"): no longer defined in terms of the observable behavior alone, but the person's thoughts or beliefs about the situation, his capabilities, her probable outcomes and so on. The proliferation of measures of self-efficacy expectations in many domains of behavior attests to the impact of this cognitive reconceptualization of trait concepts.

Researchers also explored taxonomies of situations to improve the prediction of behavior in relationships and other areas (Funder, 2009; Simpson & Winterheld, 2012). Another line of investigation stimulated by the person by situation perspective is the study of behavioral variability within individuals, including the use of experience sampling technology (Donnellan, Lucas & Fleeson, 2009; Fleeson, 2004). In this approach, traits do not simply provide a taxonomy of personality, but serve the dynamic function of explaining it in terms of personality processes (Mischel, 2009; Mischel & Shoda, 1994), as Allport had argued decades before.

In addition to cognitive traits, a major line of research in studying individual differences is the search for a universal taxonomy of trait variations throughout the human population. Much of this research began with a lexical approach, factor analyzing the words that everyday language uses to describe personality differences. Comprehensive trait models aim to represent the major variations in the human population, thought to originate from biological differences. These include the Five-Factor Model, consisting of extraversion, neuroticism, openness, conscientiousness and agreeableness, with several facets of each factor (Goldberg, 1993; McCrae, 1991); Eysenck's (1967) three-factor model consisting of extraversion, neuroticism and psychoticism; J. A. Gray's (1970) model of behavioral activation and behavioral inhibition; and others (Hough, Oswald & Ock, 2015; Saucier, 2009a, 2009b). Two reoccurring dimensions across diverse models are extraversion-introversion and emotional stability-instability (neuroticism).

Many cross-national studies are generally interpreted to support the universality of trait models, with some relatively small variations across cultures (Ashton & Lee, 2005a, 2005b; Ashton et al., 2006; Ashton, Lee, Marcus & de Vries, 2007). As the models have developed, theorists have elaborated dynamic and, to some extent, developmental aspects in addition to the obvious descriptive emphasis (e.g., Hampson, 2012; McCrae, Gaines & Wellington, 2013).

Biology and Nature

The idea that biology influences personality is nothing new. It was a familiar concept to the ancient Greeks, and an assumption behind the eugenics movement in the late nineteenth and first half of the twentieth centuries. An inherited personality predisposition, or *temperament*, produces enduring individual differences across the lifespan from childhood onward (Kagan, 1994). Early definitions of personality, including that of Freud, emphasized its biological influence, though biological mechanisms remained unknown until more recently.

Neuroscience evidence of the brain as modular suggests a model of personality that is also built of components. Pleasure, pain and other emotions have different neural pathways, helping theorists understand why people differ in their reaction to the same events. Defense mechanisms, described since Freud's time and part of the established language of psychoanalytically inspired theory, are being recast in terms of brain processes and learning, instead of flow of libido (Kandel, 2006; Northoff, Bermpohl, Schoenrich & Boeker, 2007). Ethical and moral virtues, from this point of view, are based on neural networks affected by evolutionary selection (Churchland, 2010, 2011, 2014; de Waal, Churchland, Pievani & Parmigiani, 2014). Neuroscientists collaborating with experienced Buddhist meditators report that the mind can influence the brain, as well as the reverse (Davidson, 2001).

Currently popular evolutionary approaches describe a common ancestral basis of personality, but one that is adaptive by distributing personality traits (individual differences) among individuals in a population – empathy to some, dominance to others, and so on – with many of these traits distributed differently for males and females (Buss, 1999; Silverman, Choi & Peters, 2007). Studies of personality in chimpanzees and other animals, especially primates, especially in the decades since the 1980s, have found dimensions of personality that are largely similar to broad human dimensions, including sociability and fearfulness (Freeman & Gosling, 2010). The emotional foundations of personality are sufficiently similar in animals and humans that an affective neuroscience approach across species has been proposed by Panksepp (2007) and Davis & Panksepp (2018).

Behavior geneticists investigate the impact of heredity on personality (and other) traits, and it is well established that many, some argue all, personality traits are influenced

by heredity. The overall conclusion is suggested by twin research (Loehlin & Nichols, 1976; Spinath & Johnson, 2011) and other methods, though detailed mechanisms are elusive and do not seem to relate specific genes to specific traits. Several researchers propose ways that genes interact with environments to produce personality outcomes (Spinath & Johnson, 2011; Strobel & Brocke, 2011; Turkheimer, Pettersson & Horn, 2014).

Neuroscience research permits theorists to describe biological mechanisms that underlie both personality processes (within persons) and individual differences (between persons). Neurotransmitter explanations are offered by Eysenck (1967), J. A. Gray (1970), and others, based in part on observations of anxiety and other emotional responses to reward and punishment that affect learning in animal experiments, especially the work of Ivan Pavlov (Corr & Perkins, 2006). Biological variations affecting biological subsystems related to approach, anxiety (or avoidance) and fear, are proposed to influence the development of human personality differences. Theoretical explanations incorporate experimental observations of brain responses that involve both unconscious automatic and more conscious cognitive processes and the suggestion that emotions can change neural and behavioral responses to similar events in the future (Corr, 2010). Interestingly, this analysis of emotion appears to be consistent with the general proposal by behavioral theorist Arthur Staats (1996) that emotion is central to reinforcement. Modern theories describe biology and experience (e.g., reward and punishment) interacting to shape personality, moving beyond antiquated “either-or” conceptualization of the nature–nurture question. Facilitating research based on the biological model, assessments using questionnaires have been developed (e.g., Corr & Cooper, 2016). This biology-first approach contrasts with questionnaires based on the Five-Factor Model, which began with the analysis of language (the lexical approach).

Adjustment and Wellbeing

Personality psychologists investigate “normal” personality, but many concepts relate to adjustment. Clinical psychology, despite its close connections with medicine (e.g., using the same *Diagnostic and statistical manual of mental disorders*), has had important influences on personality theory. Many of the classic personality theories were devised in a therapy context, either by physicians (e.g., Sigmund Freud, Alfred Adler, Karen Horney) or by psychologists (e.g., Carl Rogers). The psychology clinic at Harvard University, from the 1920s onward, conducted research from a more holistic view of the person, influenced strongly by the psychoanalytic ideas of Henry Murray (1938), who used the term *personology* for his holistic, idiographic study of individual persons. Murray applied the psychoanalytic model to interpret the personality of Adolf Hitler during the Second World War and to

predict his future behavior, in a report commissioned by the US government to assist the Allies in defeating him (Langer, 1972).

Although adjustment and pathology have been reoccurring themes throughout the history of personality theory, the proper conceptualization of these themes is controversial. The emphasis is on the individual, whether the individual's maladaptive learning as in behaviorism, or the individual's characteristics, as in the trait and biological approaches. Some theorists (Allport and Freud, for example) describe conflict or fragmentation within personality as a sign of maladjustment, and unity as evidence of health. Borrowing from medicine, the medical model of disease had some appeal, such as its nonjudgmental implications, and American clinical psychology's association with medical psychiatry can be understood not only because of the reception of psychoanalysis in the USA, but also as a result of government funding of clinical training that favored medicine (Sarason, 2002). As clinical psychology gained ground against psychiatry in providing therapy, it also used expertise from psychology and personality to develop assessment tools that were convenient for studying large populations, such as those in military screening. Some researchers describe pathology from a trait perspective as extreme scores on various traits (e.g., Eysenck, 1994; Markon, Krueger & Watson, 2005; O'Connor, 2002). An obvious example is extremely high neuroticism, predisposing a person to high anxiety. Purely descriptive trait measures, of course, beg the question of whether the developmental origins and dynamic implications of those measured traits are comparable in the normal and abnormal populations.

Humanists, including Abraham Maslow (1976), advocated studying the healthy personality, not only those who are disturbed. The popular movement called *positive psychology* continues the theme from humanistic psychology, focusing on understanding and promoting healthy and creative human potentials and psychological well-being (Gable & Haidt, 2005; Seligman & Csikszentmihalyi, 2000; Seligman, Steen, Park & Peterson, 2005).

Development: Continuity and Change Over Time

Personality theories address development in various ways. Does the passage of time simply reveal innate personality as it unfolds (as biological and many trait approaches imply), or provide opportunities for change (as learning theories suggest)? Do people develop in a gradual, continuous way or through discontinuous stages (as Erikson's psychosocial theory outlines)? Are there critical or sensitive stages, when experience has a particularly strong influence (as psychoanalytic and attachment theories describe)?

Longitudinal research, which is needed to address questions of change or continuity, is challenging, but fortunately some major longitudinal studies enlighten us about personality continuity and change, including ego-

control (Block & Block, 2006), and emotionality and self-regulation (Kubzansky, Martin & Buka, 2004). Stability from childhood to adulthood, while significant in many cases, is low enough to suggest that significant change occurs, especially before adulthood (Caspi, Roberts & Shiner, 2005; Hampson & Goldberg, 2006). In addition, by tracking individuals, longitudinal studies can help avoid misleading results from correlational and short-term studies because of different trajectories for various individuals (e.g., toward health, as discussed by Friedman & Kern, 2014).

Social and Cultural Factors

Personality and social psychology have developed in close relationship to one another, emphasizing (respectively) individual and less conscious, or macro and more cognitive, themes (Pettigrew & Cherry, 2012). Gordon Allport, for one, contributed to both areas, and many personality psychologists have focused research and intervention on social issues, including authoritarianism (Adorno, Frenkel-Brunswick, Levinson & Sanford, 1950) and political attitudes and behavior (Caprara & Vecchione, 2009). John Dollard, a psychologist with a background in sociology, emphasized cultural factors in understanding individuals (Dollard, 1949). Anthropology, on the other hand, has had a less consistent relationship with personality. An active field of culture and personality research in the years before World War II declined afterward, in part because of questionable methods and interpretations, including the far-fetched "swaddling hypothesis" that attributed Russian preference for an authoritarian leader, Stalin, to a history of being swaddled in infancy (LeVine, 2001).

Since personality is presumably learned in a familial and societal context, theory should elaborate on these processes and address changes over time and variation across cultures in family structure and society. Several historical theories have proposed influences of the family (Freud, Adler), of gender (Horney), and of social class (Dollard and Miller), but all of these in a Euro-American context, and assuming the values and expectations of an individualistic society. Alternative models could be revealed by looking at personality from the perspective of non-Western cultures, which emphasize the interdependence of the self and others (Markus & Kitayama, 1991). The perspective of classical Confucianism could particularly help in understanding holistic intraindividual processes (the idiographic approach) in the specific context in which they develop (especially the family), according to Giordano (2014). Cultures also change over time. David Lykken (1995), noted for his work on the genetics of personality, observes that evolution has shaped humans to develop their social behaviors in cooperative extended family groups, but recent cultural changes have left responsibility for childrearing to only one or two often underprepared parents, resulting in more poorly socialized children and therefore more criminals.

Thus cultural change can undermine the evolved developmental environment for healthy development.

Researchers have compared cultures to see what is universal and what is culturally specific. To a large extent, the available evidence supports universality for the Five-Factor Model, but this has been challenged on methodological grounds (Heine & Buchtel, 2009). One idea is that there are universal human motives, such as self-enhancement, but that the particulars of their expression vary from one culture to another, emphasizing individual achievement in some cultures and cooperation in others (Sedikides, Gaertner & Toguchi, 2003; Sedikides, Gaertner & Vevea, 2005). With respect to personality traits, many cross-cultural investigations of personality measures report similarities in the factor structure of personality tests across cultures, but there are differences too, and much theoretical and empirical work remains (Norenzayan & Heine, 2005; Rothbaum, Weisz, Pott, Miyake & Morelli, 2000; Sedikides, Gaertner & Vevea, 2005).

The assumption that there is a universal, biologically based personality factor structure that is affected by culture only in its specific behavioral expression, has been challenged on both theoretical and empirical grounds (Carlo, Knight, Roesch, Opal & Davis, 2014). An alternative viewpoint is that personality development is inextricably affected by culture, particularly in its effects on the development of a sense of self, so that personality and culture cannot be separated (e.g., cultural anthropologist Bidney, 1949; Piekkola, 2011). Immigration and demographic changes make cultural differences increasingly relevant, including themes of individualism, collectivism and honor (Oyserman, 2017). Studies within a culture can reveal the circumstances in which a particular cultural value, such as honor or saving face, is aroused (Carlo, Knight, Roesch, Opal & Davis, 2014). A greater diversity of cultures, as well as of populations within a culture, should be investigated in detail. Until then, theories should not be presumed to apply to cultures other than those in which they have been developed.

While attention has focused most often on the impact of culture on personality, there is also a case to be made for the reverse: that personality influences history and culture (Hogan & Chamorro-Premuzic, 2011). One of the insights from Erik Erikson's (1959) well-known concept of adolescent identity is that identity formation by each generation can significantly change society.

First Person or Third Person: The Experience of the Self or Observers

Some of the grand theorists, we know, drew on their own subjective life experience in developing their formal theories. Should a theory be a formalized version of personal insights that come from one's own experience, or does science require greater distance? Should personal experiences of research participants be data for theory validation? We know that, whether conceptualized as a

defense mechanism or a cognitive deficit, people's self-understanding is error-prone (McKay, Langdon & Coltheart, 2005), and so those reports should not necessarily be taken at face value. Nonetheless, people's first person experiences have proved a useful concept throughout the history of psychology and personality theory, providing a personal, lively appeal that cannot be matched by more abstract theories or comprehensive organizing schemes (Loevinger, 1996). Aside from their value for psychologists, such ideas also appeal to popular audiences.

The introspectionist methods of early scientific psychology in Wundt's laboratory and elsewhere, at the end of the nineteenth and beginning of the twentieth century, studied the mind by subjective observation and relied on subjects' verbal reports for data about their sensory experiences (Boring, 1953), unlike the more reflective thoughts studied more recently. As the method evolved under Titchener and others, it came to be interpreted not simply as sensations, but as functions of thought, aiding the transition to functional and Gestalt theories, and eventually to social perception (Boring, 1953). Modern approaches add an emphasis on the self.

Historical descriptions of introspectionism are often exaggerated and the usual account of a subsequent behavioral revolution and then a cognitive revolution in psychology is overly simplified (Costall, 2006). Subjective experience – especially experience of ourselves, not of external stimuli – has been an important theme throughout the history of personality theories. Over a century ago, William James (1890) wrote thoughtfully on the self, retaining the idea of a “spiritual me” from the era when scientific constraints had not yet strengthened their veto voice over such a soul-like idea, and supplementing the spiritual self with a variety of selves (material, social, and so on) more appealing to a secular audience. Historians note that James's descriptions of the self resemble an earlier French publication by Paul Janet (Lombardo & Foschi, 2003). With the rise of scientific psychology laboratories, the self received less attention until its re-emergence with the personological emphases of Gordon Allport, Henry Murray, and others in the late 1930s (Coon, 2000). Carl Rogers (1961) claimed that psychotherapeutic progress requires attending to a person's experience of self. In this tradition, Bohart (2006) interprets diverse findings from psychotherapy research as evidence that it is the clients themselves, not their therapists, who are the most important change agents in psychotherapy.

Self-reflection is an implicit basis for using self-report questionnaires to measure personality. It is explicit in some theoretical formulations, such as those that describe life stories or narratives as important aspects of identity and functioning (e.g., McAdams, 1996), and those that emphasize self-concept and identity (Loevinger & Knoll, 1983). Narratives help understand culture and individuals' adjustment to their culture, or failure to adjust, as in deviancy (Howard, 1991). In terror management theory, self-

esteem provides a buffer against the anxiety caused by awareness of mortality (Greenberg, Pyszczynski & Solomon, 1986; Pyszczynski, Greenberg, Solomon, Arndt & Schimel, 2004). The theoretical concept of possible selves demonstrates the power of self-reflective cognition to change behavior and to persist toward goals such as finding a job, at least when the social context provides needed support and opportunity (Lee & Oyserman, 2009; Markus & Nurius, 1986; Oyserman, Bybee & Terry, 2006). Self-referent cognitions are obviously developed with experience, and so these concepts provide a place for theorists to link the influence of family and culture on personality. There are broad implications for theory in the choice of methods, such as narratives, that explore people's subjective experience, in contrast to experimental approaches that emphasize objective control. And so including subjective measures can, as Gergen (2002) puts it, remove theoretical blinders.

THEORIES IN PSYCHOLOGICAL SCIENCE

At this point in the development of personality psychology, many discoveries have been made on key issues: identifying and measuring individual differences, describing the biological bases of personality and how personality develops through learning, adjustment and mental health and so on. Nonetheless, the field remains divided into a variety of largely disconnected theoretical and research communities that do not speak a common language. Whether that is where the field should remain, or whether the divisions impede advances that could occur with a coordinated effort, is a matter for debate.

Personality psychology has many theoretical concepts that cannot, themselves, be directly observed, called *hypothetical constructs* in a classic description by MacCorquodale and Meehl (1948). The classical view of scientific theory describes a level of theoretical terms, which are abstract, and a level of observations, which can be empirically observed (Carnap, 1956). At the abstract level, a theory offers a framework for organizing knowledge, through theoretical constructs and propositions about how they are related. When the theory is translated into a format that can be tested, by means of correspondence rules that tell what observations are evidence of a construct (that is, operational definitions of constructs), the theory can be accepted or modified, and scientific progress can occur.

Only by converging evidence from a variety of imperfect measures can we confidently infer the validity of such constructs as adjustment, extraversion or self-esteem. Consider extraversion: If the same people are found to be extraverted when measured by self-report, by peer-report and by behavioral measures, then the construct of extraversion is supported. If not, the construct may be invalid, or perhaps there is a problem with the measurement (Cronbach & Meehl, 1955). In the case of achievement motivation, two different measurement techniques do

not correlate, and so self-report measures and projective measures do not measure the same trait. Only one method (projective measure) predicts achievement behavior (McClelland, Koestner & Weinberger, 1989; Winter, John, Stewart, Klohnen & Duncan, 1998). Conscious or explicit, and non-conscious or implicit, processes differ from one another, as evidenced by considerable research using the Implicit Association Test (Bergh, Akrami & Ekehammar, 2012).

The idea of construct validity stimulated theoretical advances and efforts to measure the elusive units of theory, not only in the clinical psychology area where Paul Meehl first proposed them, but also in the broader personality area of trait psychology (Peterson, 2006). The extreme radical behaviorism of B. F. Skinner, in contrast, focused solely on observables, excluding theoretical constructs (Skinner, 1950), and thus limiting its explanatory power (Botterill & Carruthers, 1999), until cognitive behaviorism expanded its scope.

The concreteness and precision often associated with science should characterize measured observables and, as much as possible, the correspondence rules that connect these observations to theoretical constructs. When clearly defined and stated in advance of observation, correspondence rules distinguish science from pseudoscience (Klee, 1997). They serve as checks on illusory perception of verification that is based on expectation and hope instead of on objective observation and prediction.

But at the theoretical level, such precision is likely to be premature and to hamper scientific progress. Even the physical sciences, which psychology has emulated, offer theoretical ideas that began as vague, even metaphorical formulations, such as "black holes" and "molecular bonds." Bornstein and Becker-Maturo (2011) acknowledge the widespread use of metaphor in Freudian and other schools of psychoanalytic thought, but argue that metaphor is used in other areas of personality theory, too, often not acknowledged as such. In their argument, metaphor is not simply a step in the development of theory (Nash, 1959), but is an often unacknowledged characteristic of scientific (and other) thought in general. They urge, not abandonment of metaphorical language in science, but more careful use of metaphors and attention to their operational definitions. This advice is relevant not only for the often-criticized language of psychoanalysis, but also for other theoretical concepts originally discussed by pre-scientific, nonpsychological thinkers, ideas like free will and choice. It may also be applicable for constructs that are socially constructed, so long as appropriate operationalization (correspondence rules and observables) is chosen for the social context, without blindly assuming that observations apply regardless of culture.

Our discipline, emboldened by several decades of identity as science, may be ready to critically consider how such ideas can be incorporated as theoretical constructs into our theories without abandoning science. To the extent that they attend to such things, the guiding

philosophy of science for psychology was adopted from that used to study the natural world, and is ill suited to the study of human personality. The conflict between the two disciplines discussed earlier in this chapter occurs only because the understanding of “science” is limited by an unsuitably narrow conceptualization of science: one in which concepts can be precisely measured and hypotheses stated in advance of observations and then accepted or rejected based on empirical data.

The availability of new measurement techniques can stimulate theoretical advances by providing additional ways to observe and test theoretical constructs. Advancement in biomedical technology has made it possible to measure physical aspects of personality (brain function, biochemical profiles and so on) with unprecedented detail. With that has come a dizzying parade of advancement in theories that relate personality constructs to the body. Another sort of new measure, this time of the mind, has come with the availability of well-trained meditators from Buddhist culture collaborating with Richard Davidson (2001), leading to research showing the power of the mind (meditation) over the brain (measured by brain imaging techniques). Mind and brain are separate measures in these studies, but the associations challenge our theoretical constructs. Is a physical construct causing a change in the mental? Is a mental construct causing a change in the physical? In either of these two cases, the brain and mind relationship would be represented by a theoretical proposition, in which one construct causes the other to change. Or are the mental and the physical simply two manifestations of a single theoretical mind-body construct? In that case, there would be no need for a theoretical proposition in the form of “brain influences mind” or “mind influences brain.” As measurement advances, it stimulates theory as well as confirming or disconfirming it, and theorists are devoting great attention to understanding the body–mind connection in human consciousness.

Rethinking the Traditional Philosophy of Science

Standard psychology textbooks, at least in American universities, emphasize hypothesis testing as central to the scientific method, instead of describing it as a late stage in a longer process of scientific investigations (Proctor & Capaldi, 2001b). Europeans, according to Proctor and Capaldi, have been less short-sighted. This view of research is not limited to students, but also is prevalent among mainstream researchers, for whom a significant statistical test of a hypothesis has disproportionate value in the larger scheme of scientific progress and, often, professional advancement. Some psychologists hold contrary views, criticizing this focus on hypothesis testing and urging more attention to interpretation and to appreciating that the particular methods of research are, themselves, in need of a more critical evaluation (Proctor & Capaldi, 2001a).

Psychology’s emphasis on disproving the null hypothesis, as a basic research practice, is an assumption that reflects the impact of the philosophy of science espoused by Karl Popper. His influential 1934 book, *Logik der Forschung*, translated into English in 1959 as *The logic of scientific discovery* (Watkins, 2000), challenged the role of induction in science. Instead, Popper elevated the alternative of deducing predictions from theory and conducting research to falsify these deductions, thus permitting errors to be uncovered and rejected. Psychology, striving for recognition as a science, emulated this model of the physical sciences that had emerged earlier than psychology from their mutual origins in philosophy. The philosophy of science guiding the natural sciences at the time – logical positivism, and later logical empiricism – strongly influenced the development of Skinner’s behaviorism and other psychological approaches in the mid-twentieth century (Wolman, 1971). Ironically, the guiding philosophy of science borrowed from the physical sciences excluded some of the very “anthropomorphic” ideas about causality that psychological science needs, according to Wolman (1971), and certainly that is particularly true in the area of personality. The increased emphasis on methodology was accompanied by diminished critical attention to the substance of investigation.

A disproportionate focus on statistical rejection of the null hypothesis sets up a straw man, not a serious alternative to the research hypothesis suggested by theory. After all, as Rorer (1991) puts it, the researcher certainly does not believe the null hypothesis, else the research would not even be done. Rejecting the null hypothesis does not mean affirming the research hypothesis (which would be an error of logic), and it does not imply practical significance, since even trivial differences can reach statistical significance in a world where there is some degree of correlation among almost all variables. Critics contend that there are better methods for psychology to analyze data that would do more to promote knowledge than does null hypothesis testing (e.g., Loftus, 1996).

But more than choice of statistical method is at issue. There are substantive challenges, too. The content of human personality differs from the matter studied by the natural sciences in ways that challenge objectivity. Subjective experience and felt emotions are important to human personality, but how are they to be conceptualized and measured? Are they causes of behavior? What assumptions underlie efforts to measure them by asking people to report their experience, or hooking them up to physiological measuring machines? Phenomenological approaches in psychology involve different research methods than those based on a natural science model, and can be traced to existential and phenomenological philosophies of Husserl and others (Churchill & Wertz, 2015). Subjective experience is given a greater role in both humanistic and cognitive approaches that have been part of the history of personality study throughout modern times, including William James’s descriptions of religious

experience, Gordon Allport's analysis of personal documents, and Abraham Maslow's investigations of self-actualized individuals. Yet the assumptions underlying these data have not been clearly and critically explicated (Uher, 2013, 2015).

Conscious experiences are inherently private, and while they can be reported, those reports are not the same as the momentary phenomena themselves. People's verbalizations can be influenced by the duration of such events, their beliefs about the experiences, and a host of other unknowns. Questionnaires in the trait tradition, particularly those developed from lexical personality descriptions, use reports of experience, but without sufficient consideration of what these reports mean and how the reports are different from the experiences themselves, according to Uher (2013), who argues for a more fully developed and explicit philosophy of science to clarify the assumptions that guide measurement and observation. Without such examination, even statistically sophisticated questionnaire reports remain closer to everyday than scientific language, and they risk using trait labels as presumed causes of the very behaviors from which they are inferred (Uher, 2013). This is not a new criticism, of course, but it limits the extent to which questionnaire-type personality research has been able to move beyond everyday explanations.

Dealing with subjective reports requires, of course, judiciously distinguishing the scientist's theoretical concepts from the experience of participants and taking precautions to prevent researcher expectations and procedures from affecting observations. But what should be done with reports of free will or choice, or of mystical or religious experience? Can any of these be included as theoretical constructs? Or are they to be interpreted simply as the experience of the data-provider, without the theoretician committing to their possible reality – merely the content of people's individual or shared experience reports (Gergen, 2009; Slife & Reber, 2009)? Often, such concepts are simply, and without examination, written out of scientific psychology's theories as outdated metaphysical assumptions (Uher, 2015), and perhaps that is as it should be or must be. But a priori philosophical presupposition is not the same as an empirical finding. Advances in the philosophy of science that guides personality research would be required to actually study such very human subjective experiences.

The mounting data collected from neurological studies of the brain also raises questions that are difficult to address without coming to premature and perhaps unjustified conclusions about how brain processes relate to human experience. If brain measurements record distinctive activity before a person is aware of making a choice, does that mean that choice is an illusion, actually a result of biologically determined unconscious processes? Does the very act of reporting change the phenomenon, as seems reasonable considering experimental evidence that putting emotional experience into words can mitigate the

disruptive effect of such emotions (Lieberman, 2014)? If mirror neurons fire in response to other people's actions as well as our own, does that mean that empathy is a result of biology and not a morally commendable virtue? The brains of people who do not function normally lack the capacity for choice and so should be held not judicially responsible for their crimes against others? The ancient mind-body problem challenges scientists to explicate a clear philosophy of science to guide reasoning about scientific evidence and how such evidence can justifiably be interpreted. Lacking that, there is the risk of "drawing bold philosophical, political and social conclusions from neurological findings, whose correct interpretation and value are still extremely controversial" (Lavazza & De Caro, 2010, p. 39). There are, without doubt, implications for society and the general public, as well as for the scientific community, of research on free will and other topics studied by neuroscientists (Lavazza, 2015).

Joseph Rychlak (1968) proposes a more dialectical science, more open to discovery of human nature. In their effort to be scientific, he laments, many psychologists have excluded teleological responses, such as self-directed goals and growth principles, from their theories, looking for mechanistic cause-effect relationships instead. Rychlak (1986, 1988, 1997, 2000) proposes an alternative Logical Learning Theory that emphasizes intention and choice as central personality concepts. He and others contend that including constructs like choice and free will to describe humans, at the theory level, does not contradict requirements of the scientific method. To think that it does so is to erroneously equate the content of a theory with the method for its validation. The positive psychology movement agrees that human personality is forward-looking, and that a teleological concept such as "prospection" is required to correct an over-emphasis on causation from the past (Seligman, Railton, Baumeister & Sripada, 2013). The challenge is to find appropriate ways to develop and test such a human theory, taking into account such intriguing findings as neuroscience evidence that conscious awareness of making decisions comes after, not before, an action is initiated. Such timing challenges a simple interpretation of the concept of free will as a conscious choice that precedes a specific act, and requires a thoughtful theoretical reconsideration of automatic and conscious processing (Corr, 2010).

In the face of such questions about the underlying assumptions of personality science, it is time to listen to those who call for less attention to hypothesis testing and more focus on the earlier phase of developing theory, for proposing the constructs and their relationships to other constructs in the first place. Ignoring the importance of the intuitive, theory-generation phase can lead to a rigorous but sterile science. It also risks assuming that culturally constructed ideas are universal and scientific, according to criticisms from a social constructivist point of view (Gergen, 1985). The hypothesis-testing model is somewhat of a misleading account, anyhow. Although

textbooks generally teach that experiments function to test theory and are essentially independent of the theory, thus giving an objective, independent test, this idealizes the actual process by which the sciences make progress. According to Gooding (2000), trial and error occurs in the laboratory, as researchers attempt to find procedures that more or less match theoretical predictions, refining their measuring instruments, manipulations and so forth. This unacknowledged shaping of experiments so that they work and can be portrayed as tests of theory makes the findings of experiments less “universal and timeless,” more “particular and local” (Gooding, 2000, p. 124) than they appear to be. If this is so in the presumably more objective physical sciences, which Gooding (2000) describes, then how much more it can be in the psychological realm. Personality psychologists may be cautioned, therefore, to be particularly cautious about generalizing results from research settings to other places and times. The meanings of our theoretical constructs should not be assumed to be universal, unless considerable observation in diverse contexts provides an empirical basis for such an assumption.

A greater role for induction in creating theoretical ideas would be possible by using the approach of grounded theory (Glaser & Strauss, 1967), which gathers qualitative data and generally involves considerably more back and forth interaction between the researcher and the participant, thus differing from the quantitative, objective methods favored by most researchers. Grounded theory investigation is particularly well-suited to the inductive phase of discovery, as contrasted with theory testing. It permits researchers to describe the experience of those they are studying in far richer detail than research that uses more directive measures (e.g., Rennie & Nissim, 2015). It is more often used in counseling and psychotherapy (Ponterotto, 2005; Rennie, 2002) than in academic personality research. Data collection methods that open up researchers to the experiences of research participants sometimes describe them as co-investigators, rather than “subjects” or even (after psychoanalytic usage, and also Rogers, 1955) “objects.” Narrative methods, too, allow participants to provide rich details of their experience and life stories, in a format unconstrained by restrictive multiple choice instruments.

CONCLUSION

The field of personality has faced challenges throughout its history, suffering relative neglect when psychology discovered the experimental method and emulated the methods of the hard sciences; fading into the hidden black box of the organism when behaviorism reigned; risking demise when social psychology called attention to the importance of situations. Its own perspectives have matured over its history, with radical behaviorism becoming less extreme and more humanistic by incorporating cognitive aspects, and classical psychoanalysis evolving

with the discovery of brain mechanisms of nonconscious thought, and with methods for studying implicit cognitions that demonstrate their differences from conscious, explicit thought. Yet its questions have staying power, not the least because outsiders to our field want to understand people, and sense that psychologists should be able to comment on their everyday understanding of personality. It is not separate from the rest of psychology, and the field of personality, within psychology, is in a particularly promising position for the unification of theory because so many of the other areas of psychology (learning, development, biology, and so on) are interconnected to understand personality, both individual differences and the functioning of individuals.

More sophistication about philosophy of science may preclude unnecessary restrictions that are the legacy of an inappropriate model of the scientific process, as well as other misunderstandings stemming from an exaggerated portrayal of paradigm conflict based on Kuhn's (1970) theory, which is of questionable relevance to the social sciences (Driver-Linn, 2003; Green, 2004; Klee, 1997). Efforts are underway to combine multiple perspectives in a unified theory (e.g., Poropat & Corr, 2015; Sternberg, 2005). In the meantime, without a satisfactory unified theory, eclecticism may be more useful for theory development (Køppe, 2012). Those who argue for a holistic, integrative approach coexist with others who strive for rigorous methodology. That neither has prevailed has created a healthy tension that can stimulate theoretical development and exciting research.

Personality has always had a concern with the whole functioning person, though sometimes up close, like a mosaic, the pieces are more conspicuous than the overall picture. Certainly there is nothing wrong with intensive investigation within a particular theoretical approach, so long as this is not elevated to unwarranted applications. When experts focus on only one perspective, they can commit very harmful acts, as Sapolsky (2017) warns in examples of biological (lobotomy) and behavioral interventions that ignored other factors contributing to problematic functioning. Multiple perspectives are needed to keep us humble, and ethical, in our role in the larger world. Psychology generally, and personality theorists in particular, have responded to the challenge of becoming a science, and now continue to confront the core issue of what this means for the human sciences that can more wisely guide our theoretical and methodological development and our contributions to humankind.

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2

The Trait Approach

ALEXANDER WEISS AND IAN J. DEARY

INTRODUCTION

Notwithstanding the successes of the trait approach to personality in the last century-plus – one of psychology's major achievements – problems persist. Although we are closer to solving these problems, issues remain about how psychologists know whether traits – and any given model of traits – are the right way to construe human personality, and their nature is still largely mysterious. These questions concern whether we have summary or causal views of traits (Allport, 1937), and whether we have identified surface or source traits (Cattell, 1945).

There are good reasons to keep repeating this message: Humans cottoned on to the idea of traits in antiquity, and that the scientific approach to personality has cleaned up their number, provided reliable measures, and validated them. Theophrastus (371–287 BCE) enumerated typical human “characters” that the translator reckoned could be called “traits” (Rusten, 1993). Our language has thousands of words used to describe people's typical ways of being (Allport & Odbert, 1936). We talk and write, at least, as if there were traits, as if these traits are a part of our constitution, and as if they influence our behaviors. The humoral theory of bodily health, illness and personal well-being that can be traced to Hippocrates and Galen (Stelmack & Stalikas, 1991), and which held sway for about 1,500 years, described four temperaments, or personality types, which map rather well on to quadrants provided by neuroticism and extraversion: melancholic, choleric, sanguine and phlegmatic.

Just because the ideas have always been around and have got into the language, as did the nomenclature of some archaic medical theories, does not mean that there are such entities. Key developments in turning a popular into a scientific approach to personality included: the suggestion that using language terms might be useful in studying human personality (Galton, 1884); the collection of empirical data on trait-like terms (Heymans & Wiersma, 1909; Webb, 1915); the development of trait theory (e.g., Allport, 1937); the development of multiple factor analysis (Thurstone, 1947); and the development of

trait scales and applying multivariate statistical analyses to them (e.g., Cattell, 1945; Eysenck, 1947). These developments resulted in numerous personality models and instruments which, although based on different numbers of, and often differently named, traits had more in common than was obvious. For example, overlaps in coverage of Cattell's, Eysenck's, various Five-Factor Models' (e.g., De Raad, 2000; Digman & Takemoto-Chock, 1981; Goldberg, 1981, 1993; McCrae & Costa, 2003), and Cloninger's (Cloninger, Svrakic & Przybeck, 1993) traits, are substantial (e.g., Aluja, Garcia & Garcia, 2002). The history of, and convergence around, the currently dominant Five-Factor Model of personality traits has been described by Digman (1996). He recounted how prior research that retrospectively supported a Five-Factor Model was better appreciated after a key seminar by Goldberg (1983), and after the development of the NEO Personality Inventory (NEO-PI), and its comparison with other models (Costa & McCrae, 1985).

THE BIG FIVE

The completeness of the Five-Factor Model or Big Five (neuroticism, extraversion, openness, agreeableness and conscientiousness), that is, whether they capture the major sources of human personality variation, has been questioned. For example, based on a review of lexical studies conducted in a broad range of cultures, Ashton and Lee (2001) argued that a sixth trait, honesty–humility, should be included in models of human personality. Supporting this view, Lee, Ogunfowora and Ashton (2005) found that honesty–humility was associated with the first unrotated factor of Paunonen's (2002) Supernumerary Personality Inventory, the latter being a measure of ten scales that are weakly correlated with lexical measures of the Big Five. At around the same time Ashton and Lee (2005) provided evidence that honesty–humility was independent of lexical measures of the Big Five, its strongest associations being with the agreeableness scales of the Big Five Mini-Markers (0.26) and the International

Personality Item Pool (IPIP) Big Five markers (0.28). On the other hand, this study also found that the correlation between honesty–humility and Costa and McCrae’s (1992) Revised NEO-PI (NEO-PI-R) agreeableness scale was substantial (0.54). Brocklebank, Pauls, Rockmore and Bates (2015) used spectral clustering, an alternative data reduction technique (von Luxburg, 2007), to identify personality dimensions in 300 IPIP NEO questionnaire (Goldberg et al., 2006) items. They found that, although the IPIP NEO was designed to measure the Big Five, they could recover a HEXACO-like structure; honesty–humility appeared to be poorly represented in item sampling and so did not show up when exploratory factor analyses were applied. Although it is too soon to tell, the latter two findings hint that the “incompleteness” identified in lexical studies may be as readily attributable to the items chosen to measure agreeableness (and other dimensions) as they are to the appropriateness of the Five-Factor Model.

Another possibility, i.e., of there potentially being fewer than five factors, was raised by Digman (1997), who identified two higher-order factors from correlations between Big Five traits, from fourteen studies. The first factor, “alpha,” had positive loadings on agreeableness, conscientiousness, and emotional stability (the inverse of neuroticism). The second factor, “beta,” had positive loadings on the extraversion and intellect (openness). Later, DeYoung found alpha and beta in a university and community sample (DeYoung, Peterson & Higgins, 2002) and in a study where he modeled the Big Five as latent variables measured via multiple informants (DeYoung, 2006). He relabeled alpha and beta “stability” and “plasticity,” respectively, and noted that they could be important for developing biological theories of personality (DeYoung, 2006). Going further in the fewer-factors direction, some, e.g., Musek (2007), proposed that a single, even higher-order, factor had positive loadings on those uncovered by Digman and DeYoung. To wit, they proposed that a “general factor of personality” enables one to characterize people on one dimension that indicates the degree to which people are extraverted, emotionally stable, open to experience, agreeable and conscientious. Whereas these higher-order personality traits are replicable, these traits, and particularly the general factor of personality, wither when they are subjected to strong tests of whether they are substantive (see, e.g., Bäckström, Björklund & Larsson, 2009; Biesanz & West, 2004; Ferguson, Chamorro-Premuzic, Pickering & Weiss, 2011; Revelle & Wilt, 2013; Riemann & Kandler, 2010).

For the most part, though, regardless of whether future research finds support for the more-than-five-factors HEXACO and/or higher-order personality factors, the revisions to the model are not large. Remarkably, the Five-Factor Model (or, at least, four of its factors, with openness as a partial exception) does a fair job in accounting for variation in abnormal as well as normal personality variation (Markon, Krueger & Watson, 2005; Trull & Widiger, 2013).

The applicability of the Five-Factor Model to other cultures and language groups has been questioned, and the

model has done well in this sphere, too. Personality questionnaires have been translated into many languages. In a study of twenty-six cultures, many non-Western, McCrae (2001) reported that factor analyses of the NEO-PI-R retrieved very similar personality structures. A later report, also using the NEO-PI-R, in which almost 12,000 students in fifty cultures rated another person’s traits, found good agreement with regard to the American self-report structure (McCrae, Terracciano & 78 members of the Personality Profiles of Cultures Project, 2005). Another study of people in fifty-six nations who completed the Big Five Inventory (Benet-Martínez & John, 1998) also reported a similar structure across these nations (Schmitt et al., 2007). Eysenck’s personality questionnaires perform well on this type of cross-cultural comparison, too (e.g., Eysenck & Eysenck, 1982), and, although it is still early days, the same appears to be true for the HEXACO model (Ion et al., 2017). An exception to the applicability of a personality model developed in one culture to another has been identified by Gurven, von Rueden, Massenkoff, Kaplan and Lero Vie (2013). When they administered the Big Five Inventory to the Tsimane, a South American society with a literacy rate of 25 percent who make their living by foraging and horticulturalism, they found two factors that reflected industriousness and prosociality.

This type of cross-cultural personality research is characterized by what is known as the “etic” approach, in which a personality questionnaire developed in one culture (usually Western) is translated and applied to others. The other type of research is the “emic” approach, which starts with each culture’s own lexicon and asks if a similar personality structure is found in each. Peabody and De Raad’s (2002) summary of emic research was that the “effort to achieve Big Five universality has been overextended” (p. 993). They found the best generality across cultures for conscientiousness, extraversion and agreeableness but also that “emotional stability and intellect frequently do not appear as cohesive factors” (p. 993). There is especially good agreement across some languages. For example, English and German lexicons have very similar five-factor structures (Saucier & Ostendorf, 1999). On the other hand, whereas the Greek lexicon did afford a five-factor solution also possible were one-, two-, six- and seven-factor solutions (Saucier, Georgiades, Tsaousis & Goldberg, 2005).

The consensual validation of personality trait ratings has been questioned. As McCrae et al. (2004) argue, consensual validation can answer objections to rated personality traits such as response sets and cognitive schemata; consensual validation can help to suggest that traits are objective psychological attributes. They reviewed nineteen studies of cross-observer agreement and concluded that, in disparate cultures, people “include trait information” (p. 196) in self-reports and observer ratings. In self- versus spouse-ratings, consensual validity coefficients were the highest of those reported by McCrae et al.: neuroticism = 0.44; extraversion = 0.57; openness = 0.51; agreeableness =

0.50; and conscientiousness = 0.42. A more stringent test of consensual validity was conducted by Borkenau, Mauer, Riemann, Spinath and Angleitner (2004). Participants performed fifteen short video-recorded acts, such as introducing oneself, telling a story from pictures, singing and so forth. Judges rated the people in the videos using the NEO-PI-R, which was also completed by the people in the videos. The consensual validity coefficients were: neuroticism = 0.19; extraversion = 0.30; openness = 0.31; agreeableness = 0.22; and conscientiousness = 0.08. Cross-judge agreement was very good, with a mean coefficient of 0.69, and these modest, positive associations between ratings done by strangers and people's self-reports are impressive (note the unreliability of the outcome variables), especially for openness and extraversion.

The stability of personality trait ratings has been questioned. A review of over 152 longitudinal studies with over 3,000 correlation coefficients found that trait stability increased from childhood to adulthood, rising from about 0.3 to over 0.7 (Roberts & DelVecchio, 2000). This supported earlier research on the Five-Factor Model (Costa & McCrae, 1994) and Eysenck's factors (Sanderman & Ranchor, 1994), which found stability coefficients well above 0.6, rising to above 0.8, for periods of six to thirty years. Moreover, since Roberts and DelVecchio's review, Terracciano, Costa and McCrae (2006) found rank-order consistency coefficients ranging from 0.64 (emotional stability) to 0.78 (ascendancy) for the ten Guilford-Zimmerman Temperament Survey scales and coefficients ranging from 0.78 (neuroticism) to 0.85 (openness) for the NEO-PI-R domains and a median rank-order consistency for the NEO-PI-R facets of 0.71.

The stability of individual differences has also been investigated in nonadults. For example, in ten- to thirteen-year-olds, four-year stability coefficients for the NEO Five-Factor Inventory (NEO-FFI), a brief version of the NEO-PI-R, domains for boys ranged from 0.31 (agreeableness) to 0.49 (conscientiousness), and for girls from 0.30 (neuroticism) to 0.63 (conscientiousness) (McCrae et al., 2002). Personality stability in children can also be high, provided age-appropriate measurement instruments are used. Using the Berkeley Puppet Inventory, in which identical puppets make opposite statements, and the children choose which applies better to them, the stability coefficients between age six and seven years were often above 0.5, and considerably higher when corrected for period-free unreliability (Measelle, John, Ablow, Cowan & Cowan, 2005).

Genetics

The biological reality of personality traits has been questioned. A review by Bouchard and Loehlin (2001) of studies of twins and other related siblings found that genetic differences account for about half of the variation and that most remaining variation is attributable to nonshared environmental effects and measurement error; common

environmental effects account for a negligible proportion of variation. Studies cited in their review show that these estimates can be refined. Riemann, Angleitner and Strelau (1997), for example, found that adjusting for variance related to how personality was measured, i.e., whether by self- or rater-reports, increased the heritability estimates. Another study found that variation in lower-order traits that make up the Five-Factor Model are also heritable, although some (e.g., the self-discipline facet of conscientiousness) have a significant shared environmental component (Jang, McCrae, Angleitner, Riemann & Livesley, 1998). The architecture of the Big Five is also genetic: A study of twins by McCrae, Jang, Livesley, Riemann and Angleitner (2001) and a cross-cultural study by Yamagata et al. (2006) both found that the Five-Factor Model structure is attributable to genetic correlations between lower-order traits.

Further evidence of the biological reality of traits is that human-like traits are found in nonhuman primates and other animals, and these traits show similar levels of stability, consensual validity, and heritability to those of humans (Bell, Hankison & Laskowski, 2009; Gosling, 2001; van Oers, de Jong, van Noordwijk, Kempenaers & Drent, 2005). Moreover, traits found in nonhumans can be organized along dimensions that resemble to varying degrees the Five-Factor Model (Freeman & Gosling, 2010; Gosling & John, 1999). Most strikingly, chimpanzees, our closest living nonhuman relative, have something like a Five-Factor Model and an additional personality dimension related to competitive prowess, and thus labeled "dominance" (King & Figueredo, 1997).

Given the clear evidence for the biological bases for personality traits, it may be surprising to some that progress in understanding the molecular genetic bases of personality has, until recently, been slow. This is partly attributable to the considerable time that was spent chasing candidate genes for personality, which, because of the likely small effects imparted by single genes and the small studies conducted, yielded associations that were very likely false positives (Sanchez-Roige, Gray, MacKillop, Chen & Palmer, 2017).

The move from candidate gene approaches to genome wide association studies has yielded new knowledge about the genetic architecture of personality. The best evidence comes from neuroticism, where the largest samples are available, probably because its relationship with psychiatric disorders makes it more likely to be included in large scale studies. These studies have demonstrated that the heritability of neuroticism can be shown from testing the DNA of unrelated individuals (Smith et al., 2016). They have also shown that the genetic contributions to personality traits are highly polygenic, with each variant contributing a miniscule proportion of variation. For example, in over 300,000 individuals, there were over 10,000 genetic variants in 100 independent genetic loci significantly associated with neuroticism (Luciano et al., 2018).

Predictive Validity

The predictive validity of personality traits has been questioned. Neuroticism and extraversion, respectively, have negative and positive relationships with mood (e.g., Steel, Schmidt & Shultz, 2008) and its disorders (e.g., Ivkovic et al., 2007; Kendler, Gatz, Gardner & Pedersen, 2006; Kendler & Myers, 2010). The Five-Factor Model traits are also involved in other psychiatric disorders, and especially the personality disorders (Widiger & Mullins-Sweatt, 2009). A meta-synthesis revealed that all Big Five traits, but especially lower neuroticism and higher agreeableness and conscientiousness, are related to better health and longevity (Strickhouser, Zell & Krizan, 2017). Personality traits are also associated with relationship quality and career success (Ozer & Benet-Martínez, 2006; Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007), values (Steger, Hicks, Kashdan, Krueger & Bouchard, 2007), and political orientation (Kandler, Bleidorn & Riemann, 2012; McCrae & Costa, 1997). This predictive validity extends to more prosaic behaviors, too, e.g., getting a tan (Chapman & Goldberg, 2017).

Few psychological constructs can muster such a rich nomological network. What makes this more remarkable is that, for many of the cases above, e.g., the association between neuroticism and mood disorders, the associations are genetically mediated.

THE PROBLEM WITH THE TRAIT APPROACH TO PERSONALITY

There are several accounts of the consensus that emerged concerning the Five-Factor Model. One good example is by John and Robins (1993). One useful aspect of their overview is the recounting of how the descriptive scheme emerged and then started to be called a “theory” and “theoretical structure.” But the worrying explanatory gap appears as the “structure was derived through purely empirical and purposely atheoretical procedures; theoretical considerations ... were deemed unimportant” (p. 224). After that, as others do, they pull a rabbit out of the Five-Factor hat. That is, the descriptive, atheoretical – Big Five – scheme, undergoes a Clark Kent-to-Superman transformation, by being renamed (by others) the Five-Factor Model. What changed? The Five-Factor Model is the Big Five plus stuff that we know about it: for example, its stability and genetic basis. Of course, this could be contrasted with those who might seek explanations of trait differences in cognitive or social mechanisms (e.g., Shoda & Mischel, 1996), so perhaps it is a model. John and Robins (1993) then discuss the difference between those who hold to traits as merely descriptive – the summary view – and, those who hold the causal view. But the causal view, to be tractable, must be made explicit and testable. When discussing the causal view, one gets various reiterations of what this means to people, for example “unknown neuropsychiatric structures” and vague “causal

and dynamic principles” (John & Robins, 1993, pp. 227–228).

John and Robins (1993) stated, understandably, that classification often comes before explanation in science, and that one can do a lot of useful work with traits without losing sleep about their foundations. But the issue is not just one of the descriptive versus explanatory status of traits. It is a basic issue of what these entities are, whether we have the right ones, and what the “right ones” means. And these things had been a worry since the dawn of modern personality research. The contemporary work on this takes its lead from Galton (1884). He reckoned that aspects of character other than cognitive ability might be measurable. Observations of similarity in conduct between parents and their children, in similarity of feelings between twin pairs, and of his own apparent free will convinced him “that the character which shapes our conduct is a definite and durable ‘something,’ and therefore that it is reasonable to attempt to measure it” (p. 181). Galton stated the problem of choosing the entities that mark our personality traits: “We must guard ourselves against supposing that the moral faculties which we distinguish by different names, as courage, sociability, niggardness, are separate entities” (p. 181). Galton headed for the store of human trait terms that contemporary researchers who use the “lexical approach” headed, that is, “an appropriate dictionary” (p. 181).

Galton (1884) reckoned that individual differences in character might be tested before the phenomena of character were charted: “Definite acts in response to definite emergencies have alone to be noted. No accurate map of character is required to start from” (p. 182). His pithy phrase for what he was proposing was to get at people’s “statistics of conduct in a limited number of well-defined small trials” (p. 182). One of the most obvious areas of difference, he thought, was man’s “emotional temperament” (p. 182); also, “Some men are easily provoked, others remain cheerful even when affairs go very contrary to their liking” (p. 184). Galton ended his piece by noting that character would be reflected in the every-day behaviors of people (p. 185).

Much of Galton’s 130-year-old agenda is recognizable: character traits might be heritable; trait terms may be sought in the lexicon; the entities are not clear, because words are mongrels of underlying traits; character had not been mapped out; that perhaps we should bash on and measure traits using several short trials; and that emotional responses were notable aspects of personality.

Much of what Galton suggested has been realized. For example, in studies grounded in the act-frequency approach (Chapman & Goldberg, 2017), and in some animal personality research (see Réale, Reader, Sol, McDougall & Dingemanse, 2007 for a review). But the issues of *which traits we have*, and the *nature of traits* have been persistent problems, revisited many times over by influential thinkers.

THE NATURE OF TRAITS

The conceptual nature of traits was often uppermost in Allport's thinking about personality. He worried that researchers, "give only an occasional glance at problems of terminology and theory," and that "disingenuous investigators have made it appear that quantitative distinctions can outrun qualitative, and that adjectival distinctions can outrun substantive" (Allport, 1927, p. 284). The latter comment is still applicable, where the quantitative aspects of traits have been so successful despite there being no answer to "*what constitutes the essential unit of personality*" (Allport, 1927, p. 285). Even in Allport's ninety-year-old piece there were dawns of the well-established findings that broad traits comprised correlated narrower traits (Freyd, 1924), and there was discussion of a hierarchy in which traits sat above narrower entities such as habits and responses, a scheme that was included in Eysenck's (e.g., 1947, p. 29; 1953, p. 13) descriptions of traits. Whether it was conditioned reflexes or habits that formed the underlying units of traits, Allport (1927) emphasized that a trait was "a definite new entity of its own, different from its components and from everything else... a trait is functionally independent of its origins" (p. 289). Thus emerged his famous phrase that "A trait is known not by its cause, but by what it causes; not by its roots but by its fruits" (p. 289). This is a pity; deemphasizing the founding units of traits casts the superficial phenotype free from them and can lead to our leaving unaddressed the issue of isomorphism between trait patterns and bodily make-up. Indeed, it might strongly be argued that the problem of what traits we have will be settled only when we know more about their nature; we might never know the correct outlines until we have understood traits' physiological, genetic and evolutionary foundations. Whether consciously or not, much of more recent research has taken this aspect of Allport too seriously, providing the fruits of traits while our knowledge about the roots is much less. However, by the next paragraph Allport was back on the reductionist agenda: "The definition of the unit of personality is one problem pressing for solution" (p. 290).

In his classic doctrine "What is a trait of personality?" Allport (1931) put forward eight criteria:

1. Traits have more than nominal existence
2. Traits are more than generalized habits
3. Traits are dynamic, or at least determinative
4. Traits' existence may be established empirically or at least statistically
5. Traits are only relatively independent of each other
6. A trait of personality, psychologically considered, is not the same as a moral quality
7. Acts, and even habits, that are inconsistent with a trait are not proof of the nonexistence of the trait
8. A trait may be viewed either in light of the personality which contains it, or in light of its distribution in the population at large.

This is still a useful manifesto, in parts. In fact Allport (1931) started with a plea to common sense that we should

recognize the "more generalized habits" (p. 368). As Eysenck would emphasize later (1947, 1953), the identification of traits went past the regularities of habits that we can recognize easily; statistical techniques of data reduction (and perhaps even genetic covariance) are required

"If the habit of dominating a tradesman can be shown, statistically or genetically, to be related to the habit of bluffing one's way past guards, there is the presumption that a common trait of personality exists which includes these two habits" (p. 369).

Under his third criterion, Allport emphasized that the trait and not the stimulus was the driving force behind behavior that expresses personality. This idea was recast by Matthews, Deary and Whiteman (2009) when they articulated the key assumptions of the "inner locus" (p. 7) and "causal primacy" (p. 6) of personality traits. Allport suggested the definitions "derived drives" or "derived motives" (p. 369) for traits and summed up that "Whatever they are called they may be regarded as playing a motivating role in each act, thus endowing the separate adjustments of the individual to specific stimuli with that *adverbial* quality that is the very essence of personality" (p. 369).

Today's trait researchers are keener on adjectives than adverbs. Under his fourth criterion, Allport noted that one needed "evidence of repeated reactions which, though not necessarily constant in type, seem none the less to be consistently a function of the same underlying determinant" (p. 370). Under the fourth and fifth criteria, Allport saw that evidence of traits would come from factor analytic-type techniques, and he mused on how separate these traits would be, and at what level of generality one would begin to accept separable traits. Under the seventh criterion, Allport points out that traits are dispositions and not deterministic: "Even the characteristically neat person may become careless in his haste to catch a train" (p. 371). Under the sixth criterion, Allport's discussion is broader than its title might suggest. He worried that traits might be loaded with the conventional meanings of the words allocated to them and that, ideally, researchers would "find our traits... and then name them" (p. 371). Of course, he also stated that words might represent true traits but, on the other hand, "conventional meanings... [might lead us] away from the precise integration as it exists" (p. 371). Here, Allport explicitly seems to recognize that our likeliest road into traits is from language terms. However, he hints at, but does not directly address, how one might craft a research program to get at "the precise integration as it exists in the given individual." That vague phrase is at the heart of the chronic problem of personality trait research: Traits look good from the outside, but we have little idea about their bodily foundations. The surprise at the end of Allport's doctrine is his guess that there might be a few hundred nomothetic traits in a population, and that each person might have a thousand or so identifiable traits. That would give the innocent question "what's she like?" quite a long reply.

Allport's was not a lone voice in the inter-war years' thinking about the nature of traits. Carr and Kingsbury (1938) recognized that there were trait names in everyday life, that we knew what we meant by them in practical terms, and that they had been introduced to psychology. However, the worry was that "we may be unable to give any analytical and systematic definition of the concept" (p. 497). They opened up by attempting a definition: "A trait is a conceptual attribute or definition of the reactive nature of the individual. The nature of the individual is defined on the basis of certain observable behavior characteristics" (p. 497). These characteristics, lexically, were nicely described: how an adverbial description of a response (acting persistently) can become a characteristic adjective if observed consistently (a persistent person), and how these can become abstracted from people as trait nouns (persistence). They summarized three aspects of traits, on the surface, that would draw agreement: trait attributions come from observed behaviors; they are to do with how people react to situations; and trait attributions allow better-than-chance prediction about people's behavior. But, relevant to the theme of this section, their essence lies beyond this: "The observed modes of conduct [traits] are judged to be functions of the constitutional nature of the individual, and the nature and locus of these organic conditions will presumably vary with the trait" (p. 498).

Many dense pages later Carr and Kingsbury (1938, p. 510) return to the conceptual nature of traits. If we knew the "organic conditions" underlying traits we should probably define traits in those terms; but we do not, so we use "behavior correlates." Despite what they viewed as psychologists' ignorance about the fundamentals of traits, they stated that "trait terms are not mere words. They are applied to the individual in virtue of his possession of these organic conditions, and they are thus symbols that indirectly denote those conditions. Traits are conceptual realities that are highly similar to such concepts as engrams, nerve traces, neural modifications, etc." (p. 510).

Carr and Kingsbury immediately follow with two astute comments. First, they eschew naïve isomorphism in the biology of traits: "We must inhibit the naïve tendency to conceive of their organic conditions as simple and unitary in character and occupying a distinctive location within the organism" (p. 510). They then eschew mystification of traits on the basis that their fundamentals are unobservable: "Any tendency to reify these trait concepts in terms of an unsubstantial or immaterial content must be inhibited... Any such tendency leads directly to an ontological dualism" (p. 510). They understood that some trait terms were universal and nomothetic. They saw that people could be located on a dimension made up from antagonistic trait names and similarities in groups of trait words that would allow for groups of similar trait names.

Toward the end of Carr and Kingsbury's piece is a stark reminder of what was at stake for personality traits at that

time. They enumerated various possibilities regarding whether traits should be included in "general and systematic psychology" (p. 523). To the trait theorist who views traits as basic aspects of individual differences, the idea that traits might not be of use as concepts that help us understand people in general comes as a shock. A further irony comes from their last thought regarding this issue: "that abnormal and clinical psychology have evinced no interest in popular traits, but have developed a set of new traits that are supposed to possess a distinctive value for their purposes" (p. 523). Surprisingly, among these purely clinical and abnormal traits, they included introversion and extraversion, and emotional stability, the very rocks on which the systematic psychology of traits in the normal person were founded¹. And Carr and Kingsbury might not be far from having made a still-relevant comment when they wrote that "psychology is at present groping somewhat blindly about because of the absence of any definite and accepted principles of orientation in reference to [traits]" (p. 524). We still lack such anchors.

Allport (1966) revisited the trait field, and his doctrinal list specifically, decades later. What he saw was that the field had become a battlefield; trait workers were not only trying to pursue their research agendas but had to defend against the situationist "gunfire" (p. 2). Ten years later, Epstein (1979) agreed, noting that personality research had "slipped into the dark ages... method has become more important than substance" (p. 649). His targets were largely the situationist critics and their inability to appreciate the unreliability of single observations of behavior. By the 1960s, Allport had the benefit of mature multiple factor analysis methods, and emerging results about the main traits and their hierarchical arrangement. Whereas he recognized the efforts of Eysenck, Cattell, Thurstone and Guilford in classifying traits, he made it clear that he had doubts as to whether factor analytically derived traits are the sorts of things his personality ideas wanted, asserting that "Traits are cortical, subcortical, or postural dispositions having the capacity to gate or guide specific phasic reactions. It is only the phasic aspect that is visible; the tonic is carried somehow in the still mysterious realm of neurodynamic structure" (Allport, 1966, p. 3). This lack of grounding traits somewhere in the brain and body had always exercised Eysenck, whose book *The biological basis of personality* would appear a year later. Eysenck's (1957) general ideas about extraversion's basis in cortical arousability were already stated ten years earlier, and had an acknowledged basis in McDougall's (1929) work that was contemporaneous with Allport's earliest writings.

¹ In fact, prior to their article there were many writers developing scales of "neurotic tendencies" and "introversion-extraversion" that were obviously intended to be applied to normal personality differences (e.g., Bernreuter, 1933; Guilford & Guilford, 1934, 1936; Thurstone & Thurstone, 1930). Some items from these early scales were used in various personality questionnaires devised later by Eysenck (Deary & Bedford, 2011).

McDougall and Eysenck might not have been right – there is hardly a single replicable discovery concerning the biological basis of personality that has arisen from these pioneering ideas – but their scientific instincts were correct: Traits were unsatisfying fare unless one attacked the problem from the outside (appearances/consequences) and the inside (internal structure/causes) at the same time. Allport (1966, p. 3) wondered whether factor analytically derived traits and biological research would meet in the middle or whether statistically derived traits “impose an artefact of method upon the personal neural network as it exists in nature.” This exactly states the problem of whether the traits embedded in today’s market-leading personality models are isomorphic with the supporting brain structures and functions.

Even this late in his writings, Allport stuck to his plea to reasonableness about traits, urging “heuristic realism” (p. 3), which “holds that the person who confronts us possesses inside his skin generalized action tendencies (or traits) and that it is our job scientifically to discover what they are” (p. 3). He knew that that involved “cleavage” of human behavior, and that said cleaving might need revising. He also warned against the “positivistic gamesmanship” (p. 3) of those who denied the existence of traits, and the “galloping empiricism” (p. 3) of those whose only criteria were mathematical. He returned to the latter fault at the end of the article where he stated: “We find ourselves confused by our intemperate empiricism which often yields unnamable factors, arbitrary codes, unintelligible interaction effects, and sheer flatulence from our computers” (p. 8, spelling as in the original). One wonders what he would say if he saw today’s profusion of factor analyses, often ungrounded in a theory of traits’ biological origins. Near the end of his article, one can extract from Allport (p. 8) a shorter and defensible agenda for trait research: “persons are real beings... each has a real neuropsychic organization, and... our job is to comprehend this organization as well as we can... To do so requires that we be guided by theory in selecting our trait slices for study, that we employ rationally relevant methods, and be strictly bound by empirical verification.”

That makes it sound as if the science of traits had progressed little in the forty years or so that Allport had been working, and the forty years again between his early writings and those of Galton before him. However, just before Allport’s (1966) valedictory article, there was a remarkable report about the regularity of human trait structure derived from Allport’s early work, and which still stands today as the Five-Factor Model. Tupes and Christal (1961, reprinted in 1992), despite acknowledging the work of Eysenck and Cattell and others, stated that little work had been done on trait ratings from the 1920s to the time of their writing, and that, aside from extraversion–introversion and emotionality–stability, there was little agreement about which traits were agreed from different studies. Their focus was on the usefulness of trait ratings,

their predictive validity for real-life outcomes, validating paper and pencil tests, and traits’ factor structure. Their short introduction makes no mention of traits’ essential nature.

The starting point for Tupes and Christal was thirty-five trait variables developed by Cattell (1947), whose work derived from the identification of dictionary trait terms by Allport and Odbert (1936). Their analyses of eight studies seemed ideally set up *not* to find regularities: The raters knew their rates for different lengths of time, the relationships were of different kinds, the subject types were different across the studies, and the raters across the studies ranged from laypeople to clinical psychologists and psychiatrists. Nevertheless, from their eight heterogeneous studies “five fairly strong rotated factors emerged” (p. 232): surgency (extraversion), agreeableness, dependability (conscientiousness), emotional stability and culture (openness). This was a breakthrough in dispelling some uncertainty about the structure of personality trait ratings, at least with these chosen traits and in these settings, leading them to conclude that “There can be no doubt that the five factors found throughout all eight analyses are recurrent” (p. 244).

There was discussion over the rotational position, and some about the number of factors that should be extracted, but not about whether one had got real phenomena that could be translated into brain functioning. There was modesty in acknowledging that their factors had appeared in others’ analyses, though in different combinations and called by different names. Three comments toward the end of the discussion deserve attention: “One interpretation is that there are only five fundamental concepts running through the 35 trait names used in these studies... It is unlikely that the five factors identified are the *only* fundamental personality factors... it is likely that other fundamental factors may be identified in future studies” (p. 247).

The use of “fundamental” is moot. The five traits identified from the ratings were recurrent, but in what sense were they fundamental? Certainly not with respect to their origins, nor their known bodily foundations.

At about the same time as the publication of Tupes and Christal’s report, citing the same empirical history and with a similar aim, Norman (1963) found similar results. His focus was in clarifying the observational language of personality, arguing that personality research “will be facilitated by having available an extensive and well-organized vocabulary by means of which to denote the phenotypic attributes of persons” (p. 574). There was no assumption that such taxonomic efforts would provide traits as such: “In the opinion of this writer, there is a good deal more to theory construction and refinement than the development of an observational language – even a good one” (p. 574). That is the key issue, that is, even if one achieves a well-ordered structure for personality trait terms, that does not comprise a theory, nor does it necessarily identify the traits as such, or inform us about their

bases. Norman acknowledged the difference in results between Cattell's (1947) and Tupes and Christal's (1961) findings, despite their using the same stimuli. Norman used the four best marker scales for each of Tupes and Christal's five factors. A total of 622 men in four samples were used to make personality ratings and the Five-Factor Model emerged from all four samples. Although the factors were clear, there were sizeable correlations among them: Among the ten possible correlations, one sample had four correlations above 0.4 and another had three. In both samples, for example, there were positive correlations of around 0.6 between conscientiousness and culture. One of Norman's conclusions was that researchers should go back to the pool of items, seek traits that were not "easily subsumed" by the Big Five (p. 582), and to factor analyze these traits alongside the existing traits.

By this stage, one can discern three processes (there might be more) in the trait approach to personality. First, there was progress in identifying traits for measurement and predictive validity. Second, the trait approach was defended from whatever was the anti-trait zeitgeist in psychology (Freudiansim, behaviorism, situationism, etc.). Third, there was the process of thinking about and studying what traits were as things. Meehl (1986) addressed the third issue by referring to Cattell's (e.g., 1945) surface traits and source traits distinction. He gave a good account of how, in everyday language we make trait attributions, and how these generalize from narrow to broader traits. These attributions (surface traits) are from observed behaviors. Narrow traits that make up broader traits are "related by (a) empirical covariation and (b) content similarity" (p. 317). And Meehl was good in bringing together disparate-seeming psychologists and showing how they essentially recognize something like traits: "what is shared methodologically by Skinner, Freud, Allport, Murray, and Thurstone?... [T]hey all take as the rock bottom basis for their views the *fact of covariation*" (p. 329).

Getting beyond surface traits, what causes that covariation? One possibility Meehl considered was Cattell's idea of the "environmental mould" (p. 322). That is, trait correlation could occur because something like social class brought about certain correlated (but not causally linked) preferences in lifestyle. Meehl went on to discuss four other possible sources of apparent traits. The first three are learning processes, with mentions of Skinnerian and Freudian ideas. The last – what Meehl calls "*postulated internal entities*" – are Freudian concepts. Thus, the choice about true as opposed to apparent traits is between learning theory and psychoanalytic ideas. He then discussed what the differential psychologist means by traits:

When psychometrician Cattell introduced the phrase "source traits," what he had in mind was *factors*, those strange mathematical entities alleged to be discovered (some would say invented) by the statistical methods of Spearman, Kelly [sic], Thurstone and Co. ... If one conceives factors merely as

parameters parsimoniously representing the cross-sectional correlations among surface traits, the operant behaviorist should have no problem accepting them. But if one conducts factor analytic studies with a theoretical interest, aiming to discover source traits that are explanatory, *causal* entities, the interpretative problem is muddy. Having worried about the reality status of factors for some 45 years (meanwhile using it sparingly in my research with a fairly clear conscience) I will not be so foolish as to engage *that* terrible problem here. (pp. 325–326)

Meehl's discussion was clearly meant to be emollient to behaviorists, but is telling, in that he admits and wrangles with the possibility of psychometrically derived traits being valid mental entities. A little later he states that

It seems rather obvious that no mathematical reduction of cross-sectional trait correlations could warrant giving *causal* meaning to a factor in the interpretative text. I am not saying that psychometric factors never represent a kind of physical reality. Sometimes they do, for example, the heritable component of *g* must correspond to some quasi-fungible properties of brain microstructure or, if you prefer entities we know more about, the set of polygenes involved. (p. 326)

There is a strong assertion there: that *g* is given the breath of construct-validity life by having heritability; and the remark about polygenes is in line with current thinking and findings on *g*. Perhaps personality traits now deserve that recognition too, because they have substantial heritability and their polygenic variation is emerging. But perhaps not. The term "quasi-fungible" is an admission that the nature of *g* (and personality traits) was still mysterious; it adds nothing beyond stating that *g* emerges as a statistical entity, and we know nothing about what aspects of the brain contribute to the individual differences it represents. But Meehl ends with a strong statement about the ultimate causal underpinnings of personality variation: "A mathematical expression of the functional relations holding among behavioral variables always contains parameters. These parameters exhibit individual differences over organisms. Such individual differences have a heritable component... The genes provide what the logicians call *dispositions*, of varying orders; and the dispositions of any order exist in varying *amounts*" (p. 330).

That is a reasonable account of where we still are and does not tell us how parameters map to underlying dispositions. Ultimately Meehl's piece is an appeal to keep open the possibility that surface covariation in behavior might be caused by traits.

A useful basis for more up-to-date thinking about traits may be had from Tellegen (1991). He assessed Cattell as too ready to accept factor analytically derived factors as traits and characterizes Meehl as a believer in traits as entities with "biological underpinnings" (p. 10). Tellegen carpet-bombed seven anti-trait ideas by summarizing Kenrick and Funder's (1988) answer to those who see traits as fictions. Kenrick and Funder also described the conditions under which traits had the best predictive

power. The attacks on traits were repelled by Kenrick and Funder, and the lessons they declared having learned from this exercise were important achievements in establishing that traits should be taken seriously. But the by now repeatedly stated problem remains. “Remarkably . . . the trait debate did not deal directly with one core issue; the nature of personality traits, that is, the nature and viability of a strong, rather than straw-man, trait position” (Tellegen, 1991, p. 12).

Tellegen then argued that, if we merely proceed by observing behavior, inferring a trait and then using that successfully to predict another behavior, we have got to covariation but not explanation. Even if we induce a broader construct of a trait cluster and use that to predict behavior we still have the limitation that “from an explanatory viewpoint the construct is vacuous,” and nothing but a “tautological statement,” and “no causal explanations are provided” (p. 14). Other accounts were able to go from surface to source traits. One example he gives is Gray’s (1982) linking of positive emotionality, a trait, to the behavioral activation system. Tellegen seemed not to be accepting such accounts but indicated that this was a possible route to get at the nature of source traits. He reiterated that phenotypic traits might not be isomorphic with source traits: “A trait dimension is clearly not in itself an individual organismic structure” (p. 15). He also warned that factor analysis might not (probably would not) reveal a structure of traits that was isomorphic with underlying traits. “What is more, the study of personality and personality disorders cannot simply be reduced to an analysis of how lay persons or even experts process information about people. To psychologize to that degree is to turn serious inquiry into trivial pursuits” (p. 16).

Or leaving it all to psychometricians. Tellegen was clear, too, that the “psychological nature” (p. 30) of the Big Five had yet to be clarified.

One leader of current-day personality research described the, “celebrated achievement” of the growing consensus on the “Five-Factor Model . . . as a reasonably comprehensive taxonomy” (McCrae, 2004, p. 4). When McCrae asserted that “traits are not cognitive fictions, but real psychological structures” (p. 4), the supporting evidence included consensual validation, prediction of life outcomes, longitudinal stability, and heritability. One provocative suggestion by McCrae was that traits are unaffected by the environment and caused by biological factors. The idea (see Figure 2.1) was that biologically founded traits influence characteristic adaptations (like attitudes, goals, etc.). But these “do not include personality traits, which [Five-Factor Theory] depicts as . . . basic tendencies . . . grounded in biology” (p. 5). McCrae’s strong commitment to the biological underpinnings of traits is based on their heritability, virtually zero contribution from shared environment, and the fact that even the residual in the nonshared environment probably contains variance that is attributable to genetic and other biological

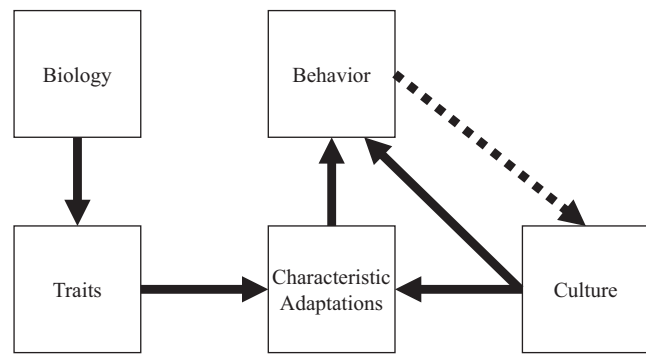


Figure 2.1 A simplified representation of components of the personality system and their interrelations, according to Five-Factor Theory. From McCrae (2004) Figure 1

variance “such as intrauterine environment, disease, and aging” (p. 6). The stability of personality traits over the lifespan is also cited as evidence for these claims.

McCrae argues further that, because personality traits are “shaped solely by biology, which is the common heritage of the human species . . . their characteristic properties ought to be universal” (p. 7). The universalities tested and confirmed to date include: universality of the Five-Factor Model structure (e.g., McCrae et al., 2005; Schmitt et al., 2007); universality of age-related declines in neuroticism, extraversion and openness, and increases in agreeableness and conscientiousness (McCrae & Costa, 2003); universality of women scoring higher in neuroticism and agreeableness (Costa, Terracciano & McCrae, 2001); and universality of cross-observer agreement (McCrae et al., 2004). These are impressive empirical achievements, but they still do not reveal what traits look like under the skin.

CONCLUSION

Allport might have agreed with the reservations entertained above about the current state of personality theory, for as John and Robins (1993) state: “The [Five-Factor Model] is not based on idiographic methods, nor does it explicate the neuropsychiatric structures Allport believed to underlie personality.” There are two extreme conclusions possible about current work in personality traits.

The first would be to extract defeat from the jaws of partial victory. The consensus around the approximate number of broad traits, and the evidence that they are reliable, and have predictive validity, consensual validity, heritability, and so forth, are empirical achievements worth celebrating. To abandon or over-criticize traits, therefore, would do violence to one of the better-attested constructs in psychology, which have been the foundation of a science with notable and replicable findings, such as the association between conscientiousness and health.

The second would be to declare victory and withdraw prematurely: that is, to announce that we have valid personality traits. To mistake the findings collected already as better than they are, and to fudge about the nature of traits would be a disservice to existing empirical gains. It is not enough to say that if it looks, walks and quacks like a duck, then it is a duck. Understanding the origins of traits has hardly got off the ground. Until that does happen, we cannot be sure that the pattern of phenotypes will not change.

A way forward for the quantitative traits that we have is likely to be a steady revising of the phenotype, through psychometric work, including lexical and questionnaire studies, across cultures, species, and time, and more predictive validity work. This should be done while recognizing that even our notion of the correct trait outlines could be altered after we learn more about the foundations of traits. As knowledge is gained about the foundations of psychological traits, there may be an iterative revising of which surface traits are most useful to recognize and measure. But, once again, it is where to put the reductionistic efforts that causes the most head scratching.

Reductionistically, it is an interesting time for personality traits. However, even with the genetic association information from the study by Luciano et al. (2018), it was only possible to predict less than three percent of the variation in neuroticism in an independent sample who had taken the same neuroticism questionnaire. Understanding the biological mechanisms of personality trait variation is therefore likely to be complex, and possibly practically intractable.

It is hoped that, from the point of view of believers in personality traits' existence and importance, that this emphasis on their limitations does not underplay their achievements. In past times, the attacks on traits were strong and much of the work on traits was defensive. Traits are now well established and so more self-critical work can be done to get at the correct descriptions of traits and their foundations.

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3

Accuracy in Person Perception

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INTRODUCTION

When noticing the people we pass on the street, chatting briefly with someone in line behind us at a cafe, or engaging in any other brief social interaction with a person that we may never meet again, we naturally form impressions of their personality and characteristics. In other situations, as when meeting new coworkers, interviewers and potential romantic partners, our desire to form accurate impressions may be quite conscious and deliberate.

Why do we form such quick and spontaneous impressions of other people across a variety of situations? Initial impressions and judgments of the personalities and characteristics of others are a crucial part of our understanding of our social world. Our impressions of another's personality provide structure and coherence to our observations of their behavior, providing a framework to explain their past behavior and allowing us to anticipate and help predict their future behavior. Is this new coworker someone that I should try to avoid? Which of the people at this shop is likely to be helpful and can give me directions to my hotel? Our impressions of others serve an adaptive function (McArthur & Baron, 1983), influencing our thoughts and behaviors, encouraging or deterring future social interactions, and even channeling the development of potential relationships (Sunnafrank & Ramirez, 2004). As the impressions that we form of other people have far-reaching consequences for both ourselves and for them, there are a number of critical questions worth asking. Are our impressions of others accurate and, if so, how accurate? Are we able to accurately discern the unique characteristics and defining traits of others? What are the factors that determine when our impressions are more or less accurate?

The answers to these questions are not simply academic but rather are critical for the field of personality psychology. Individual differences – broad dispositions that are consistent, coherent, and temporally stable – are one of the building blocks for scientific inquiry on personality. Both the existence of personality traits, as well as the

ability to form impressions of other people that have at least some degree of accuracy, are fundamental premises dating back to the nineteenth century. For instance, the lexical hypothesis of personality states that noticeable and important individual differences will become encoded into natural language (see Allport, 1937; Saucier & Goldberg, 1996). Following initial work by Galton (1884), Allport and Odbert (1936) comprehensively scoured the English language for words that can be used to describe another person. The goal of this laborious task was to provide the raw material needed to determine the broad categories of relevant and important individual differences. The lexical hypothesis makes two critical assumptions. First, that individual differences which are useful to observe and understand do indeed exist. The second assumption is that our impressions of these individual differences are made with at least some degree of accuracy. If our impressions of others were neither useful nor accurate, there would be no point in creating words to convey impressions of another person's level of *arrogance* or *friendliness* for instance and have those words persist in our lexicon.

WHAT IS INTERPERSONAL ACCURACY?

At the broadest level, interpersonal accuracy is the accurate perception of another person's characteristics, dispositions, attributes or current state. The ability to perceive these things requires being exposed to some information, through meeting the person and having a brief conversation or through more passive means such as reading their Facebook profile or scanning their Instagram account. Based on this information the perceiver, or judge, makes an inference or judgment about the other person, often referred to as the target. As Hall, Mast and West (2016) review, research on interpersonal accuracy within more narrow contexts often uses more specific terms such as interpersonal sensitivity, emotion recognition, nonverbal sensitivity, decoding ability, deception detection, empathic accuracy, mental states attribution, mind reading, first impressions accuracy and judgmental accuracy.

All of these terms and research areas fall within the general rubric of interpersonal accuracy.

Assessment of interpersonal accuracy requires a definition of the truth – some working measure of the actual disposition, characteristic, attribute, or state of the target – along with a statistical summary of the correspondence between the working measure of truth and the perceivers' inferences. The working measure of the truth, referred to as the criterion, is used paradoxically as the predictor of the perceivers' inferences. We will defer more detailed discussion of statistical models and summaries of interpersonal accuracy for the moment. The assessment of the working measure of truth is one of the most critical decisions in interpersonal accuracy research. For instance, in emotion recognition, targets may be instructed to display a specific emotion that is then recorded. Alternatively, targets may be recorded in natural conversation and then later asked for their retrospective accounts of what emotions they were experiencing at different points and the level of intensity of that emotion. Similarly, targets may be asked for their retrospective assessment of their thoughts. For social attributes like ethnicity, socioeconomic status or sexual orientation, the working measure of truth may be the target's self-report on the attribute of interest. For dispositions and personality traits, working measures of truth could include self-reports, informant reports, behavioral measures or composites of these different sources. Regardless of the specific context in which interpersonal accuracy is being assessed, the working measure of truth will contain error. Participants may not recollect precisely what they were thinking or feeling at a specific point in time. Personality traits – broad dispositions to behave in certain ways – change over time and have good but not perfect reliability over shorter time windows. Even social attributes have measurement error – participants may distort their answers or may be unaware of their racial or ethnic heritage. This latter phenomenon is becoming recognized as genetic testing linked with familial registries gains popularity and provides more detailed information and ancestral links. In short, interpersonal accuracy is limited by the reliability of the working measure of truth. This is not a criticism but a simple acknowledgment that interpersonal accuracy can be considered a latent variable. Given the existence of measurement error in the working measure of truth one can never directly assess the true level of accuracy. This is no different than any other area such as attitudes, voter preferences or unconscious bias that relies on assessments. The validity and utility of assessing interpersonal accuracy rests on the choice of the working measure of truth.

A BRIEF HISTORY OF ACCURACY RESEARCH

Both of the two critical premises in personality psychology – (1) that individual differences useful to observe and understand exist and (2) that our impressions or

judgments of these individual differences are made with at least some degree of accuracy – have come under serious question and critical examination for decades in the twentieth century. Doubts have been raised about both the importance of individual differences in predicting behavior as well as the accuracy in understanding such individual differences in others. Accuracy research suffered a near fatal blow when Lee Cronbach wrote a series of difficult and dense articles criticizing how researchers were measuring individual differences in the accuracy of personality judgments (e.g., Cronbach, 1955). Much work on interpersonal accuracy prior to Cronbach's critique functionally labeled a person a good "judge" by comparing impressions measured on rating scales to some working measure of truth and calculating the squared difference between these two assessments. Cronbach noted that many different measurement artifacts could influence accuracy measured in this manner and he proposed disentangling these measurement artifacts by deconstructing interpersonal accuracy into different components. This proposed solution required more effort on the part of researchers, more extensive and difficult data collection and more sophisticated quantitative analytical expertise. Researchers interested in interpersonal accuracy were apparently disheartened by the increased complexity Cronbach advocated and instead pivoted away from directly addressing questions of interpersonal accuracy. More specifically, following a trend that started with Asch (1946), a number of prominent researchers switched from examining questions of assessing interpersonal accuracy and its correlates to instead asking questions of simply *process* (see Tagiuri & Petrullo, 1958; Funder, 1999, pp. 57–60). Indeed, instead of assessing interpersonal accuracy and worrying about gathering reliable and valid working measures of truth, it is much easier to study inferences based on artificial stimuli such as vignettes or word lists that do not require any working measure of truth. This switch cleanly resolved the difficulties in assessing interpersonal accuracy and the need to engage with Cronbach's critiques, as Funder (1995) notes, by simply bypassing the question and topic altogether.

Mischel (1968), following parallel work by Guion and Gottier (1965), outlined a major challenge to the first critical premise in personality psychology. The core argument raised by Mischel was that correlations between assessments of personality and behavior across situations were generally low. This suggests, at first glance, that generalities in behavior as related to broad dispositions are not worth considering. In essence, what is the utility of personality traits if their predictive validity is weak? This argument resonated with the zeitgeist at the time as the pendulum in the nature–nurture debate had swung strongly towards nurture. The doubts that Mischel cast were on the utility of personality traits as a construct and he argued that research attention should be focused instead on understanding specificity of behavior: Why do

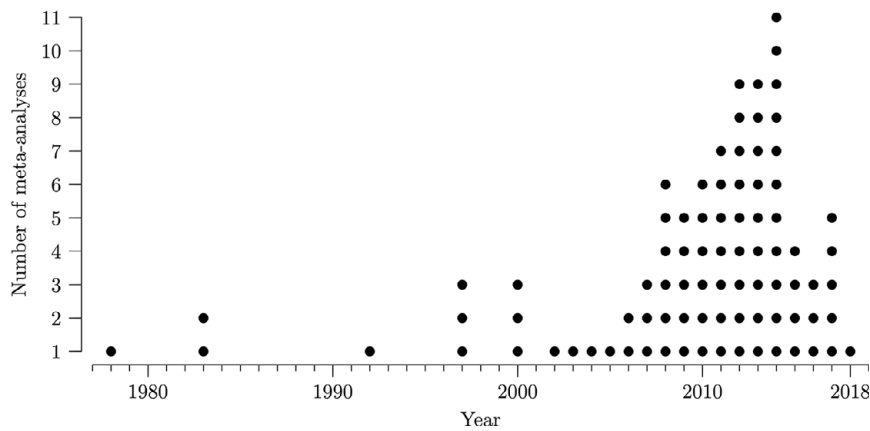


Figure 3.1 Number of meta-analyses examining questions in interpersonal accuracy each year to spring 2018

people behave the way they do within a specific situation? The distillation of Mischel's argument was that the effect sizes for assessments of personality are very small so therefore personality does not matter in predicting behavior. Consequently, if broad personality measures are, at best, weakly related to behavioral measures, why study the accuracy of perceiving such apparently ephemeral constructs?

Recent decades have seen a resurgence in activity on theory, methods and research on interpersonal accuracy. This work has followed on the heels of detailed rebuttals to critical elements of Mischel's arguments. For instance, Funder and Ozer (1983) demonstrated that effect sizes in personality research correspond closely with those of classic social psychological experiments where effect sizes were not reported and thus this correspondence was overlooked and interpreted as substantively significant rather than statistically significant. At about this same time a general consensus on the Big Five factor structure of personality emerged to provide a unifying framework for personality researchers (for reviews, see Goldberg, 1993; John & Srivastava, 1999) that clarified the cacophony of ostensibly different constructs. Kenrick and Funder (1988) reviewed the substantial levels of self-other agreement and consensus that exist among raters on measures of personality traits and argued strongly that these levels of agreement and consensus could not be the result of biases or other forms of cognitive errors. Reconciling this with Mischel's (1968) review, Epstein (1983) noted that single behavioral measures are akin to low grade ore. There is something valuable inside, but much ore needs to be mined and refined to extract meaningful quantities of the metal. In practical terms this requires aggregation of many behavioral measures which we naturally do ourselves for self-ratings and which our friends and long-term acquaintances have had the opportunity to do as well. Careful empirical work demonstrating the remarkable efficacy of aggregating behavioral measures (e.g., see Borkenau et al., 2004; Moskowitz & Schwarz, 1982) has provided clear evidence supporting the reliability and validity of individual differences.

THE RESURGENCE OF INTEREST IN INTERPERSONAL ACCURACY

The resurgence of interest in broad questions of interpersonal accuracy can be seen in the recent proliferation of meta-analyses focusing broadly on questions of interpersonal accuracy. In a nonexhaustive review of the field Hall, Mast and West (2016) identified sixty-three meta-analyses through 2015. Updating that search through the spring of 2018 yields seventy-six meta-analyses, excluding those focused solely on clinical diagnoses. The vast majority of these quantitative reviews were conducted within the past decade (see Figure 3.1). What is striking about this set of meta-analyses is the breadth of research covered. Of the reviews, sixteen focused on accuracy related to broad personality dispositions and traits, fourteen on social attributes, fifteen on questions of deception, and fifty-three on affect and emotion recognition. Many of the meta-analyses examined multiple domains of accuracy so these categories were not exclusive. The most common source of information used to form impressions was interpersonal communication (e.g., meeting and talking to a person or watching a video) which represented seventy-five of the meta-analyses. The sheer number of meta-analyses helps to convey the immense number of empirical research articles that have been conducted on questions of interpersonal accuracy. This is a revitalized and energized research area once again.

MEASURING INTERPERSONAL ACCURACY: BREADTH AND DEPTH

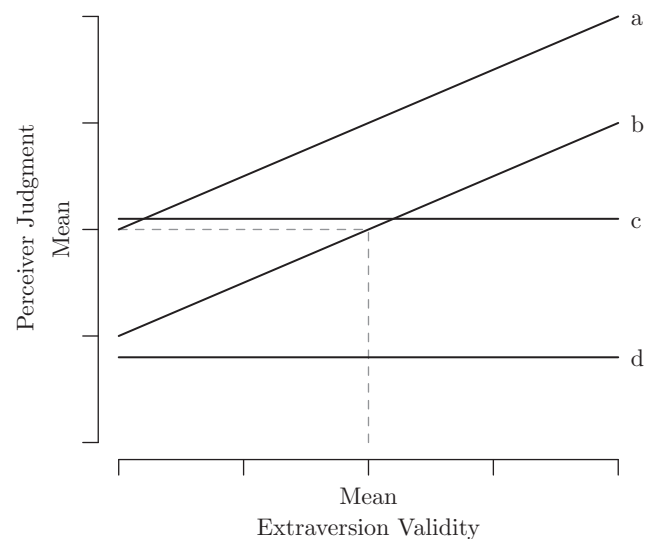
We can think about research in interpersonal accuracy in terms of two broad dimensions. The first is the *breadth* of information. What are the sources of information that are available to the perceiver? These sources of information are often referred to as cue channels. For instance, we may meet and talk to someone briefly, hear a description of them from a colleague, watch them give a professional presentation, or examine their online social media presence. In research contexts these cue channels can be

Table 3.1 Number of meta-analyses as a function of depth (personality domain) and breadth of information examined (cue channel)

Personality Domain	Cue Channel			
	Interpersonal	Text	Residue	Preferences
Stable Disposition				
Traits	15	5	2	1
Motivations	0	0	0	0
Life Narrative	0	0	0	0
Current State	–	–	–	–
Transient				
Traits	0	0	0	0
Motivations	0	0	0	0
Affect/Emotion	53	3	1	1
Deception	15	1	1	0

isolated to examine solely nonverbal or verbal information or other specific sources of information in a manner that is rarely encountered *in vivo*. This allows more precise examination of the critical components and information that is used to form more accurate impressions. The second important dimension to consider when examining interpersonal accuracy is *depth*. What are the levels, domains, or units of personality (e.g., see Emmons, 1995) that are examined for interpersonal accuracy? These may be broad personality dispositions such as the Big Five personality framework, motivations, life course narratives, current personality states, mood or affect, emotions or social attributes. In other words there are many different aspects of a person – both relatively stable and more transient – that could potentially be examined with respect to interpersonal accuracy. Most empirical research typically examines just one aspect of personality.

Together, breadth and depth represent the situation, material or information that one has to form an impression of another, as well as *what* impression or judgment one forms. Theoretically there are many combinations between the elements of breadth and depth that can be studied. Yet, examining the breadth and depth matrix for interpersonal accuracy, categorized coarsely for the meta-analyses presented in Figure 3.1, noting that meta-analyses sometimes examine multiple cue channels, it is readily apparent that research on interpersonal accuracy has been focused heavily on a limited number of combinations of breadth and depth – primarily interpersonal $\times$ trait, interpersonal $\times$ affect, and interpersonal $\times$ deception (see Table 3.1). There are a few combinations that are starting to develop a nascent literature (e.g., text $\times$ trait; interpersonal $\times$ motivations) and many combinations where the gaps lie (e.g., residue $\times$ motivations; interpersonal $\times$ life stories). While decades of research have given us a solid understanding of how

**Figure 3.2** Potential combinations between accuracy and bias including (a) high accuracy, positive bias, (b) high accuracy, low bias, (c) low accuracy, low bias and (d) low accuracy, negative bias

accurately we can perceive personality traits from interpersonal cues, for example, much clearly remains to be examined. Here, we will briefly discuss the different elements of the personality perception matrix before outlining an exemplar study for the available combinations.

BREADTH: PERCEIVING PERSONALITY FROM VARIOUS SOURCES OF INFORMATION

Interpersonal

One of the most studied contexts in interpersonal accuracy is that of interpersonal interactions (e.g., groups of

strangers interact briefly and assess each other's personalities or provide other judgments). Sources of information here have included live, in-person interactions, video, audio, still photographs or combinations of these. Perceivers are thus able to base their target ratings on a wide selection of cues, depending on the specific source: verbal information, behaviors, voice pitch, inflection and volume, and physical appearance. The average level of accuracy from interpersonal sources of information varies depending on many factors, including the specific study design and what personality domain is being perceived. These interpersonal sources of information have been used along the depth axis of personality perception matrix, from traits to states.

People can form quite accurate perceptions after only thirty seconds of observation for specific traits related to extraversion, agreeableness and conscientiousness (e.g., Ambady & Rosenthal, 1993). In video studies, perceivers have rated targets either interacting with others (e.g., Rogers & Biesanz, 2015), reading out weather reports (e.g., Borkenau & Liebler, 1993); completing interviews (Gangestad et al., 1992), or answering questions taken from a dating site (Human et al., 2012). Overall, there seems to be a tendency to perceive people accurately but less positively from these indirect contexts. We can perceive attributes such as sexual orientation and status surprisingly accurately even from interpersonal sources as limited as photographs (e.g., Ambady, Hallahan & Conner, 1999). The various interpersonal sources of information, even those with fewer cues available, clearly contain the necessary diagnostic information to help us make surprisingly accurate perceptions.

Text

In the past decade, research has expanded to look at text-based sources of information. Perceivers have been found to use both the content of the textual information as well as the structure and style, such as length, language choice and level of detail to make their personality ratings (Borkenau et al., 2016). This latter study illustrates how rich and accurate impressions can be made on the basis of minimal textual information. Participants ($N = 208$) wrote short essays about five important life domains: hobbies, friends, family, academic studies and plans for the future. Participants were provided with several blank lines for each of the essays and encouraged to use all of them. A separate group of judges ($N = 130$) then read the essays and rated the targets' personality traits according to the Big Five Inventory (BFI; John & Srivastava, 1999). Some judges read all five essays written by a single target, while other judges read only one essay per target. Interpersonal accuracy on personality traits from the essays was approximately as accurate as ratings from physical appearances or other brief sources of information. Openness to experience was the trait judged most accurately and neuroticism was judged least accurately. The study found an acquaintanceship effect; judges who had access to the targets' essays on all five life domains were usually

more accurate than those who read only one essay. This suggests that reading additional essays increased the chances of obtaining more diagnostic information but, if judges had received the most diagnostic information already, reading additional essays did not raise their accuracy any further. Given that targets averaged 75 words per essay, these participants wrote on average 1.5 pages across the 5 essays which is a remarkably small amount to allow perceivers to accurately infer broad personality traits.

So far text-based sources of information have only been used to perceive personality traits but the results have been positive. A 2014 meta-analysis on accurate personality judgments from written and online contexts showed small effect sizes for the typically less visible trait of neuroticism to medium effect sizes for extraversion (Tskhay & Rule, 2014). These results parallel levels of accuracy for perceiving traits from interpersonal sources of information. Textual sources of information are becoming an increasingly relevant area of study as more communication is done through online and text-based channels. The growing number of jobs done remotely and the number of people venturing into online dating mean we make more and more first impressions from textual information before actually meeting someone in person. Future areas of study could expand along the personality domains, using text to perceive targets' emotions, social attributes and whether they are being deceitful.

Residue

Gosling et al.'s (2002) seminal study examined whether targets leave behind behavioral residue that is relevant to their personality and opened up a new source of information for potential study. For example, someone high in extraversion may have several group photos up on her desk at work, or a day planner full of weekend plans, thus providing observers insight into her personality. In the first phase of the study, eight observers briefly went into ninety-four empty offices (in various types of workplaces, including a real estate agency, advertising agency, business school, architectural firm and bank) and rated the personalities of the occupants based on the Big Five Inventory (BFI; John & Srivastava, 1999). The second phase replaced the offices with eighty-three student living spaces. In both phases of the study raters were able to form accurate judgments of traits with self- and peer reports of personality used as the working measures of truth. Based on behavioral residue from both locations, openness to experience was seen most accurately and agreeableness was seen least accurately. However, all traits were seen more accurately from looking at personal living spaces than offices. Observers in the study used a range of cues to form their judgments, choosing the most valid cues for conscientiousness (good use of space, clean, organized) and openness to experience (distinctiveness, level of decoration, quantity of magazines and books). Thus indirect sources of information like bedrooms and offices hold relevant information

about individuals that can be used to form accurate impressions of many traits. Perceivers seem to use a range of environmental cues to form their judgments, including size, contents, level of neatness, use of space and color.

Within this new area, researchers have thus far only examined accuracy in perceiving the trait domain of personality. It seems that some environments, like personal living spaces, retain more diagnostic behavioral residue than others, and some traits can be perceived more accurately than others. Unlike through interpersonal and textual sources of information, openness can be perceived most accurately from behavioral residue and agreeableness least so (Gosling et al., 2002), although substantial replications and followup work remain to be done to confirm these basic findings and differences among personality traits. Although it might be difficult to use this source of information across the whole of personality domains, behavioral residue appears to be a valid source of information for perceiving various social attributes, warranting more extensive study.

Preferences

After studies that used photographs as sources of information indicated that static elements like clothing style were valid cues (Naumann et al., 2009), a new area of study emerged: that of personal preference. Can a target's personal preference for clothing style or their taste in music alone allow perceivers to make accurate judgments? Recent studies have examined whether a target's music preferences (Nave et al., 2018), clothing (Naumann et al., 2009) and shoes (Gillath et al., 2012) can be used to form accurate impressions. The few studies done thus far in this area have looked at the domains of personality traits and social attributes. It appears that preferences for specific music dimensions can predict all five personality traits using machine learning, after controlling for gender and age (Nave et al., 2018). Using a target's favorite pair of shoes as a source of information allowed perceivers to make accurate judgments of their age, gender, income, and attachment anxiety, but not significantly accurate judgments of personality traits (Gillath et al., 2012). There are countless ways this area of study can be expanded, including into the different categories in which targets can hold a preference, and along trait, state, and social attribute domains. For example, can we perceive a target's personality traits, motivations or social attributes from their lunch preferences? The combinations are endless and much remains to be examined.

DEPTH: PERSONALITY PERCEPTION TRAITS AND BEYOND

Stable Domains: Traits, Motivations and Life Stories

Much research has focused on the trait domain of personality, primarily through the Big Five or Five-Factor Model

(e.g., Wiggins, 1996). This perspective considers five broad dispositional traits: extraversion versus introversion; agreeableness versus antagonism; conscientiousness versus lack of direction; neuroticism versus emotional stability; and openness versus closedness to experience. These traits are considered to be relatively stable over time (Conley, 1985) and can predict one's behavior (e.g., Kenrick & Funder, 1988). Other studies have examined and found that accurate perceptions can be formed for other stable individual differences such as intelligence (e.g., Murphy, Hall & Colvin, 2003), self-esteem (Kilianski, 2008), narcissism (Buffardi & Campbell, 2008) and aggressiveness (Kenny et al., 2007). Studies examining interpersonal accuracy on stable individual differences have used many different sources of information to perceive traits including interpersonal, text, residue and preferences.

While broad traits such as the Big Five are an integral and important aspect of personality, they are not sufficient to truly know a person. McAdams (1995) has labeled this level of personality "psychology of the stranger" and emphasized two additional ways of knowing others: (a) personal concerns, describing goals, motivations and other constructs held within the context of one's time, place or role; and (b) life stories, incorporating an overall unity and purpose into one's identity. Emerging research has suggested a connection between goals and personality perception. For instance, the Fundamental Motives Framework (Kenrick et al., 2010) focuses on motivations in the categories of self-protection, disease avoidance, affiliation (group, exclusion concern, independence), status, mate seeking, mate retention (general, breakup concern) and kin care, and can predict relevant and important behavioral outcomes. Knowing what motivates a person can help us predict whether they will volunteer, break a bone or see a relationship counselor (Neel et al., 2016). This broad domain of personality is relatively understudied across the matrix of information sources with respect to interpersonal accuracy. It seems plausible that interpersonal and textual sources of information are likely to have the most relevant cues for this domain, although the ability to accurately perceive another's motivations from their personal spaces or preferences as well may exist. Research examining interpersonal accuracy on motivations is just emerging and more systematic attention to this aspect of personality is warranted.

While no studies have yet examined whether we can accurately perceive a person from their life story, this potential area of study in interpersonal accuracy carries practical difficulties. McAdams (1995) suggests that this personality domain may be relevant only to adulthood, and perhaps only in cultures that place importance on self-individuation. Quantifying accuracy for life stories presents more substantial hurdles than for traits and motives which are dimensional. Life stories can be coded and reduced to dimensions (e.g., agency and communion), but much of the richness of the narrative is lost in such simple reductions. As well, determining the validity

measure for interpersonal accuracy rests strongly on self-reports as there is a strong asymmetry in the knowledge of the life story as one's life story is not readily available to others (e.g., see Vazire, 2010). Thus, this domain remains fertile ground for new research but careful consideration of how to best assess interpersonal accuracy for life stories is needed.

Social Attributes: Stable but Open to Change

Social attributes are a broad category of relatively stable traits, such as sexual orientation, religious identity, political ideology, socioeconomic status, professional success and kinship. While social judgments often may contain biases, studies have shown that we have nearly perfect accuracy at categorizing a target's age, race and sex (e.g., Macrae & Martin, 2006) and can accurately identify even ambiguous social groups at better than chance rates (Alaei & Rule, 2016). In one of the first studies examining interpersonal accuracy of social attributes, Ambady, Hallahan and Conner (1999) examined whether sexual orientation could be accurately perceived by thin slices of behavior; namely, short videos and still photographs. To measure the sexual orientation of targets ($N = 25$), researchers had targets answer several filler questions about their personalities and behaviors as well as one question rating their sexual tendencies (a continuous item ranging from exclusively heterosexual to exclusively homosexual). Targets were then videotaped while responding to a prompt about balancing extracurricular and academic activities. Researchers created 10-second and 1-second silent video clips as well as still photographs from each target's response. For each of three conditions (10-s silent video, 1-s silent video, still photo) judges ($N = 96$) rated the extent to which they thought each target they saw was homosexual and the extent to which they thought each target they saw was heterosexual on a seven-point scale. The researchers found that for all stimuli types, judges were accurate at well above chance levels at perceiving targets' sexual orientation for videos and photographs. A follow-up study indicated that motion and gesture, not static cues, play an important role when perceiving sexual orientation as perceptions were accurate at only slightly lower levels than when watching the full videos.

Overall, it appears that the cognitive processes we use to make perceptions about obvious discrete social groups are the same processes used to make perceptions about more ambiguous social groups. For example, although sexual orientation can be measured on a continuum of sexual behavior (e.g., ranging from exclusively gay to exclusively straight), perceivers tend to use discrete categories and make automatic, unconscious judgments (Alaei & Rule, 2016).

Research into perceiving social attributes has focused on interpersonal sources of information, from videos to photographs, and examined the variables that make judgments on social groups more or less accurate. For

example, it is easier to judge the sexual orientation of both gay and straight targets when they are talking to a gay person rather than a straight person (Carahaly, 2000). As well, culture, race, sex, political ideology and levels of motivation can all impact how accurate people are at judging others' social attributes (Alaei & Rule, 2016), and even birth order seems to moderate accuracy when judging kinship (Kaminski et al., 2010). Future areas of study will likely expand to other moderators, and can easily include all other cue channels: text, residue and preferences.

States: Affect, Deception, Traits and Motivations

One area of research that has a relatively long history is that of empathic accuracy – whether we can accurately infer what other people are thinking and feeling at a particular moment (Ickes, 1997). Studies have found that strangers can accurately perceive each other's thoughts and feelings at rates well above chance (e.g., Stinson & Ickes, 1992). The two basic research methods used to study empathic accuracy both use interpersonal sources of information: unstructured dyadic interactions, where two participants meet with each other and later assess the thoughts and feelings of their partner; and standard stimuli, where all participants watch a video of the same targets interacting, and assess their thoughts and feelings (Ickes, 2001; Mast & Ickes, 2007). The validity measure is generally assessed by having participants go back and review the tape of their interaction and provide their retrospective thoughts and feelings for specific points in time. A recent study had targets act out particular emotions in photographs or videos for perceivers to rate and observers were able to accurately infer complex information (e.g., subjective feelings, appraisals, action tendencies and social messages) from observing these stimuli (Shuman et al., 2015). Empathic accuracy research has examined clinical populations (Chung, Barch & Strube, 2013), potential differences in perceiving affect between cultures, (e.g., Elfenbein & Ambady, 2002), and the impact of empathic accuracy on negotiation (Elfenbein et al., 2007). There may be interesting opportunities for assessing empathic accuracy from other sources of information. For example, can one judge a target's thoughts and feelings from the current state of their office? Or indeed, their current musical choice?

Standing out from other domains of accuracy in person perception is that of deception. Here, perceivers are simply asked to determine whether a target is telling the truth or lying. While other domains show accuracy levels at well above chance levels, researchers have found that individuals are notably poor at judging whether another person is lying. Meta-analyses consistently rate accuracy at only slightly above chance (e.g., Hartwig & Bond, 2011). So far, we know there are several biases that interfere with accuracy, most notably the truth bias. People tend to assume others are telling the truth because lies are rare

relative to truths, and we usually do not want to accuse others of lying (Burgoon & Dunbar, 2016). Other variables that moderate accuracy include communication skills of the target (Bond & DePaulo, 2006), familiarity with the target, length of interaction and level of interactivity (Burgoon et al., 1996; Buller, Strzyzewski & Hunsaker, 1991). For example, it is more difficult to tell that someone is lying during a face-to-face interaction than from a video, because the target can adapt their demeanor in response to perceiver suspicion. Most studies have focused on these interpersonal sources of information, and extending future research to text-based sources of information seems warranted. Perhaps we might be more able to perceive deception in this way, and assisting professionals and laypeople alike is a valuable outcome of this area of study.

Although personality traits and motivations are generally considered strongly stable elements of personality, behavior is labile and can change in drastically short periods of time (e.g., Biesanz & West, 2000; Flesson, 2001). However, there are theoretically ways to study accuracy in trait and motivation perception from a state perspective. For instance, Zaki, Bolger & Ochsner (2008) examined the accuracy of perceptions of affect, which were assessed continuously while watching targets discuss emotional events. These assessments, on average, correlated strongly with the targets' own assessments of their affect across the video. This same methodology, broadly speaking, can be adapted for other domains and levels in personality. For example, while we may know a person is generally motivated primarily by status, we can separately assess what motivates that person *during a particular interaction*. Perhaps in one interaction, this target is more motivated by affiliation; by protection in another. A similar approach may be taken with personality traits. We may know that a target is generally high in extraversion and openness to experience, but which trait is revealing itself more in a particular situation? Have they been more extraverted during this past day than they typically are? Are perceivers able to discern changes in others over time? Thus, even the domains of personality that have been extensively studied such as the Big Five can be expanded upon in new ways. The accuracy of state perceptions remains relatively unexplored outside of the domain of affect.

METHODS AND MODELS

How can we best assess and model impressions in order to better understand and measure interpersonal accuracy? Do different models provide different insights? There are two broad classes of models that are used to examine interpersonal accuracy: trait and componential models. Trait or variable-based models assess interpersonal accuracy for a single dimension such as extraversion or positive affect usually through simple correlations between judgments and the validity measure. This provides a simple and accessible statistical model and convenient standardized effect sizes. In contrast, componential models are

more complicated analytical frameworks that attempt to specify and assess the different dimensions (e.g., perceivers, targets, dyads, groups) that are related to interpersonal accuracy or to disentangle different components of accuracy. The gain from increasing the analytical complexity is that componential models of interpersonal perception allow for more nuanced and specific questions. For instance, are some individuals more accurate in how they perceive others? Are some individuals more accurately perceived by others? Since Cronbach's (1955) critique and proposed solution a number of different componential models have been developed and used extensively. These include the social relations model (Kenney, 1994), the lens model (Hirschmüller et al., 2013; Nestler & Back, 2013), and the social accuracy model (Biesanz, 2010). These different componential models were designed to address different questions and a brief overview is useful to understand the similarities and differences among the models presently available and being used more frequently.

Lens Models

Brunswik's (1956) lens model examines the process or mediators through which perceivers achieve interpersonal accuracy for a given trait and is generally an extension of variable-centered analyses. The working measures of truth, or validity measures, are used to predict potential cues which, in turn, are used to predict the perceiver's impressions. The relationship between the validity measures and the cues are termed the cue validities. In Funder's (1995) terminology, these provide an estimate of the relevance and availability of behaviors that targets provide with respect to a particular trait. The relationship between the cues and the perceiver impressions are termed the cue utilizations – the extent to which perceivers detect and utilize these cues when forming impressions. The lens model helps identify the pathways through which perceivers form accurate impressions. What behavioral cues are actually valid indicators of a given trait? To what extent are these cues related to perceiver impressions? The lens model allows for the computation of cue sensitivity – the correlation between the cue validities and utilizations – which assesses the extent to which perceivers correctly incorporate valid cues in their impressions. The difficulty of actually implementing a lens model lies in identifying the appropriate cues and reliably measuring those cues which can be quite challenging in practice. However the rewards can be great as the basic lens model provides insight into the process through which perceivers achieve interpersonal accuracy (e.g., see Borkenau & Liebler, 1992). More recent work has provided analytical and theoretical extensions of the lens model that allow a much richer set of questions to be addressed (for a review, see Nestler & Back, 2013). For instance, Hirschmüller et al. (2013) developed the dual lens model to separate the validity measure into explicit and implicit assessments on a

particular dimension (e.g., self-concept). In turn, perceiver personality impressions were similarly separated into deliberate and intuitive judgments. This separation of validity and perceiver judgments into two components allows the lens model to cleanly map onto dual-processing theories of information processing. This allows for interpersonal accuracy to be examined as a function of controlled impressions as well as the process through which more automatic impressions are formed. This extension of the basic lens model (for another extension, see Nestler et al., 2012) demonstrates how much richer questions of process can now be addressed and allows the potential for understanding *how* interpersonal accuracy is achieved, not just the simpler question of if impressions are indeed accurate.

Recent work on machine learning and personality prediction holds promise for extending work on interpersonal accuracy. For instance, Park et al. (2015) demonstrated the accuracy of prediction algorithms for the Big Five personality traits using just Facebook status updates. Skowron et al. (2016) examined Big Five accuracy predictions for Facebook, Instagram and Twitter. These results both demonstrated moderate to large accuracy correlations. Thus there are strong cues to personality in limited information that atheoretical algorithms are able to extract. These results are essentially the cue validities in a lens model analysis. Although machine learning approaches are sometimes criticized as being atheoretical black boxes, they might provide a useful springboard for data reduction and identifying the most critical cues that can then be used in a full lens model analysis, saving the researcher the difficult decision of what cues to assess and measure based either on nascent theory, hunches, or desperate guesses.

Social Relations Model

Kenny's (1994) social relations model (SRM) is a malleable componential model that has proven extremely productive and useful. Requiring multiple targets and perceivers, SRM examines the impressions on a single attribute and can be considered a trait-level model. We note that SRM can instead be used to examine behaviors if one wishes, but the present focus is on impressions. By focusing on a single trait, the social relations model provides for variance decompositions to determine the percentage of variance in impression ratings attributable to perceiver, target and the unique relationship effects (Kenny et al., 2006). Specific questions one can address through the social relations model, described in detail in Kenny (1994), include *assimilation*, the extent to which perceivers view others similarly across targets, *consensus*, the extent to which targets are viewed similarly across perceivers, and *uniqueness* or how a perceiver evaluates a target after accounting for how that perceiver evaluates others in general on that trait and how that target is evaluated by others in general. When a validity measure

is available for targets, a number of different measures of accuracy are available and can be estimated. The social relations model has been used more to examine consensus in personality impressions, which may or may not be related to accuracy as consensus does not imply accuracy.

Social Accuracy Model

The social accuracy model (SAM; Biesanz, 2010) was developed to assess average levels of agreement and consensus, similar to the social relations model, while at the same time modeling individual differences on components of interpersonal accuracy. SAM can be viewed as combining Cronbach's (1955) componential model and Kenny's (1994) social relations model to assess questions generated by Funder's (1995) realistic accuracy model. For instance, are some perceivers more accurate (i.e., does the good judge exist)? Are some targets more accurately perceived by others (i.e., does the good or transparent target exist)? SAM is a profile analysis as it requires multiple dimensions in order to assess individual differences. If this does not seem intuitive at first, consider the question of whether Tom is perceived more accurately than Terry on extraversion. This question cannot be answered as it is not possible to assess accuracy separately for Tom and Terry – we cannot estimate a slope based on a single data point! Multiple observations are needed to compute a slope or correlation. Assessing each person's extraversion multiple times and gathering multiple measures of the validity measure would not work as there would not be much useful (or real) variation across those measures as most would reflect simple measurement error. The solution is to use multiple different measures or traits as this reflects real variation across different aspects of their personalities. This changes the question as to whether Tom is seen more accurately than Terry across extraversion, conscientiousness, agreeableness, etc. The initial formulation of SAM had two different components that individual differences could be assessed on across a series of different traits or dimensions. These are *distinctive accuracy*, which assesses the ability to discern the unique characteristics of other individuals (i.e., how they are different from the average person), and *normative accuracy*, which is the relationship between the average target on the validity measures across a series of traits and the perceiver's impressions. Normative accuracy is highly related to positivity as the average personality profile correlates extremely highly with the social desirability of those personality traits. Distinctive and normative accuracy, closely related to Cronbach's (1955) measures of differential and stereotype accuracy (see Biesanz, West & Millevoi, 2007; Furr, 2008), are assessed and measured for each specific perceiver-target dyad. SAM provides the inferential leverage to assess individual differences when this analytical approach is embedded within a larger research design such as a round-robin design where each perceiver forms impressions of multiple targets. This allows for estimation

of individual differences: What is each perceiver's average level of accuracy across the targets that they form impressions of? What is each target's average level of accuracy across the perceivers that judge them? Recent research using SAM has demonstrated that although there are reliable and modest individual differences in perceiver distinctive accuracy, there are large individual differences in how accurately individuals are perceived by others, termed "expressive accuracy" (Biesanz, 2010; Human & Biesanz, 2013). Critically, there are strong individual differences in the good judge in terms of distinctive accuracy (i.e., some perceivers are better able to form more accurate impressions) but this absolutely requires a good target (Rogers & Biesanz, 2018). The good target, it turns out, is a necessary condition to assess the good judge.

Accuracy Versus Bias

Accuracy and bias may seem at first glance to be inversely related. Should not high accuracy indicate low bias? However, accuracy and bias can be unrelated both conceptually and empirically. Reducing bias may or may not change accuracy as they are *not* flip sides of the same coin. For this reason James (1897) admonished against focusing solely on shunning error. Different combinations of high and low accuracy and bias can coexist. Large amounts of bias do not inform us of the existence or magnitude of accuracy, with exceptions at the extreme theoretical limits due to floor or ceiling effects on rating scales. The existence of biases and errors in judgments is not informative of the accuracy of our impressions of others.

Research has begun to systematically examine and document the levels of accuracy and biases in impressions of personality traits and dimensions. Correlations, by their very nature, remove and thus ignore mean level information. Profile analyses like the social accuracy model allow one to explicitly capture and assess the magnitude of biases that are contained within that mean-level information. Recent work on normative accuracy has shown that perceivers do use their generalized knowledge of people to help inform their impressions and improve accuracy (Rogers & Biesanz, 2015). This basic finding has been extended to demonstrate that knowing someone well and liking them have different effects on the accuracy and positivity of impressions (Wessels et al., 2020). This work supports the utility of generalized accuracy that is independent of bias/positivity and is lost in variable-centered analyses.

SUMMARY AND CONCLUSIONS

Impressions of others based on minimal information and a wide variety of apparently impoverished sources can yield remarkable levels of accuracy. Decades of research in accuracy in personality perception have resulted in a

matrix that frames our areas of study into various domains of personality – what we can know about a person – and sources of information – what material we can use to know these things. However, as work continues to fill in the gaps, the matrix continues to expand, creating new opportunities in which to gain knowledge. Our understanding of personality perception and interpersonal accuracy is beginning to deepen with the advent of new models, techniques and awareness of how few combinations of personality domains and sources of information have been systematically examined thus far.

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4

States and Situations, Traits and Environments

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INTRODUCTION

According to a famous quotation, “Every man is in certain respects (a) like all other men, (b) like some other man, (c) like no other man” (Kluckhohn & Murray, 1953, p. 53). General psychology is concerned with Point (a), and personality psychology with Points (b) and (c) (Allport, 1937, who owed most of his ideas to Stern, 1911). Personality psychology attempts to describe, predict, and explain those recurrent behaviors and experiences that set an individual apart from some or all other age-mates (personality *traits*; see Chapter 2). These behaviors and experiences (psychological *states*) do not occur in a vacuum – they occur in psychological *situations*, and if these situations recur, these environmental characteristics (*environments*) also characterize individuals. This chapter is concerned with the relations between these four key constructs of personality psychology: states and traits, situations and environments.

STATES AND SITUATIONS

We understand the psychological state of an individual in a broad sense as all current behaviors and experiences (cognitive, emotional and motivational) that characterize the individual at a particular point in time (see Fleeson, 2001; Fleeson & Jayawickreme, 2015; Chapter 26). Similarly, we understand the psychological situation of an individual in a broad sense as all current external conditions causally connected to the individual, either by influencing the individual’s information processing and/or behavior, or by being influenced by the individual behavior (Asendorpf, 2017; Rauthmann, Sherman & Funder, 2015a,b). Later we will discuss the concept of situation and the causal mechanisms connecting traits and situations in more detail. For the meantime, it is only important to note that situations are current external conditions. *Current* means that past or future external conditions are not situations (although they may be remembered or imagined), and *external* implies that perceived, remembered, or imagined situations are not situations but merely

cognitive representations of situations and therefore internal to the individual (Rauthmann et al., 2015a). In other words, situations are “out there.” The advantage of this realistic approach to the definition of a situation is that it makes it possible to study how different individuals may perceive and mentally represent the same situation differently depending on their personality and current psychological state (see Funder, 2006, 2016; Rauthmann et al., 2014; Reis, 2008).

TRAITS AND ENVIRONMENTS

States and situations fluctuate within any individual from minute to minute, and therefore also between individuals in different situations. Often, they are aggregated across one day based on retrospective overall daily reports (e.g., daily mood), reported responses to specific few events during the day (e.g., social interactions with a particular member of the social network), or a few randomly scheduled moments during waking time (experience sampling studies) (Bolger & Laurenceau, 2013; Wrzus & Mehl, 2015). Whereas personality traits show a typical rank-order stability of .70 to .80 over one month (Gnambs, 2014), momentary or daily behaviors or experiences (psychological *states*) show a relatively low rank-order stability from moment to moment or day to day (typically .20 – .40; Epstein, 1979; Fleeson & Gallagher, 2009; Sherman, Rauthmann, Brown, Serfass & Jones, 2015).

If we observe the same states of many people again and again, we can take the mean state of each person (i.e., we *aggregate* the states). If we know the day-to-day retest stability of the states, we can estimate with the Spearman-Brown formula¹ how many days we have to observe until the aggregated states show a retest stability of at least .70 (in other words, when they are becoming more trait-like). For example, if the day-to-day stability is

¹ If we observe the same daily states k times and the day-to-day retest stability is r , the retest stability of the aggregated states is $R = kr / (1 + (k-1)r)$. This formula requires that the day-to-day similarity of the states remains identical across all days.

Table 4.1 Units of analysis in personality research

Unit	Observed for	Retest reliability	Typical change	Person	Context
Unstable	1 day	below .50	day-to-day	state	situation
Stable	1 month	at least .70	year-to-year	trait	environment

.20, we have to aggregate the states across ten days to get a retest stability of at least .70; if the day-to-day stability is .40, we have to aggregate only across four days.

Situations show a stability that is similar to states (Sherman et al., 2015), and the Spearman-Brown formula applies to situations as well. If we aggregate situations sufficiently, we get a measure of the relatively stable *situational exposure* of each person with a retest stability of at least .70. Examples for the relatively stable situational exposure are environmental risk factors, parenting styles, personality traits of members of one's social network, etc. To set these more stable external conditions apart from the momentary situations, we call them *environments* in line with Asendorpf (1996, 2017). Thus, in terms of stability, environments correspond to traits, and situations correspond to states (see Table 4.1).

TRANSACTIONS VERSUS STATISTICAL INTERACTIONS

Transactions between States and Situations, and between Traits and Environments

If we consider relations between traits and situations, we compare units of analysis of a different stability level. Ignoring this asymmetry between traits and situations often results in confusion of states and traits, or situations and environment. If we consider causal effects of the four units of analysis on each other, traits can influence the selection of situations (Rauthmann, Sherman, Nave & Funder, 2015) and situations can evoke states (Rauthmann, Jones & Sherman, 2016), but situations influence traits only in extremely rare cases, if at all.² What can influence traits is the exposure to environments (e.g., chronic exposure to violent films increases adolescents' aggressiveness; Krahé, 2014) or environmental change (e.g., engaging in the first stable partnership decreases neuroticism and increases self-esteem; Neyer, Mund & Zimmermann, 2014). Therefore, it makes no sense to talk about trait-situation transaction, but it does make sense to talk about trait-environment transaction when it comes to personality *development*.

² Even the effect of traumatic situations may depend on repeating memories about the situation again and again rather than the direct effect of the situation itself (Wrzus & Roberts, 2016).

A confusion of states with traits, and situations with environments, also often occurs when authors refer to Lewin's formula $B = f(P, E)$ when they want to state that behavior B is a function of personality P and the current situation S (e.g., Bond, 2013; Funder, 2008). However, Lewin (1936, 1946) used P as denoting the current *mental state* of a person and E as the current actual environment of a person (what we term *situation*). Therefore, Lewin (1946) correctly noted that P and E can be mutually dependent (a notion that is reflected also in contemporary thinking: Wagerman & Funder, 2009): $P = f(E)$ and $E = f(P)$. He also coined that $B = f(P, E)$ could be abbreviated as $B = f(S)$ where S is the "life space" within which a person navigates, resulting from the person's state *and* external situation. To avoid confusions, it is helpful to use small letters for less stable units (e.g., behavioral states b , mental person states p , and situations s) and large letters for more stable units (e.g., personality traits P , environmental characteristics E). Thus, if one wanted to formalize that behavioral states are a function of personality and momentary situations (as most personality and social psychologists want to), we would need to write $b = f(P, s)$.

Statistical Trait $\times$ Situation Interaction

In the preceding discussion of transactions between states and situations, and traits and environments, we used the term "transaction" and not the term "interaction" to avoid another confusion in the literature, the confusion between dynamic interactions and statistical interactions. What is most often meant by person $\times$ situation interaction in personality psychology is a *statistical* interaction between the effects of one's personality trait(s) and current situation on current behavior, thus: $b = f(P, s)$ (Cronbach, 1957; Endler & Hunt, 1966; Funder, 2008). Note that a statistical interaction does not involve time and thus does not describe dynamic processes such as social interaction or transactions over developmental time. A statistical interaction $P \times s$ means that an individual's behavior b in a situation s depends nonadditively on the individual's personality trait(s) P and on the situation s .

In a study design where the behavior of many persons is observed in many different situations, the observed behavior depends on the main effect of one personality trait (or the joint main effect of many traits), the situational main effect, and their statistical interaction. As many have noted, it is harder to find replicable two-way interactions than main effects in typical experimental designs where

P and s are independently assigned by the experimenter, and it is even harder to find replicable interactions in naturalistic designs where P and S are often correlated which acts against statistical interactions (Sherman et al., 2016; Wahlsten, 1990). Nevertheless, statistical interactions between P and s do exist, particularly ordinal interactions where a personality trait predicts behavior better in highly *trait-relevant situations* than in less trait-relevant situations (Allport, 1966; Tett & Guterman, 2000).

In a few cases, even cross-over interactions occur such that the effect of personality on behavior is reversed between two situations. Grant, Gino and Hofmann (2011) studied effects of self-rated extraversion differences among fifty-seven leaders of a large pizza company. The situational variable was the proactivity of the employees of the leader's store which was reported by the employees. Proactivity was the extent to which employees were committed to the store (e.g., tried to correct a faulty practice, made recommendations on how to improve organization). The outcome was the profit of the store. Extraverted leadership predicted higher store performance when employees were passive, but lower store performance when employees were proactive. It seems that the extraverted, assertive managers did not like too much initiative by their employees because this would interfere with their tendency to be dominant in social interaction, whereas the introverted managers allowed initiative of their employees.

Statistical State $\times$ Situation Interaction

Studies of trait $\times$ situation interactions measure traits independent of the behavior and situation (e.g., shop profit as a function of extraverted leadership and employees' proactivity). A different use of the term person $\times$ situation interaction refers to statistical interactions between *states* and situations where no traits are involved. In this case, the statistical interaction can be described in terms of *cross-situational consistency*. A person $\times$ situation interaction occurs if the between-person differences in the state (here: behavior) vary across the situations. Thus, the behavioral profiles of the persons differ only in level but not in shape (see Figure 4.1); indeed, they correlate perfectly ($r = 1$) across all pairs of situations.

The first large study along these lines was conducted by Hartshorne and May (1928), who constructed eight situations designed to elicit between-person differences in honest behavior among more than 800 school children. The average cross-situational consistency between the situations was .19, which was much lower than the average short-term retest stability of the situation-specific between-person differences. This result violates assumptions that personality traits are as much consistent across situations than across time.

This problem was debated for some time (*consistency debate*) but remained unresolved and nearly forgotten until Mischel (1968) revived the debate with more

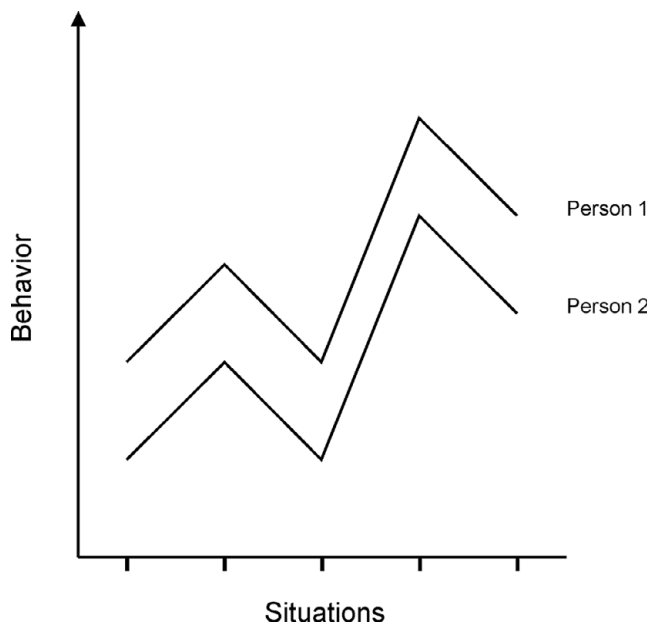


Figure 4.1 Perfect cross-situational consistency of inter-individual differences despite strong situational effects on behavior

empirical evidence, proposing a “magical limit” of .30 for the cross-situational consistency of behavior. From this, he concluded that traits exist only in the eye of the observers but not in reality, because behavior was apparently so much situation-specific. Subsequently, .30 went into literature as the derogatory “personality coefficient,” which was – wrongfully – interpreted as not useful for prediction (but see the predictive power of traits: Ozer & Benet-Martínez, 2006; Roberts et al., 2007; see also Parts III and VII of this handbook).

Five misinterpretations of the “magical limit” of .30 fueled a twenty-year long debate about “whether personality exists” (Kenrick & Funder, 1988; Fleeson & Nofhle, 2008a,b; Funder, 1991). First, mostly social psychologists who are used to studying within-person differences in behavior confused within-person with between-person differences. They thought that the low cross-situational consistency was due to a large within-person variation of behavior. But the between-person differences in behavior (to which cross-situational consistency refers) can be completely consistent across situations even if the within-person differences across situations are large. In fact, correlations between two situations are independent of differences between the means of the situations such that the between-person concept of cross-situational consistency is independent of the within-person concept of situational effects.

The second misunderstanding was the confusion of states and traits in Mischel's (1968) conclusion. Hartshorne and May (1928) were well aware of the difference between states and traits because they related cross-situational and temporal consistency to each other, arguing that the former was lower than the latter. If the

cross-situational consistency of .19 in the study by Hartshorne and May (1928) is corrected for attenuation by the short-term unreliability of the assessments of honesty, the “true” cross-situational consistency is .37. Also, when the situations are grouped into different domains, such as home versus school, the aggregation of situations within domains once more increases the consistency between the domains because of further reduction of measurement error (see also Geukes et al., 2017).

The third misunderstanding was that between-person differences are consistent across *any* situations, even if they are irrelevant for the observed between-person differences. Tett and Guterman (2010) varied the trait relevance of situation descriptions for five traits and found a relatively high cross-situational consistency of trait-relevant behavior in trait-relevant situations (e.g., .55 for risk-taking). Thus, cross-situational consistency should be restricted to state- or trait-relevant situations.

Fourth, even a low cross-situational consistency of behavior does not violate the concept of personality traits if they are based on stable individual *situation profiles* which characterize personality as well as cross-situationally consistent traits. The first evidence for stable situational profiles was provided by Shoda, Mischel and Wright (1994). These authors trained staff of a summer camp to closely observe fifty-three children aged seven to thirteen years over the full six-week period of the camp. Each child was observed for 167 hours on average. Analyses of children’s verbal aggression in five different types of situations revealed individual aggression profiles as depicted in Figure 4.2. The temporal stability of these profiles varied considerably, with an average of .47. Thus, many children showed stable situation profiles for verbal aggression. Such stable profiles are used, for example, in

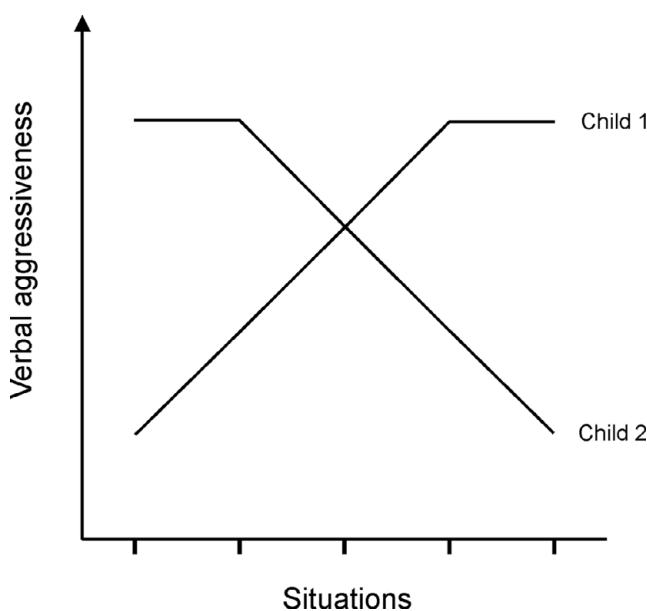


Figure 4.2 Situational profiles of two children in verbal aggressiveness across five situations

clinical assessment in order to determine critical situations that evoke a particular problem. A classic example is the Fear Survey Schedule by Wolpe and Lang (1964) that is used for assessing the degree to which situations such as spiders, crossing a street, blood extraction, or social evaluation evoke fear. The profile of a client tells the therapist what the critical situations are for this client. Should the profile be unstable, there would be no basis for stable fears and no basis for a fear-specific intervention.

Finally, there is a misunderstanding concerning the size of correlations. Correlations around .30 have often been labeled as small or small-to-moderate in accordance with Cohen’s (1988) rule-of-thumb guidelines, but actual empirical evidence suggests that they are at least medium if not substantial (Gignac & Szodorai, 2016). Furthermore, even if .30 were classified as small, then it needs to be taken into account that even small effects can be practically or society important (Hemphill, 2003) and/or accumulate to sizable proportions across time (note that traits predict *aggregated* behavior often above the .30 threshold; Kenrick & Funder, 1988).

Researchers were soon not content with just tabulating correlations (and variance explained) by simple main effects of traits and situations. In the early days of so-called *interactionism* in personality research, researchers tried to identify generalizable estimates of the proportion of variance that can be attributed to persons, situations and the person $\times$ situation interaction (e.g., Endler & Hunt, 1966). Such attempts are often futile because empirical studies which controlled measurement error by aggregating behavior over time or across similar situations found that the size of person $\times$ situation interaction varies greatly between different traits. For example, Diener and Larson (1984) reported that the interaction component was virtually zero for subjective wellbeing but maximum (zero cross-situational consistency) for sociability at work versus in recreational situations. In addition, the size of the interaction varies greatly with the similarity of the situations; the more similar the situations, the smaller the interaction component. This problem can be solved by studying representative samples of trait-relevant situations such that it is an important issue to determine the population of trait-relevant situations for specific traits (see section on situational taxonomies, this chapter).

The Actor-Partner Interdependence Model

One especially relevant case of person $\times$ situation interaction is a situation defined by the behavior of a *dyadic social interaction partner*. My behavior and experiences vary according to the behavior of the person I am interacting with. The interaction partner is a *situation* for me, which is characterized by the partner’s momentary behavior which, in turn, is based on the partner’s personality and our social relationship. If the partner is unfamiliar, we do not yet have a relationship such that only the

momentary state of the partner is influencing my reactions to him or her. If the partner is highly familiar, I may react more to the partner's (perceived and/or actual) personality traits than to his or her current behavior because our recurrent behavior in the past has formed my *relationship schema* of us which includes three ingredients: a script for the typical interaction pattern, a cognitive schema of myself in our interactions, and a schema of the partner in our interactions (Baldwin, 1992).

In this case, person $\times$ situation interactions are by and large person $\times$ person interactions because the interaction partner largely defines the social situation (Asendorpf, 2017). Because persons cannot interact with themselves and because persons and situations are not statistically independent in most cases (e.g., marital satisfaction correlates positively between husbands and wives across different couples), traditional ANOVA or correlational methods cannot be applied here. Instead, the behavior of one dyad member (the actor) can be simultaneously predicted by the actor's own personality (*actor effect*) and by the personality of the interaction partner (*partner effect*). From a situation perspective, the partner effect is the effect of the situation controlled for the effect of the actor's personality, and the actor effect is the effect of the actor's personality controlled for the effect of the situation.

Because this approach applies to both members of a dyad, the effects are best analyzed with a structural equation model for both dyad members (*Actor-Partner Interdependence Model [APIM]*; Kenny, Kashy & Cook, 2006). Kenny et al. (2006) illustrated this case with data of couples that were observed in a discussion of a recent conflict; the observed distress of both partners in the discussion was predicted by both partners' self-rated neuroticism. Women's neuroticism influenced men's distress, whereas the partner effect of men on women's distress was nonsignificant. From a situation perspective, women's, but not men's neuroticism had an impact on the respective partner.

The APIM can include also the statistical interaction between the effects of actor and partner. An example is the study by Cuperman and Ickes (2009) where the observed self-disclosure of randomly paired students was predicted from their self-rated Big Five personality traits. Strong cross-over interactions were found for both extraversion and agreeableness, but in opposite directions. Similar extraversion but dissimilar agreeableness led to more frequent self-disclosure. From a situation perspective, similarity to the partner's extraversion but dissimilarity to their agreeableness fostered the actor's self-disclosure. The latter effect was mainly driven by agreeable partners who interacted with disagreeable actors.

The Social Relations Model

The dyadic perspective of the APIM can be extended to the case where many actors interact with many different targets. In a *round robin design*, all members of a group

interact with each other, whereas in a *symmetrical-block design* all members of a Group A interact with all members of a different Group B without within-group interactions (e.g., only women with men) (see Kenny et al., 2006). In these designs, *actor effects* capture the tendency to show a particular level of behavior across all interaction partners, which can be attributed to the actor's personality. Actor effects are thus based on consistent behavior across situations. *Partner effects* capture the tendency to *evoke* particular levels of the behavior in one's targets, thus one's situational effect on the targets. Partner effects are thus based on consistent situation effects across interaction partners. *Relationship effects* capture a specific actor's tendency to show a unique level of behavior toward a specific target after controlling for the actor's own actor effect and the *target's* partner effect. If only one interaction situation is observed for each dyad or if the behavior in question is measured with only one item, relationship effects cannot be separated from situation- or item-specific measurement error. Consequently, actor and partner effects of an actor can be predicted by the actor's personality, whereas relationship effects are necessarily uncorrelated with both interaction partners' personality as they capture statistical actor $\times$ target interaction effects.

Because the dyads in such designs are not independent and actors cannot interact with themselves, estimation of the actor, partner and relationship effects is accomplished with Social Relations Model (SRM) analyses (Kenny et al., 2006; Schönbrodt, Back & Schmukle, 2011). As the number of different targets is often limited to the size of a small group or school class, the estimation of within-group actor, partner, and actor $\times$ partner effects is often not very reliable, and the corresponding effects are group-specific. However, if the effects are aggregated across many similar groups (i.e., different school classes) or if the data of different groups are analyzed with multilevel analyses that respect the nested structure of the data (both actors and targets are nested in groups), the results are more reliable.

For an illustration, we use here data from the Berlin Speed Dating Study (Asendorpf, Penke & Back, 2011). A total of 190 male and 192 female singles looking for a partner were assigned to seventeen groups of similar size and age. Each man interacted with each woman of his group for three minutes (full-block design). The behavior considered for the present purpose is a simple choice after each of the interactions: Each man and woman marked after each interaction whether they would like to receive the e-mail address of the interaction partner (the target) for further interaction. Only in the case of reciprocal choices, were the required e-mail addresses sent. The actor effect captures low choosiness; the higher the actor effect, the higher the tendency to choose a target, thus the less choosy the actor. Therefore, the actor effect is a personality effect of the actor. The partner effect captures the actor's popularity among the targets; the higher the partner effect, the higher the probability to be chosen by a

Table 4.2 Significant predictors of speed dating choices by sex (adapted from Asendorpf et al., 2011, Table 3)

Predictor	Choices			
	Actor effect		Partner effect	
	Men	Women	Men	Women
Facial attractiveness	-.17*	-.12	.49***	.52***
Vocal attractiveness	-.05	-.12	.33***	.19*
Body mass index	.11	.24**	-.13*	-.18*
Height	-.08	-.02	.17*	.05
Years of education	-.22**	-.02	.16*	.08
Income	-.13	.02	.13*	-.03
Sociosexuality	.03	.01	.24**	.10
Shyness	.08	.15**	-.15*	-.08
Openness	-.03	-.04	.20*	.05

Note. 190 men, 192 women, 17 sessions. All variables were standardized within sex. Reported are β s in multilevel predictions with the predictor at level 1 (individuals) and no predictor at level 2 (sessions). Predictors in boldface were retained in the final set of predictors with significant unique variance.

* $p < .05$, ** $p < .01$, *** $p < .001$.

target, thus the more popular. This partner effect is *not* a situation effect for the actor, it is *another* personality effect of the actor (the tendency to be chosen by targets). Instead, an actor's situation is described by the *target's* partner effect: More popular targets evoke more choices than less popular targets. Finally, relationship effects capture the tendency of an actor to choose a specific target with a higher or lower probability than expected by the actor's choosiness and the target's popularity, plus the measurement error in the interaction with the target. If they were measured without error, they would capture a specific relationship between actor and target that developed within three minutes.

The data of the 2,160 dyads were analyzed within groups by SRM analyses, and subsequently with multilevel analyses because the groups strongly differed by age. Table 4.2 presents significant personality correlates of the actor and partner effects. From a situation perspective, the actor effects are irrelevant as they describe correlates of low choosiness. Instead, the partner effects are relevant because they describe situation effects *for the opposite sex*. For example, men's vocal attractiveness (independently assessed by having them count from one to ten and having

the recordings rated for the attractiveness of the voice by independent raters) significantly influenced women's choices. The more attractive his voice was, the more often the man was chosen by a woman for further interaction ($\beta = .33$). Table 4.2 indicates that, for men, only physical cues in the speed dating situation were relevant for their choices (women's facial and vocal attractiveness and their body-mass index (BMI)), whereas women were influenced by many more cues, including men's education, income, sociosexuality, shyness and openness to experience.

TAXONOMIES OF SITUATIONAL INFORMATION

To understand how traits or states are related to situations, it is important to consider which kinds of situational information can be used at all. There are at least three fundamental kinds espoused in current literature (Rauthmann, 2015): cues (physical and objectively quantifiable stimuli or information in the environment: e.g., books, light, temperature, other people), characteristics (psychological representations of meanings of situations: e.g., interesting, stimulating, adverse, friendly) and classes (groups or types of situations: e.g., threat situations, sexual situations). Each of these kinds – cues, characteristics and classes – may have their own taxonomic systems (for a review, see Rauthmann, 2015). Taxonomies bring different variables or entities into a coherent structure and are thus important in reducing inherent complexity but also guiding more systematic research.

Situation Cue Taxonomies

Social psychologists are predominantly occupied with stimuli influencing observed behavior, via explicit and implicit information processing mechanisms (Rauthmann, 2016). While there is as of yet no full list of such stimuli that impact behavior (but see Reis, 2008), a comprehensive catalog may not be what researchers are looking for. In fact, it might be easiest to first think about the types of cues that are possible and then try to systematize different variables within each type. The general types, inspired by simple W-questions, are (to be abbreviated as "PEARL" following Nofle & Gust, 2015): Persons (*Who* is with you?), Events (*What* is happening?), Activities (*What* are others doing?), Relationships (*Which* types of relationships are present?), and Locations/Time (*Where* are you? *When* is the situation taking place?). Situation cues are best assessed via different pieces of apparatus, objective coders or by asking participants to report on the stimuli they have seen without evaluating or interpreting them.

Situation Characteristics Taxonomies

A fruitful avenue for personality psychologists might be to systematize the psychological meanings of situations that

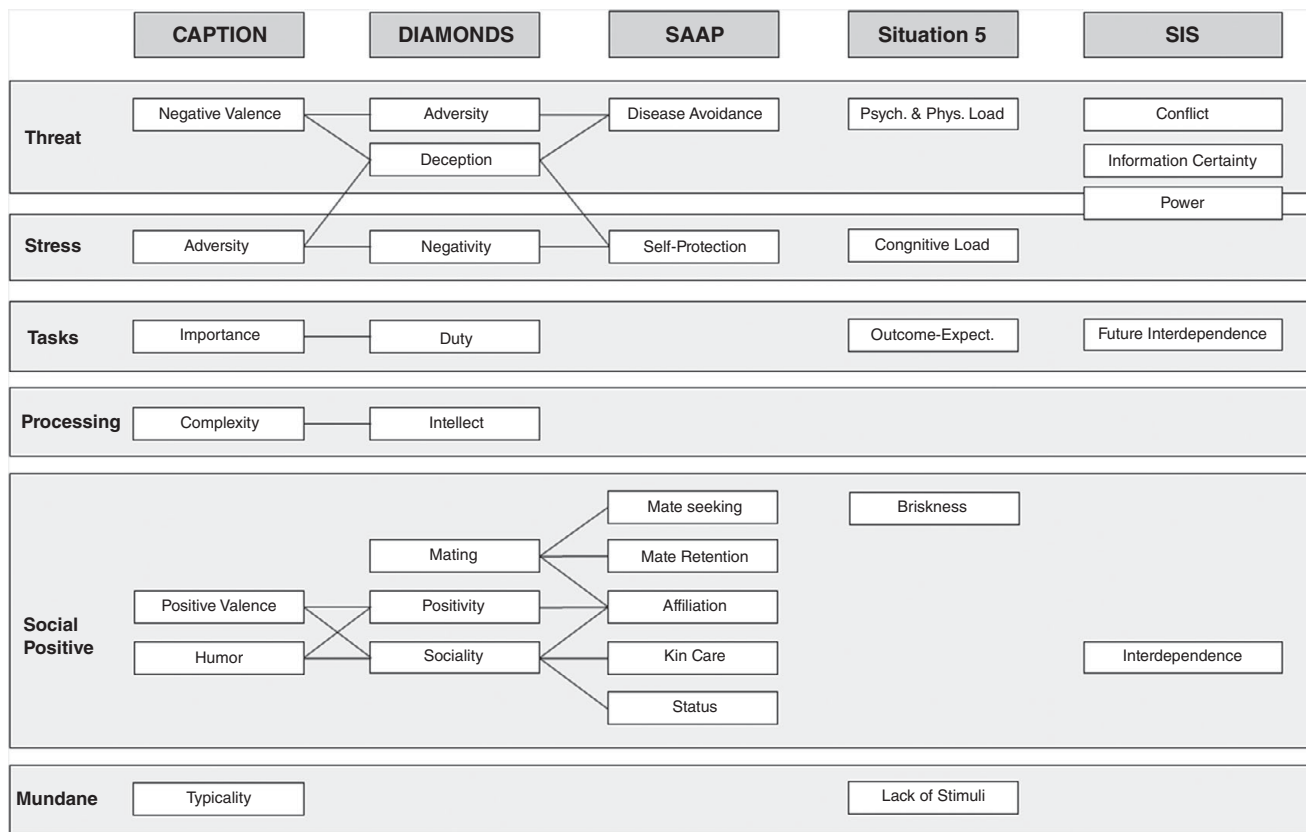


Figure 4.3 Convergences between situation characteristic dimensions (Adapted from Rauthmann & Horstmann, 2017, licensed under CC-BY 4.0) SAAP = Situational Affordances for Adaptive Problems, SIS = Social Interdependence Scale. Lines represent empirically uncovered correlations between dimensions. To keep the figure simple, not all relations could be inserted (e.g., DIAMONDS – Situation 5).

may impact personality-relevant states. Rauthmann et al. (2014) have compiled several taxonomies of psychological situation characteristics and proposed, based on several large samples from different countries, a synthetic model that encompassed the dimensions of previous models, the Situational Eight DIAMONDS taxonomy: Duty (Does something need to be done?), Intellect (Is deep information processing possible?), Adversity (Is someone threatened by external forces?), Mating (Is there an opportunity or attract or court mates?), pOsitivity (Is the situation fun?), Negativity (Could negative events or feelings taint the situation?), Deception (Is there mistrust among people?) and Sociality (Is meaningful social interaction or relationship-building possible?).

The DIAMONDS taxonomy represented an advance in situation research because it not only allowed describing and comparing virtually any situation along a parsimonious set of major dimensions, it also provided several measurement tools (32-item RSQ-8: Rauthmann et al., 2014; 24-item S8*: Rauthmann & Sherman, 2016a; 8-item S8-I and S8-II: Rauthmann & Sherman, 2016b). Previous taxonomies of situation characteristics were rather insular as they were devised either in isolated research contexts and thus did not connect to other taxonomies or did not provide psychometrically well-validated measurement tools.

Recently, however, several taxonomies have been proposed based on theory or purely on empirical data that have also spawned valid and reliable scales (for an overview, see Horstmann, Rauthmann & Sherman, 2017). These are: SAAP (Situational Affordances for Adaptive Problems; Brown et al., 2015), the CAPTION model (Parrigon et al., 2017), the Situation 5 (Ziegler, 2014), and SIS (Situational Interdependence Scales; Gerpott et al., 2017). An overview of their dimensions can be found in Figure 4.3.

It is remarkable that these taxonomies – devised by different research teams using different perspectives, methods, item pools, samples and countries – seem to converge on five to six domains that are repeatedly uncovered (Figure 4.3), thus providing *replicable* evidence for characteristic structures. These replicable domains are (Table 4.3): I (*Threat*), II (*Stress*), III (*Processing*), IV (*Tasks*), V (*Fun*) and VI (*Mundane*). Interestingly (but not necessarily surprisingly), the first five of these domains are strikingly similar to the Big Five or Six (HEXACO) personality traits. This similarity is plausible as the human perceptual system has become attuned to perceiving particular kinds of fitness-relevant information over the course of evolution (Miller, 2007; Rauthmann, 2016). For example, it is vital to survival and reproduction to decode the extent to which other people or the situation will pose

Table 4.3 Replicable domains of situation characteristics

Domain	Describes situations that afford/require...	Analogous personality traits
I <i>Threat</i>	Dealing with or overcoming external problems, obstacles and threats	Agreeableness (–), Honesty/Humility (–)
II <i>Stress</i>	Dealing with or overcoming internal problems, obstacles and threats that may lead to distress	Neuroticism (+)
III <i>Tasks</i>	Getting an important, meaningful or urgent task done	Conscientiousness (+)
IV <i>Processing</i>	Engaging in deeper cognitive information processing	Intellect/Openness (+)
V <i>Fun</i>	Engaging with pleasant and fun events	Extraversion (+)
VI <i>Mundane</i>	Routine, automaticity, repetition	?

Note. + = Keyed in direction of the trait domain, – = Keyed in the opposite direction.

threats, lead to stress, demand problem-solving, need things to be done, will be fun or provide routine. As Big Five trait domains seem to capture the structure of social perceptions (Srivastava, 2010) and many situations are social or interpersonal in nature (Bond, 2013; Reis, 2008), contentwise overlap between trait and situation characteristic dimensions is to be expected. This is fortunate because it grants examining state or trait associations with corresponding situation or environment characteristics more easily (e.g., Rauthmann et al., 2015a,b; Rauthmann, Sherman, Nave & Funder, 2015; Rauthmann et al., 2016; Sherman et al., 2015).

Situation Class Taxonomies

Class taxonomies structure entire situations into groups (nominal categories) based on similar or identical cues and/or levels of single characteristics or profiles consisting

of several characteristics. They are thus the situation analog to personality types which classify people according to their trait levels or profiles. The most comprehensive taxonomy so far, built from Dutch nouns, comes from van Heck (1984, 1989). He distinguished ten classes of situations: interpersonal conflict, joint working and information exchange, intimacy and interpersonal relations, recreation, traveling, rituals, sport, excesses, serving and trading. These classes could be assessed empirically by either cluster-analyzing discrete situations or by having participants report on the membership of a given situation to one (or more) of the classes.

MECHANISMS LINKING STATES, SITUATIONS, TRAITS AND ENVIRONMENTS

There has recently been a flurry of frameworks, theories and models that focus on transactions between personality traits and environments or states and situations (e.g., CAPS: Mischel & Shoda, 1995; the Disposition-Adaptation-Environment (DAE) model: Asendorpf & Motti-Stefanidi, 2018; Integrating personality structures and processes: Baumert et al., 2017; NIPS: Schmitt et al., 2013; PERSOC: Back et al., 2011; Revised Sociogenomic Model of Personality Traits: Roberts, 2017; Self-regulation model by Denissen et al., 2013; TESSERA: Wrzus & Roberts, 2016; State Process Model: Geukes et al., 2018, 2017; Whole Trait Theory: Fleeson, 2012; Fleeson & Jayawickreme, 2015). Together with recent advances in psychological situation research (e.g., Funder, 2016; Rauthmann et al., 2015a,b; Rauthmann et al., 2016; Rauthmann & Sherman, 2016), these point toward ways in which persons, with their traits and states, shape their environments and situations which, in turn, may again shape persons.

How Persons Shape Environments and Situations

Traits and environments (including repeated exposure to similar situations, prolonged episodes within one's life, and enduring life events) are linked in different ways: Pheno- and genotypical traits can (a) be *correlated* with environments (e.g., passive, reactive, evocative or active correlations: Plomin, DeFries and Loehlin (1977); Scarr & McCartney, 1983), (b) statistically *interact* with different environmental exposures or life events (e.g., Caspi et al., 2002), (c) *transact* with environments across time (e.g., evocation, selection and manipulation: Buss, 1987) or (d) *fit* to environmental supplies or demands (e.g., Edwards, Caplan & Harrison, 1998; Kristof-Brown & Guay, 2011).

Moreover, traits (as well as trait-manifestations in states) may also impact situations via different situation management mechanisms (Rauthmann & Sherman, 2016c) so that traits and situations are correlated (Ickes et al., 1997). For example, Rauthmann and colleagues (2015) found that higher trait openness to experiences

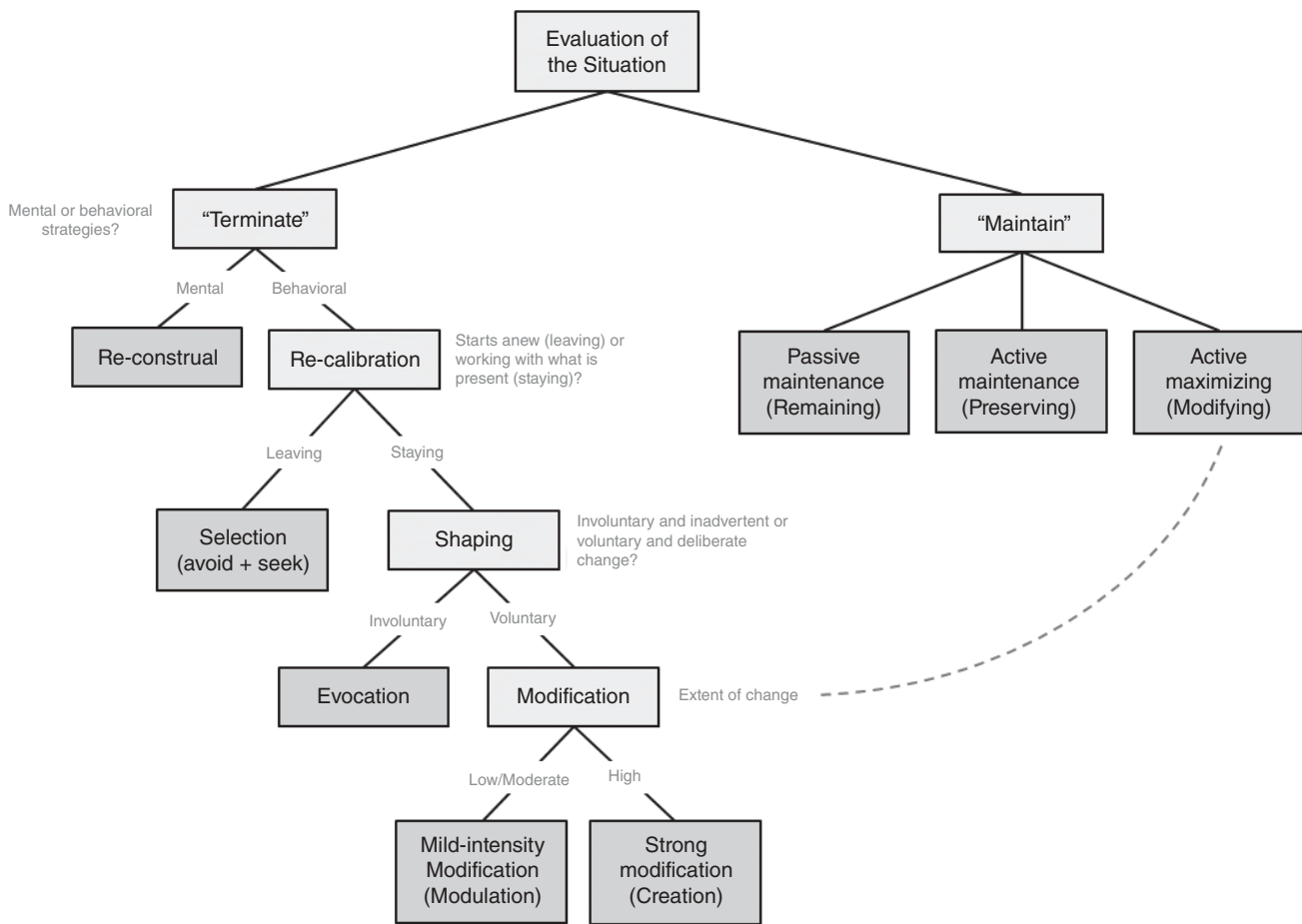


Figure 4.4 Overview of situation management strategies (adapted and modified from Rauthmann, 2017, licensed under CC-BY 4.0)

was correlated with being in more intellectual situations and that this correlation occurred mostly because open individuals tended to idiosyncratically construe their situations as more intellectually stimulating. Such construal of situations represents one out of several strategies of how to navigate and deal with one's daily situations. Further, traits manifest with some regularity in perceptual, cognitive, affective, motivational and behavioral states (Fleeson & Jayawickreme, 2015), and these states are also associated with momentary situations (Jones et al., 2017; Rauthmann et al., 2016; Sherman et al., 2015).

A paramount question for any process-focused personality researcher is *how* a person navigates from situation to situation because this will give rise to fluctuating states within persons (which can be captured by density distributions; Fleeson, 2001; Fleeson & Jayawickreme, 2015). In other words, systematic within-person variation in states can be attributed in great parts to objective and/or subjective situation characteristics changing (as well as other states, such as goals, changing; e.g., McCabe & Fleeson, 2012). To zoom in on *how* and *why* such situation change may occur, Rauthmann and Sherman (2016c) have systematized different "situation management strategies." People may use such strategies voluntarily or involuntarily

to structure and deal with their daily situations. These strategies – whether deliberately utilized or otherwise – may also stand in the service of longer-term developmental regulation, life management and niche carving (e.g., Duckworth et al., 2016; Haase et al., 2013; Ickes et al., 1997; Plomin et al., 1977) which, across time, may lead to increasing attunement or calibration traits and environments (Ickes et al., 1997; Möttus et al., 2017).

Figure 4.4 summarizes different situation management strategies. People can do different things to or with a situation, with the most basic options of maintaining versus terminating them, broadly speaking. *Maintenance* can take the forms of (a) passively remaining in the situation (i.e., doing nothing and letting things unfold), (b) actively trying to preserve the existing situation "as is" or (c) trying to increase or maximize the existing characteristics of the situation (which ties into the modification strategies outlined further down). Maintenance mechanisms will likely be employed in situations with more positive characteristics (e.g., they feel social, mating-relevant or intellectually stimulating; Rauthmann, 2016), with the aim of prolonging them and thus conserving desired states. In contrast, *termination* will likely be employed in situations with more negative characteristics (e.g., they

feel dutiful, adverse, deceptive, or intellectually demanding; Rauthmann, 2016), with the aim of ending the current situation and entering a modified or new one somehow.

The termination of existing situations can also take different forms. A first distinction is whether mental or behavioral strategies are used to end a situation. *Mental strategies* result in reconstruing the current situation, either by focusing attention on different aspects or by actually reinterpreting it. While such strategies do not lead to the actual situation changing, the subjective situation in terms of its perceived characteristics can change for the person. *Behavioral strategies*, in contrast, are geared towards changing and recalibrating actual aspects of the situation or the entire situation itself. First, a person can *select* her/his situations, meaning that she/he can leave (i.e., avoid the current situation and seek another one). Second, a person could still stay in the existing situation, but try to *shape* it in different ways, either unwillingly (evocation: eliciting certain reactions) or willingly (modification: actively and purposefully changing something). A very strong modification of the existing situation, to the point where the changes situation is almost unrecognizable to the previous one, may result in an entirely new situation (creation). Thus, persons have several strategies at their disposal for navigating and transforming their daily situations.

Baumert et al. (2017), in their attempt to integrate research on personality structures and processes, have emphasized the importance of person-situation transactions. In doing so, they have defined personality structures as “results of [mental and behavioral] processes in transaction with situational affordances...” Thus, it is important to gather data on people’s situation management strategies as these can illuminate how people transact with situation in their daily lives. For example, Brown, Blake and Sherman (2017) had 298 students walk around with wearable cameras that would record photos of their daily situations. Students later sifted through the recorded situations and indicated when, in their eyes, a situation ended and a new one began. Across all participants and situations, new situations came to be mainly because of selection (46.6 percent), followed by all other situation management strategies (manipulation as modification + creation: 23.9 percent; construal: 13.8 percent; evocation: 11 percent; other: 4.7 percent). While these are self-reported data, they are the first to examine why exactly people’s situations have changed.

How Environment and Situations Shape Persons

Situations will not likely impact traits directly; rather, they will do so (if at all) via repeated exposure (thus, as environments). Situations, of course, impact momentary personality states (Jones et al., 2017; Sherman et al., 2015), and if these are recurrent, important, intense or even traumatic, then lasting change in traits may be instilled. Although

there seems to be some evidence from prospective studies on personality change that live events may lead to changes in traits, much of it is still preliminary as the nature, shape and timing of change in response to life events remains unclear (for a review, see Bleidorn, Hopwood & Lucas, 2018). As a result, the exact mechanisms and processes that would instill life events to change traits gradually or abruptly also remain uncharted as of yet (but see excellent theoretical starting points, such as Wrzus & Roberts, 2016).

CONCLUSION

We have argued that it is more precise to distinguish on conceptual grounds between rather stable variables of persons and their external conditions (i.e., traits and environments) and rather fluctuating ones (i.e., states and situations). These variables may be operationalized differently – most notably as personality traits and states as well as environment and situation cues, characteristics and classes – and they can be studied with sophisticated data-analytical techniques (e.g., APIMs, SRMs). Persons and their situations and environments may be linked in different ways that need not be linear or additive; rather, there can be nonlinear interactions and transactions across time between both. Importantly, persons can shape their situations and environments in different ways, but environments, and sometimes even single situations (especially when affording recurring, important or intensive presses) can also shape personality traits.

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5

Personality and the Unconscious

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INTRODUCTION

Personality can be defined as about studying characteristic patterns of behaviors and mental processes (thoughts, feelings and motivations) that are relatively stable across time and can be used to differentiate among individuals (Baumert et al., 2017). One of the issues connected to the study of personality is how these behaviors happen. Do people intentionally behave in a certain way? Are they aware of how they behave? Do they know why? Are they aware of the antecedents and consequences of their behavior? Do they hold beliefs about who they are (i.e., their self-concept)? How much do they know who they are? How willing are they to reveal who they think they are to other people?

Decades of research in the personality field help to understand that we may know something about these issues but, most important, we certainly know that there is no simple answer. Consider the role of unconscious processes in personality. The idea that we might be unconscious of the reasons underlying our behavior goes a long way in Psychology: Sigmund Freud will be surely among the first names coming to mind to readers. The importance given by his psychoanalytic approach to the role of the unconscious is difficult to exaggerate, as well as its historical relevance for personality: Many textbooks in personality still have parts dedicated to these themes (Funder, 2013). However, modern conceptualizations of the unconscious have little connection to the psychoanalytic approach and are rather embedded within the current understanding of cognitive functioning (Hassin, Uleman & Bargh, 2005). In this chapter, we will refer to these conceptualizations.

WHAT IS THE UNCONSCIOUS?

Unsurprisingly, there is no clear-cut definition of the unconscious. One key reason is that some of the defining features depend heavily on the underlying theoretical models and approaches (Moors & De Houwer, 2006). Besides the psychoanalytic definition related to Freud's

theorizing that emphasized the content inaccessibility feature, one common recurring element is unawareness. However, what is unawareness is less consensual. Some authors have emphasized unawareness of stimuli (Greenwald, 1992) whereas other authors have defined unconscious in terms of unintentional processes (unintentionality) and unawareness of the influence and effect of the triggering stimuli on mental processes and behaviors (Bargh & Morsella, 2008). At the same time, automaticity has been defined in terms of four components, namely unawareness, unintentionality, uncontrollability and efficiency (the "four horsemen"; Bargh, 1994) and unconscious has been considered as a feature of automaticity together with uncontrolled and unintentional (Moors & De Houwer, 2006), yet often automatic is used as a synonym of unconscious (Bargh, Schwader, Hailey, Dyer & Boothby, 2012). Moreover, the term implicit is also commonly used as a broad category overlapping with unconscious, in opposition to explicit that overlaps with conscious, and is characterized by introspectively unidentified (or inaccurately identified) traces of past experiences that mediate some behaviors (Greenwald & Banaji, 1995, p. 5). Along similar lines, dual-process or dual-systems models are often used as a framework to reflect the distinction between conscious (explicit, reflective, deliberative, propositional) and unconscious (implicit, impulsive, automatic, associative) processes (e.g., Hofmann & Wilson, 2010).

Given these different perspectives and the difficulties to find a consensual definition of unconscious, we will mainly focus on what seems to us a common feature, (un)awareness, that commonly goes together with unintentional, uncontrolled and automatic, although all these features can be disentangled (Moors & De Houwer, 2006). We will use the term unaware rather than unconscious, because it is often used as a less charged synonym of the latter. Moreover, we will focus on the self-concept because it is the appropriate level of analysis for understanding personality functioning in a dual-process framework (Back & Nestler, 2017). Finally, concerning the measurement level, we will focus on what is commonly known as

implicit versus explicit measures but that, for reasons clarified later, should be better called indirect versus direct measures.

Different Types of Awareness/Unawareness

Awareness lends itself to different specifications, mostly depending on the level of analysis, self-concept versus behavior, and on the specific aspect or feature of awareness involved (Gawronski, Hofmann & Wilbur, 2006). The self-concept level concerns summary beliefs about oneself and can be further distinguished in implicit and explicit depending on whether they are mainly based on automatically activated beliefs versus declarative knowledge about oneself, whereas the behavioral level concerns the specific actions that people do under given circumstances (e.g., Back, Schmukle & Egloff, 2009). At a behavioral level, one can distinguish between awareness of the *input* of the process (the stimulus that provokes the process), the *process* itself, the *outcome* of the process (the behavior), and the *consequences* of the output (Moors & De Houwer, 2006). In-depth reviews and analyses of these different features concerning awareness of cognitive processes can be found elsewhere (Bargh et al., 2012; Hassin et al., 2005; Hofmann & Wilson, 2010; Moors, 2016; Moors & De Houwer, 2006; Wilson, 2004). In brief, people are generally unaware of the specifics of the *process* itself (algorithmic and hardware levels) because it is impenetrable to self-knowledge, whereas they can be aware of the computational level of the process (e.g., aware that they are evaluating something; Moors & De Houwer, 2006, p. 312). Concerning the other three aspects (*input*, *output*, *consequences*), there is substantial variation regarding awareness both between persons and within the same person in different circumstances, and considerable empirical evidence of unawareness and automaticity exists for many behaviors in many contexts (Bargh, 2016; but see Newell & Shanks, 2014).

It is important to stress that awareness is difficult to measure (Timmermans & Cleeremans, 2015) and is moreover a matter of degrees not only within but also across aspects. One can be aware of the stimulus (*input*) and the behavior (*output*), yet not aware of the causal link between the two (e.g., that one behaves systematically in a certain way given an environmental cue). One can even be aware of all three aspects yet not aware that his/her behavior has certain predictable consequences (e.g., a pattern of interpersonal reactions). In brief, it would seem more the rule than the exception that people are unaware of at least some of these aspects in many situations (Bargh et al., 2012).

People can and do reflect on who they are, and they use summary beliefs about themselves (e.g., I am outgoing, I am agreeable, I am impulsive) both when describing themselves to others and when reflecting on themselves. Hence, at this level of analysis, it makes sense to consider awareness of their self-concept. Mirroring the previous

analysis at the behavioral level, we can articulate awareness regarding similar main aspects.

Concerning the input, one can think in terms of self-concept *activation*, that is the awareness of the conditions under which (i.e., triggering elements) one's self-concept is made salient. For example, it would require being aware that when certain environmental elements are present, what we think about ourselves (i.e., who we are) becomes salient. A second aspect concerns *content*, that is whether someone is aware of having a certain level of a specific aspect of the self-concept (e.g., to be more or less extraverted). This relates to the broader issue of accuracy in self-knowledge, whereby the evidence suggests that summary beliefs about oneself generally do not match actual behaviors yet have a certain level of accuracy (Vazire & Carlson, 2010). Finally, another aspect concerns *implications*, that is being aware of the way one's self-concept guides the processing of the elements in the situation and our actions, for example by biasing our further processing and determining our actions in a context. Based on decades of research on automaticity, it seems unlikely that people are generally fully aware of their self-concept activation and their related implications: It would seem safe to argue that an important portion of human behavior is characterized by unawareness. Concerning the content, not only there are differences in awareness among persons but what we can know about their self-concept depends heavily on how we try to measure it. As pointed out by Greenwald and Banaji (1995), asking people to reveal their self-concept directly in a given domain assume that they know it (introspective accuracy) and are willing to do so (lack of concern about social desirability). Both assumptions are not obvious to hold, and there is shared appreciation that direct self-reports have limitations in this respect. It is one key reason why in the last twenty years there has been a growing interest in psychometrically adequate measures that attempt to tap indirectly into aspects such as the self-concept and why we will mainly focus the remainder of this chapter on indirect measures.

PERSONALITY AND THE SELF-CONCEPT

The most common way to measure personality is via self-report. Basic personality structures such as the Big Five (McCrae & Costa, 2008) and the Big Six (Ashton et al., 2004) are based on direct self-report measures. This means asking people about some aspects of their personality such as the frequency of a series of behaviors, what they think about themselves, and what they do or would do in specific contexts. Personality self-reports are easy to administer and there is cumulated empirical evidence concerning their validity (e.g., Ozer & Benet-Martínez, 2006). However, people are sometimes unwilling or unable to provide accurate reports of their personality, for instance when the questions raise issues related to personal or social desirability. Starting from the seminal work of Greenwald, McGhee and Schwartz (1998),

another way of measuring self-concepts has been developed such that it lessens participants' ability to control their responses and is less reliant on introspection, therefore reducing the potential biases described previously. These types of measures are usually named implicit or indirect, in contrast with traditional self-reports, called explicit or direct.

As suggested by previous analyses (De Houwer & Moors, 2010; Gawronski & De Houwer, 2014; Perugini, Costantini, Richetin & Zogmaister, 2015), implicit refers to the way by which a psychological attribute influences measurement outcomes if this influence is unintentional, resource-independent, unconscious, or uncontrollable. Indirect refers to measurement procedures when the measurement outcome is not based on a direct assessment of the attributes that are defining elements of the to-be-measured constructs (e.g., extraversion is inferred from reaction times to a categorization task containing stimuli related to the trait and the self). Specifically, an indirect measure is a task that reflects the to-be-measured construct through automatic processes that operate in the relative absence of awareness, intention, cognitive resources or time (Gawronski & De Houwer, 2014). Therefore, an indirect measure has the potential to tap at least partly into aspects of the self that are less accessible through introspection or less willing to be disclosed. By contrast, a direct measure relies on a self-assessment of the participant on an attribute (e.g., talkative) that is a defining part of the construct (e.g., extraversion) that the measurement outcome is assumed to capture.

Implicit and Explicit Self-Concept

Indirect measures for personality research rely on the self-concept. Self-concepts are defined at an abstract level and incorporate summary beliefs about oneself (e.g., I am outgoing). These beliefs become connected over time to one's self-representation (see Back et al., 2009, for a model of how this can happen). We will restrict our attention to some specific contents of these personality-related beliefs, the ones related to personality traits and self-esteem (for a review including implicit and explicit motives, see Perugini, Back, Hagemeyer & Wrzus, 2020). With this restriction in mind, we can define the self-concept of personality as a collection of attributes (stimuli) describing relatively stable personality traits (categories) that are paired with the self-concept. By relatively stable personality traits, we mean both broad traits such as the Big Five and the Big Six and narrower traits such as Anxiety and Aggressiveness. The most commonly used attributes are personality-descriptive adjectives (e.g., threatening) but occasionally also other types of words, such as verbs (e.g., to threaten), have been used. Self-esteem is instead characterized by the attributes referring to a global valence dimension (positive versus negative). We define the explicit versus implicit self-concept as a function of the assessment method. That is, when the measurement procedure is direct and thus aims at

capturing one's knowledge about oneself, we refer to it as a measure of the explicit self-concept. When it is indirect, therefore aiming at reflecting one's automatic beliefs about oneself, we refer to it as a measure of the implicit self-concept. In other words, the specific operating conditions of the measurement procedures can be used to determine whether the measurement outcome applies to the implicit versus explicit self-concept.

Note that we did not use the term "propositions" and "associations" in contrast with standard definitions of direct and indirect measures. It is intentional: Recent theorizing and new empirical evidence suggest that what are usually called associations might also be the result of the automatic activation and formation of propositions (De Cuyper et al., 2017). We decided, therefore, to use the more neutral term "beliefs" instead of "associations" and "knowledge" instead of "propositions." This choice of terms should help to leave as an empirical question for future research whether automatically activated beliefs also include relational qualifiers (e.g., I am) hence being a simple form of propositions, instead of assuming that they are associations, hence they cannot possibly have relational qualifiers (De Houwer, 2014). We will come back to this issue later in the chapter.

PARADIGMS OF INDIRECT MEASURES

Researchers have used several indirect measurement tasks to assess specific or broad aspects of implicit self-concept and self-esteem. Table 5.1 reports a list of tasks with examples of research applications. We provide below procedural and validity details for these tasks. This is not an exhaustive list of all the tasks used to assess personality traits and self-esteem. We focus mainly on the ones that demonstrated reasonable psychometric properties (see Bosson, Swann & Pennebaker, 2000 for a test of various indirect measurement tasks of self-esteem; De Cuyper et al., 2017 for a review of various indirect measurement tasks of personality). The tasks presented in Table 5.1 can be classified according to different criteria. The majority of them were adaptations of already developed measures changing only the stimuli (e.g., the Implicit Association Test, the Go/No-Go Task). Some resulted from the modification of procedural details of other measures to make them more suitable to the assessment of personality (e.g., the Implicit Association Procedure [IAP], the Semantic Misattribution Procedure [SMP]). Some others have been elaborated specifically for assessing a specific concept (e.g., Initials and birthday preference for self-esteem). Therefore, most indirect measurement tasks can be adapted to measure any trait (e.g., IAT, SMP) whereas some are concept specific. Moreover, most tasks are based on response interference (e.g., IAT) whereas a few others are based on misattribution (e.g., SMP; see Deutsch & Gawronski, 2009). Finally, scores can be computed from reaction times (e.g., IAP), errors (e.g., Go/No-Go task), both criteria (e.g., IAT), or response content (e.g., SMP).

Table 5.1 Main indirect personality measurement tasks

Tasks	Examples
Implicit Association Test (IAT; Greenwald et al., 1998)	Agreeableness (e.g., Steffens & Schulze-König, 2006) Angriness/Aggressiveness (e.g., Banse, Messer & Fischer, 2015; Bluemke & Friese, 2012; Hofmann, Gschwendner, Friese, Wiers & Schmitt, 2008; Richetin, Richardson & Mason, 2010) Anxiety/Anxiousness (e.g., Glashouwer & de Jong, 2010; Schnabel et al., 2006a) Big Five dimensions (e.g., Back et al., 2009; Schmukle et al., 2008; Vecchione, Dentale, Alessandri & Barbaranelli, 2014) Conscientiousness (e.g., Costantini et al., 2015) Extraversion (e.g., Suslow, Lindner, Kugel, Egloff & Schmukle, 2014) Humility (e.g., Rowatt, Powers, Targhetta, Comer, Kennedy & Labouff, 2006) Morality (e.g., Aquino & Reed, 2002; Perugini & Leone, 2009) Risk propensity (e.g., Horcajo, Rubio, Aguado, Hernández & Márquez, 2014) Self-esteem (e.g., Bosson et al., 2000; Jordan, Spencer, Zanna, Hoshino-Browne & Correll, 2003) Shyness (e.g., Asendorpf et al., 2002)
Single Category IAT (SC-IAT; Karpinski & Steinman, 2006)	Dependency (e.g., Cogswell, Alloy, Karpinski & Grant, 2010) Perfectionism (e.g., De Cuyper et al., 2013)
Brief Implicit Association Test (BIAT; Sriram & Greenwald, 2009)	Self-esteem (e.g., Krause et al., 2011)
Implicit Association Procedure (IAP; Schnabel et al., 2006b)	Shyness (e.g., Schnabel et al., 2006b)

Continued

Table 5.1 (cont.)

Tasks	Examples
Questionnaire-based IAT (qIAT; Yovel & Friedman, 2013)	Extraversion (Yovel & Friedman, 2013) Shame aversion (Currie et al., 2017)
Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006)	Actual vs. Ideal self (e.g., Remue et al., 2014)
Go/No-Go Association Task (GNAT; Nosek & Banaji, 2001)	Big Five dimensions (Boldero et al., 2007)
Semantic Misattribution Procedure (SMP; Sava et al., 2012)	Conscientiousness, neuroticism, and extraversion (Sava et al., 2012)
Irrelevant Feature Task (IFT; Huntjens et al., 2014)	Self-control (Huntjens et al., 2014)
Initials and Birthday Preference Task (Bosson et al., 2000)	Self-esteem (Bosson et al., 2000)

The IAT (Greenwald et al., 1998) is the most frequently used paradigm to assess the implicit self-concept of personality. It is a speeded sorting task of stimuli appearing individually – two attribute categories (e.g., moral versus immoral) and two target categories (e.g., self versus others) – using two keys. The standard 5-block structure includes a single classification block of attributes (i.e., moral versus immoral), a single classification block of targets (i.e., self versus others), a first critical block, a reverse classification block of targets (i.e., others versus self), and finally a second critical block. In the critical blocks, one target and one attribute category (e.g., moral and self) are classified with one response key and the other two categories (e.g., immoral and others) with another key. The key assignments of the categories vary between the two critical blocks. The underlying principle of the IAT is that if an individual's automatic beliefs about him/herself has more to do with morality rather than with immorality, he/she will perform better (faster and more accurate responses) in the critical block in which moral and self-stimuli are classified with the same key than in the critical block in which immoral and self-stimuli are classified with the same key. The difference in performance (errors and reaction times) between the two critical categorization tasks is reflected in a D-score (Greenwald, Nosek & Banaji, 2003).

Few variants of the IAT have been used to assess the implicit self-concept of personality. The Single Category IAT (SC-IAT; Karpinski & Steinman, 2006) in which only

one attribute category is assessed, is useful for concepts that do not have a natural opposite such as perfectionism (De Cuyper, Pieters, Claes, Vandromme & Hermans, 2013). The Brief IAT (BIAT; Sriram & Greenwald, 2009) is shorter than the standard IAT and allows focusing on just two of the four IATs' category-response mappings. It has been used to assess implicit self-esteem (e.g., Krause, Back, Egloff & Schmukle, 2011). However, De Cuyper et al. (2017) showed that reliability indexes are usually higher for the IAT compared to the Single-Category and the Brief IAT.

The IAP (Schnabel, Banse & Asendorpf, 2006b) has been developed to assess the implicit personality self-concept of shyness but could be applied to other dimensions. In the shyness IAP, participants push a joystick toward or away from oneself depending on whether a stimulus has to be paired with "me" or "not me." Similar to the IAT, the IAP combines attribute discriminations (shy versus not shy) with target discriminations (me versus not me). However, unlike in the IAT, only the "me" label is present on the screen, "not me" describing the self-irrelevant alternatives, and allowing thus the assessment of beliefs with unipolar concepts. Participants first discriminate, as quickly and accurately as possible, "me" and "not me" words, then, with the addition of "shy" and "not shy" words, they have to pull them toward or push them away from themselves, respectively (combined block 1), and finally, "shy" and "not shy" responses are reversed (combined block 2). Error feedbacks are given in case of incorrect, too slow or too fast responses. The IAP score is the difference in reaction times between the two combined blocks. The shyness IAP showed satisfactory internal consistency and correlated with a shyness IAT and with explicit shyness (Schnabel et al., 2006b).

Starting from the limitation of indirect tasks in using single words to operationalize complex psychological constructs, Yovel and Friedman (2013) developed the qIAT, an indirect measurement of standard self-report questionnaires based on reaction times. In particular, the qIAT uses items and instructions resembling self-reports. Participants classify ordinary questionnaire items (e.g., "I start conversations", "I do not talk a lot") referring to certain personality types (e.g., extravert person versus introvert person) and self-related sentences (e.g., "I am in a psychology laboratory" versus "I am playing soccer outside") as true or false. The qIAT follows the same 5-block IAT structure with two critical double categorization blocks. Facilitation is expected when true sentences and sentences compatible to one's personality (e.g., extraversion items for an extraverted individual) are classified with the same key compared to when true sentences and sentences are incompatible (e.g., introversion items for an extraverted individual). A qIAT D score is computed following Greenwald et al.'s (2003) procedure. Its internal consistency seems comparable to the IAT's (Yovel & Friedman, 2013; Currie, Katz & Yovel, 2017).

The IRAP (Barnes-Holmes et al., 2006) has been adapted to assess the actual and ideal selves (Remue, Hughes, De Houwer & De Raedt, 2014). Unlike the IAT, the IRAP allows qualifying the relationship between two concepts. In the case of self-esteem, it consents differentiating beliefs related to being good from those related to wanting to be good using different types of stimulus combinations. The actual self-esteem IRAP consists of trials that present one of two self-related stimuli (e.g., "I Am" versus "I Am Not") paired with one of two target stimuli (positive versus negative words) (e.g., "I am good") and requires participants to provide "True" or "False" response. There are thus four different types of trials (Self-Positive, Self-Not Positive, Self-Negative and Self-Not Negative). In the ideal self-esteem IRAP, participants responded to the same target stimuli but using the self-related stimuli "I Want To Be" or "I Don't Want To Be." A D-IRAP score is computed using an adaptation of Greenwald et al.'s D algorithm. The actual self D-IRAP and the ideal self D-IRAP were able to distinguish between dysphoric and nondysphoric participants such that there was no difference between actual and ideal self-esteem for nondysphorics whereas dysphorics demonstrated lower actual than ideal self-esteem. Such theoretically expected distinction was not found with the IAT.

Among the priming measures, the Irrelevant Feature Task has been elaborated for assessing the implicit self-concept of self-control (Huntjens, Rijkeboer, Krakau & de Jong, 2014). Each trial starts with a 1,500 ms prime "I am" versus "Others are," followed by a fixation cross of 500 ms, and then the target that consists of self-control congruent words (e.g., controlled, calm) versus self-control incongruent words (e.g., chaotic, impulsive) presented in uppercase or lowercase. Participants answer orally and as fast as possible "Yes" (versus "No") to uppercase letters and "No" (versus "Yes") to lowercase letters. Response latencies are recorded through a voice key and errors by a research assistant. A priming facilitation score is computed on correct response latencies by subtracting latencies from schema-congruent trials to latencies from schema-incongruent trials. The reliability of the facilitation score was low in Huntjens et al.'s (2014) study.

With the Semantic Misattribution Procedure (SMP), Sava et al. (2012) assessed the implicit personality self-concept related to conscientiousness, neuroticism, and extraversion. In the SMP, the trial structure is similar to the one in the Affect Misattribution Procedure (Payne, Cheng, Govorun & Stewart, 2005). Each trial follows the sequence of a 200ms prime, a 125ms mask, a 200ms neutral Chinese pictograph, and a grey rectangular noise pattern until response. Participants indicate whether they would like each Chinese character to be printed on a personalized T-shirt by responding "Fits me" or "Does not fit me." Bipolar descriptors of each trait are used as primes. An SMP score is obtained by summing "fits" responses to high conscientiousness (neuroticism) primes and "does not fit" responses to low conscientiousness

(neuroticism) primes. In Sava et al. (2012), results showed good convergent validity of the SMP scores with self-reports.

Boldero, Rawlings and Haslam (2007) used the GNAT (Nosek & Banaji, 2001) to assess Big-Five dimensions (neuroticism, extraversion, openness, agreeableness, conscientiousness) using ideographically generated roles. The extraversion/introversion GNAT had two blocks, one in which the target categories were “self” and “extraversion” whereas in the other they were “self” and “introversion.” The distractor terms were “not-self” roles and alternative personality terms (i.e., introversion terms for the self-extraversion block). For each of the single Big-Five factors, there was only one block in which the target categories were “self” and the to-be-measured trait and the distractor categories were “not-self” roles and the alternative personality traits (i.e., terms from the other four traits). Participants had to press the spacebar as quickly as possible (response window of 700ms) if the term belonged to a target category or do nothing if it did not. They received performance feedback. D measures were computed using correct responses and errors to self and personality terms, as described by Nosek and Banaji (2001). In Boldero et al. (2007), split-half reliabilities of the d' indices reported were adequate and implicit extraversion, openness and agreeableness assessed with the GNAT correlated with their corresponding explicit dimensions measures.

The initials- and birthday-preference tasks are used to measure implicit self-esteem. Participants evaluate each letter of the alphabet and numbers from 0 to 35. Initials-preference score is computed by subtracting the average rating of all participants' two initials from the ratings of each participant's initials. The same method is adopted for calculating a birthday-preference score. Each score reflects the extent to which individuals like their name, initials and their birthday number above the average liking of those letters and numbers and thus constitutes a proxy for self-esteem (for a comparison of different procedural and scoring methods, see LeBel & Gawronski, 2009; Stieger, Voracek & Formann, 2012). In Bosson et al. (2000), the internal consistency was satisfactory.

ELEMENTS FOR THE DEVELOPMENT OF INDIRECT MEASURES AND EVALUATION OF THEIR PSYCHOMETRIC PROPERTIES

Each of the indirect measurement procedures described above can be implemented in very different ways, thereby a procedure such as the IAT or the IRAP should be conceived of as “class of measures” rather than as “a measure.” The knowledge that the IAT is, in general, a valid procedure from a psychometric standpoint does not imply that each specific implementation will be valid nor that all implementations are equally valid (Perugini et al., 2015). When developing an indirect measure, researchers face

several choices that affect its properties substantially. First, one has to identify a measurement procedure that is suitable for assessing the construct at hand. Whereas the IAT seems to possess good psychometric qualities in general, other measurement procedures can be more suitable for specific purposes. For instance, whereas the IAT requires a contrast attribute category, other procedures such as the SC-IAT do not have this requirement. Furthermore, the IAT cannot easily assess propositions, a possibility that is instead straightforward with the IRAP or the qIAT (Remue et al., 2014; Yovel & Friedman, 2013).

Second, it is important to choose an appropriate level of abstractness for the construct. For example, in the case of the self-concept of personality, one could assess a broad dimension, such as one of the Big Five (Schmukle, Back & Egloff, 2008) or its facets separately (Costantini, Richetin, Borsboom, Fried, Rhemtulla & Perugini, 2015). In the case of the IAT, the construct selected should be sufficiently cohesive, such that the stimuli can be easily paired with the corresponding category. It is also important to choose an appropriate set of stimuli to assess the construct. When examining candidate attribute stimuli for self-concept measures, adjectives and nouns are often preferred. However, some empirical evidence suggests that verbs may perform better when assessing constructs that are strongly connected to action tendencies, such as aggressiveness (De Cuyper et al., 2017). Whereas the importance of stimuli (i.e., items) is recognized for direct measures, it is often underestimated when it comes to indirect measures (Perugini et al., 2015). One possibility is to identify a valid set of markers for each construct through a preliminary study, which also gives the possibility of validating an additional direct measure of the construct against known validated measures and establishing convergent and discriminant validity (e.g., Costantini et al., 2015, 2016). The qIAT offers the intriguing possibility to use validated questionnaire items as stimuli (Yovel & Friedman, 2013). This strategy allows capitalizing on extensive psychometric evidence about the validity of some items as an assessment of a certain trait, thus facilitating pretests. The International Personality Item Pool constitutes an ideal public-domain repository to assess most personality traits (Goldberg et al., 2006).

Regarding stimuli for target categories (e.g., those referring to oneself or others in the IAT), one has to choose between using the same for all participants (e.g., personal pronouns) and using idiographic ones (e.g., participant's name, birthdate, phone number; Greenwald & Farnham, 2000). Idiographic items may introduce unwanted variability in the measurement procedure, which is not the same across participants. However, they are also more closely associated to a person's core than nonspecific pronouns, thereby leading to improvements in the psychometric properties of the measures (Bluemke & Friese, 2012; Greenwald & Farnham, 2000). Personalizing stimuli for the attribute categories, instead, does not seem to

improve the properties of the measure (Stieger, Göritz & Burger, 2010).

Apart from the choice of stimuli, several other details of the implementation of an indirect measure can affect its psychometric properties (Krause et al., 2011; Remue et al., 2014). One particularly relevant is the choice of a scoring algorithm. Different ways of treating errors and extreme latencies can make a difference (Greenwald et al., 2003; Krause et al., 2011; Richetin, Costantini, Perugini & Schönbrodt, 2015). For instance, the IAT and its variants are often scored using the algorithm developed by Greenwald and colleagues (2003). However, recent evidence suggests that incorporating robust statistical concepts in the scoring procedures, for instance by using winsorized means instead of fixed cutoffs to handle extreme latencies, seems to have beneficial effects on reliability and validity (Chevance, Héraud, Guerrieri, Rebar & Boiché, 2017; Richetin et al., 2015).

Once an indirect measure is developed, evaluating its psychometric properties can be far from trivial. First, computing internal-consistency reliability of indirect measures is not as straightforward as for self-report questionnaires. Scoring algorithms do not provide scores for each single trial, therefore most studies estimate internal consistency using either Cronbach's alpha on parcel scores (e.g., item-specific scores; e.g., Steffens & Schulze König, 2006) or split-half reliability (e.g., computed on odd/even split of trials; e.g., Krause et al., 2011). Although these strategies are the most widespread methods for evaluating internal consistencies of indirect measures (De Cuyper et al., 2017), they are not always appropriate (e.g., see Williams & Kaufmann, 2012 for how to calculate reliability for a GNAT procedure). Moreover, one should be careful on details, such as to avoid computing splits on first/second half of trials as this will likely introduce error variance due to unrelated individual differences in task learning, with implications for differential general speed of responses. Second, whereas correlations among different indirect measures are usually regarded as indicating convergent validity (e.g., Bosson et al., 2000; Krause et al., 2011; Teige, Schnabel, Banse & Asendorpf, 2004), the interpretation of correlations between indirect and direct measures of the same trait (which has been estimated in a recent meta-analysis as being on average around .20; De Cuyper et al., 2017) is more controversial (e.g., Gawronski & Hahn, 2019).

Research using indirect measures initially focused on patterns of double dissociation (e.g., Asendorpf, Banse & Mücke, 2002) to show evidence of the incremental validity of indirect measures as well as of divergence with direct measures such as self-reports. An initial mainstream assumption was that the more the two types of measures diverged, the better, both because this was creating better conditions to show evidence of the validity of indirect measures and because it was an indication that they were tapping into different processes and mental contents. However, Greenwald, Poehlman, Uhlmann and Banaji (2009)

found in their meta-analysis that the strongest significant moderator of the IAT predictive validity was its correlation with direct measures, meaning that IATs were more predictive with increasing correlations with indirect measures. The explanation given by Greenwald et al. (2009) is that the constructs assessed by indirect and direct measures could reinforce each other in determining behavior (see also Perugini, Richetin & Zogmaister, 2010). Conversely, discrepancies between measures would indicate unpleasant psychological states or the asymmetric effect of additional factors such as social desirability concerns, affective focus and validation processes (Gawronski & Hahn, 2019). However, discrepancies between measures could be due to lower reliability of indirect measures, to violations of the principle of correspondence (i.e., degree of matching content in the relevant target object) and of the principle of structural fit (i.e., degree of methodological similarity between two different measures), or to a poor process of development of an indirect measure leading to mediocre psychometric properties, including their validity (Gawronski & De Houwer, 2014; Perugini et al., 2010, 2015). One consequence is that before interpreting divergence between direct and indirect measures in terms of theoretical implications, one should make sure that it is not a by-product of psychometrically deficient measures.

Finally, little attention if any has been devoted to collecting a normative reference sample before embarking in individual score interpretation. The question is not so much that, as often pointed out, the metric of indirect measures is arbitrary (Gawronski & Hahn, 2019) because this is an issue for most if not all psychological measures, direct and indirect alike (Blanton & Jaccard, 2006). The actual issue is that any substantive interpretation of an individual score requires, among others, a normative sample to which it should be compared (Cicchetti, 1994). More in general, the current practice of the process of development and validation of an indirect measure needs improvements to achieve the standards established over the years for the development of direct measures (e.g., self-reports for personality traits). Indirect measures pose new and complex challenges to psychometric theory and applying techniques developed for direct measures is sometimes not sufficient, yet one should always have clear in mind that a measure is a measure is a measure. Hence, indirect measures should aspire to achieve the same standards commonly used for direct measures. We argue that adequate solutions to these methodological issues are a precondition for more widespread adoption of indirect measures in the personality field, traditionally very attentive to psychometric issues.

Relationship between Indirect Measures and Processes

Initially one of the biggest attractions of indirect measures was their purported capability to provide a window to the unconscious given that they were meant to be tapping into

automatic associations. Indirect measures do not require introspective access to the relevant mental contents but rely on indirect performance-related indicators (e.g., comparative speed in specifically designed double-classification tasks). However, as argued by Gawronski and Hahn (2019), this does not allow the reverse inference that the mental content tapped by indirect measure is therefore introspectively inaccessible. Empirical evidence in the domain of attitudes shows indeed that people are to some extent aware of their implicit attitudes as measured with the IAT and can even partly predict them (Hahn, Judd, Hirsh & Blair, 2014). Although we do not know of similar studies in the domain of the self-concept, there are no principled reasons to believe that it should be different. It is likely that people can be aware of their implicit self-concepts, which would seem in contradiction with the idea that indirect measures tap into the unconscious. Therefore, two questions open up: If people can be aware of their implicit self-concepts, it appears unclear why and for what reason an indirect measure should be useful and, relatedly, into what kind of mental contents is tapping. Concerning the first issue, it is important to stress that the available empirical evidence is mostly borrowed from the attitudinal field and that it shows partial as opposed to full awareness, with consistent individual differences. Furthermore, experimental manipulations of meditation have been shown to increase the correlation between implicit (assessed with the Name Letter Task, see LeBel & Gawronski, 2009) and explicit self-esteem (Koole, Govorun, Cheng & Gallucci, 2009), experimental manipulation of thinking about the to-be-measured trait has been shown to increase the correlation between implicit (assessed with the IAT) and explicit anxiety (Egloff, Weck & Schmukle, 2008) and, more in general, mindfulness has been shown to increase self-knowledge (Carlson, 2013). Concerning the type of mental contents revealed by indirect measures, the traditional assumption has been that they reflect automatically activated mental associations. However, this is problematic for at least two reasons. First, there is substantial empirical evidence showing that indirect measures are not process pure. Decompositional approaches have identified some processes underlying this type of measure, among which only a portion might be ascribed to automatic associations (Conrey, Sherman, Gawronski, Hugenberg & Groom, 2005; Klauer, Voss, Schmitz & Teige-Mocigemba, 2007). Second, as we mentioned previously, what is commonly called associations could be the result of the automatic activation and formation of propositions (De Cuyper et al., 2017; De Houwer, 2014). Hence, indirect measures might be sensitive to simple relational qualifiers (e.g., I am calm versus I wish to be calm versus I should be calm), a property that could seem relevant for personality self-concepts, as shown by recent research on implicit self-esteem (Remue et al., 2014). It is important to stress that simple propositions can be both automatically activated and with relatively low introspective accessibility and personal desirability,

at least for some people, and be easier to tap into certain operating conditions (e.g., speeded task). Going back to the original question, that is if indirect measures provide a window to the unconscious, the answer defies a simple yes or no but it would seem a question of degrees and conditional qualifications. Indirect measures can reveal some self-related aspects of which some people might be partly unaware and may be easier to detect under certain operating conditions. Research exploring these conditional aspects would add much to existing knowledge.

Relationship between Indirect Measures and Behaviors

In their meta-analysis on the predictive validity of the IAT, Greenwald et al. (2009) reported an effect size of $r = .28$ for the IAT-criterion correlation for a total of twenty-four studies using self-concept measures. This relation was weaker than the one reported for consumer or political preferences but stronger than the one for intergroup domains. More recently and reviewing studies including the IAT as well as other tasks for assessing implicit self-concepts, De Cuyper et al. (2017) showed evidence for predictive validity but not for all measures and all domains of personality.

Although far from being systematic, evidence for the self-concept IATs supporting the different patterns of prediction (Perugini et al., 2010) is present. Aquino and Reed (2002) found significant correlations between the moral identity IAT and explicit judgments of the self-importance of moral traits (*single association*, see also Perugini & Leone, 2009 for similar results for a morality IAT). Schnabel, Banse and Asendorpf (2006a) showed that the anxiousness IAT, and not the angeriness IAT, added incremental validity over direct measures for the prediction of behavior (*additive pattern*, see also Asendorpf et al., 2002; Egloff & Schmukle, 2002; Back et al., 2009). Jordan, Spencer, Zanna, Hoshino-Browne and Correll (2003) have shown that the interaction between a self-esteem IAT and a measure of explicit self-esteem predicted defensive behaviors and narcissism (*interactive pattern*, see also Schröder-Abé, Rudolph & Schütz, 2007 for a similar pattern for attribution styles and health). Asendorpf and colleagues (2002) showed that a shyness IAT uniquely predicted spontaneous but not deliberate behavior whereas self-reports uniquely predicted deliberate but not spontaneous behavior (*double dissociation pattern*). Note that using the IAP, Schnabel and colleagues (2006b) could not replicate this double dissociation pattern.

Considering other indirect measures than the IAT, Bosson and colleagues (2000) showed that of seven measures of implicit self-esteem, together with the IAT, only the initials and the birthday preferences correlated with some criterion variables. Although evidence is obtained from one research, the IFT showed predictive validity for spontaneous self-control behavior (Huntjens et al., 2014). The SMP has also been shown to predict self-reported and

objective behaviors (Sava et al., 2012). Yovel and Friedman (2013) showed that an extraversion qIAT predicted behavior over and above the self-report extraversion measure.

To sum up, although other measures demonstrated some promising psychometric properties (e.g., SMP, qIAT), current evidence seems to suggest that, in the domain of personality and self-esteem, the IAT is generally the best available indirect measure regarding psychometric properties (De Cuyper et al., 2017). One key challenge that lies ahead is to provide further evidence of the pragmatic validity of indirect measures in the personality field. Despite promising results, they are still scattered and less systematic than desirable. There are some key areas where consequential progress could be made. We have already indicated the importance of developing psychometrically sound indirect measures and highlighted some methodological aspects that should be given careful attention when developing a new indirect measure. It is hardly questionable that a precondition for showing systematic evidence of predictive validity is to have a psychometrically adequate measure. Expectations about what kind of behavior is more likely to be predicted should also be matched to what is being measured and under what conditions. As we have argued before, the main difference between implicit and explicit self-concept lies in the differential conditions under which indirect and direct measures operate. Matching between features characterizing indirect measurement conditions, such as rapid responses and low controllability, and features characterizing behavior should increase predictive validity. This matching consideration also applies to the correspondence between the level of abstraction of measure (e.g., facet versus broad trait) and behavior (e.g., specific behavior theoretically related to the facet versus aggregate of behaviors theoretically related to the broad trait).

The convergence between indirect and direct measures is relevant also for the validity. If the predictive validity of indirect measures has been shown to be higher when there is greater convergence between direct and indirect measures, an important question becomes under what conditions convergent validity can be increased. Besides the methodological suggestions in the process of development of an indirect measure that we have reviewed before, we can also add a procedural suggestion. Research has shown that greater convergence can be achieved by increasing focus either specifically on the to-be-measured construct (e.g., reflecting on that construct before measurement) or generally about oneself (e.g., meditation, mindfulness). Based on this initial empirical evidence, one could hypothesize that predictive validity of indirect measures will increase if similar procedures are used as part of a standard measurement protocol, ideally following a pretest to ascertain their effectiveness for increasing convergent validity for the specific construct of interest. In other words, if indirect measures that converge with direct measures can have increased predictive validity,

researchers may wish to adopt procedures that tend to increase convergent validity.

CONCLUSION

Indirect measures have started to be used in the personality field mainly after the introduction of the IAT. Their use has increased over time although not as much as in the attitudinal field. The evidence regarding their validity accumulated so far is encouraging, especially for the IAT, but not overwhelming. Alternative paradigms of indirect measures have been developed over the years, and some of them appear promising, although the evidence is still too limited and future studies are needed to establish their validity. Increasing attention to methodological and procedural issues can lead to improvements in the research area. From a personality perspective, once one accepts the idea that many behaviors for many people under several circumstances are characterized at least partly by unawareness of some of the relevant aspects, the next main question becomes how to measure relevant individual differences. One way is to use indirect measures of self-concepts. Given their operating conditions, indirect measures can reveal some aspects of the self-concept that are difficult to capture otherwise and that can be at work (i.e., predicting what behavior one will do) in real life under similar conditions as the measurement operation (e.g., actions based on quick processes with relatively little room for control or overriding mechanisms). In this sense, indirect measures can provide, if not a picture window, at least an awning window to some aspects of what we have described as unconscious.

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6

Personality and Emotion

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INTRODUCTION

Since its beginnings as a subdiscipline of psychology (e.g., Allport, 1937; Shand, 1914), personality psychologists have pursued two different, though related goals (see e.g., Cervone, 2005; Mischel & Shoda, 1998). The first goal is to construct a *general theory of the person*, understood as the integrated whole of the several subsystems of the mind. The second goal is to describe and explain the *important psychological differences between individuals*, that is, those relatively stable psychological attributes of individuals that allow us to uniquely characterize them and to distinguish them from each other. Most psychologists would agree that the *emotion system* is a central subsystem of personality, and that interindividual differences traceable to this system are important for describing individuals. However, if one accepts this, then it follows immediately that, to attain its goals, personality psychology must consider the emotions. In accordance with this conclusion, (1) most classical personality theorists proposed an affective (or affective-motivational) system as a core system of the mind (see, e.g., Shand, 1914; Murray, 1938), and emotions also play a prominent role in recent theories of personality (e.g., Mischel & Shoda, 1995). Furthermore, (2) most taxonomic models of stable and general (transsituational) psychological dispositions (usually called *personality traits*) include a subset of dispositions that refer directly or indirectly to emotions (see the second part of this chapter). Nonetheless, the in-depth investigation of emotions from a personality perspective has only begun comparatively recently, in the wake of an upsurge of interest in emotions that arose in the 1980s and continues to this day. Since that time, the previously largely separate fields of personality psychology and emotion psychology – the latter being the subdiscipline of psychology that studies emotions – are becoming increasingly integrated, to the benefit of both fields.

In keeping with the two tasks of personality psychology, we will in this chapter first outline a model of the emotion system as a subsystem of personality (see also,

Reisenzein & Horstmann, 2018). With this model serving as our theoretical background, we will then address emotion-related interindividual differences.

THE EMOTION SYSTEM AS A SUBSYSTEM OF PERSONALITY

Definition of Emotions

Although there is as yet no generally accepted, *precise theoretical definition* of emotions (for a discussion of what such a definition is, see Reisenzein, 2012), there is widespread agreement among emotion researchers that the objects of their inquiry are, centrally, the transitory states of persons denoted by ordinary language words such as “happiness,” “sadness,” “fear,” “anger,” “pity,” “pride,” “guilt” and so forth. There is also agreement that these *emotional states* or *emotion episodes* normally occur as reactions to the perception, imagination, or the thinking about certain objects (typically, events or states of affairs), and that they have both subjective and objective (inter-subjectively observable) manifestations. *Subjectively*, emotions manifest themselves, centrally, as pleasant or unpleasant feelings that seem to be directed at the objects that elicit them (e.g., one feels happy about the arrival of a friend; see Reisenzein, 2012; Russell, 2003). *Objectively*, emotions manifest themselves, at least at times, in particular actions (e.g., flight or avoidance in the case of fear), expressive reactions (e.g., smiling in the case of joy) and physiological changes (e.g., a blood pressure increase in anger). Taken together, these largely agreed-upon assumptions about emotions provide for a rough *working definition* of emotions. This working definition is sufficient for demarcating the domain of inquiry of emotion psychology (Reisenzein, 2007; Reisenzein & Horstmann, 2018).

Common-sense psychology goes beyond this working definition of emotions by identifying emotions with what we called their central subjective manifestation (the experience of feelings), while regarding the objective manifestations of emotions as their concomitants or

consequences. Most classical, as well as many contemporary emotion theorists have followed common-sense psychology in these assumptions (e.g., Ortony, Clore & Collins, 1988; Russell, 2003). However, some theorists (e.g., Lazarus, 1991; Scherer, 1984) have argued that, from a scientific perspective, emotions should be defined more broadly: They should be defined as *response patterns* or *response syndromes* that include not only emotional experiences but also their bodily manifestations, such as facial expressions and physiological arousal. However, this *syndrome definition* of emotions is problematic for at least two reasons (Reisenzein, 2007): First, it constitutes a significant deviation from common-sense, implying that scientific and lay emotion concepts refer to different, if related entities. Second, the correlations between emotional experience and the bodily components of emotion syndromes have turned out to be typically low (e.g., Durán, Reisenzein & Fernández-Dols, 2017; Mauss & Robinson, 2009; Reisenzein, 2007). For these reasons, we will use the general term “emotion,” as well as terms for specific emotions (e.g., “fear,” “anger”) to refer to the subjective experience component of emotion syndromes.

How Emotions are Generated

In today’s psychology, the dominant theory of emotion generation is the *appraisal theory of emotion* (e.g., Arnold, 1960; Lazarus, 1991; Ortony et al., 1988; Roseman, 1979; Scherer, 2001; see Moors et al., 2013; Moors, Ellsworth, Scherer & Frijda, 2013, for an overview), a variant of *cognitive emotion theory* (Reisenzein, 2017). The basic assumption of appraisal theory is that emotions arise if an event is appraised in a motive-relevant manner, that is, as constituting an actual or potential fulfillment or frustration of a motive (also called a desire, wish or concern). For example, Liz feels happy that Schmidt, the candidate of the socialist party, was elected chancellor if she (a) comes to believe that Schmidt was, indeed, elected and (b) evaluates this event positively, meaning that she (or more precisely speaking, her appraisal mechanism) detects that the event is congruent with her motives. Analogously, Oscar is unhappy that Schmidt was elected chancellor if he comes to believe that this event has occurred and evaluates it negatively (as motive-incongruent). Thus, apart from cognitions in the narrow sense of the word (i.e., *informational* mental states, paradigmatically beliefs), emotions also presuppose *motivational* mental states (Lazarus, 1991; Roseman, 1979; see Reisenzein, 2012 for further discussion).

According to appraisal theory, appraisals are the linchpin of the emotion process: The appraisal of an event determines whether or not this event elicits an emotion, which emotion it elicits, how intense the emotion is and at which object it is directed. Hedonically positive (i.e., experientially pleasant) emotions arise if an event is evaluated as good (motive-congruent); hedonically negative (experientially unpleasant) emotions occur if an event is evaluated as bad (motive-incongruent). The further

distinctions between emotions depend, first, on the more specific kind of evaluation made, for example, on whether an event is evaluated as just personally undesirable, or as morally wrong (e.g., Ortony et al., 1988). Second, they depend on particular nonevaluative appraisals (factual beliefs) about the eliciting event, including the assessment of the event’s probability, its unexpectedness (i.e., its deviation from explicit or implicit expectations), its controllability and the appraisal of one’s own or other people’s responsibility for bringing it about (see Ellsworth & Scherer, 2003). The appraisals associated with specific emotions (happiness and sadness, hope and fear, pity and joy for another, guilt and shame, etc.) have been detailed in several *structural appraisal models* (e.g., Lazarus, 1991; Ortony et al., 1988; Roseman, Antoniou & Jose, 1996; Scherer, 2001). In addition, attempts have been made to develop *information-processing models of appraisal*, i.e., models that describe how event appraisals are computed by the cognitive system (for an overview, see Marsella, Gratch & Petta, 2010). Most of these models assume that appraisals can be computed in several different ways. Of particular importance is the distinction between nonautomatic and automatic forms of appraisal processing and hence, of emotion generation. Whereas *nonautomatic* appraisal processes are usually conceptualized as a form of conscious inferences, *automatic* appraisals are thought to be the product of unconscious processes, such as the activation of memory schemata containing appraisal information, that are automatically triggered by the perception or cognition of events. Furthermore, it has been proposed that, like other mental processes, initially nonautomatic, conscious appraisals can become automatized as a result of their repeated execution (see Reisenzein, 2001). Automatic appraisals could explain why emotions often follow eliciting events rapidly. They may also explain *moods*, that is, emotional experiences which seem to lack concrete objects (for further discussion of moods, see e.g., Schwarz & Clore, 2007; Siemer, 2009).

FUNCTIONAL EFFECTS OF EMOTIONS

Common-sense psychology assumes that emotions can have powerful effects on thought and action, and most emotion psychologists agree. Indeed, this assumption is probably the main reason why emotions interest both lay people and professional psychologists. Traditionally, psychologists have emphasized the negative, maladaptive effects of emotions, such as performance decrements caused by test anxiety (e.g., Zeidner, 2014), or inconsiderate impulsive actions caused by anger (e.g., Deffenbacher, Stephens & Sullman, 2016). However, during the past thirty years, it has become increasingly accepted that, notwithstanding their occasional negative consequences, emotions are *overall* adaptive (i.e., if one considers their positive and negative effects across all situations in which they occur). The adaptive effects of emotions are their

functions – the reasons why the emotion-producing mechanisms came into existence in the first place (Mitchell, 1995). The majority of emotion theorists, including most appraisal theorists, assume that at least the core of the emotion system has emerged (via natural selection) during evolution and hence, that the adaptive effects of emotions are, more precisely, their *evolutionary* functions (e.g., Arnold, 1960; Frijda, 1994; Lazarus, 1991). In the following discussion, we will adopt this assumption, but readers should be aware that according to a minority view, the emotion mechanisms are for the most part acquired via sociocultural learning processes (e.g., Averill, 1982). This view implies that the adaptive effects of emotions are *sociocultural* functions of emotions.

Although today's emotion psychologists largely agree that emotions are functional, there is still only partial agreement on what exactly the adaptive effects of emotions consist of (for overviews of proposed functions, see e.g., Frijda, 1994; Hudlicka, 2011). In the following paragraphs, we describe three main proposed functions of emotions concerning which there is reasonable consensus, as well as empirical support: the attention-directing, the informational and the motivational function of emotions.

The Attention-Directing Function of Emotions

According to a first functional hypothesis, a primary function of emotions is to shift the focus of attention to the eliciting events; or computationally speaking, to allocate central processing resources to the analysis of the emotion-eliciting events and thereby give them priority in information processing (e.g., Simon, 1967; Frijda, 1986; Reisenzein, Meyer & Niepel, 2012). The adaptive value of this attentional effect of emotions is easy to understand for negative events, particularly those that occur unexpectedly: Such events often require immediate action or a change of beliefs. However, unexpected positive events (e.g., an unexpected opportunity) often also call for immediate adaptive actions or belief changes. Although generally adaptive, the focusing of attention on emotion-eliciting events has a non-adaptive side-effect that sometimes dominates: It binds cognitive resources and, as a consequence, can impair performance at parallel tasks (e.g., Zeidner, 2014).

The Informational Function of Emotions

According to many emotion psychologists, a second important function of emotions consists in making adaptively useful information available and/or salient to other subsystems of personality (e.g., Schwarz & Clore, 2007), as well as to other people (via the nonverbal and verbal communication of emotions). According to the dominant version of this hypothesis, this information concerns the results of (possibly unconscious) appraisal processes (e.g., Schwarz & Clore, 2007) and closely related to this, information about the value of the emotion-eliciting objects and events, including actions and their

consequences (e.g., Damasio, 1994; Meinong, 1894; Slovic, Peters, Finucane & MacGregor, 2005). To illustrate this functional hypothesis, nervousness experienced when meeting a stranger would serve to inform the decision-making system about the subconscious appraisal of the encounter as threatening. Similarly, a pleasant feeling experienced when reflecting on a possible course of action serves to signal the subconscious approval of the action and mark it as a good one to choose. Empirical evidence that emotions are indeed used as pieces of information for judgment and decision-making is summarized in Greifeneder, Bless and Pham (2011) and Slovic et al. (2005). Analogously, the nonverbal and verbal communication of emotions could serve to communicate the information about appraisals conveyed by emotions to other persons. Note, however, that similarly to the attention-directing effect of emotions, their informational effect is not always adaptive. In particular, the information provided by emotional feelings is usually not adaptive if (a) the emotion is based on erroneous appraisals (e.g., a harmless situation is appraised as dangerous), or (b) feelings are attributed to the wrong causes (see Greifeneder et al., 2011).

The Motivational Function of Emotions

The attention-directing and informational effects of emotions prepare a person for dealing with emotion-eliciting events, but they do not prescribe *how* these events are to be dealt with. According to a third functional hypothesis, however, emotions also address this adaptive problem to a certain degree: They propose to the motivational and action-control systems possible actions that are suited to cope with the emotion-eliciting events. More precisely, emotions generate desires or impulses to actions that are useful (or at least, have been useful in the evolutionary environment) in the majority of the situations in which the respective emotions are elicited. This adaptive effect of emotions – the production of more or less emotion-specific action tendencies – is what is meant by the motivational function of emotions.

Two main routes from emotion to motivation have been proposed (Reisenzein, 1996). According to the first route, emotions influence motivation because they are themselves important targets of human action, i.e., states people seek to regulate by their actions. This path from emotion to motivation is central in *hedonistic theories of motivation* (e.g., Bentham 1789/1970; Cox & Klinger, 2004). The basic assumption of these theories is that one ultimate or basic motive of humans, if not their only basic motive, is the desire to maximize pleasure and to minimize pain (displeasure). Furthermore, most hedonistic motivation theorists assume that the hedonistic motive can not only be activated by currently experienced emotions, but also by anticipated emotions (i.e., the expectation that one will experience positive or negative feelings in a possible future situation). Negative feelings are assumed to generate a desire to reduce them (if present) or to avoid them (if anticipated); positive feelings are

assumed to generate a desire to maintain them (if present) or to bring them about (if the opportunity arises). It is also widely assumed that hedonistic desires motivate not only overt motor actions, but can also influence “mental actions,” i.e., voluntary cognitive processes, including appraisals. For example, the unpleasant feeling of fear elicited by a threatening event can motivate a person to avoid thinking about the event, or to try to reappraise it in more benign terms (Lazarus, 1991; Gross, 1998).

There can be little doubt that emotions influence motivation at least sometimes through the hedonistic route (see e.g., Baumeister, Vohs, DeWall & Zhang 2007). However, several prominent emotion and motivation theorists have argued that the hedonistic route is neither the only, nor even the most important pathway from emotion to action (e.g., McDougall, 1908/1960; Frijda, 1986; Lazarus, 1991; Weiner, 1995). Rather, according to these theorists, at least some emotions (e.g., fear) evoke adaptive action impulses (e.g., the desire to flee) *directly*, that is, without the mediation of hedonistic desires (see Reisenzein, 1996). This *nonhedonistic theory* of the emotion–action link seems better suited than the hedonistic theory to account for the motivational effects of some emotions, such as the effect of pity on helping and of anger on aggression (Rudolph, Roesch, Greitemeyer & Weiner, 2004).

In addition to the three described, widely agreed-upon functional effects, emotions have yet another documented effect with more controversial adaptiveness: Emotions tend to increase the salience or apparent plausibility of “emotion-congruent” interpretations of ambiguous events. For example, angry people have a heightened tendency to interpret ambiguous negative events in an anger-typical way (e.g., to blame them on others; Siemer, 2001; Lerner & Tiedens, 2006). Because the resulting, emotion-tinged event interpretations often appear to be biased and even irrational, this effect of emotions seems at first sight to be maladaptive. However, it has been argued that emotion-biased appraisals could in fact be adaptive in evolutionarily significant situations (Price, 2006; Reisenzein & Siemer, 2013). To see this, note that the biasing effect of emotions on appraisals can alternatively be described as manifesting an emotion-caused, *temporarily heightened sensitivity* (or a lowered threshold) of the person to events of certain kinds: The fearful person is more sensitive to threats, the angry person to norm violations by others, and so on. Such temporarily lowered thresholds would be adaptive in situations in which events of the same kind (e.g., threats, norm violations) tend to occur together or in close temporal succession. This seems indeed to be the case in many situations. For example, in the evolutionary environment of humans, the fear-eliciting attack of a predator or a member of another tribe, was probably to some degree predictive of further attacks. In these circumstances, a temporarily heightened sensitivity to threat would be adaptive, as it would increase the probability of protective actions. Likewise, a temporarily heightened sensitivity to anger-inducing norm violations by others would be adaptive if the

occurrence of a norm violation raises the probability that other, similar norm violations have occurred, or may occur.

To sum up the preceding discussion, the emotion system seems to consist, at its core, of a mechanism (which may comprise several submechanisms) that (1) monitors the relevance of cognized events for the person’s desires or motives; and, if a motive-relevant event (e.g., a threat to or a frustration of a desire) is detected, (2) shifts attention to the event, communicates its detection to other personality subsystems, and proposes more or less specific actions for dealing with the event (Frijda, 1994; Reisenzein, 2009). It stands to reason that such a system should have a marked influence on the person’s actions and thoughts. Therefore, the emotion system is rightly regarded as a central component of personality.

The Regulation of Emotions

It must be emphasized that the described effects of emotions on actions and cognitive processes are by no means inevitable. Rather, a person can, to a considerable degree, decide to heed versus ignore the behavioral and cognitive “suggestions” made by her emotions (e.g., the tendency to aggress, to smile or to put blame on others). In addition, and perhaps even more important, the person can to a considerable extent control, or regulate, the emotions themselves (e.g., by deliberately shifting attention away from the emotion-eliciting event or by trying to reappraise it; Gross, 1998). As Frijda (1986, p. 401) put it, “people not only *have* emotions, they also *handle* them” (emphasis added). Even radical hedonistic theorists – theorists who assume that the attainment of pleasure and the avoidance of pain is the only ultimate goal of humans – do not claim that humans are slaves to their momentary emotions, but emphasize instead that humans can decide to, for example, tolerate a current unpleasant feeling if they believe that doing so will spare them greater pain in the future (e.g., Bentham, 1789/1970). And if, as probably most contemporary motivation and emotion theorists believe, humans are not only motivated by hedonistic desires but also by other basic motives (e.g., Aunger & Curtis, 2013; Reiss, 2000), then the possible reasons for the control of emotional states and their effects on behavior and thought multiply (see also, Parrott, 1993; Tamir, Chiu & Gross, 2007). To understand the role of personality for emotions discussed in the second part of this chapter, it is therefore not only important to consider its role in *emotion generation*, but also in *emotion regulation*. Furthermore, to fully understand the effects of emotion on behavior, we also need to consider interindividual differences in the *expression and communication* of emotions.

EMOTION AND PERSONALITY: INTERINDIVIDUAL DIFFERENCES

Having described the emotion system as a central subsystem of personality, we turn to the second traditional task

of personality psychology: the description and explanation of the important psychological differences between individuals – their relatively stable psychological dispositions. In keeping with the topic of this chapter, we focus on individual differences (psychological dispositions) related to emotions.

Common sense suggests that interindividual differences regarding emotions exist for all aspects of the emotion process discussed in the first part of this chapter: the generation of emotions, the regulation of emotions, and the effects of emotions on action, thought and expression. For example, people differ in how easily they get angry in response to potentially anger-evoking events, to which degree they tend to control their anger once present, and if and how they express it in action and nonverbal behavior. Any of these dimensions of individual difference can potentially be used to describe individuals and distinguish them from another. In the following subsections, we focus on three groups of emotion-related dispositions. First, we discuss *emotional dispositions* in the core sense of the term, that is, propensities to experience emotions. This subsection is the most extensive one, because the bulk of research on emotion-related individual differences has focused on emotional dispositions. Second, we discuss *habitual styles of emotion regulation and coping*. Third, we summarize research on individual differences in *non-verbal emotion communication*, which subsume the tendency to express emotions nonverbally and the ability to infer other's emotion from their nonverbal expressions. In all three sections, we will also discuss the relation of the respective emotion-related dispositions to classical personality traits, specifically those postulated in the Five-Factor Model of Personality (e.g., John & Srivastava, 1999; McCrae & Costa, 1999).

Although we discuss the three classes of emotional dispositions in separate sections, this is not meant to imply that these dispositions are completely independent. For example, one reason why a person rarely experiences intense anger may be that she habitually applies an effective coping strategy to anger-evoking events (e.g., reinterpreting them in a humorous way). Similarly, one reason why a person rarely expresses her anger in the face could be that she habitually controls her facial expressions.

Emotional Dispositions

The bulk of research on emotion-related interindividual differences has focused on emotional dispositions in the core sense of the term: propensities to have emotions, or to react with emotions to potentially evocative events. As is true for research on emotion-related dispositions generally, most of this research is of a descriptive nature; that is, its main aim is to identify the relatively stable emotional dispositions in which individuals differ, and to study their relations to each other, with the larger goal of devising an empirically based taxonomy of emotional dispositions. In

addition, the relations of emotional dispositions to established personality traits such as neuroticism and extraversion have been studied.

A main reason why research on emotion-related interindividual differences has traditionally focused on these questions has probably been that they can be investigated without making detailed assumptions about the structure and functioning of the emotion system (as described in the first part of this chapter). About all that needs to be done to conduct meaningful descriptive studies of emotional dispositions is to reliably measure them, and then analyze the covariations among them and their correlations with other personality traits (Reisenzein & Schimmack, 1999).

The Structure of Emotional Dispositions

Emotional dispositions (e.g., anxiousness or anger-proneness) are relatively stable tendencies or propensities to experience particular emotions (e.g., fear or anger) in potentially evocative situations. Therefore, the ideal method of *measuring* emotional dispositions would be the following: (a) confront a large, representative sample of people with a wide variety of carefully crafted events capable of eliciting the full spectrum of human emotions, (b) measure the quality and intensity of their emotional reactions to these events and (c) compute, from these data, suitable indices of their readiness to experience different emotions. However, the experimental induction of emotions in large samples (which are needed for individual-differences studies) is costly and, at least in the case of strong negative emotions, ethically problematic. To circumvent these problems, researchers have assessed emotional dispositions using alternative measurement approaches. These include in particular: (1) self-reports of emotions experienced in naturally occurring situations (e.g., Diener, Smith & Fujita, 1995; Schimmack, 2003) or (2) hypothetical scenarios (e.g., Schimmack, 1997); (3) retrospective self-ratings about habitually experienced emotions (e.g., Watson & Clark, 1992; Izard, Libero, Putnam & Haynes, 1993); (4) direct self-ratings of perceived emotional propensities, such as "I am an anxious person" (e.g., Spielberger, 1999; Wolpe & Lang, 1964; Gusewell & Ruch, 2012); and (5) analogous ratings of a person's emotional propensities by her peers (e.g., Shiota, Keltner & John, 2006). Although each of these measurement methods has drawbacks (for discussions, see e.g., Schimmack, 1997; Tignor & Colvin, 2017) and the obtained findings are not always consistent, several main conclusions can be drawn from this research.

1. At least moderately stable, reliable interindividual differences in the propensity to experience emotions exist for all commonly distinguished emotions (anger, fear, etc.), as well as for subtypes of these emotions directed at particular classes of objects (e.g., fear of dogs, fear of exams). This conclusion is suggested by the outcomes of attempts to measure emotional dispositions using the described measurement approaches

(most often, methods 2 and 3 seem to have been used). This research has, among others, succeeded in constructing psychometrically sound scales for numerous more or less specific emotional dispositions: Scales that have adequate to high reliability, as well as at least moderate predictive validity, i.e., they allow to predict the likelihood and intensity of the corresponding emotional states to some degree (the explained variance is typically about 10 percent). To mention but a few examples: Scales for text anxiety have been shown to predict state fear experienced in academic testing situations (for a recent example, see Lotz & Sparfeldt, 2017); scales measuring anger-proneness have been found to predict anger evoked by insults or provocations (e.g., Leki & Wilkowski, 2017; Deffenbacher, Stephens & Sullman, 2016); scales for disgust-sensitivity have been shown to predict the intensity of disgust evoked by potentially disgusting stimuli (e.g., Stark, Walter, Schienle & Vaitl, 2005); a trait empathy scale has been found to predict the intensity of empathic concern felt for people in need (e.g., Davis, 1983); and a scale for exhilarability was found to predict the intensity of people's amusement evoked by a clowning experimenter (Ruch, 1997). While unsurprising, these findings support the predictive and explanatory usefulness of emotional dispositions in science, as well as in everyday life.

2. The dispositions to experience different hedonically positive emotions correlate with each other, as do the dispositions to experience different hedonically negative emotions. This means, for example, that people who easily feel happy also tend to easily feel euphoric, amused and proud, whereas people who are prone to sadness also tend to be prone to fear, anger and guilt. Note that these correlations among *emotional dispositions* do not imply that the *emotional states* to which they predispose necessarily co-occur in the same situation. Rather, sadness-prone persons (people who are more likely than others to feel saddened by potentially saddening events) also get more easily afraid in potentially fear-evoking situations, angry in potentially anger-evoking situations, and so on. However, if an emotion-eliciting situation is complex, i.e., if it contains elements potentially suited to evoke several different emotions, then people with a strong propensity to feel one positive (negative) emotion will indeed also tend to experience other positive (negative) emotions in this situation.
3. The intercorrelations of different positive, and those of different negative emotional dispositions are not so high as to make further distinctions within these two groups unnecessary. For example, Smits, De Boeck, Kuppens and van Mechelen (2002) found that the dispositions to experience fear, anger, guilt-regret, shame-embarrassment and sadness, while correlated, are still distinct, i.e., they cannot be fully predicted from other

dispositions in the set. Similarly, Güsewell and Ruch (2012) found that the dispositions to experience joy-contentment, pride, love, compassion, amusement and awe (measured with scales devised by Shiota et al., 2006), while correlated, are distinct.

4. The two superordinate emotional dispositions – the dispositions to experience pleasant and unpleasant emotions – seem to be largely independent (e.g., Diener et al., 1995; Schimmack, Oishi & Diener, 2002; Schmukle et al., 2002; Watson & Clark, 1997). This means, for example, that people who get easily angry are about as likely to get euphoric as people who do not easily become angry. Again, this does not imply that the corresponding positive and negative *emotional states* are statistically independent. On the contrary, measurements of positive and negative emotional states are usually negatively correlated (e.g., Schmukle et al., 2002). This negative correlation reflects the fact that positive and negative emotions typically do not occur together in the same situation (Russell & Carroll, 1999; Schimmack, 2001). The main reason for this is probably that most emotion-evoking situations are unambiguous, i.e., they do not include elements that evoke emotions of opposite hedonic tone. In addition, positive and negative emotions may be hedonically incompatible, i.e., they may inhibit each other, particularly at higher intensities.

In sum: (1) Reliable interindividual differences in the propensity to experience emotions exist for all commonly distinguished emotions as well as for subtypes of these emotions; (2) these emotional dispositions seem to be organized in the form of two largely independent hierarchies of correlated dispositions, one for hedonically positive and the other for hedonically negative emotions.

An interesting question is whether the described covariational structure of emotional dispositions is *universal* (i.e., holds true for all humans), or whether there are subgroups of people in which emotional dispositions are related in different ways. For example, are there subgroups of people in which the dispositions to experience positive and negative emotions are positively or negatively correlated rather than independent? The existence of such subgroups would be a possible explanation for the finding that there are individual differences in the covariations among *emotional states*. For example, Rafaeli, Rogers and Revelle (2007) found that the correlation between two scales for positive and negative momentary affect (energetic versus tense arousal), measured repeatedly using an affect diary method, ranged from moderately positive to moderately negative in different individuals (see Revelle & Wilt, 2016 for further discussion). Analogous interindividual differences have been found for correlations between the feelings of pleasure-displeasure and arousal (Kuppens, 2008).

EMOTIONAL DISPOSITIONS AND THE FIVE-FACTOR MODEL OF PERSONALITY

Emotional dispositions, at least those that are stable and general (i.e., generalize across situations), are a species of personality traits. How are these emotional traits related to the personality dispositions typically featured in trait theories of personality? As mentioned in the introduction, nearly all proposed taxonomies of personality descriptors contain terms that refer directly or indirectly to emotions. In fact, closer inspection suggests that emotional dispositions lie at the core of these taxonomies. To document this claim, we take a closer look at the currently most popular trait model of personality, the *Five-Factor Model*.

The Five-Factor Model of Personality posits five main, largely independent, broad personality dimensions called the “Big Five”: neuroticism, extraversion, agreeableness, openness to experience, and conscientiousness (e.g., John & Srivastava, 1999; McCrae & Costa, 1999). It turns out that at least the first four of these personality traits are related to emotional dispositions. This is suggested by (1) an examination of the theoretical definitions of the traits, (2) content analyses of the questionnaires used to measure them (Pytlik Zillig, Hemenover & Dienstbier, 2002) and (3) their correlations with explicit measures of emotional dispositions, such as the trait form of the *Positive and Negative Affect Schedule* (PANAS; a frequently used instrument for the assessment of pleasant and unpleasant emotions; Watson, Clark & Tellegen, 1988).

Neuroticism

The strongest as well as the most obvious link between the Big Five and emotional dispositions exists for neuroticism. As a matter of fact, neuroticism is not just *associated with* emotional dispositions, but *is* primarily a (broad) emotional disposition: the propensity to experience negative emotions, in particular fear, anger and sadness. No wonder, then, that strong correlations have been obtained between standard measures of neuroticism and measures of dispositional negative affect, such as the trait form of the Negative Affect subscale of the PANAS. The robustness of this finding led Tellegen (1985) to propose that neuroticism should be renamed “negative emotionality”; and this label is indeed sometimes used as an alternative name for neuroticism (e.g., John & Srivastava, 1999).

Extraversion

Tellegen (1985) also proposed to rename extraversion “positive emotionality” because of its conceptual and empirical relations to the propensity to experience positive emotions (measured, for example, with the Positive Affect subscale of the PANAS), which he considered to be the core of extraversion. However, although positive emotionality may be its core (Tellegen, 1985), extraversion as

traditionally conceptualized and measured is more than that, because it also comprises characteristic desires and action tendencies (Wilt & Revelle, 2008). In particular, extraversion also comprises sociability, the tendency to be outgoing and sociable (see John & Srivastava, 1999; DeYoung, Quilty & Peterson 2007). Empirically, too, the correlations between extraversion and positive emotionality are not strong enough to justify the identification of these dispositions (e.g., Lucas & Fujita, 2000).

Agreeableness

Agreeableness is usually defined as a behavioral disposition that contrasts a prosocial, communal orientation toward others with an antagonistic attitude. However, some of the best markers of agreeableness actually refer to emotional dispositions toward other people (e.g., “affectionate,” “soft-hearted” versus “cold”; John & Srivastava 1999); and empirically too, agreeableness has been found to correlate positively with the tendency to experience empathic emotions (i.e., emotional reactions to the fate of others, see Del Barrio, Aluja & García, 2004) as well as the tendency to experience love and compassion (Shiota et al., 2006), and negatively with trait anger (agreeable people are less anger-prone; e.g., Kuppens, 2005).

Openness to Experience

Openness (also called Intellect or Culture, see DeYoung, Peterson & Higgins, 2005) comprises the general proclivity of individuals towards intellectuality, as well as more specific traits such as open-mindedness and imaginativeness. Although these traits may at first seem to be unrelated to emotional dispositions, Peterson and Seligman (2004) found a correlation of .73 between openness and a scale constructed to measure habitual curiosity, suggesting the possibility that habitual curiosity may be the main underlying cause of openness. Curiosity, however, is classified by some theorists as an emotion (e.g., McDougall, 1908/1960). If one accepts this classification, then openness, too, can be regarded as being at least in part an emotional disposition. Beyond its link to curiosity, openness has been found to correlate with the dispositions to experience joy, love, amusement, compassion and awe (Shiota et al., 2006). Furthermore, individuals high in openness seem to be more emotionally sensitive to art and beauty (McCrae, 2007), to experience a wider range of feelings and emotions (Terracciano, McCrae, Hagemann & Costa, 2003), and to have a higher tendency to experience mixed emotions (e.g., simultaneous feelings of happiness and sadness; Barford & Smilie, 2016) than people low in this trait.

Conscientiousness

Conscientiousness can be broadly defined as a person's tendency toward discipline, achievement, and work and

performance. In addition, conscientiousness comprises more specific traits, in particular cautiousness and scrupulousness in a moral sense. This definition suggests that conscientiousness is not an emotional disposition, but a tendency to act in a particular way – roughly, to meet standards of excellence and to comply with social and moral norms (see Ortony et al., 1988). Conceivably, however, the underlying causes of conscientious actions could in part be emotional dispositions (e.g., a heightened sensitivity to feelings of pride, shame and guilt).

In sum, four of the Big Five personality factors are related, one way or other, to emotional dispositions: Neuroticism *is* essentially a broad emotional disposition (to experience negative emotions); extraversion and agreeableness *comprise* emotional dispositions (toward, respectively, positive affect and interpersonally relevant emotions) as central subcomponents; and openness to experience *is related to* a specific emotional disposition (the capacity to experience aesthetic emotions) and to emotional differentiation, as well as to habitual curiosity, which is conceptualized by some theorists as an emotional disposition as well.

THE PSYCHOLOGICAL BASIS OF EMOTIONAL DISPOSITIONS

The main reason why emotional dispositions play a prominent role in descriptions of individuals in both common-sense and scientific psychology is that they allow us to explain and predict, to some extent, the emotions and thereby, the behavior of people in potentially emotion-eliciting situations. For example, if we know that Oscar is a timid person, we can explain his fearful reaction to a concrete event, at least in part, by attributing it to his fearfulness, and we can predict that he will probably also react with fear to other similar events. The empirical evidence for the predictive validity of emotional dispositions, summarized in the preceding section, confirms that these explanatory and predictive practices are justified. Thereby, this evidence also supports the assumption that underlies these practices, namely that emotional dispositions are partial causes of the corresponding emotional states. This assumption, in turn, explains at least in part the predictive validity of the Big Five personality traits for emotional states found in many studies. To mention but two examples: Larsen and Ketelaar (1991) found that individuals high in neuroticism reacted more strongly to a negative mood induction, whereas extraverts reacted more strongly to a positive mood induction than people low in the respective traits; Pfeiler, Weber and Kubiak (2018) found that individuals high in neuroticism experienced more anger in response to a provocation than those low in neuroticism. These findings can be made intelligible by pointing out that neuroticism is essentially a disposition to experience negative emotions, while extraversion contains a disposition to experience positive emotions as a subcomponent.

The (partial) explanation and prediction of emotional states by reference to emotional dispositions has practical utility, and such dispositional explanations and predictions are perfectly valid and indispensable forms of scientific explanation and prediction (e.g., Vanderbeeken & Weber, 2002). However, these dispositional explanations and predictions leave an important question unanswered: Which structures or mechanisms in the person underlie her emotional dispositions, i.e., are causally responsible for them? For this reason, the explanation of emotional reactions by dispositions is only a promissory note toward a deeper explanation that clarifies the causal mechanisms underlying the dispositions (see e.g., Fletcher, 1993).

One strength of the appraisal theory of emotion is that it can provide such an explanation, and thus can elucidate the psychological basis of emotional dispositions. The reason is that appraisal theory contains, at least in the outlines, a theory of how interindividual differences in the emotional reactions to a given event arise on the psychological level (Roseman & Smith, 2001). To illustrate, let us reconsider the example given in the first part of the chapter: Liz is happy that Schmidt, the candidate of the socialist party, was elected chancellor, whereas Oscar is unhappy about this event. According to appraisal theory, these differences in Liz's and Oscar's emotional reactions can be explained as follows: (1) Both Liz and Oscar came to believe that Schmidt was elected, but Liz appraised Schmidt's election as desirable and Oscar as undesirable; (2) these interindividual differences in the appraisals of Schmidt's election victory in turn, are due to differences in the cognitive and motivational structures that underlie the appraisals. To connect this explanation to emotional dispositions, one only needs to assume that some of these intrapersonal structures are sufficiently stable and general to be regarded as components of personality. These are, in particular, relatively stable and general *desires*, and relatively stable and general *beliefs* about the world and the self (e.g., Lazarus, 1991; Pekrun, 1988; Smith & Kirby, 2001). For example, Liz and Oscar's opposing appraisals of Schmidt's election as chancellor can be traced to their different, long-standing political preferences: Liz is left-wing, whereas Oscar is a conservative, implying that Liz wants the socialist and Oscar the conservative party to dominate the political scene. These two different, stable political desires ground corresponding stable, moderately general emotional dispositions (Shand, 1914): Liz is disposed to react with positive emotions to all events that seem to help the socialist party, and with negative emotions to all events that seem to harm it, and the same is true for Oscar with respect to the conservative party.

Viewed from an information-processing perspective, the just-mentioned personality determinants of appraisal concern the *content* of the cognitive and motivational structures that underlie the appraisals of concrete events (Reisenzein, 2001). The information-processing perspective additionally suggests that the personality determinants of appraisal may also comprise inter-individual

differences in the *chronic accessibility* of appraisal-relevant cognitive and motivational structures (e.g., memory schemas; for support, see e.g., Higgins, Bond, Klein & Strauman, 1986), as well as differences in the *procedures* habitually used for processing appraisal-relevant information (e.g., Cacioppo, Petty & Feinstein, 1996). For further discussion of these possibilities, see Wilkowski and Robinson (2008).

Although clarifying the personality determinants of appraisals, and thereby those of emotions, was already declared a main task of emotion psychology by Lazarus, Averill and Opton (1970), nearly fifty years later, systematic research on this issue is still limited. The main part of this research has been concerned with the effects of stable, general desires and beliefs on emotional states.

General Desires as Personality Determinants of Emotions

Appraisal theory postulates that emotions arise if an actual or possible event is appraised as congruent or incongruent with the person's desires (motives), and that a central determinant of the intensity of the resulting emotions is the strength of the desire, or the subjective importance of the goal (the content of the desire) at stake. Motive and goal theorists commonly assume that the goals that proximately cause actions and emotions in a specific situation (e.g., a student's goal to pass a particular examination) are derived from more fundamental goals for which the former goals are viewed as means to ends (e.g., Brunstein, Schultheiss & Grässmann, 1998; Reiss, 2000). At the top of this motive hierarchy are presumably a set of basic desires which constitute the ultimate sources of human motivation (e.g., Aunger & Curtis, 2013; Reiss, 2000). These assumptions entail that the emotional reactions to a concrete event will be influenced by the degree to which this event is appraised as furthering or obstructing the satisfaction of superordinate desires, as well as the strength of these desires. A number of tests of this assumption have been made.

For example, Sheldon, Elliot, Kim and Kasser (2001) asked participants to recall the single most satisfying event experienced during the last month and to rate the extent to which this event satisfied each of ten candidate basic desires (e.g., the desire for competence, security, relatedness, popularity and personal autonomy). For nine of the ten desires, the satisfaction scores were positively correlated with ratings of positive affect experienced during the event. Other research has focused on an intermediate level of the motive hierarchy, where the top-level desires (e.g., the achievement motive) are concretized to more specific desires that represent what the person wants to attain in her current life situation (e.g., getting good grades; see Brunstein, Schultheiss & Grässmann, 1998). For example, Emmons (1986) related these intermediate-level desires, called personal strivings, to emotions using an experience-sampling method. He obtained evidence that the

successful versus unsuccessful pursuit of personal strivings constitutes a major source of positive versus negative affect in everyday life (for additional information, see Emmons, 1996; Brunstein, Schultheiss & Maier 1999).

Beyond relating positive and negative emotions to desire fulfillment and desire frustration generally, some appraisal theorists have linked subgroups of emotions to the fulfillment or frustration of *specific kinds* of desires (e.g., Lazarus, 1991; Ortony et al., 1988; Roseman, 1979). An important distinction in this context is that between *wanting* versus "*diswanting*" a state of affairs (Roseman 1979), or between having an *approach goal* versus an *avoidance goal*: It has been proposed that qualitatively different positive and negative emotions are experienced if an approach versus an avoidance goal is attained or nonattained. To illustrate, assume Oscar has informed Liz that he intends to visit her. If Liz wants Oscar to visit (approach goal), she will be pleased if he comes and disappointed if he does not; whereas if Liz does not want Oscar to visit (avoidance goal), she will be displeased if he comes and relieved if he does not (e.g., Ortony et al., 1988; Roseman, 1979). Several theorists (e.g., Gray, 1994; see Carver, 2006 for a review) have expanded on this idea by proposing (a) that the pursuit of approach versus avoidance goals is controlled by different, basic motivational systems, a *behavioral approach system* (BAS) versus a *behavioral inhibition system* (BIS); and (b) that people differ in central parameters of these systems, specifically the relative ease with which they are activated and the strength of the resulting, general approach and avoidance motivation. If so, these interindividual differences should predict the type and intensity of the emotions experienced when approach and avoidance goals are attained or nonattained. Supporting this assumption, it has been found that a questionnaire measure of interindividual differences in general approach motivation (BAS sensitivity) predicts the intensity of sadness and anger in response to frustration (the nonoccurrence of an expected positive event, whereas a measure of general avoidance motivation (BIS sensitivity) predicts the intensity of anxiety (Carver, 2004, 2006).

General Beliefs as Personality Determinants of Emotions

There is also evidence that appraisal-related, general beliefs influence emotional reactions to events. The two general beliefs that have probably been most extensively studied for their relation to emotions are (a) optimism (versus pessimism), defined as a generalized expectancy for positive (versus negative) outcomes (Scheier, Carver & Bridges, 2001); and (b) general self-efficacy, defined as a person's generalized belief in her ability to reach her goals and to master difficult or stressful situations (Bandura, 1997; Schwarzer & Jerusalem, 1995).

Optimism has been found, for example, to correlate negatively with depressive symptoms and negative

habitual mood, but positively with positive habitual mood (e.g., Scheier et al., 2001; Symister & Friend, 2003). *General self-efficacy* has been found, for example, to be associated with lower state anxiety during a stressful cognitive task (Endler, Speer, Johnson & Flett, 2001) and lower levels of depression and anxiety in medical patients (e.g., Luszczyńska, Gutiérrez & Schwarzer, 2005). These findings are consistent with the hypothesis that optimism and general self-efficacy affect emotional states at least partly by influencing the appraisals of concrete events (see Kaiser, Major & McCoy, 2004; Schwarzer & Jerusalem, 1999). However, this is most likely not the only causal path through which optimism and general self-efficacy influence emotions. For example, compared to pessimists, optimists make more use of active coping strategies aimed at eliminating or reducing problems and negative emotions (Solberg Nes & Segerstrom, 2006).

Other general beliefs that have been found to predict the emotional reactions to concrete events include interpersonal trust, hostility and sensitivity to injustice. *General interpersonal trust* was found to moderate the effects of a violation of the social norm of equality on negative emotions (Stouten, De Cremer & van Dijk, 2006). *Hostility*, defined as a disposition whose core is the general belief that other people are unworthy and likely to be sources of frustration and aggression, was found to predict the intensity of state anger evoked by negative interpersonal events (see Aquino, Douglas & Martinko, 2004; Smith, 1992). *Sensitivity to injustice* (e.g., Baumert & Schmitt, 2016), a disposition characterized among others by the belief that one is frequently the victim of unfairness, was found to predict state anger and moral outrage caused by a concrete unfair treatment (Mohiyeddini & Schmitt, 1997; Schmitt, 1996), as well as guilt if the person is the beneficiary of the injustice (see Pretsch et al., 2016; Thomas, Baumert & Schmitt, 2013).

For a complementary perspective on how appraisal theory can explain interindividual differences in emotional dispositions, see Kuppens and Tong (2010).

Is the Link between Appraisals and Emotions Universal?

Most appraisal theorists assume that while individuals vary in their emotion-relevant general beliefs and desires, which then lead to interindividual differences in how they appraise concrete events, the connection between appraisal patterns and emotions is the same in different individuals – it is universal. However, several studies have reported findings that, at least at first sight, seem to put this assumption into question. For example, Tong (2010) found that the associations between negative emotions (anger, sadness, fear and guilt) and the appraisals presumably characteristic for them were stronger for individuals high than those low in neuroticism; Kuppens, Van Mechelen, Smits, De Boeck and Ceulemans (2009) reported findings which suggest that for some people appraising an event as frustrating is sufficient for anger, whereas others

become angry only if they also appraise the event as either unfair and deliberate, or as a threat to their self-esteem. These studies could be taken to suggest that at least the strength, but possibly even the nature of the links between appraisals and emotions vary between people, which if true would constitute yet another important emotion-related dimension of interindividual differences (Kuppens & Tong, 2010). However, whereas variability in the *strength* of appraisal-emotion relations may still be compatible with classical appraisal theory (Reisenzein, 2015), variability in the *nature* of these relations is not. Rather, as said, most appraisal theorists assume that the link between appraisal patterns and emotions is universal; either because this link has been established in evolution (e.g., Arnold, 1960; Lazarus, 1991) or alternatively, because emotions are partly defined, in common language, by reference to appraisals (e.g., “fear” is in part defined as a state caused by an appraisal of threat; cf., Reisenzein, 2012). In support of the universality assumption, it has been pointed out by several authors that at least for the core appraisals that characterize specific emotions, interindividual differences in the appraisal-emotion link are hard to even imagine. For example, it is hard to imagine that in some people, unexpected events do not evoke surprise, perceived wish-fulfillments do not evoke happiness or perceived threats do not evoke fear. At least with respect to such core appraisals for specific emotions, the universality assumption seems plausible. For this reason, possible alternative explanations of the reported findings should be considered. These include method problems (problems with the measurement of the emotions or appraisals, including interindividual differences in the meanings of the appraisal and emotion terms used to label the scales), as well as the possibility that the appraisals for which interindividual differences in the appraisal-emotion link were found, were not core appraisals of the respective emotions (see e.g., Junge & Reisenzein, 2013; Reisenzein & Spielhofer, 1994).

The Origins of Emotional Dispositions

Individuals differ in their emotional sensitivities. But how do these differences arise? Specifically, to which degree are they inherited and to which degree learned? Whereas the importance of learning and experience for the development of emotional dispositions may be obvious and is widely acknowledged (see e.g., Wrzus & Roberts, 2017), the role of inheritance has often been questioned. However, the existence of an inherited basis of emotional dispositions is supported by both theoretical considerations and empirical findings. Regarding theory: If one accepts that at least the core of the emotion system is inherited (see the first part of this chapter), then – given the ubiquitous variability of biological systems – it is hard to escape the conclusion that basic interindividual differences in the parameters of the emotion system are inherited as well. Empirically, this prediction is supported by evidence for a substantial degree of heritability of the Big Five traits (e.g.,

Bleidorn, Kandler & Caspi, 2014; Bouchard, 2004): Given the close relation of the majority of these traits to emotional dispositions described above, this evidence also supports the partial heritability of basic individual differences in emotional dispositions.

If one accepts the existence of inherited individual differences in emotional dispositions (e.g., fearfulness), the question arises whether these differences, like presumably the emotion system itself, have emerged in evolution because of their adaptive (fitness-enhancing) effects. The answer to this question is by no means self-evident, for the fact that a *mental mechanism* emerged in evolution because of its adaptive effects does not imply that *heritable interindividual differences in this mechanism* are likewise adaptive. On the contrary, it has been argued that the existence of heritable interindividual variation in a trait signals a *lack of adaptive significance* of this interindividual variation (Tooby & Cosmides, 1990). Applied to emotional dispositions, Tooby and Cosmides' (1990) argument is as follows. (1) If differences in emotionality (e.g., low versus high fearfulness) had differential fitness effects, they would have been subject to selection pressure, and as a consequence would not have prevailed over evolutionary times but would have converged to an optimal level of emotionality (e.g., medium fearfulness). (2) Therefore, the individual differences in emotional dispositions observed in today's humans have no significant consequences for inclusive fitness. Rather, like (presumably) the differences between individuals in the size of their eyes, individual differences in emotional dispositions represent remaining random variation that lacks adaptive significance. However, this argument has been disputed (e.g., Buss, 2009; Penke, Denissen & Miller, 2007). For example, Penke et al. (2007) argue that interindividual differences in emotionality could have evolved if a *generally* optimal level of fearfulness, irascibility, etc. did not exist in our evolutionary past, but different levels of emotionality were most adaptive in different environments or social niches.

HABITUAL EMOTION REGULATION AND COPING STYLES

As mentioned at the end of the first part of this chapter, people are not slaves to their emotions and in fact often try to control their emotions or their effects on thought and action. This consideration suggests that the personality determinants of emotions will also comprise habitual strategies or "styles" of regulating emotions and of coping with emotional events. This suggestion has been explored in numerous studies (e.g., Carver, Scheier & Weintraub, 1989; Lazarus & Folkman, 1984; see Carver & Connor-Smith, 2010 for a review). As the theoretical basis of these studies, researchers have usually relied on one of several proposed classification systems for emotion regulation strategies or coping styles. The best-known classification of *emotion regulation strategies* has been proposed by

Gross (1998; see also, John & Gross, 2007; Gross, 2015), who distinguishes five classes of emotion regulation strategies: *situation selection*, *situation modification*, *attentional deployment* (e.g., vigilance versus avoidance), *reappraisal* and *response modulation*. The first four of these emotion regulation strategies represent attempts to influence the emotion itself, by intervening at different steps in the emotion generation process (as conceptualized in appraisal theory), whereas the fifth comprises all strategies aimed at influencing the effects of emotions on expression and action (e.g., suppression). Regarding *coping styles*, which pertain specifically to stress-related emotions (notably fear, anger and depression; Lazarus, 1991), a basic distinction is that between engagement and disengagement coping (Carver & Connor-Smith, 2010). Each of these two coping styles combines specific forms of the emotion regulation strategies distinguished by Gross (1998): Engagement coping is aimed at actively dealing with the stressful event by, in particular modifying the eliciting situation, devoting attention to it, or trying to reappraise it; whereas disengagement coping is aimed at escaping or avoiding the event or the negative emotions it elicits.

Based on these and other taxonomies, measurement instruments for habitual emotion regulation and coping strategies have been developed to study the effects of these dispositions on emotions and emotion-related behavior. Some of these studies have focused on emotions in general (although mostly on negative, stress-related emotions), whereas others have concentrated on specific emotions, in particular the stress-related emotions of anxiety, anger and depression. In addition, the associations of these dispositions to classical personality traits have been investigated.

Coping with Anxiety

Theory and research on anxiety regulation has traditionally focused on the opposed coping strategies of avoiding versus approaching anxiety-related information (e.g., Byrne, 1964; Krohne, 2003), which can be regarded as special forms of disengagement and engagement coping (Carver & Connor-Smith, 2010). For example, Krohne (2003) distinguished between *cognitive avoidance* and *vigilance* as the two fundamental forms of anxiety regulation and proposed that avoidance is motivated by the short-term hedonistic desire to reduce the feeling of fear, whereas vigilance is motivated by the epistemic desire to gain information about the threatening event. According to Krohne, these two coping strategies are uncorrelated at the dispositional level, that is, individuals may score either low or high on both dimensions. Both coping strategies can lead to anxiety reduction: Avoidance because attention is no longer focused on the threatening event, and vigilance, because it can lead to the acquisition of new information that allows a more benign reappraisal of the event.

Coping with Anger

Research on habitual tendencies of “handling” anger initially distinguished two coping styles: *anger-out* (showing overt, aggressive reactions) and *anger-in* (suppressing the overt expression of anger; Spielberger, 1999; these can be regarded as two specific forms of response modification). However, neither of these strategies seems to be very effective for reducing anger (Deffenbacher et al., 1996). Subsequent research, which has taken a broader range of anger regulation strategies into view (Linden et al., 2003), has identified more effective anger-reduction strategies. These include nonhostile feedback (an attempt at situation modification) and humor (a form of reappraisal) (e.g., Kubiak, Wiedig-Allison, Zgoriecki & Weber, 2011; Weber & Wiedig-Allison, 2007).

Coping with Depression

In research on depression, the *ruminative coping style* has been extensively studied. It is defined as the focusing of attention on the symptoms of one's distress and their possible causes and consequences (Nolen-Hoeksema, 1991). Several studies found that rumination increases negative feelings and can lead to impaired cognitive and social functioning (e.g., Brinker & Dozois, 2008; Lyubomirsky & Tkach, 2004; Thomsen, 2006). A meta-analysis by Olatunji, Naragon-Gainey and Wolitzky-Taylor (2013) confirmed the association between rumination and depression, as well as anxiety. This meta-analysis also found that these relationships were much stronger for *brooding*, a subform of rumination characterized by the passive comparison of one's situation with some unachieved standard, than for *ruminative reflection*, a form of rumination aimed at problem-solving. These findings can again be well explained by the appraisal theory of emotion: Thinking about an emotion-evoking negative event reinstates the emotions elicited by this event as long as the appraisal of the event remains the same (brooding); however, if rumination leads to a more benign reappraisal of the event (which is likely to occur in a subset of the cases of ruminative reflection), then the negative emotions are reduced.

Emotion Regulation and Classic Personality Traits

Several reliable associations of emotion regulation and coping styles to classical personality traits have been found. Regarding negative, stress-related emotions generally, John and Gross (2007) found that conscientiousness and extraversion foster the use of situation modification, and that conscientiousness also fosters the use of situation selection and attentional deployment (devoting attention to the eliciting event). In contrast, people high in neuroticism tend to refrain from changing the eliciting situation, as well as from thinking about it and trying to reappraise it. A meta-analysis by Carver and Connor-Smith (2010) essentially confirmed these findings, revealing that

extraversion, conscientiousness and openness to experience, as well as optimism (not considered by John and Gross, 2007) foster the use of engagement coping styles, whereas neuroticism fosters disengagement coping. These links between personality traits and coping styles could be due to personality-associated differences in the perceived ability to successfully use particular emotion regulation strategies (Gross, 2015). The use of engagement-type coping strategies by individuals high in conscientiousness is a possible explanation for the finding of Jensen-Campbell, Knack, Waldrip and Campbell (2007) that these individuals were less angry about negative feedback received from another person than people low in conscientiousness. In addition, conscientious people were less likely to express their anger in aggression (Jensen-Campbell et al., 2007). This can be explained by conscientious people's greater sensitivity to social norms (see the section on emotional dispositions and the Big Five).

INTERINDIVIDUAL DIFFERENCES IN EMOTION COMMUNICATION

Individual differences exist not only with respect to the generation and regulation of emotions, but also in regard to the nonverbal expression of emotions and the ability to detect or infer other people's emotions from expressive cues (Hildebrandt, Olderbak & Wilhelm, 2015; Scherer, 2007). These expressive tendencies and decoding abilities represent, respectively, individual differences in the sender versus the receiver involved in a nonverbal emotional communication. Several measurement instruments have been developed to measure these dispositions and to study their relation to each other and to classical personality traits.

Emotional Expressiveness

The structure of individual differences in emotional expressiveness has so far been mainly investigated via self-report measures (e.g., Gross & John, 1997). Correlations of these measures to peer ratings of expressivity and to the frequency of facial expressions shown in emotion-eliciting situations are moderate (e.g., Gross & John, 1997), suggesting that people's beliefs about their expressivity are not very accurate. Therefore, measurements of individual differences in expressivity should preferably be based on observations of their actual expressions in emotion-eliciting situations (see Reisenzein, Junge, Studtmann & Huber, 2014). However, so far only few studies of this kind exist (Hildebrandt, Olderbak & Wilhelm 2015). Riggio and Riggio (2002) concluded on the basis of a meta-analysis that emotional expressiveness, measured by self-reports or objective measures, is moderately positively related to extraversion, and negatively to neuroticism (although the latter was only found for behavioral measures of expressivity). These conclusions were partly confirmed by Barr, Kahn and Schneider (2008),

who likewise found that the tendency to express emotions is positively related to extraversion, as well as to agreeableness. Furthermore, emotional expressivity has been found to be reduced in depressed individuals, although only in males (Flynn, Hollenstein & Mackey, 2010).

Emotion Perception

Research on individual differences in the ability to infer emotions from expressive behavior suggests that this ability is only weakly correlated with facial expressivity, particularly for spontaneous expressions of emotion (Elfenbein & Eisenkraft, 2010). However, these findings may underestimate the actual relation between the two dispositions because of methodological shortcomings (Hildebrandt et al., 2015). Similar to emotional expressivity, emotion perception ability has been found to be modestly associated with classical personality traits, specifically with agreeableness and openness (Mayer, Roberts & Barsade, 2008). Emotion perception abilities have also been studied in relation to psychopathology and personality disorders. Specifically, a meta-analysis of studies on the perception of negative emotions in borderline personalities found that these individuals have a bias to perceive neutral facial expressions as expressing negative emotions (Mitchell, Dickens & Picchioni, 2014). Furthermore, there is some evidence for an emotion perception deficit in psychopaths (e.g., Hastings, Tangney & Stuewig, 2008). However, Olderbak et al. (2018) have pointed out that these perception deficits may not be due to the personality traits typically associated with psychopathy (which include low conscientiousness and low agreeableness), but to a lower general intelligence of the forensic samples usually studied in research on psychopathy.

Emotional Intelligence

Salovey and Meyer (1990) proposed that the capacity to regulate and express one's emotions in situationally appropriate ways, as well the ability to recognize other's emotions, should be viewed as different facets of a higher-order capacity termed *emotional intelligence* (see also Mayer, Salovey & Caruso, 2004). They defined this capacity as follows: "Emotional intelligence is the ability to recognize one's own and other's emotions, to use the information contained in emotional experience to guide judgment and action, and to manage the experience and expression of emotions" (Salovey & Mayer, 1990; see also, Mayer, Roberts & Barsade, 2008). Since then, the concept of emotional intelligence has become highly popular, and numerous studies have been conducted that have related individual differences in emotional intelligence, measured through various tests (some of which are, however, based on competing concepts of emotional intelligence, e.g., Bar-On, 1997) to a variety of outcome measures. These studies found that emotional intelligence has a small to moderate positive correlation

with cognitive performance (Van Rooy & Viswesvaran, 2004) and with mental and physical health (Schutte et al., 2007). Although measures of emotional intelligence also correlate substantially with measures of more traditional personality dispositions, including coping styles (e.g., Day, Therrien & Carroll, 2005; Van Rooy & Viswesvaran, 2004), they appear to retain some predictive validity even when these correlations to traditional measures are taken into account.

Peña-Sarrionandia, Mikolajczak and Gross (2015) have tried to integrate the research on emotional intelligence with that on individual differences in emotion regulation, using the technique of meta-analysis. They found that individuals high in emotional intelligence regulate their emotions up to the earliest stage of the emotion process (situation selection), have a multitude of regulation strategies at their disposal, and are generally successful in regulating their emotions when necessary. At the same time, however, they are flexible enough to allow their emotions to emerge when doing so is appropriate.

CONCLUSION

Although research at the intersection of emotion and personality has greatly increased during the past thirty years and considerable progress has been made, it seems fair to say that the two basic goals of personality psychology mentioned in the introduction have not yet been reached. However, the first of these goals – to develop an agreed-upon theory of personality understood as the integrated whole of the several subsystems of the mind – must realistically be regarded as a long-range goal whose attainment will take time. Furthermore, this goal should best be regarded as a long-range goal of psychology as a whole, because reaching it presupposes a more complete understanding of all of the subsystems of personality (e.g., perception, belief-formation, emotion, motivation, action control). It is therefore unrealistic to expect the subdiscipline of personality psychology to achieve this goal all by itself. Indeed, creating a satisfactory theory of the complete person will most likely even require an interdisciplinary approach. In agreement with this conclusion, creating a unified theory of the human mind has been proclaimed to be the overarching goal of cognitive science (Newell, 1973). This goal has recently been taken up again in the field of affective computing with the argument that emotions can be understood only by considering their functions in "complete" agents (Reisenzein et al., 2013). In pursuing this goal, cognitive scientists and affective computing researchers have developed precise computational models of agents, several of which incorporate emotion mechanisms (Marsella et al., 2010; Reisenzein et al., 2013). Inasmuch as these models come perhaps closer to the goal of a unified theory of the person than the theories that have so far been developed within personality psychology, they deserve more attention by personality psychologists than they have so far received.

The second traditional goal of personality psychology – to describe and explain the important, emotion-relevant personality dispositions – is more realistic to achieve, and notable progress toward this goal has indeed been made. The empirical structure of emotional dispositions has been clarified to a considerable extent. Measurement instruments have been developed for emotional dispositions, as well as for emotion regulation and coping styles and for the tendency to express emotions and the ability to recognize them. The relations of these emotion-related dispositions to classical personality traits have been explored. And the causal basis of these dispositions has to some extent been elucidated. Nevertheless, all of these topics need further research. In our view, the most important task is the further clarification of the cognitive and motivational structures that underlie emotion-related dispositions. In addition, the development of personality dispositions as products of the interaction of heritable traits and learning experiences is an important topic for future research (see e.g., Buss, 2009; Wrzuz & Roberts, 2017). Further progress on all these questions will require a still closer cooperation between personality and emotion psychology.

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PART II

DESCRIPTION AND MEASUREMENT: HOW PERSONALITY IS STUDIED

7

Personality Assessment Methods

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INTRODUCTION

Given the enormity of the field of personality assessment, it is beyond the scope of the present chapter to provide an exhaustive review of the many approaches to personality assessment in common use today. With entire books and peer-reviewed periodicals devoted to a variety of personality assessment instruments, a brief chapter such as this is necessarily limited in its coverage of the personality assessment domain. However, this chapter provides a comparison of the multidimensional personality assessment instruments constructed empirically using the empirical factor analytic methods advocated by Raymond B. Cattell and his colleagues (e.g., Cattell, 1973, 1978, 1983; Cattell & Kline, 1977; Hall, Lindzey & Campbell, 1998; cf., Boyle et al., 2016) with a variety of other multidimensional assessment instruments constructed using nonfactor analytic approaches including the construct-oriented methods advocated by Jackson (e.g., 1970, 1984, 1989, 1994, 2000).

It should be noted that the present chapter does not provide an overview of projective methods of personality assessment involving maybe the *Rorschach Inkblot Test*, or the *Thematic Apperception Test*. Readers interested in such methods may consult, for example, Groth-Marnat (2003) and Weiner (1997), as well as the *Journal of Personality Assessment*, and/or the *Journal of Projective Techniques & Personality Assessment*. Contemporary interest in projective tests has declined as the Freudian notion of repression that underlies such tools has become unpopular among more scientifically oriented psychologists. Also, estimates derived from projective instruments tend to be unstable, and depend greatly on a particular examiner's idiosyncratic interpretations of an individual's momentary responses (Exner's, 2005, comprehensive scoring system of the *Rorschach*). There are many critiques of projective tests (e.g., Hojnoski, Morrison, Brown & Matthews, 2006; Hunsley, Lee & Wood, 2003; Juni, 2006; Wood, Nezowski, Lilienfeld & Garb, 2003).

While a multitude of different personality assessment approaches are currently in use, psychological interpretations based on the intercorrelations of item responses or

scale scores derived from introspective self-report instruments remain the dominant form of assessment whether administered and scored online or via traditional pencil and paper format (Bentler, 2007; Drasgow & Olson-Buchanan, 1999). Being introspective, such questionnaire (Q-data) item responses are necessarily subjective and superficial, only tapping into an individual's conscious and pre-conscious awareness. If we accept the Freudian "tip of the iceberg" model, approximately 75 percent of an individual's psyche is at the unconscious level of awareness and therefore not accessible to introspective self-report. Aside from not being capable of adequately measuring an individual's psyche, item-transparent self-report measures and rating scales are also highly susceptible to the influence of response sets and motivational distortion (Boyle, 1985).

Economy, ease of use and interpretation, and freedom from the need for trained interviewers (or third parties) are advantages of standardized assessment instruments that often outweigh the putative benefits of other more technical approaches to personality assessment. Although other assessment methods, including actual test (T-data) measures such as the *Objective Analytic Battery* (Cattell & Schuerger, 1978; Schuerger, 1986, 2008) or the *Motivation Analysis Test* (see Boyle, 1983, 1984; Boyle & Cattell, 1984; Cattell & Child, 1975), are mentioned briefly, the bulk of this chapter will be concerned with the currently popular, subjective self-report questionnaire (Q-data) and subjective other-report (L-data) rating scales, which are currently so prevalent. Despite their popularity, self-report questionnaires and rating scales can only "tap into" personality insights available through superficial conscious awareness. There are many documented sources of motivational and response distortion that may reduce the validity of L-data and Q-data measures (Boyle, Helmes, Matthews & Izard, 2015).

The method used for construction of psychometric instruments directly relates to their content and structure and greatly influences interpretation. For example, concerns about reading level can influence item phrasing and the complexity of ideas being expressed, while

assumptions about sex differences will influence whether scales have gender-based norms or not, thus determining the nature of inferences that can be drawn about clients. This latter point deserves particular attention in the modern era of “political correctness” whereby items known to elicit differential responses from males and females have been deliberately removed from many major personality instruments, in order to comply with the current “gender-neutral” ideology in vogue. However, there are indeed significant sex differences in responses to particular rating, questionnaire and objective personality test items (e.g., see Boyle, 1989; Boyle & Start, 1989; Boyle, Neumann, Furedy & Westbury, 2010; Pilar-Matud, 2004).

The multivariate experimental work of Cattell and his colleagues is notable for its empirical use of the inductive-hypothetico-deductive factor-analytic method used to identify items that were deemed to reflect personality trait constructs as expressed and structured in the English-language trait lexicon (Cattell, 1946; Cattell & Kline, 1977; Gillis & Boyle, 2019; cf., Boyle, 2008b). Cattell’s pioneering psychometric research into the structure and measurement of human personality also involved different media of measurement and did not restrict itself to self-report (Q-data) questionnaires alone (see Boyle, 2006; Boyle & Barton, 2008). The impact on psychology of Cattell’s work has been monumental (Boyle, 2019, 2020). Indeed, based on citations of the peer-reviewed journal literature alone, Cattell was the seventh most highly cited psychologist of the twentieth century (Haggbloom et al., 2002, p. 142).

In contrast, Jackson’s (2000) construct-oriented approach to personality assessment emerged from a rather different orientation, starting within clinical psychological practice and influenced historically by the work of Murphy (1947), Cronbach and Meehl (1955), Campbell and Fiske (1959) and Loewinger (1957). Jackson’s interest in multivariate assessment and factor-analytic methods in many ways rivaled Cattell’s, but his approach to construction of psychometric instruments relied upon the existence of an *a priori* theory that guided the processes of item writing and analysis. Jackson also emphasized construct validation via the classical multitrait-multimethod approach (Campbell & Fiske, 1959; Fiske, 1949; Marsh, 1983, 1993) and this technique formed part of the construction process for many of his own psychometric measurement instruments.

While both Cattell and Jackson relied on use of factor analysis (see Cattell, 1978; Child, 1990; Gorsuch, 1983; McDonald, 1985) the empirical factor analytic methodology employed by both researchers differed substantially. Cattell argued that use of methodologically sound factor analytic procedures (with simple-structure solutions) were needed to provide empirical evidence into the structure of human personality. Cattell (1973, 1978) as well as Burdsal and Vaughn (1974) cautioned against undertaking factor analyses of item intercorrelations due to the unreliability of single item measures, and recommended instead the

factor analysis of groups of related items (*item parcels*) which provide more reliable indicators (in line with the Spearman-Brown prophecy formula – e.g., see Nunnally & Bernstein, 1994; Winer, Brown & Michels, 1991). Similarly, taking into account the unreliability of individual items, Comrey (1988), and Comrey and Lee (1992) had also argued for the use of item parcels (rather than individual items) as the input variables for factor analysis, which he termed *Factored Homogeneous Item Dimensions* (FHIDs – Comrey, 1984). There are now several alternative computational methods for analyzing groups of personality questionnaire items (see Cattell, 1978; Comrey, 2008; Wirth & Edwards, 2007). In contrast to Cattell’s empirical search for maximal simple-structure solutions (enunciated by Thurstone, 1931, 1947; cf., Child, 1990, pp. 48–49), Jackson utilized factor analysis more subjectively as a guide to confirming structures that had already been formulated on *a priori* theoretical grounds.

Briggs and Cheek (1986) provided an overview of several of the relevant issues needing consideration in using factor analytic methods for scale construction and provided examples showing how factor analysis can help refine a scale intended to measure a particular construct and other examples of where factor analysis can obscure matters. They highlighted the important distinction between *exploratory factor analytic* methods, wherein the goal is to “discover” the latent structure underlying a set of variables (items, item parcels or subscale scores) and *confirmatory factor analytic* methods in which the goal is to verify whether a theoretical or predetermined structure provides a satisfactory fit to the empirical data (e.g., see Brown, 2006; Byrne, 2010; Kline, 2005; and Loehlin, 2004). As Boyle, Stankov and Cattell (1995, p. 423) pointed out,

a two-handed approach to factor analysis of the personality and ability domains is desirable. Exploratory (EFA) and confirmatory (CFA) factor analyses should be carried out on independent samples, and both sets of analyses cross-validated. (Byrne, Shavelson & Muthén, 1989)

However, according to Marsh, Morin, Parker and Kaur (2014, p. 85):

Although CFA has largely superseded EFA, CFAs of multidimensional constructs typically fail to meet standards of good measurement: goodness of fit, measurement invariance, lack of differential item functioning, and well-differentiated factors in support of discriminant validity.

Since publication of Cattell’s (1978) book on exploratory factor analysis (Gorsuch, 1983, 1988; McDonald, 1985), CFA (Mulaik, 1988), and structural equation modeling (SEM) techniques implemented, for example, via LISREL, EQS, MPlus, R or AMOS have become commonplace (e.g., see Bentler, 1988, 2015; Marsh, 2007, 2008; R Core Team, 2016; Savalei & Bentler, 2010). Undertaking most of his taxonomic/psychometric research prior to the advent of modern CFA and SEM methods, Cattell (1978, 1988) had relied on the common factor-analytic model for

constructing and evaluating personality instruments. In contrast, the less sophisticated principal components method, together with extraction of components based on Kaiser's eigenvalues > 1 rule, and reliance on orthogonal Varimax rotation (Kaiser, 1959) has been the default option in statistical packages such as SPSS, resulting in crude solutions with spuriously inflated loadings. This "Little Jiffy" approach (Gorsuch, 1983) has distorted much of the published social and health sciences literature (Velicer & Jackson, 1990). In general, the use of CFA with iterations of initial communality estimates followed by oblique rotation to *maximum* simple structure appears to be the optimal EFA strategy, producing the most accurate, reliable and robust factor solutions (see Boyle, 2008b; Boyle et al., 1995; Cattell, 1978; Gorsuch, 1983).

Regrettably, EFA methods have often been used without a detailed understanding of their limitations as also is the case with the exploratory use of CFA procedures (Boyle, Helmes, Matthews & Izard, 2015; Grimm, Steele, Ram & Nesselroade, 2013; Marsh et al., 2013; Morin, Marsh & Nagengast, 2013; Savalei & Bentler, 2010). CFA procedures can be quite informative, but they also have their shortcomings, particularly when used for undertaking exploratory analyses. Cuttance (1987, p. 243) commented on such applications:

MacCallum (1985) investigated the process of the exploratory fitting of models in simulated data...for which the true model was known. He found that only about half of the exploratory searches located the true model... He obtained this limited rate of success...in samples of 300 observations...and his success rate in smaller samples ($N = 100$) was zero... An exploratory analysis of data thus entails the risk of inducing an interpretation founded on the idiosyncracies of individual samples.

Wirth and Edwards (2007) also noted that most CFA and SEM programs require substantial sample sizes and cannot handle the number of parameters required if large multiscale personality measures are analyzed at the item level (Cuttance & Ecob, 1987). In contrast, while most item response theory (IRT) programs can deal with the number of items, they may encounter difficulties if the assumption of homogeneous scales is violated, which is likely to happen with measures of personality constructs.

In order to enable comprehensive assessment and to undertake multidimensional measurement of personality traits, it is generally considered desirable to use a variety of measurement media, including subjective questionnaires, structured interviews and objective test instruments (Cattell, 1986a,b; Smith, 1988). Cattell argued cogently that personality traits should be identified through multiple measurement media including subjective ratings or life-record data (L-Data), subjective self-report questionnaire data (Q-data) and objective test data (T-data). The choice of specific media of measurement has critically important implications in terms of susceptibility to response distortion, as well as for psychometric

properties such as reliability and validity (Boyle, 1985, 2008b; Cattell, 1986a,c,d).

Motivational and response distortion have also been investigated in relation to response styles such as social desirability and acquiescence in the *Minnesota Multiphasic Personality Inventory* (MMPI; Butcher et al., 1989) and in other subjective self-report instruments (e.g., see Block, 1965; Edwards, 1957). The importance of social desirability as a confounding variable has faded somewhat in personality assessment subsequent to the major debates in the 1960s and 1970s, although there is widespread recognition of the nature of social desirability as a measurement confounder and as an important personality variable in itself (Helmes, 2000). The latter position is illustrated, for example, in the work of Paulhus (1984, 1986) and the development of his measures of self-deception and impression management as major components of social desirability (Paulhus, 1998, 2002).

The types of information referred to by Cattell as L-data are more commonly known as *biodata*, and includes such biographical information as education, work experience and volunteer activities. Biodata have been used in various applications (Stokes, Mumford & Owens, 1994), but are most widely used in personnel selection in industry and the military. Some research (Mount, Witt & Barrick, 2000) suggests that biographical data appear to account for additional variance over and above that measured by self-report personality measures and general mental ability, supporting Cattell's argument that L-data can provide valuable information beyond that obtained with conventional personality measures.

On the assumption that personality characteristics are represented in language, a major Q-data instrument, the *Sixteen Personality Factor Questionnaire* (16PF) was constructed using methodologically sound factor-analytic procedures by Cattell and his colleagues (e.g., Cattell, 1994; Cattell, Eber & Tatsuoka, 1970; Cattell & Krug, 1986; Krug, 1981). The 16PF was based on exploratory factor analyses of several clusters of personality traits that had been derived from a comprehensive search of over 4,000 trait-descriptive terms relating to personality in the English language compiled by Allport and Odbert (1936).

Burisch (1984) classed factor-analytic methods as *inductive*, in contrast to external methods such as the criterion groups method used in the original development of the *Minnesota Multiphasic Personality Inventory* (MMPI). In contrast, Burisch classed Jackson's construct-oriented approach as *deductive*, along with other methods that can be described as rational, intuitive or theoretical. Some methods of scale construction do lead to higher validity coefficients than others. For example, a study by Goffin, Rothstein and Johnston (2000) contrasted Jackson's (1984) *Personality Research Form* (PRF) and Cattell's 16PF (4th ed.) in predicting the job performance among 487 managers. They found (p. 261) that in that specific context the PRF exhibited some predictive advantage over the 16PF.

Previously, Hough and Paullin (1994) had also reported some advantages in using construct-based instruments.

Many of the major multidimensional personality instruments in use today were initially constructed decades ago. The actual procedures used go beyond the simple classifications of Burisch (1984, 1986). For example, Jackson (1970) advocated a sequential process that stressed the importance of convergent and divergent validity and the suppression of confounding response styles. In Jackson's view, factor analysis was always secondary to substantive considerations. These procedures were used in his measures of normal personality, the *Personality Research Form* (Jackson, 1984) and *Jackson Personality Inventory* (Jackson, 1994). Interestingly, the latest (5th) edition of the 16PF (Cattell, Cattell & Cattell, 1994) adopted item analytic approaches similar to those used by Jackson in order to promote convergent properties among the items within each of the 16PF scales.

One important issue in evaluating personality assessment instruments relates to the actual items and how they are phrased. Emphasis on this aspect of instruments has been more evident in the area of public opinion and attitude measurement (Sudman & Bradburn, 1982; Schwarz & Sudman, 1996), but has also been an issue with personality measures (e.g., Austin et al., 2011; Boyle, Saklofske & Matthews, 2015; Nicholls, Licht & Pearl, 1982) and with life history (L-data) in the form of symptoms (Schwarz, 1999). Care on these matters is important for defining both how a particular scale measures what it is designed to measure (Angleitner, John & Lohr, 1986) and what it is not intended to measure, including its convergent and discriminant validity. Angleitner et al. (1986) rated various item characteristics and noted that ostensibly parallel forms had some scales with different item properties across forms. Clearly, sequential test construction strategies that incorporate structured analysis of item properties in the early stages can lead to better quality items. For example, Rudinger and Dommel (1986) provided a multitrait-multimethod analysis of the German translation of *Jackson's Personality Research Form* (PRF) (Tubré, Miotke & Sawdy, 2017).

Within the personality trait domain, potentially controversial items pertaining to religion, sex and politics are often excluded from subjective questionnaires and rating scales, leading for example to the revision of the MMPI (Butcher et al., 1989). Likewise, items relating to social desirability and other response sets typically are kept to a minimum during the developmental stages for large, multiscale measures. This may not be the case for shorter, more narrowly focused measures of single or a few attributes where extensive developmental research on a measure may not have been completed before an instrument appeared in the research literature. Ideally, users of personality instruments should always investigate the method of test construction as well as the psychometric properties before using such measures.

The recent "politically correct" tendency towards production of gender-neutral personality inventories (by removing items that exhibit significant sex differences) makes it more difficult to obtain personality profiles that distinguish between males and females (Boyle & Saklofske, 2004). One example of such an instrument is Morey's (1991) *Personality Assessment Inventory* (PAI), for which a decision was made to minimize sex differences and not only remove items that showed a sex difference, but also not to report gender-based norms. One justification for the decision derives from the nature of the PAI as a measure of psychopathology where a stronger argument can be made for less emphasis upon the direct assessment of sex differences. Measures of normal personality, however, must address sex differences in psychological functioning resulting from differences in genes, brain anatomy and sex hormone levels, in addition to significant differences in acculturation and social conditioning. The most common method is the provision of separate norms for males and females. Other instruments, such as the *Comrey Personality Scales* (CPS) include scales that specifically reflect behavioral and attitudinal differences between males and females.

Measures of psychopathology often include the term "personality" in their title in order to reduce possible negative reactions among respondents. As with measures of normal personality, similar contrasts within the psychopathological domain are apparent, depending on the particular test construct approach adopted. Prior to release of the PAI instrument, the factor-analytically constructed *Clinical Analysis Questionnaire* (CAQ, Krug, 1980) had been constructed to provide a Q-data measure of abnormal (psychopathological) personality traits. Part 1 of the CAQ measured the usual 16PF normal personality primary trait factors, while Part 2 of the instrument provided measures of twelve abnormal personality trait dimensions. Part 2 of the CAQ was constructed from an extensive series of factor analyses that included the entire MMPI item pool, together with many additional items pertaining to depression and other aspects of psychopathology with the aim of measuring fundamental, underlying source-trait dimensions (Boyle, 1990, 2006; Boyle & Comer, 1990; Smith, 1988). Factor analysis was employed to empirically derive scales that reflect areas of content presumed to be present in the initial pool of items, for example, in constructing the CAQ (now renamed the *PsychEval Personality Questionnaire* (see Boyle & Barton, 2008; Krug, 2008). Use of factor analysis also was prominent in constructing the *Basic Personality Inventory* (BPI, Jackson, 1989) wherein psychopathological dimensions were identified through a combined factor analysis of the MMPI scales and Jackson's *Differential Personality Inventory* (DPI, Jackson & Messick, 1971). This led to the identification of psychopathological constructs for which new items could be written, using sequential item analytic strategies to finalize the scales.

While the MMPI remains the most widely used personality and psychopathology measurement instrument (Piotrowski & Keller, 1989), the 1989 revision failed to correct some serious psychometric weaknesses (Helmes & Reddon, 1993). Some of those weaknesses derived directly from the contrasted groups method used to select items for the MMPI scales. Such weaknesses are not as problematic with the CAQ, DPI, or BPI instruments. However, the methods of scale construction used with these measures have influenced their respective item content. For example, the CAQ includes scales labelled: *Boredom and Withdrawal*, *Guilt and Resentment*, *Low Energy Depression*, *Anxious Depression* and *Suicidal Depression*. The BPI merges into a single *Depression* scale the fine distinctions based upon severity and the associated symptoms discerned factor-analytically in constructing the CAQ. Even so, the two instruments converge on scales for the constructs of hypochondriasis, paranoia/ideas of persecution, anxiety and thinking disturbance/schizophrenia. The CAQ also includes additional scales labelled: *Agitation*, *Psychopathic Deviation*, *Psychasthenia*, and *Psychological Inadequacy* – scales with clear links to the parent MMPI item pool and associated psychiatric syndromes, some of which are no longer used diagnostically. In contrast, the BPI includes scales that diverge to assess a wider range of other forms of psychopathology, labelled: *Interpersonal Problems*, *Alienation*, *Impulse Expression*, *Social Introversion*, and *Self Depreciation*, respectively.

Both the 16PF and the PRF have withstood the test of critical scrutiny over many years, both in the *Test Critiques* series of psychological test reviews, and in the *Buros Mental Measurements Yearbooks*. Unlike the fifth edition of the 16PF (16PF5; see Conn & Rieke, 1994), the fourth edition with its multiple parallel forms (A, B, C, D, E) had the decided advantage of being able to attain virtually any desired level of reliability through the administration of additional forms. It is important to note that Cattell had repeatedly advised that at least two forms of the 16 PF (Forms A + B or C + D) should be administered together, in order to ensure high reliabilities for each of the 16PF subscales. While parallel forms of the PRF are available for both shorter (A + B), and longer versions (AA + BB), the current version (PRF-E) is only available in a single form. All PRF forms have readability evaluated during the item selection stage, while the 16PF uses different forms for different educational levels: 16PF Forms A and B are suitable for use with most adults whereas Forms C and D are less demanding in terms of vocabulary and administration time, while Forms E and F are intended for individuals with low literacy levels. As with use of multiple forms of the 16PF, the longer PRF scales are more reliable because of their increased length, in line with the Spearman-Brown prophecy formula (Ferguson, 1981; Nunnally & Bernstein, 1994; Winer et al., 1991).

Both the PRF and the original forms of the 16PF were constructed before the advent of the currently popular Big Five or Five-Factor Model (FFM) that emphasizes five

broad constructs most-often labelled *Neuroticism*, *Extraversion*, *Openness to Experience*, *Agreeableness*, and *Conscientiousness* (Costa & McCrae, 1992; Goldberg, 1990; McCrae & Costa, 1987). However, Boyle et al. (1995, p. 432) reported that the various versions of the Big Five account for just over half the known trait variance within the normal personality sphere alone. It is noteworthy that Cattell, Boyle and Chant (2002), Jackson, Ashton and Tomes (1996), as well as Paunonen and Jackson (2000) have all argued for measurement of additional personality dimensions. Furthermore, the Big Five and related Five-Factor Model have also been criticized on many other grounds (e.g., Block, 1995; Boyle, 2008a; Cattell, 1995; Eysenck, 1992). It is clear that reliance on fewer broad second-order dimensions necessarily accounts for less predictive variance than does prediction based on a larger set of primary factors (Mershon & Gorsuch, 1988).

When the consequences of personality assessment might be especially positive (e.g., job selection, approval from a therapist or release from a mental institution) or extremely negative (e.g., admission to a psychiatric facility, incarceration in a prison or as a more extreme example, possible imposition of death penalty), there may be very strong motivation to distort responses to personality questionnaire items. In order to control for motivational/response distortion, many instruments incorporate various validity and correction scales, ranging from simple “lie scales” such as in the *Eysenck Personality Questionnaire* (EPQ-R; Barrett et al., 1998; Eysenck & Eysenck, 1975; Eysenck, Eysenck & Barrett, 1985) or the L scale of the MMPI/MMPI-2, as well as social desirability scales, random responding scales, and scales that identify other forms of motivational distortion and/or response sets (see Paulhus, 1986, 2002). Multidimensional measures of psychopathology such as the MMPI/MMPI-2 (Butcher et al., 1989) frequently have multiple scales to assess the validity of item responses (see Bagby et al., 2006, and Helmes, 2010, for reviews of the MMPI-2 validity scales). The issue of response distortion is complex, and trait view corrections (Cattell & Krug, 1971) suggest that there are distinct “desirability response tendencies” which differentially distort responses on subjective personality instruments, which can be manipulated easily because of item transparency.

A recent development in assessing individuals where distortion of self-reports or minimization of reporting problems is likely to be present is based upon conditional reasoning, a process in which response alternatives are designed to elicit responses based on self-serving cognitive premises (James, 1998). Although still using a conventional self-report format, this is an indirect or implicit measure of personality that may be more resistant to faking than traditional Q-data methods (Fiske & North, 2015; LeBreton, Barksdale, Robin & James, 2007). This approach relies upon knowledge of the forms of self-protective or biased reasoning likely to be used, together with a careful selection of response alternatives. It is quite

distinct from measures used for the implicit assessment of stereotyped attitudes, such as the *Implicit Association Test* (Greenwald & Banaji, 1995). To date, relatively few applications of conditional reasoning have been published, although James et al. (2005) outlined one of the early applications, namely the measurement of aggression.

While subjective self-report assessments currently dominate personality assessment, other approaches have advantages and continue to be used. Ratings (L-data) based upon previous periods of observation and acquired knowledge of the person being rated have been in use for decades. This form of assessment is particularly useful when there are grounds for believing that self-reports may not be accurate. In addition, such forms of assessment (although prone to biased observations) also provide another source of information that can be useful in developing a more complete understanding of a client's personality profile. Psychiatric settings are certainly ones in which there are good reasons for doubting the accuracy of many self-reports and instruments for these purposes. One of the first examples of a rating scale for psychiatric problems was that constructed by Wittenborn (1951). There is now an extensive literature on psychiatric rating scales (Sajatovic & Ramirez, 2003, provide examples of many such scales).

A similar context in which there are solid grounds for doubting the accuracy of self-report is the assessment of young children. This has become one of the major areas in which such rating instruments are used, the evaluation of psychosocial functioning and behavior problems in children (e.g., Achenbach & McConaughy, 2003; Conners, 1997; Reynolds & Kamphaus, 2004). Hartup and van Lieshout (1995) reviewed many of the issues relevant to the assessment of personality during child development.

The instrument used by Costa and McCrae (1992) to assess the Five-Factor Model, the NEO-PI-R, incorporates an unusual form of observer rating. The standard self-report form is converted into third-person format. For example, item 1 on Form S, "I am not a worrier," is changed on the male version of Form R to "He is not a worrier" and on the female form to "She is not a worrier." The observer-report Forms R are intended to be completed by a spouse, a peer or an expert who knows the individual well. Instead of providing ratings for putative traits based on definitions, or a series of adjectives, the NEO-PI-R (Form R) asks the rater to complete the equivalents of the self-report items. Costa and McCrae (1992) reported substantial agreement using intraclass correlations for both the five major domains of the NEO-PI-R, but also for the facet scales across peer/peer, peer/self, and spouse/self comparisons. Thus, the reduction in method variance associated with comparisons of other forms of peer rating with self-reports may lead to better reliability and better agreement on personality characteristics between observers (Kurtz, Lee & Sherker, 1999). A series of studies of personality change in people with Alzheimer's disease, as rated by spouses and other caregivers, has also shown the utility of the observer-rating forms of the NEO-

PI-R (Siegler, Dawson & Welsh, 1994; Strauss & Pasupathi, 1994; Strauss, Pasupathi & Chatterjee, 1993; Wellford, Harkins & Taylor, 1995). However, it should be noted that the NEO-PI-R has serious psychometric deficiencies (see Boyle, 2008a; Boyle et al., 1995).

Self-descriptive adjectives have had an extensive history of use in psychological assessment, in both experimental and applied settings. Allport and Odbert's (1936) lexical compilation of English words pertaining to personality/motivation/affectivity has led to the widespread use of adjectives in various formats and many empirical studies, but with relatively few widely recognized and used standardized versions. One of the best-known such self-report measures based on adjectives is the *Multiple Affect Adjective Check List* (MAACL, Zuckerman & Lubin, 1965), and its subsequent revisions (MAACL-R; Zuckerman & Lubin, 1985, 1999). A bibliography of research using the MAACL has identified over 1,900 articles and dissertations (Lubin, Swearingin & Zuckerman, 1997). The original version contained 132 adjectives, of which only 66 were scored for the domains of Anxiety, Depression and Hostility. Ratings of the adjectives could assess either immediate, "State" responses or longer term, "Trait" attributes through changes in instructions (Boyle, 1979). The revised versions added scales for both Positive Affect and Sensation Seeking. The construction of adjective checklist scales generally relies upon the use of exploratory factor analyses. Like other adjective check lists, the MAACL-R is very flexible and takes relatively little time to complete in comparison with standard multiscale personality inventories (Boyle, Helmes, Matthews & Izard, 2015).

Early theories of interpersonal relationships (e.g., Benjamin, 1974; Wiggins, 1979) have been used in constructing measures of both normal personality and psychopathology (e.g., Horowitz, 2004; Kiesler, 1996). Such interpersonal models generally involve dimensions of agency (dominance) and communion (warmth) derived factor analytically. Furthermore, various specialized instruments have been constructed to explore particular interpersonal models. One based entirely upon adjectives is the *Interpersonal Adjective Scales* (IAS, Wiggins, 1995). The development of the IAS can be traced to Allport and Odbert's (1936) list of adjectives that had been refined by Norman (1967). A total of 567 interpersonal adjectives were classified into 16 categories and successively refined to form eight 16-item scales. The 128 items assess the domains of *Assured-Dominant*, *Arrogant-Calculating*, *Cold-hearted*, *Aloof-Introverted*, *Unassured-Submissive*, *Unassuming-Ingenuous*, *Warm-Agreeable*, and *Gregarious-Extraverted*. These circumplex models that are used in interpersonal theories are easily understood and appealing to many psychologists.

CONCLUSION

There is currently a plethora of "personality tests" used in various research and applied settings (almost all of which

are subjective/introspective self-report questionnaires, or subjective/biased ratings of others' personality attributes – see Boyle, 2007). The number of subjective personality assessment instruments has literally exploded in recent years as reported in the research literature and from commercial publishers (see the *Buros Mental Measurement Yearbooks*). A major problem with self-report or rating scales of others is that they depend upon easily manipulated responses to transparent, face-valid items. Item transparency may make it easy for invalid responses and may be influenced by motivational distortion (Boyle, 2009). The consequence of paying insufficient attention to item characteristics is that a variety of current personality assessment instruments are based on flawed methodology that can be easily criticized, raising serious questions as to the validity of the measures. Correction scales can go only so far (and in some cases, such as that of the MMPI/MMPI-2, with the *K* correction scale, the application of corrections may themselves be problematic). While much personality assessment is based on subjective answers to L-data or Q-data items, what is needed is increased empirical analysis of items prior to their inclusion in the final version of scales, inclusion of motivational distortion correction scales, and administration of the resulting instrument across multiple different samples of individuals in order to ensure generalizability (Helses, Holden & Ziegler, 2015). Such considerations should be applied to instruments whether they are traditional personality measures or are administered via interactive, computer-based methods. Greater attention paid to the items constituting personality instruments as well as to their construction and psychometric properties will necessarily lead to improved evidence-based assessment procedures (Hunsley & Mash, 2005), and hopefully to better, more objective personality assessment instruments (Boyle et al., 2015).

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8

Models of Personality Structure

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INTRODUCTION

In the present chapter, models of personality structure are discussed. With the term “personality structure” we refer to the organization of the various features of personality as based in theory or in empirical findings. By adding the term “models,” the *structure* quality seems a bit tautological because a model is usually recognized by its typical form or its organization. Most of the ambiguity in the expression “models of personality structure,” is, however, in the term “model” (from the Latin *modulus*, diminutive of measure or standard), as the term has accrued a variety of functions which can appear at different levels of abstraction.

A model can be a concrete, small-scale example or an abstract schematic representation, but it can also be a person. The fashion model Naomi Campbell, for example, a model with a delicate and commanding personality structure, not only iconizes beauty, but also shows models or designs (Bertels & Nauta, 1969). As a person or an object, a model can function as example or ideal to imitate, to follow, or to portray; the original person or object may evoke in others a variety of (behavioral) expressions revolving around a common theme as seen in the model, or different themes as connoted by the observers. Such ambiguity is also found in scientific discourse, for example, where the Big Five *model* of traits (Goldberg, 1981; Norman, 1963) became a paradigm for research on the *structure* of personality.

Models do not only represent people or objects, but also events, thoughts, or theories. There are models of learning, models of rational choice, models of communication, models of political behavior, etc. (Lave & March, 1975). Models are most typically simple. A model is a device that can be reproduced, lived after, communicate a concept, and be tested for its adequacy. A model of personality may represent its characteristic traits, its mechanisms, its internal processes, at different levels of abstraction, and given form from different domains of interest (social, biological, cognitive, etc.).

In personality research, roughly two approaches are followed to arrive at a structuring of personality. The one

is a top-down theoretical approach, most typically psychological in character, exemplified in personality systems of Eysenck (1967), Zuckerman (1991), and Gray and McNaughton (2000), to be discussed briefly further on. The other is a bottom-up, empirically based, taxonomic approach. This taxonomic approach traces back to Allport and Odbert (1936), Cattell (1943, 1945), Norman (1967) and Goldberg (1981).

An almost standard recipe to arrive at a structure in these different approaches involves the use of factor analytic techniques. Also, in this chapter factor analysis is used as metonymy for structure, yet explicitly not in the sense of panacea. Other procedures to arrive at structure are certainly possible (Panter, Tanaka & Hoyle, 1994). In the present chapter, the emphasis is on the use of factor analysis, in which the focus is on the representation of the contents of dispositional characteristics of persons in an economic way. The focus is also on the organization of those characteristics in the resulting structural model, and on the communicational efficacy of the model. We assume such models to be hypothetical by definition.

In this chapter, the rise of the taxonomic models is reviewed, followed by a review of alternative models, including those with a psychobiological orientation; this will be concluded with a brief discussion on relations between the various models. Next, the focus will be on approaches that aim to arrive at structure that exhaustively represents the personality trait descriptive vocabulary, with particular reference to cross-cultural replicability. Finally, an exposition is given of the different types of structures one may encounter in personality research.

THE RISE OF TAXONOMIC MODELS: THE PERSONALITY SPHERE IN 35 VARIABLES

The model of personality that has drawn most of the attention during the last few decades is possibly the Big Five model, which is indeed a model of the organization or the structure of a full listing of traits. That model is taken

as the system of reference throughout this chapter. The model has obtained the characteristics of an icon, with features that transcend the empirical facts, witness, for example, the attribution of notions of universality to the model. In the further discussion, the term “structure” is used to refer to correlations among traits, which should not be equated with structure of personality, and with the term “model” we refer to economized or simplified representations of such structures. Theoretical notions not only may follow from the formulation of structural models; they may also precede both structures and models, as in for example the definition of criteria used for the inclusion or exclusion of trait descriptors in a structuring program.

The Big Five model (De Raad, 2000; Goldberg, 1981; Norman, 1963; Wiggins, 1996) is broadly accepted, which is a sign of its popularity, but also of its authoritative nature and its adequacy in representing traits. We briefly trace the history of the model, since that history also brought forth the Cattellian model of personality. “. . . the trouble with measuring traits is that there are too many of them,” R. B. Cattell (1965, p. 55) exclaimed, referring to the thousands of traits catalogued by Allport and Odbert (1936). Cattell pioneered in bringing order in the trait-alphabet by searching for the underlying structure. In his “lexical” period he was forced to reduce the catalogue of traits to some tens of trait-variables, because that was the number that could be structured by applying factor-analysis in that early computational era. That number, thirty-five items only, was supposed to represent the full domain of personality traits. It was also that set of items that formed the basis, albeit in different ways, for three different personality models, namely the 16 personality factor model (16PF) of Cattell, Eber and Tatsuoka (1970), the Big Five model (Goldberg, 1981; Norman, 1963), and the NEO three factor model (Costa & McCrae, 1985).

The Cattell list of 35 trait-variables was the result of a thorough process of reduction of the full trait-domain to describe the trait sphere exhaustively. Nevertheless, that 35-variable list later turned out not be representative of that full trait-domain (John, Angleitner & Ostendorf, 1988; Peabody, 1987).

Cattell's Primary Factors and the 16PF

The original set of thirty-five trait variables was the result of a process of condensation of a list of 171 trait descriptive items considered by Cattell (1943) to summarize the complete “personality sphere.” That condensation took place on the basis of correlations of ratings from 100 subjects. The reduction to thirty-five variables was, in Cattell's (1945, p. 70) words, “a matter of unhappy necessity,” considering the period preceding the use of computers.

Cattell (1945) administered the thirty-five items to several small groups of subjects (Totaling to $N = 208$), obtained correlations based on the ratings, and averaged the correlations over these small groups. Factoring those

correlations yielded a set of factors of which twelve were obliquely rotated for simple structure (a trial and error procedure covering a six-month period!). These twelve “primary” factors, together with four questionnaire-specific scales that Cattell added, constituted the so-called 16PF, the 16 Personality Factors questionnaire.

Cattell (1950) distinguished trait-elements (single trait words), surface traits (traits tending to cluster in a person), and source traits (trait-factors), essentially forming a hierarchy of traits. The concept of hierarchy was extended in Cattell's emphasis on the distinction between primary factors and higher order factors. The results of factoring ratings on trait-elements or on clusters of traits treated as variables were blindly rotated to pursue a simple structure where variables have a substantial loading on only one factor. Those primary factors were permitted to be correlated so that factors at a higher level of abstraction would become possible.

Secondary Factors of the 16PF

To understand traits at a higher level of abstraction, global traits of personality or secondary order factors were examined. Cattell (1994), for example, reports on the constancy, over a period of twenty years, of eight secondary factors of the 16PF scales. Although research on the secondary factors often gave rise to more than five global factors (e.g., Karson, 1961; Krug & Johns, 1986), Hofer and Eber (2002) reported strong evidence in support of a five factor structure of the 16PF scales, including Extraversion (e.g., liveliness versus privateness), Tough-Mindedness (negatively, e.g., sensitivity and openness to change), Self-Control (e.g., perfectionism versus abstractedness), Anxiety (e.g., tension versus emotional stability), and Independence (e.g., dominance).

Costa and McCrae (1976) clustered 16PF scales on the basis of data from three different age groups, resulting into two consistent age-group independent clusters, called Adjustment–Anxiety and Introversion–Extraversion, and a third inconsistent age-group dependent cluster, which was conceptualized as an Experiential Style dimension. The three clusters formed the starting point for the development of the three-factorial NEO-PI (Costa & McCrae, 1985).

Five Primary Factors

The 35 trait-variables put forward by Cattell as exhausting the trait sphere and giving rise to the 16PF, formed also the bases for factor analyses in an increasing number of samples by Fiske (1949), Tupes and Christal (1958, 1961) and Norman (1963). In those analyses, not twelve but five factors were repeatedly considered to best summarize the various correlation matrices. Goldberg (1981) referred to that five-factorial structure as the “Big Five,” comprising Extraversion, Agreeableness, Conscientiousness, Emotional Stability (the opposite of Neuroticism) and Intellect.

Alternative Models of Personality

In a parallel history to the unfolding of the psycho-lexical approach, several other independently developed personality structures entered the stage. Besides Cattell's 16PF, there was Guilford's model embodied in the Guilford–Zimmerman Temperament Survey (Guilford & Zimmerman, 1949), and Eysenck's three-factor model (Eysenck, 1952). Eysenck's model is conveniently classified in this chapter together with additional psychobiological models of personality.

In spirit, Guilford is closest to the psycho-lexical approach, although he did not start to design a complete structure of personality. Yet, the subsequent studies he performed resulted in an instrument that should enable a comprehensive portrait of someone's personality. Starting with the application of a 36-item questionnaire (Guilford & Guilford, 1936), three clear factors, Introversion–Extraversion, Emotional Sensitivity and Masculinity–Femininity, and two less clear factors were found to summarize the items. In subsequent analyses with additional sets of items, additional factors were isolated, up to a list of thirteen primary factors (Guilford, 1975). Sells, Demaree and Will (1970, 1971) thoroughly compared the Cattell and Guilford structures, and found major commonalities in only two factors, Emotional Stability and Social Extraversion, and some fifteen more factors for which one or the other system was primarily responsible. Of the first three or four of these additional fifteen factors, two were related to factors being part of Norman's (1963) five-factor model, namely Conscientiousness and Agreeableness.

There are some interesting issues, both common features and distinctions, regarding the two major structural systems of Cattell and Eysenck, such as thinking in terms of hierarchies, and the reference to syndromes of traits at different levels. Cattell and Eysenck generally agreed about the hierarchical organization of traits. While

Cattell's hierarchy developed out of presuppositions and observations, and was especially given further form through psychometric considerations and empirical results, Eysenck's hierarchy was more determined by theoretical and empirical findings than by psychometric considerations, yet he suggested that his model “fits in almost completely with the statistical model elaborated by factor analysis” (Eysenck, 1953, p. 14) in which error factors, specific factors, primary factors, and second-order factors are distinguished. Cattell (e.g., 1945, pp. 78–79), on the other hand, let himself be guided by psychometric principles, such as rotation to simple structure, so that results would “agree with clinical and general psychological syndromes” (p. 79).

Both Cattell and Eysenck made use of the concept of clusters of psychological characteristics. Cattell referred to trait-elements that correlate positively in every possible internal combination as syndromes or surface traits, with very broad surface traits being referred to as types (Cattell, 1950, p. 21). Cattell thus essentially referred to primary factors when talking of types. Eysenck used the term “type” to refer to second-order factors, as organizations of traits based on observed correlations.

PSYCHOBIOLOGICAL MODELS

Eysenck's PEN Model

Eysenck's three-factor model of personality has roots in biology. In his conceptualization of personality, Eysenck (1947) distinguished four levels of behavior–organization that were hierarchically organized, namely (from bottom to top): single observable behavioral acts, habitual responses (recurrent acts under specified circumstances), traits (based on intercorrelations of different habitual responses) and types of traits (based on correlations between various traits; see Figure 8.1). Eysenck (1947)

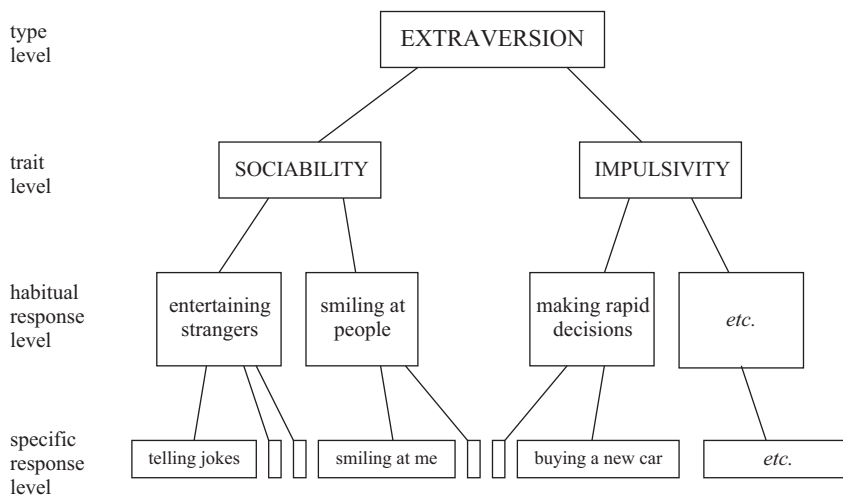


Figure. 8.1 Hierarchical model of Extraversion (based on Eysenck, 1970)

originally used a relatively small ($N = 39$) set of items, selected from an “item-sheet” on which for each patient “the psychiatrist in charge” recorded data regarding family history, such as personal history, symptoms, etiology, diagnosis and treatment, and social data.

On the basis of ratings on this “intentionally heterogeneous” item list, Eysenck concluded to two factors, a general “neuroticism” factor and a factor contrasting “affective, dysthymic, inhibited” symptoms and traits and “hysterical and asocial” symptoms and traits. Eysenck suggested this second factor to be related to Jung’s introversion-extraversion distinction. Further discussions of related literature, especially that of Kretschmer (1948) and Jung (1923), of the distinction between the observed extraversion-introversion distinction and the schizothymia-cyclothymia distinction emphasized by Kretschmer, and further empirical results, led to the emergence of the psychoticism dimension (Eysenck, 1952). The resulting three factors, Psychoticism, Extraversion and Neuroticism (the PEN system), maintained to play a major role throughout in Eysenck’s modelling of personality.

The two biological underpinnings of Eysenck’s PEN factors are heritability and the presence of a physiological substrate. All PEN factors have indeed been found to be moderately heritable, as have other personality characteristics (e.g., the Big Five). Moreover, extraversion has been linked to cortical arousal through the ascending reticular activating system (ARAS). Activity in the ARAS, according to Eysenck (1990) stimulates the cerebral cortex, which results in higher cortical arousal. Introverts would therefore become more easily aroused than extraverts. Eysenck also explains neuroticism in terms of activation in the brain, more specifically the limbic system, which is responsible for the flight-or-flight response. Neurotic individuals, having greater activation levels and lower thresholds, get more easily upset in response to even minor stressors than emotionally stable individuals (Eysenck, 1990). Psychoticism has been related to high levels of testosterone and low levels of monoamine oxidase (MAO; Eysenck, 1990).

According to Wiggins (1968), consensus existed in the realm of temperament structure with respect to the dimensions extraversion and anxiety (neuroticism), dubbed the Big Two by Wiggins. He arrived to that conclusion on the basis of work by Eysenck, Cattell and Guilford, among others. Zuckerman, Kuhlman and Camac (1988) asked what is beyond E and N, with which they marked the general contemporary understanding that Extraversion and Neuroticism were beyond dispute.

Gray’s Biopsychological Model

Gray (1970, 1981) agreed with Eysenck’s hierarchical description of personality, but not with the notion that his initial two factors, extraversion and neuroticism, were the two most defining trait-factors. Instead, Gray argued *impulsivity* (Imp-D) and *anxiety* (Anx-D) to be the major

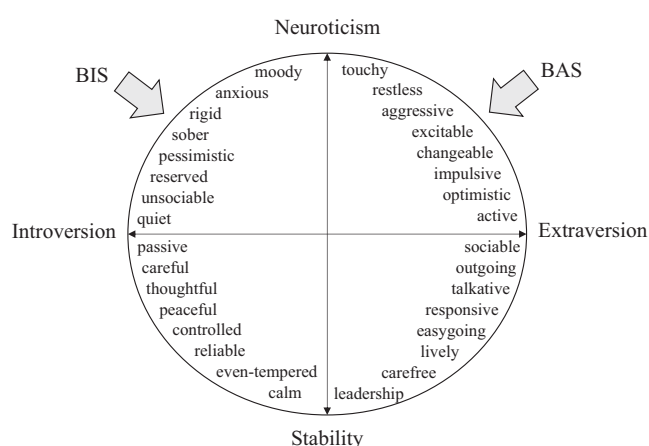


Figure 8.2 Circumplex of Eysenck’s Neuroticism and Extraversion factors and the position of Gray’s BIS and BAS

personality factors. These trait-factors can be found by rotating the axes in the two-dimensional representation (a circumplex) that is formed by Eysenck’s traits of Neuroticism and Extraversion by 45 degrees (see Figure 8.2). Impulsivity, in that case, is a combination of high neuroticism and high extraversion, and anxiety a combination of high neuroticism and low extraversion. According to Gray, extraversion and neuroticism are just secondary consequences of the interaction between impulsivity and anxiety. In Eysenck’s model, impulsivity was first grouped under Extraversion (see Figure 8.1), but, based on research among psychopaths, was later moved to Psychoticism. Gray’s reformulation of the PEN model is also linked to neurological systems. Highly impulsive individuals are particularly sensitive to reward and nonpunishment, related to the behavioral activation system (BAS). Anxious individuals, on the other hand, are sensitive to punishment and nonreward, related to the behavioral inhibition system (BIS). The BAS involves the medial fore-brain bundle and lateral hypothalamus, and the BIS the “septohippocampal system (SHS), its monoaminergic afferents from the brain stem and its neocortical projection in the frontal lobe” (Gray, 1981, p. 261). Gray’s BIS/BAS model later evolved to also include a third system, the so-called fight-flight-freeze system (Gray & McNaughton, 2000). These three systems comprise the latest version of Gray’s reinforcement sensitivity theory.

Zuckerman: Sensation-Seeking

Sensation-Seeking, another personality trait with strong biopsychological roots, originally emerged from studies by Zuckerman and colleagues on sensory deprivation, closely tied also to the development and revisions of the Sensation-Seeking Scale (SSS; Zuckerman, Kolin, Price & Zoob, 1964). This scale was based on postulated individual differences in an optimal stimulation level, related to the concept of an optimal level of arousal (Zuckerman, 1979). The SSS was initially intended to assess one

construct (sensation-seeking), but later four lower level aspects of Sensation-Seeking were identified (Zuckerman, 1971): Thrill and Adventure Seeking, Experience Seeking, Disinhibition and Boredom Susceptibility. The trait of sensation-seeking was found to relate to a wide range of behaviors (e.g., risky driving, risky sexual behavior, smoking, drinking, drug use, risky sports). In line with Eysenck's biological underpinnings of the PEN model, sensation-seeking was found to be moderately heritable, and linked to a physiological substrate, more specifically to the enzyme monoamine oxidase (MAO), with individuals with higher levels of MAO (type B) displaying lower levels of sensation-seeking. The trait of sensation-seeking was postulated to be characterized by high impulsivity: a strong approach orientation, and weak inhibition. Both Eysenck and Zuckerman have reported sensation-seeking to be related to Eysenck's traits of Extraversion and (more strongly) Psychoticism (low levels of MAO have also been linked to psychoticism by Eysenck). In that regard, there appears to be a clear relation between Sensation-Seeking, and both Eysenck's PEN model (e.g., Zuckerman & Glicksohn, 2016), and the trait of Impulsivity, as identified by Gray. Zuckerman, Kuhlman, Joireman, Teta and Kraft (1993) later developed an alternative five-factor personality model formed by impulsive sensation seeking, aggression–hostility, activity, sociability and neuroticism–anxiety. In that model, sensation-seeking was relabeled as impulsive sensation seeking. In the more recent questionnaire for assessing this model, however, these dimensions were redefined as Extraversion, Neuroticism, Sensation Seeking, Aggressiveness and Activity (Aluja, Kuhlman & Zuckerman, 2010). Impulsiveness is now a facet of Sensation-Seeking, and is now viewed by Zuckerman (2005) as a style instead of a general trait.

EXHAUSTING THE TRAIT DOMAIN

While the Big Five structure was originally hypothesized as an alternative way to summarize correlations among the 35 Cattell scales as early as 1949 by Fiske, firm confirmations of that model, stipulated, among others, by Norman (1967), had to wait half a century. Those confirmations were provided through comprehensive taxonomic studies using trait-descriptive adjectives in three Germanic languages (De Raad, Hendriks & Hofstee, 1992; Goldberg, 1990; Ostendorf, 1990). With that Big Five structure as the major spin-off, undoubtedly a new era had begun in which an all-embracing intention characterized indigenous programs to catalogue personality traits.

The start of this Big Five era was accompanied with both enthusiasm and critical reactions. Part of the enthusiasm is demonstrated in subsequent psycho-lexical studies in various languages and in utilizing the Big Five model in a large variety of both research fields and applied fields. Critical reactions came from authors of competing systems (e.g., Cattell, 1995; Eysenck, 1991), and from

others who pointed out certain weaknesses of the psycho-lexical approach (e.g., Block, 1995).

Part of the criticism was about the numbers and contents of trait-factors at the different levels in a hierarchical representation. Cattell (e.g., 1995) suggested that five factors is the wrong number of secondary factors, and Eysenck (e.g., 1991) suggested that some of the Big Five are primary factors and some are secondary factors. There is a certain amount of indeterminateness in that dispute. Where Cattell (1995), for example, refers to the Norman (1963) Big Five, these factors are primary factors derived from the same (35) variables that gave rise to Cattell's twelve primary factors (and the 16PF). Cattell emphasized that there are eight secondary order factors of the 16PF. The only competitor of the eight secondary factors of the 16PF is the three-factorial NEO-PI, which questionnaire was indeed based on secondary analyses of the 16PF scales (Costa & McCrae, 1976). The psychometric issue involved here is mainly about criteria for the extraction of the adequate number of factors.

Eysenck's disagreement was theoretical and empirical; he proposed three factors at the highest level of abstraction, which he conceived of as "secondary" factors or super-factors. Empirical relations between super-factor Psychoticism and Big Five factors Agreeableness and Conscientiousness (e.g., De Raad & Szirmák, 1994; Goldberg & Rosolack, 1994; McCrae & Costa, 1985) made Eysenck suggest that these latter two factors would be primary order factors constituting partial aspects of the super-order factor Psychoticism.

THE CROSS-CULTURAL PERSPECTIVE: COVERAGE AND REPLICABILITY

There is nothing definitive about the number of factors in the Big Five model. Psycho-lexical analyses usually involve hundreds of variables and hundreds of participants. Parallel analysis with such numbers, for example, may suggest fifteen to twenty factors. Hofstee, Ten Berge and Hendriks (1998) proposed a criterion based on alpha reliabilities of principal components (approximately $1 - 1/\text{Eigenvalue}$), which still suggests factors exceeding the number five. A scree test often suggests a number of factors of more parsimonious proportion, with a clear drop in eigenvalues signaling factors with diminishing returns.

The cross-cultural perspective is probably helpful in finding an acceptable number of factors. This perspective has been dominated by two orientations, with one aiming at a maximal representation of all important traits in a language in an economic way, and the other aiming at a representation of traits found relevant across the languages of the world. The first focuses on full coverage of traits, an orientation that has led to diverse models with five (Big Five), six, seven and eight factors. The second focuses on cross-cultural replicability of traits, an orientation that has rather led to models with no more than two or three factors.

The Coverage Orientation

While the Big Five structure has found large adherence, claims for psycho-lexically based factors beyond the Big Five have been made, for two reasons mainly. The first reason is that the correlation matrices may not be optimally exhausted, and the second reason is that the trait domain may not be truly exhausted. This second reason comes in two versions, one suggesting that the psycho-lexical approach has been too restrictive in selecting personality descriptors (Almagor, Tellegen & Waller, 1995), and the other suggesting that the psycho-lexical approach has been restricted to the use of trait-descriptive *adjectives* (De Raad & Hofstee, 1993).

Six Factors

Ashton and Lee (2001) argued along the lines of exhausting the correlation matrix. They suggested that an additional Honesty–Humility factor, representing such traits as *honest*, *sincere*, *fair* and *just*, versus *dishonest*, *conceited* and *boasting*, could systematically be extracted. Support for this sixth factor was observed in several languages (Ashton et al., 2004), but not, or not clearly, in all languages where this sixth factor was studied, as in American-English (Ashton, Lee & Goldberg, 2004), Turkish (Somer & Goldberg, 1999) and Croatian (Mlačić & Ostendorf, 2005).

Seven Factors

Because most psycho-lexical studies have excluded evaluative, esteem-descriptive terms and state terms used for trait description, Almagor et al. (1995) and Benet-Martinez and Waller (1997) suggested that the Big Five do not fully capture the personality language domain. Using a so-called “non-restrictive” approach with respect to selecting personality descriptors, Almagor et al. (1995) produced a Big Seven model in Hebrew, including versions of some of the Big Five, and two additional factors, called Negative Valence (e.g., *fabricator*, *envious* and *corrupted* versus *honest*, *sincere* and *dependable*) and Positive Valence (e.g., *sophisticated*, *sharp* and *original* versus *mediocre*). Support for one or both of these factors was found in Spanish (Benet-Martinez & Waller, 1997), in Filipino (Church, Katigbag & Reyes, 1996), and in Greek (Saucier, Georgiades, Tsaousis & Goldberg, 2005).

Eight Factors

The Big Five model is based on ratings on trait-descriptive *adjectives*, under the assumption that adjectives are the typical carriers of trait meaning. De Raad and Barelds (2008) argued that at this point the psycho-lexical approach has not made use of its full potential. In their study they not only used adjectives, but also nouns, verbs, adverbs, and some standard expressions as the basis for the formulation of trait-descriptive items. Moreover, trait-descriptive state terms and trait-descriptors with strong evaluative loading were not excluded. Factor analysis of

ratings on this truly exhaustive list of 2,331 descriptors yielded eight factors, the Big Five and three new factors called Virtue (*trustworthy*, *good*, *polite* versus *unfair*, *indecent*, *annoying*), Competence (*has vision*, *solves problems*, *enterprising* versus *gives up*, *passive*, *avoids difficulties*), and Hedonism (*sensation-seeking*, *fortune-hunter*, *impulsive* versus *impeccable*, *moderate*, *home-loving*).

The Replicability Orientation

The Big Three: Dynamism, Affiliation and Order

An important issue with the psycho-lexically derived factors and their indigenous character is their cross-cultural replicability. In pursuit of a cross-lingual trait-structure, Hofstee, Kiers, De Raad, Goldberg and Ostendorf (1997), De Raad, Perugini and Szirmák (1997), and De Raad, Perugini, Hrebícková and Szarota (1998) compared several psycho-lexically derived five factor structures using psychometric criteria. The general conclusion of those studies was that congruence coefficients calculated for corresponding Big Five factors suggested the replicability of the first three factors of the Big Five (Extraversion, Agreeableness and Conscientiousness) and moderate replicability of the fourth factor, Emotional Stability. Such a three-factor solution was also shown to be more stable than others across participant and variable samples in Di Blas and Forzi (1999). It was probably Peabody (1987) who, in a single language, first pointed to the importance of the first three factors of the Big Five relative to the remaining factors. Cross-cultural comparisons based on the substance of Big Five factors from six different psycho-lexical studies also led to the conclusion that Extraversion, Agreeableness and Conscientiousness are cross-culturally coherent, Emotional Stability and Intellect are not (De Raad & Peabody, 2005; Peabody & De Raad, 2002). On the basis of comparisons of fourteen (De Raad et al., 2010) and eleven (De Raad et al., 2014) different trait taxonomies, the Big Three showed its strength as a pan-cultural model of personality.

The Basic Two: Agency and Communion

Digman (1997) factored fourteen sets of correlations of Big Five personality factors, based on ratings of children, adolescents and adults on instruments with different origins. Two factors were typically evident, provisionally labeled α and β , with α capturing Agreeableness, Conscientiousness, and Emotional Stability, and with β capturing Extraversion and Intellect. Central to this basic two-dimensional structure is a distinction between the two metaconcepts *agency* and *communion* (Bakan, 1966). These two concepts have been put forward by Wiggins (e.g., 1996) as higher order indicants of Big Five Extraversion and Big Five Agreeableness, together considered as comprising the relatively large interpersonal subdomain of personality traits. From this viewpoint, where Extraversion and Agreeableness are granted conceptual priority,

the remaining three factors are seen as facilitating the role of agentic and communal movements in a group or as interfering with it (Wiggins, 1996, p. 134).

DeYoung (2006) gave support for the two-dimensional system, naming the *communion* dimension Stability, describing “the need to maintain a stable organization of psychosocial function,” and the *agency* dimension Plasticity, describing “the need to explore and incorporate novel information into that organization” (p. 1149). Saucier et al. (2005) distinguished Morality (*considerate, humble, responsible*) and Dynamism (*dynamic, exciting, energetic*) in a two-factor solution in Greek, and De Raad and Barelds (2008) distinguished two similar factors in Dutch, called Virtue (*good, reliable, polite*) and Dynamism (*enthusiasm, energy, vividness*). Saucier et al. (2014) found support for the two factors in a study with nine distant languages, which factors were interpreted as Social Self-Regulation and Dynamism. De Raad et al. (2018) used data from eleven trait taxonomies to test the Digman (1997) model. When focusing on what is common to those different taxonomies, clear support was found for the two-factor structure.

The P-Factor: Individual Desirability

In both Saucier et al. (2005) and De Raad and Barelds (2008), the first unrotated factor largely captured characteristics of evaluation and morality. Musek (2007) argued on the importance of a general factor of personality. It makes sense to identify such a single basic factor, called *p-factor* by Hofstee (2001) who made a parallel with the structure of intelligence. The *p-factor* draws its meaning from the positive manifold among the large majority of personality traits (Hofstee & Ten Berge, 2004). Arguments for a single general personality factor have previously been given by Webb (1915), who tried to identify a general factor of character next to a general factor of intelligence (*g*), and defined it as the “sum of all personal qualities which are not distinctly intellectual” (p. 2). Here, the *p-factor* seems to reflect the extent to which a person has desirable qualities; it can therefore be called Individual's Desirability (Hofstee, 2003).

HIERARCHY

Throughout the history of personality structures, hierarchy has played an inherent role. The preceding paragraphs may suggest a basic hierarchy with the *p-factor* at the apex of the hierarchy, representing the most valued psychological characteristics in a person. This possibly concerns the first question one has about a person in a variety of contexts: Is this person reliable, trustworthy and decent? At the lower level one would find two basic dispositional orientations, the first with a “communal” emphasis comprising those traits that cover the relationship to other individuals or to groups of individuals, and the second being the “agentic” orientation comprising those traits that emphasize the fulfillment of personal

goals. Interestingly, the two Dutch factors, related to Communion and Agency, namely Virtue and Dynamism (De Raad & Barelds, 2008), turned out to have high correlations (0.90 and 0.85, respectively) with an index of evaluation.

Hierarchy is not only brought about psychometrically, through factoring variables or through factoring factors. Hampson, John and Goldberg (1986) explicitly searched for indexes of hierarchy according to principles of Category Breadth and Concept Asymmetry, to enable an empirical test of hierarchy. Category breadth was defined as the number of behaviors subsumed by a trait concept. The broad and narrow trait distinction implied in the Category Breadth principle parallels that between trait-factors and trait-variables, respectively. The Concept Asymmetry principle was operationalized in a technique with the same name, in which subjects had to indicate which of two statements made more sense, the statement “To be X is a way of being Y” and the statement “To be Y is a way of being X,” X and Y representing trait-terms. If, for example, the second statement was judged to make more sense, Y would represent a narrower trait than X.

Hampson et al. (1986) provided empirical support for expected two-tiered (e.g., talkative is a way of being social) and three-tiered (e.g., musical is a way of being artistic, and artistic is a way of being talented) hierarchies for different types of descriptors (adjectives, verbs, nouns). Hampson et al. (1986) suggested that well-differentiated hierarchies are found in certain domains of the Big Five and not in others. For example, when overt occurrence of behavior is signaled by a trait (e.g., Emotional Instability), differentiated hierarchies are more frequent than when nonoccurrence (e.g., being passive, silent, reserved) of behavior is signaled by a trait (e.g., Introversion).

Possibly the most well-known hierarchy of traits is the strict hierarchy hypothesized by Eysenck (1970), as presented partially in Figure 8.1. In this four-level hierarchy of Extraversion, specific responses (e.g., “telling jokes”) are included in one and only one higher level category of habitual responses. The habitual responses (“entertaining strangers” and “smiling at people”) are included in one single higher level category of traits (“sociability”), and the traits (e.g., “sociability” and “impulsivity”) are finally included in one type level category (“extraversion”). No links are specified between categories at a single level (e.g., between “sociability” and “impulsivity”), nor between categories (e.g., “smiling at people”) at one level (e.g., habitual response level) and a different category (e.g., “impulsivity”) at another level (e.g., trait level).

Hierarchy Through Successive Emergence of Factors

A very informative form of hierarchy is through presenting factors from different levels of extraction and by giving correlations between factors from adjacent levels of extraction. This hierarchy through successive emergence

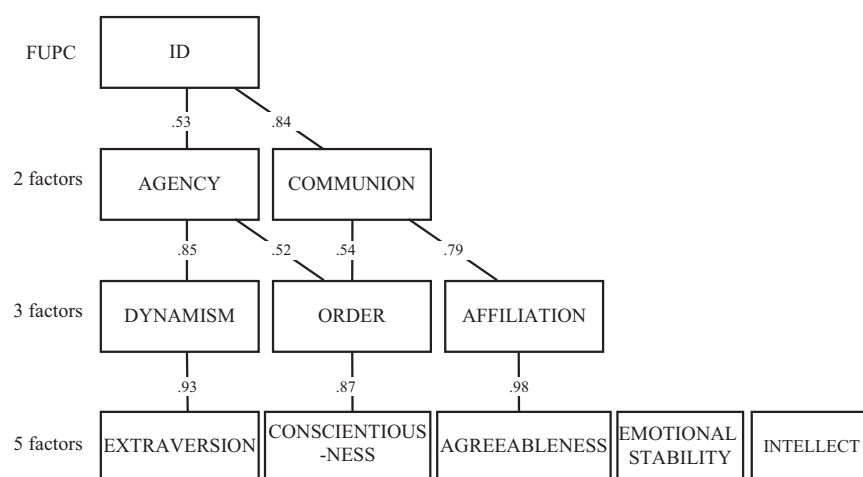


Figure 8.3 Hierarchical emergence of factors (correlations between factors are derived from De Raad et al., 2014)

of factors has been applied by Zuckerman, Kuhlman and Camac (1988), De Raad and Szirmák (1994) and Saucier et al. (2005), and put forward as the “bass-ackwards” method by Goldberg (2006). Figure 8.3 gives a partial representation of such an emergence of factors, with correlations between factors based on data from De Raad et al. (2014). On top is the first unrotated principal component (FUPC, here called Individual Desirability). The two-factor solution is represented by the labels Agency and Communion, the three-factor solution by the labels Dynamism, Order and Affiliation, finally followed by the Big Five factors. In the figure, only correlations higher than .40 are given.

Hierarchy of Variables and Factors

The general methodology used to arrive at some order in the domain of traits produces hierarchy. Principal Components Analysis, for example, produces correlations between trait-variables and the more abstract factors, and after Varimax-rotation the abstract factors are interpreted in terms of clusters of correlating trait-variables within those factors. The result is a hierarchical simple structure model, such as represented through two of the Dutch Big Five factors in Fig. 8.4. In this five-factor solution (De Raad et al., 1992), after Varimax-rotation, for example, the trait-variable triplets beginning with *spontaneous*, *cheerful*, *energetic*, *vivacious* and *enthusiastic* each have their highest loadings on the factor Extraversion. Similarly, the triplets beginning with *cordial*, *mild*, *caring*, *tolerant* and *humane* each have their highest loadings on the factor Agreeableness.

In the preceding, simple structure is actually a relative concept. While Varimax-rotation strives after simple structure, of the trait-variable triplets, only those starting with *spontaneous* and *mild* actually empirically behave according to the simple structure ideal. While the trait-variable triplets all have their highest (primary) loadings on the indicated factor, for the factor Extraversion, the

second to the fifth trait-variable triplets have also substantial positive (secondary) loadings on Agreeableness, Conscientiousness, Emotional Stability, and Intellect, respectively. Similarly, the first and the third to the fifth trait-variable triplets for Agreeableness have also secondary loadings on Extraversion, Conscientiousness, Emotional Stability, and Intellect, respectively. The factors with secondary loadings can thus be seen as facets of the factor on which the triplets have primary loadings. This feature with primary and secondary loadings is characteristic of the majority of the trait-variables in the Big Five structure. This feature is also indicative of the fuzziness of membership of trait-variables of the categories (e.g., triplets) that build the hierarchy.

Because the vast majority of trait variables in a factor-loading matrix have up to two substantial loadings, each trait-variable is best represented in a two-dimensional space made up by two factors. The simple structure concept is drastically compromised by this observation. With five factors, this observation has led to the development of the so-called AB5C model (Abridged Big Five Circumplex; De Raad et al., 1992), in which each trait variable is placed on the basis of the pairs of factors with which it correlates. The model can be depicted as a kind of “periodic table of personality traits” (see e.g., De Raad, 2000), essentially consisting of a ten by ten matrix with ten columns to represent the five factors each with two poles (Extraversion–Introversion, etc.), and with those ten-factor poles also put row-wise to represent the secondary loadings and providing facets of the column-factor. Each cell accommodates traits that have their highest loadings on the column factor and their smaller but still substantial secondary loading on the row-factor.

CIRCULAR STRUCTURES

Enumerating factors in a factor structure, and specifying categories or classes at a certain level in a hierarchy pertains to splitting up the domain of interest into distinct

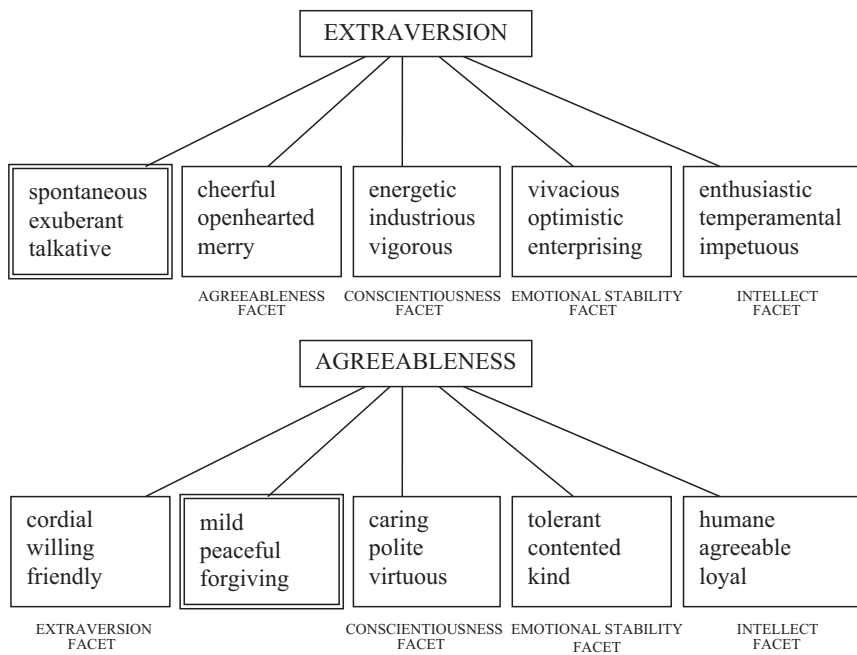


Figure 8.4 Partial models of extraversion and agreeableness (based on De Raad, Hendriks & Hofstee, 1992). The triplets in the boxes have their highest, or primary, loadings on the factor on top; the triplets in four of the boxes have secondary loadings on the factors given below the boxes.

clusters of meaning. In certain models, for example Eysenck's model, those clusters are categorically distinct. The simple structure ideal pursued in Varimax rotation epitomizes such a "horizontal" (Goldberg, 1993) structuring. From this horizontal perspective, a further differentiation of the trait domain consists of finding additional factors that have scientific and applied relevance. Part of the discussion on a six-factor structure (Ashton et al., 2004), a seven-factor model (Almagor et al., 1995), and the eight-factor structure (De Raad & Barelds, 2008), is about how to decide about the next relevant factors beyond the Big Five.

Most of the discussion on factoring the trait-domain thus far has implied fuzzy categories and partially overlapping clusters of trait meaning, as exemplified in Figure 8.4. The figure assumes that most trait-variables correlate with more than one factor. The study by De Raad et al. (1992) on the so-called Abridged Big Five Circumplex model was based on the finding that the simple structure concept was compromised substantially by the fact that the large majority of the Big Five trait-variables loaded substantially on two factors, and only a small set (less than 10 percent) loaded substantially on only one factor. This means that trait-variables can best be categorized in terms of pairs of factors with which they correlate, yielding ten two-dimensional planes in which trait-variables are depicted using the pairs of loadings as coordinate values.

With only two factors, as in the case of the two-factor level with Virtue and Dynamism (De Raad & Barelds, 2008), the circular arrangement (Figure 8.2) that proceeds from using the pairs of loadings for the variables in a representation, is exemplified in Figure 8.5, using the related labels "Communion" and "Agency," respectively.

Figure 8.5 is based on data that were ipsatized before factoring them. This ipsatization procedure involved subtracting the mean score (based on pairs of opposites) of an individual from all scores of that individual. The trait-descriptive items along the circumference of the circle form a small selection of a total set of 2,331 variables in the study. The vast majority of those variables did not load high on any of the two variables, and those that are put in Figure 8.5 come closest in representing the varieties in meanings made possible by the two-factor solution. Moreover, the locations of the items along the circle correspond to their actual locations within the circle.

The advantage of using this circumplex representation is that the positions of the trait-variables relative to each other become clear. One could read Figure 8.5 according to simple structure, by focusing on the two sets of opposite clusters of variables. The "Communion" related set of opposite clusters is pivoted by *kind-hearted* and *mild* on the one hand, and *seeks conflict* and *hotheaded*, on the other hand. The "Agency" related set of opposite clusters is pivoted by *energetic* and *direct*, on the one hand, and by *inhibited* and *fearful*, on the other hand. In addition, the meanings of adjacent traits on the circle are close in meaning and differ in the extent to which they represent the two main dimensions. Considered clockwise, from *direct* (at twelve o'clock) to *gets party going* (at seven past twelve) the traits diminish in representing Agentic features and gain in representing the opposite Communal features. Moreover, each cluster of traits (e.g., from *direct* to *gets party going*) may be considered as a blend of the two adjacent clusters (*energetic* to *pleasant* and *merrymaker* to *seeks conflict*). Finally, traits or clusters of traits find their semantic and psychological opposites at about 180 degrees

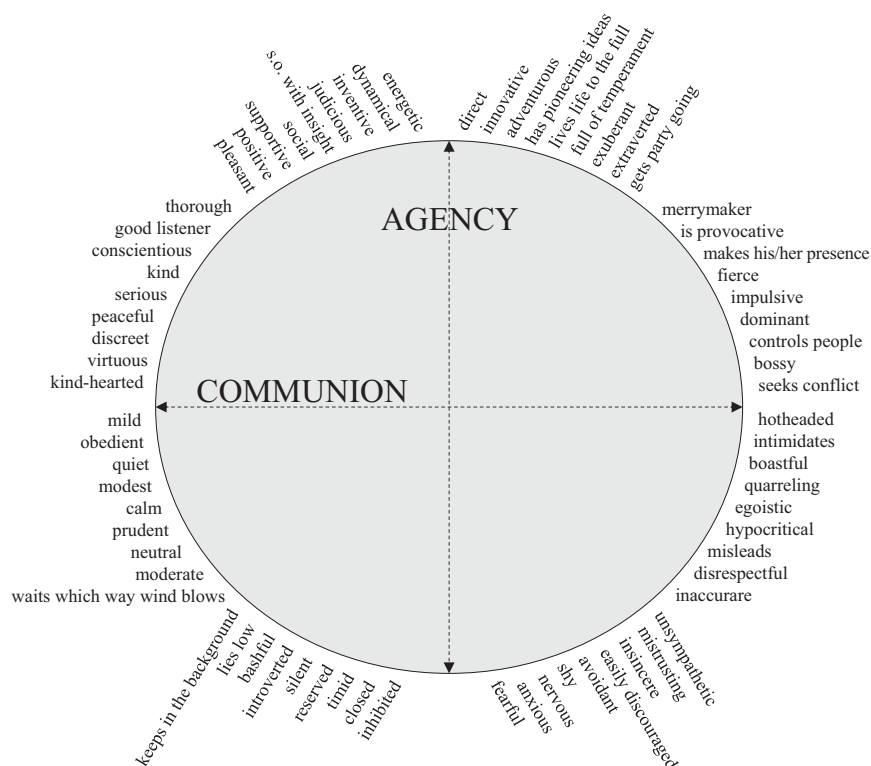


Figure 8.5 Circumplex representation of two-factor solution (based on De Raad & Barelds, 2007)

further on the circle. Examples are the single traits *extraverted* versus *introverted* and *unsympathetic* versus *pleasant*, but also the sets of traits *hotheaded* to *quarreling* versus *kind-hearted* to *peaceful*.

Segmenting the Circle

Whether one distinguishes single traits or clusters of traits at this horizontal level of structuring depends on the context. Most applied and research contexts follow economic principles and require a segmentation of the circular pie into a level of clustering that has theoretical and applied relevance. The interpersonal circumplex research tradition (Trapnell & Wiggins, 1990), for example, distinguishes eight clusters, segments or octants, theoretically defined by a facet theory approach (Foa & Foa, 1974). In that circumplex, interpersonal traits are arranged around the underlying coordinates Dominance and Nurturance – dimensions or factors that have respectively been linked to the mentioned Agency and Communion concepts by Wiggins and Trapnell (1996). Four of the eight segments capture the interpersonal traits centered on the four poles of Dominance and Nurturance, and the other four segments capture the traits that form the blends of each pair of poles, centered on a vector at 45 degrees.

In the Abridged Big Five Circumplex model (De Raad et al., 1992), twelve segments are distinguished. A reason for this finer partitioning is that valid distinctions may be lost when using octants. In Figure 8.5, for example, *conscientious*, *kind*, and *serious* have a primary loading on

Communion and a secondary loading on Agency, whereas *s.o. with insight*, *social*, and *supportive* have a primary loading on Agency and a secondary loading on Communion. These sets of traits are distinct from each other and are also distinct from the adjacent factor-pure sets of traits with *kind-hearted* and *mild* for Communion and *energetic* and *direct* for Agency.

CONCLUSION

According to Lave and March (1975) models should be evaluated on three main characteristics, namely Truth, Beauty and Justice. Restricted to structural models of personality, the Truth-criterion would be about an adequate representation of the trait domain in the model, and its testability. The history of structural models of personality is characterized by a plethora of strong opinions about the proper representation of the trait sphere and the testability of the model, particularly expressed in the works of Cattell (representation) and of Eysenck (theory and testability). In the new era, where the discussion was focused on representation and where testability was restricted to the number five, a certain level of consensus was rapidly obtained with the Big Five model. Yet, part of the consensus is probably due to a form of circular reasoning: pursuing the Big Five while they need to be demonstrated (De Raad & Peabody, 2005). More use should be made of sets of markers for expected dimensional structure (Saucier & Goldberg, 1996), of the substantive alternative proposed by Peabody and De Raad

(2002), and of psychometric methods of factor comparison (De Raad et al., 1998), in which congruence coefficients are calculated before and after rotation. A highly interesting technique to find whether a factor or component observed in one set of data or under one particular instruction is also found in another set of data or under a different instruction is a rotation to perfectly congruent weights (Ten Berge, 1986; cf., De Raad, Mulder, Kloosterman & Hofstee, 1988).

The Beauty-criterion suggested by Lave and March (1975), applies to the simplicity of the Big Five model or models with fewer or with more factors. Part of the attractiveness is in the relatively small number of factors, relative to the enumerable lexically sedimented traits. Part of the attractiveness is also in the inevitable hierarchical or vertical nature of the trait structure. In this respect, historically, the debate consisted of a mixture of psychometric reasoning (Cattell and Guilford) and theoretical consideration (Eysenck). In the new era, with the emergence of the Big Five structure, hierarchy was implied in the relations between trait-variables and the trait-factors, but the emphasis was largely on the "horizontal" juxtaposition of distinct trait-factors. Subsequently, developments furthered towards circular representations. With a cross-cultural emphasis, new studies with an expectedly smaller number of factors to be cross-culturally replicable should include analyses of semantic equivalence, and studies with an emphasis on semantic coverage in a language, and with expectedly additional candidates beyond the Big Five factors should be accompanied by psychometric tests. Moreover, both vertical and horizontal differentiations should be an explicit focus in the development of trait-models.

With the Justice-criterion, Lave and March (1975) focus on making a better world. Here, the Justice-criterion is embodied in theory development and especially in the development of assessment instruments that enable an adequate tackling of scientific and societal problems. During the last few decades, personality questionnaires have been geared toward representing the major trait dimensions as represented in the Big Five model (De Raad & Perugini, 2002). Such instrument-development should gain from establishing the major personality dimensions, but also from the distinctions between the different levels of traits in a hierarchy and the horizontal characteristics as demonstrated in the circumplex configuration.

At an international, cross-cultural level, the domain of structural models of personality traits may make an important step forward, if consensus is reached over the most fundamental, kernel-structure of personality, both horizontally and vertically, with an emphasis indeed on the basic one, two or three dimensions in the various indigenous psycho-lexical projects. This should include the assessment of the *p-factor*, the Basic Two as conveyed in the generic Communion and Agency concepts, and the Big Three model with Dynamism, Affiliation and Order.

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9

The Five-Factor Model of Personality: Consensus and Controversy

ROBERT R. MCCRAE

INTRODUCTION

There is little doubt that the Five-Factor Model (FFM) of personality traits (the “Big Five”) is currently the dominant paradigm in personality research and one of the most influential models in all of psychology. Digman’s 1990 review on the topic has become one of the most highly cited articles in the history of the *Annual Review of Psychology*, with over 8,500 citations. Barrick and Mount’s 1991 meta-analysis of job performance and the FFM – itself cited 11,000 times – brought personality back into the mainstream of Industrial/Organizational Psychology. The FFM has led to novel and compelling reformulations of the personality disorders that have influenced *DSM-V* (Widiger & Trull, 2007). Cross-cultural collaborations have shown the universality of the FFM and demonstrated pervasive fallacies in national character stereotypes (Terracciano et al., 2005). Social Psychologist Harry Reis (personal communication, April 24, 2006) characterized the FFM as “the most scientifically rigorous taxonomy that behavioral science has,” and for his research on the FFM, Paul Costa was selected by the Division of General Psychology of the American Psychological Association to present the 2004 Arthur W. Staats Lecture for Contributions towards Unifying Psychology.

What is it that researchers from so many disciplines have come to appreciate? As Digman and Inouye (1986) put it, “If a large number of rating scales is used and if the scope of the scales is very broad, the domain of personality descriptors is almost completely accounted for by five robust factors” (p. 116). In other words, these five factors provide a structure in which most personality traits can be classified. This structure arises because traits covary. For example, people who are sociable and assertive tend also to be cheerful and energetic; they are high on the Extraversion (E) factor, which is said to be *defined* by sociability, assertiveness, cheerfulness, and energy. However, people who are sociable and assertive may or may not be intellectually curious and imaginative. Those latter traits define a separate factor, Openness to Experience (O). Neuroticism versus Emotional Stability (N),

Agreeableness versus Antagonism (A) and Conscientiousness (C) are the remaining factors (Widiger, 2017).

There is a widespread consensus that these five factors are necessary and more-or-less sufficient to account for the covariation of most personality traits, and it is this comprehensiveness that chiefly accounts for the utility of the FFM. Researchers who wish to conduct a review of the literature on personality correlates typically find that many different scales and instruments have been used to assess personality. If each is assigned to one of the five factors, their results can be meaningfully combined. Again, the FFM provides a framework for systematic exploratory research. Suppose, for example, one wished to study the effects on personality of growing up in East versus West Germany (Angleitner & Ostendorf, 2000). One might hypothesize that East Germans would be, say, higher in C and lower in O, and administer only measures of those two factors. But if the real differences turned out to be in levels of N and A, such a design would not reveal it. By administering measures of the full FFM one can be sure that important traits have not been overlooked.

BACKGROUND TO THE FIVE-FACTOR MODEL OF PERSONALITY

The origins of the FFM can be traced back to Sir Francis Galton and the beginnings of trait psychology, and the details of its history have been recounted by a number of authors (Digman, 1990; John, Angleitner & Ostendorf, 1988). Perhaps the most interesting historical question, however, is why the FFM was not widely adopted until the end of the twentieth century. There were a number of contributing causes to this delay.

It was not immediately clear how one could specify the full list of traits in order to determine what structure was needed to organize them. The solution came with the adoption of the lexical hypothesis, which argues that traits are so important in human affairs that common words will have been invented to name them all; an unabridged dictionary ought to provide an exhaustive listing of traits,

which could be sorted out into a basic structure. Several generations of researchers pursued this strategy (see John et al., 1988), and it led to the discovery (Tupes & Christal, 1961, 1992) and rediscovery (Goldberg, 1983) of the FFM.

However, the great majority of personality psychologists did not adopt the lexical hypothesis. They were skeptical that the lay vocabulary could be a proper basis for a scientific account of traits, and they tended to offer and defend their own, competing systems. Eysenck (1947) proposed a highly simplified system with only two factors, E and N; Jungian psychologists assessed four psychological preferences (Myers & McCauley, 1985); Block (1961) created a set of 100 theoretically eclectic descriptors intended for use in clinical research. Disputes between rival schools continued for decades, but in the 1980s a series of studies showed that all these instruments assessed variations on the FFM. For example, research showed that the Extraversion, Intuition, Feeling, and Judging preferences of the Myers-Briggs Type Indicator (Myers & McCauley, 1985) correspond to E, O, A and C, respectively (McCrae & Costa, 1989).

The discoverers of the significance of the FFM, Tupes and Christal, were Air Force psychologists who published their work in a Technical Report that was essentially lost to the literature until it was published thirty years later (Tupes & Christal, 1961, 1992). It had been brought to the attention of psychologists by Norman (1963), but at a time when personality psychology was entering a period of crisis. In 1968 Mischel published a critique of trait psychology that led most psychologists to conclude that traits were cognitive fictions with no predictive value; the FFM was merely an adequate taxonomy of illusions. Slowly, defenders of traits made the case that traits were both real (McCrae, 1982; Yamagata et al., 2006) and consequential (Ozer & Benet-Martínez, 2006). The revival of trait psychology and the ascendance of the FFM went hand in hand.

Most personality assessment takes the form of self-report inventories, in which respondents are asked to say if, or how well, each of a series of statements describes them. This has proven to be a very useful technique, but it is by no means perfect. People may not understand the questions, or they may not understand themselves. They may be prone to agreeing with almost any assertion, or may choose to endorse only positive statements about themselves. They may be bored by the task and careless in their responses. Skeptics came to believe that self-reports were nothing but a collection of errors and biases.

It was, therefore, an important advance when psychologists showed that there was substantial (though not complete) agreement between descriptions from self-reports and those obtained when the same questions were put to knowledgeable informants – spouses, roommates, friends (Funder, 1980; Kurtz & Sherker, 2003). In 1987, McCrae and Costa showed that the FFM could be found in analyses of peer ratings as well as self-reports, and that there was substantial agreement across these different methods of measurement on the standing of each individual on all five

factors. The FFM was subsequently found using Q-sort methods, in which people sort statements from most to least characteristic (Lanning, 1994; McCrae, Costa & Busch, 1986), and even in sentence completion tests, in which people describe themselves in response to the question, “Who am I?” (McCrae & Costa, 1988).

Questionnaires, however, remain the most popular and well-validated tools for assessing the FFM. The most widely used are the NEO Inventories (McCrae & Costa, 2010), whose 240 items assess thirty specific traits (or facets) that define the five factors. A brief version, the NEO Five-Factor Inventory-3 (NEO-FFI-3) assesses only the five factors. The Big Five Inventory (BFI; Benet-Martínez & John, 1998) is another widely-used measure of the five factors; De Raad and Perugini (2002) have edited an entire volume devoted to alternative measures of the FFM in a variety of languages.

RESEARCH DISCOVERIES

Armed with a comprehensive model and a variety of validated assessment tools, personality psychologists began to address basic questions about how traits operated. Widely replicated results have yielded a body of knowledge that had proven elusive during most of the twentieth century. Traits had always been assumed to be enduring dispositions; longitudinal research showed that individual difference in all five factors are in fact remarkably stable (Costa & McCrae, 1992b; Roberts & DelVecchio, 2000). At the same time, there are gradual changes in the average levels of traits. Both cross-sectional and longitudinal studies suggest that between adolescence and old age, individuals generally decline in N and E and increase in A and C. O increases until some time in the 20s, after which it slowly declines (Costa, McCrae & Löckenhoff, 2019).

Research on the FFM has shown consistent patterns in gender differences. These differences are generally small, with substantial overlap between the distribution of traits in men and in women. But in most samples, women score higher in N and A than men. At the level of specific facets, there are sometimes differences within domain. Thus, both Warmth and Assertiveness are facets of E, but women are typically warmer and men more assertive. Again, women are more open to aesthetic experiences, whereas men are more open to ideas.

Over the past twenty years, researchers around the world have begun to translate instruments such as the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992a; McCrae & Allik, 2002) and the BFI (Schmitt et al., 2007), and have administered them to respondents in dozens of countries. Results are easily summarized: Personality is much the same everywhere. The FFM structure itself is universal. McCrae and colleagues (McCrae, Terracciano & 78 Members, 2005) reported an almost perfect replication of the American adult self-report NEO-PI-R structure using 11,985

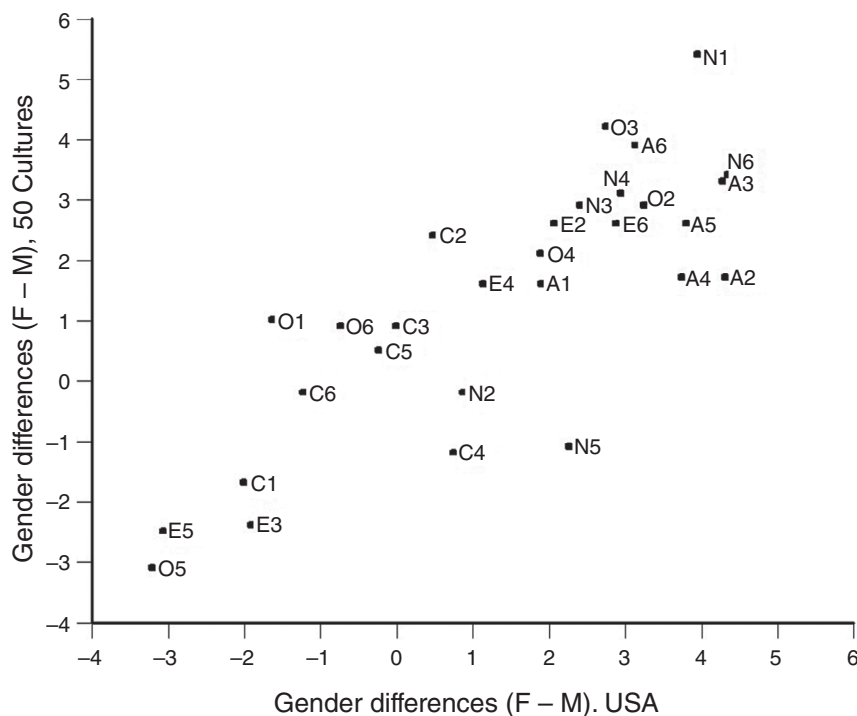


Figure 9.1 Gender differences, in *T*-scores, for adults in the United States (self-reports) versus fifty cultures (observer ratings) on the facets (= 1–6) of the domains (= N, E, O, A and C) of the NEO-PI-R. Women score higher than men on traits in the upper right quadrant, such as N1: Anxiety, O3: Feelings and A6: Altruism. Men score higher than women on traits in the lower left quadrant, such as O5: Ideas, E5: Excitement Seeking and C1: Competence. Data from Costa and McCrae (1992a) and from McCrae, Terracciano & 78 Members (2005)

observer ratings of college-age and adult targets from fifty cultures. The same study replicated the American pattern of age differences (although the age effects for N and A were much smaller in the international sample). As Figure 9.1 shows, that study also replicated gender differences seen in the self-reports of American men and women ($r = .82, p < .001$).

Despite the challenges of adequately translating questionnaires, cross-cultural studies have also shown that many basic psychometric properties are preserved across nations and languages. If one ranks the thirty facet scales of the NEO Inventories from most to least internally consistent, very similar orders are found around the world, and the same is true for retest reliability and longitudinal stability (McCrae, Kurtz, Yamagata & Terracciano, 2011).

Such findings would have astounded psychologists and anthropologists who studied personality and culture in the first half of the twentieth century. They believed that personality was a cultural creation that would probably vary as much across cultures as diets and religious beliefs. As late as 1996, Junger-Tasman wrote that “Different cultures and different languages should give rise to other models that have little chance of being five in number nor of having any of the factors resemble those derived from the linguistic/social network of middle-class Americans” (p. 864). Cross-cultural research on the FFM has created a revolution in thinking on this issue.

There is a plausible explanation for this universality: The FFM is strongly rooted in biology. Each of the five factors is heritable (Riemann, Angleitner & Strelau, 1997), and the facets that are most heritable in Canada and Germany tend to be most heritable in Italy and Japan

(McCrae et al., 2011). Studies of twins (Yamagata et al., 2006) and of family relatives (Pilia et al., 2006) show that the five-factor structure of the observed traits mirrors the structure of their underlying genes. Apparently, Warmth and Assertiveness are both definers of E because they are influenced by some of the same genes. We know that the human race is a single species, so the universality of the FFM is probably a reflection of the fact that variations on the same trait-related genes are found in *Homo sapiens* worldwide.

There is now consensus that the general personality dimension of N is associated with most personality disorders (Widiger, Costa, Gore & Crego, 2013), that E predisposes people to be happy (DeNeve & Cooper, 1998), that O predicts social and political liberalism (McCrae, 1996), that low A is a risk factor for substance abuse (Ball, 2002), that C is associated with good job performance (Barrick & Mount, 1991). The utility of the FFM has been securely demonstrated.

STRUCTURAL ISSUES

Precisely because it plays such a prominent role in contemporary psychology, the FFM has become the target of numerous critiques. This is healthy; science advances by constantly challenging established views. Sometimes these challenges force a change in thinking, as when Costa and McCrae moved from their three-factor model (Costa & McCrae, 1980b) to the FFM (McCrae & Costa, 1987). Other times, they result in stronger evidence for the challenged ideas. In the end, trait research benefited from Mischel’s (1968) critique, because researchers had to

design better and more telling studies to demonstrate what they thought they knew about traits.

Objections to the FFM take two different forms. The first is a critique of trait theories themselves from other perspectives in personality psychology. Network (Möttus, 2016) and functionalist (Wood, Gardner & Harms, 2015) theorists have argued that traits are not underlying causes of behavior, but mere epiphenomena that emerge from evolving patterns of behaviors (see McCrae, 2018 for a critique of these positions). Advocates of a person-centered approach claim that types more faithfully represent the operation of psychological processes than do variable-centered traits (see Asendorpf, Caspi & Hofstee, 2002 for a balanced discussion of these issues). Social cognitive theorists (Cervone, 2004) have argued that traits merely describe, without explaining, behavior (see McCrae & Costa, in 2008a, for a rebuttal). Other personality theorists have pointed out that, even if it is a fully adequate model of personality traits, the FFM itself does not constitute a full theory of personality, which would also explain human development, day-to-day functioning and social interactions in cultural context (McAdams & Pals, 2006). That point is well taken, and McCrae and Costa have offered a much broader perspective on personality in the form of Five-Factor Theory (McCrae & Costa, 2003, 2008b).

The other class of objections to the FFM – which will be considered here in more detail – come from researchers who are committed to trait models and factor analytic methods, but who propose some variation on or refinement of the FFM. The FFM is a hierarchical model of personality traits: Each of the five broad factors is defined by more narrow and specific traits or facets. There are currently disagreements among researchers at the level of the five factors; at a level above the five factors; and at the level of the specific facets. There are also new reasons to think that traits even narrower than facets – *nuances* – form a part of the trait hierarchy.

Three- and Six-Factor Alternatives

The foundation of the FFM and thus of contemporary trait psychology is that five factors are both necessary and sufficient to summarize covariation among specific personality traits. However, some researchers have argued that more or fewer than five factors are needed. De Raad and Peabody (2005) reported analyses of trait descriptive adjectives in Dutch, Italian, Czech, Hungarian and Polish samples and found more robust support for a three-factor model consisting of E, A and C than for the full FFM. Conversely, Ashton and colleagues (Ashton & Lee, 2005; Ashton et al., 2004) reported lexical studies in a number of languages in which six replicable factors appeared. Ashton and Lee's HEXACO (from **H**onesty–**H**umility, **E**motional Stability versus Neuroticism, **E**Xtraversion, **A**greeableness, **C**onscientiousness, and **O**penness) model basically divides FFM A into two factors, the second called *Honesty–*

Humility; in addition, the factors are rotated a bit from their FFM positions.

Perhaps the most problematic feature of these studies is that they are, properly speaking, not so much studies of personality traits as of personality trait *language*. The people of two different cultures might have identical traits, but a factor that is richly represented in the vocabulary of the first culture might be missing from the vocabulary of the second. McCrae (1990) noted that there are relatively few English-language adjectives that reflect O. For example, there is no single term that designates sensitivity to aesthetic experience; *artistic* comes closest, but it refers to the producer rather than the consumer of art. Yet surely English speakers are capable of responding to beauty (McCrae, 2007). One can embrace a weak form of the lexical hypothesis (natural language provides a useful guide to personality structure) without adopting a strong form (the structure of natural language *is* the structure of personality).

Lee and Ashton (2004) have developed a questionnaire measure of their six-factor model, the HEXACO Personality Inventory. It has been extensively used, and a number of studies show the value of the Honesty–Humility factor (Ashton & Lee, 2008). These traits are included in the FFM, but at a different level of the hierarchy: Straightforwardness ($\approx$ honesty) and modesty ($\approx$ humility) are considered facets of the FFM Agreeableness factor.

Other researchers have argued that entirely new factors are needed. Cheung and her colleagues (Cheung, Cheung, Leung, Ward & Leong, 2003; Cheung et al., 1996) developed an inventory based on indigenous Chinese personality characteristics, which was subsequently translated into English. She argued that the Chinese Personality Assessment Inventory (CPAI) revealed a new factor, originally called Chinese Tradition but later renamed Interpersonal Relatedness because it was also found in non-Chinese samples. In a joint factor analysis with the NEO-FFI, when six factors were examined, the FFM was supplemented with a factor defined by CPAI Harmony, Relationship Orientation, Thrift, Logical Orientation, Self Orientation, Defensiveness and low Flexibility. However, when only five factors were extracted, the elements of this factor were simply redistributed among A and C factors (Cheung et al., 2003, Table 9.4). It thus appears that the FFM encompasses distinctively Chinese traits.

Spirituality has also been proposed as a sixth factor (Piedmont, 1999). The Spiritual Transcendence Scale includes facets assessing Prayer Fulfillment, Universality and Connectedness, and these three defined a separate factor in a joint analysis with the facets of the NEO-PI-R. One might question whether spirituality is in the domain of personality at all, or whether it is better regarded as an attitude or practice. However, in this case another issue is raised. All the items in this version of the Spiritual Transcendence Scale are positively keyed, so their intercorrelation may be inflated by acquiescent responding, the tendency to agree with items regardless of content.

(NEO-PI-R facet scales are balanced, with roughly equal numbers of positively and negatively keyed items, so acquiescence is not relevant to their structure.)

Some evidence for this hypothesis comes from analyses of a different instrument, the Temperament and Character Inventory (TCI; Cloninger, Przybeck, Svrakic & Wetzel, 1994). The TCI has three scales that define a spirituality factor, Self-Transcendence, and these scales, too, are susceptible to acquiescent responding, because all the Self-Forgetfulness and Transpersonal Identification items and ten of thirteen of the Spiritual Acceptance items are positively keyed. A joint factor analysis of the twenty-five TCI scales with the five NEO-PI-R factors yielded clear N, A and C factors, a factor defined by both E and O, and a separate Self-Transcendence factor (McCrae, Herbst & Costa, 2001). However, when acquiescence was assessed and statistically controlled, the full FFM appeared, with the three Self-Transcendence scales loading on the O factor (evidently measuring something like Openness to Spiritual Experience).

In an attempt to move psychiatric diagnosis from a categorical to a dimensional model, the committee on personality disorders developed a trait model with five factors (American Psychiatric Association, 2013) that was intended to capture pathological variations in personality. Four of the five factors were clearly pathological counterparts of the FFM: Negative Affectivity [corresponding to N], Detachment [low E], Antagonism [low A], and Disinhibition [low C]. However, the fifth factor, Psychoticism, was not clearly related to Openness, suggesting that it might constitute a sixth factor, at least in the realm of psychopathology. However, a more fine-grained analysis (Suzuki, Griffin & Samuel, 2017) showed considerable overlap between Psychoticism (which includes subscales of Unusual Beliefs, Eccentricity and Perceptual Disregulation) and two Openness facets, Fantasy and Aesthetics. The FFM thus appears to encompass personality pathology.

A Higher-Order Structure

Digman (1997) proposed that the five factors are not the highest level of personality structure. Across different instruments and samples he showed that the factors were themselves intercorrelated, and that a factor analysis of these correlations revealed two higher-order factors, alpha (defined by A and C versus N) and beta (defined by E and O). Such factors have been reported by a number of other researchers (e.g., DeYoung, Peterson & Higgins, 2002), so there is little controversy about their existence. What remains in doubt is their interpretation. Some researchers believe that they are real, if highly abstract, features of the structure of personality, perhaps even with a genetic basis (Jang et al., 2006).

Other writers have argued that they are artifacts of evaluative bias (McCrae & Costa, 2008a). Such biases come in two forms, called Positive and Negative Valence,

and McCrae and Costa (1995) showed that Negative Valence is related to N and low A and C, and thus low alpha, whereas Positive Valence is related to E and O, and thus beta. Biesanz and West (2004) reported that the five factors were correlated when self-reports and observer ratings were examined separately, but were orthogonal across observers – for example, E and O were correlated in self-reports and in observer ratings, but self-reported E was unrelated to observer rated O. Such a finding suggests that the higher-order factors are the result of method biases. DeYoung (2006), however, claimed correlations both within and across raters. McCrae, Yamagata and colleagues (2008), directly compared substantive and artifact models of the higher-order factors, and found that the artifact explanation was consistently better. If there are any real associations among the five factors, they are so small as to be of little practical significance.

Some researchers have also proposed a single highest-order factor, the so-called General Factor of Personality (Musek, 2007), but this is more parsimoniously interpreted as a general evaluative artifact (Pettersson, Turkheimer, Horn & Menatti, 2012).

Specifying Facets

Although scores on the five factors give a general sense of what an individual is like, much more can be learned by assessing the specific traits that define the factors. For example, both sociability and assertiveness are definers of E, because both reflect ways of interacting with others. But some people are sociable without being assertive, and others are assertive without being sociable, and knowing which is which is important to clinicians (Singer, 2005) and researchers (Paunonen & Ashton, 2001). The problem at the facet level is that there is no generally recognized way of subdividing the factors into constituent traits. For example, Costa and McCrae (1992a) distinguished between Warmth and Gregariousness facets of E, corresponding to the subdivisions of the need to belong: “ongoing mutual caring and concern,” and “a desire for frequent interactions” (Baumeister, 2005, p. 112). By contrast, Watson and Clark (1997) thought this distinction was unnecessary, and combined them into a single trait of sociability.

The NEO-PI-R has thirty facet scales, six for each factor. They were chosen to represent the most important constructs in the personality literature, while at the same time being maximally distinct. Items to tap each were written using rational methods, and the best items were selected by item analyses and targeted factor analyses in a series of samples (Costa & McCrae, 1995).

The facet system of the NEO-PI-R has been criticized as being arbitrary, because “the key ingredient for a system to provide an adequate lower order structure of the Big Five is some empirical foundation to selecting lower-order traits” in contrast to the “theoretical insight and intuition” used in developing the NEO-PI-R (Roberts, Walton &

Viechtbauer, 2006, p. 29). Certainly it would be ideal to identify, solely by empirical means, a set of lower-level traits that consistently emerged across languages, methods of measurement and item pools, as the FFM often does at a higher level (e.g., Markon, Krueger & Watson, 2005; McCrae, 1989; McCrae, Terracciano & 78 Members, 2005). So far, however, that has not happened, and an ambitious effort to provide an empirical basis for the facets of C (Roberts, Bogg, Walton, Chernyshenko & Stark, 2004; Roberts, Chernyshenko, Stark & Goldberg, 2005) illustrates some of the problems (see McCrae & Costa, 2008a). The facets of C identified by those researchers in a pool of trait descriptive adjectives bore only limited resemblance to those they found in a selection of personality inventory scales. The eight factors found in adjectives included Punctuality and Formalness facets not found in inventory scales; the six factors found in inventory scales included a Virtue facet not found in adjectives. The empirical strategy does not seem to yield consistent results at the facet level.

In the meantime, the facets of the NEO-PI-R do provide one system that has been successfully used in many applications and in dozens of cultures. Researchers have documented the discriminant validity, heritability and developmental course of all thirty facets, and no obvious gaps in covering the scope of the FFM have been identified. At present, NEO-PI-R facets arguably offer the best available delineation of the FFM at the next-lower level in the trait hierarchy.

Traits below Facets: Nuances

Facet scales are composed of items, but the conceptual status of individual items has been unclear. Are they interchangeable indicators of the facet? If so, why not just ask respondents the same question over and over to get a reliable answer? Aside from the fact that respondents resent repetitive scale content, this strategy has been criticized as yielding only what Cattell called “bloated specifics”: The facet scale would be too narrow. For a trait such as angry hostility there may be several distinct expressions: Characteristically angry people may be resentful, or touchy, or aggressive, or frustrated, or contemptuous, and a broad facet scale would sample all these different expressions.

An individual might be resentful and touchy on one occasion and aggressive and contemptuous on another. In that case, their level of angry hostility would be more or less constant (as traits by definition are), but the expressions would not be, and thus they would not qualify as traits. Alternatively, resentment and touchiness and the other expressions might themselves be stable characteristics, and thus qualify as traits at a lower level. McCrae (2015) called such traits-beneath-facets *nuances*. Empirical analyses of individual items fully support this view. In addition to the trait assessed by the facet scale to which they are assigned, items also have unique variance specific

to the item. This specific variance is heritable, stable over time, and consensually agreed-upon by different observers (Möttus, Kandler, Bleidorn, Riemann & McCrae, 2017). Nuances are very narrow traits.

Nuances can help explain the nature of retest reliability (McCrae, 2015) and may account for some of the curiously detailed similarities of identical twins (Harkness & McNulty, 2002). Whether they (i.e., single items) will prove useful in predicting outcomes of interest remains to be seen.

BIOLOGICAL BASES OF PERSONALITY

Evidence from behavior genetics, cross-cultural and comparative studies make it abundantly clear that the FFM factors and facets have some biological basis, but relatively little is currently known about its nature. Five-Factor Theory (McCrae & Costa, 2008b) goes so far as to assert that personality traits are grounded solely in biology – although their *expression* is shaped by the psychological environment – yet it offers no clue as to what specific neurohormonal or neuroanatomical systems are involved. This avowed ignorance is consistent with our very limited understanding of how the brain functions (at least as regards personality). For example, hundreds of twin, family and adoption studies show that traits are heritable, but intensive efforts to identify specific genes associated with traits have had extremely modest success (McCrae, Scally, Terracciano, Abecasis & Costa, 2010).

Probably the most influential biological theories of personality were offered by Eysenck (1967) and Gray (1970; Gray & McNaughton, 2000). Gray’s Reinforcement Sensitivity Theory argued that personality traits arise because people differ in their sensitivity to punishments and rewards. He hypothesized that the brain includes two distinct systems, for behavioral inhibition (BIS) and behavioral activation (BAS), and these corresponded to variations on Eysenck’s personality dimensions of N and E, respectively. Scales to assess BIS and BAS have been developed (e.g., Carver & White, 1994) and they do show predictable associations with trait measures: BIS is correlated with N, and especially its Anxiety facet; BAS is correlated with E and its Excitement Seeking facet (Keiser & Ross, 2011). The conceptual links between punishments and negative affect, and between rewards and positive affect, are mirrored by empirical associations between N and unhappiness and between E and happiness (Costa & McCrae, 1980a). Refinements of Reinforcement Sensitivity Theory (Corr & McNaughton, 2012) have led to new and more differentiated measures, but they are still chiefly related to aspects of N and E (Corr & Cooper, 2016).

The chief merit of Eysenck’s and Gray’s theories was that they offered ways to test theories of personality within the experimental learning paradigms that dominated psychology in the twentieth century. The problem is that studies conducted in that tradition have yielded “a bewildering array of experimental findings” (Corr, 2004, p. 320)

that provide at best very mixed support. From the perspective of the FFM, these theories are also incomplete, because they do not address the biological bases of O, A or C.

With advances in the technology of neuroscience, there has been a revival of interest in identifying the biological mechanisms underlying personality traits. DeYoung (2015) has proposed Cybernetic Big Five Theory to account for the five factors in terms of brain structure and function. Following Gray, DeYoung associates N with punishment sensitivity and E with reward sensitivity; he sees O (or Openness/Intellect) as a domain concerned with “exploring the world perceptually, abstractly, and imaginatively” (p. 44); A as the basis of altruism and cooperation, and C as a regulator of rule-based behavior. Neuroimaging, electroencephalographic and pharmacological studies suggest a number of associations (Allen & DeYoung, 2017). For example, E is associated with the dopaminergic system and C with structures of the prefrontal cortex. The specific mechanisms involved have yet to be elucidated. As Allen and DeYoung pointed out, the technology of neuroscience research is expensive, and the field is consequently characterized by studies using small samples with low power. This has retarded progress, but there is reason to be optimistic about the future.

DESCRIBING CULTURES WITH THE FFM

The FFM is a model of the organization of personality attributes that works well around the world. It is therefore reasonable to ask if it can also be used to describe groups of people – even whole nations or cultures. Early studies suggest that there are at least three ways the FFM framework might be meaningfully applied at this superorganic level: Characterizing *ethos*, *national character* and *aggregate personality* (McCrae, Terracciano & 79 Members, 2005).

Ethos refers to the pervasive spirit of a culture (if such a thing really exists), reflected in its laws, customs and institutions. Compared to Europeans, Americans work long hours; American ethos might be described by high Achievement Striving, a facet of Conscientiousness. The traditions of excellence in literature, music and ballet suggest that Openness to Aesthetics is part of the Russian ethos. In two studies, McCrae (2009, 2017) asked natives and other experts to estimate the degree to which the constructs assessed by the thirty facets of the NEO Inventories characterized a particular culture. Five to twenty judges rated American culture and Japanese, German, Russian or Chinese culture. The judges generally agreed in their characterizations, and results seemed reasonable: Chinese culture was seen to be low in Openness to Values and high in Modesty; German culture was low in Impulsiveness and high in Competence. Much more data would be needed before one could determine the validity or utility of ratings of ethos.

National character refers to shared beliefs about the “typical” member of a nation: Americans are thought to be brash, the British to be reserved. To assess these national stereotypes, Terracciano and colleagues (2005) asked members of forty-nine cultures to describe the typical member of their own nation. (This is called an auto-stereotype, and research has shown that autostereotypes are similar to national heterostereotypes held by members of other nations; Hřebíčková & Graf, 2014.) Data were gathered using a thirty-item rating form assessing the thirty traits of the NEO Inventories. Analyses of data from almost 4,000 respondents showed that individuals held a wide variety of opinions, but shared a small common core of belief about each trait. When ratings from many judges were averaged, these consensual national stereotypes were highly reliable, with similar personality profiles across raters of different ages and genders. When the thirty scales were factored, five factors were indicated, and they clearly resembled N, E, O, A and C. The FFM thus appears to represent the structure of personality trait stereotypes as well as rating of particular individuals.

A series of analyses revealed several influences on consensual national stereotypes. By a kind of metaphorical logic, people living in colder climates are thought to be low on interpersonal warmth; people living in rich countries are assumed to be industrious (McCrae, Terracciano, Realo & Allik, 2007). Sometimes stereotypes are based on contrast effects. Americans and Canadians, although highly similar in language, religion, government and ethnic composition, are perceived as polar opposites in personality: In contrast to Americans, Canadians are seen as warm, unassertive, compliant and modest (Terracciano et al., 2005).

There is also some evidence that consensual national stereotypes are based to some extent on ethos. When judges' ratings of American, German, Japanese, Russian and Chinese ethos were correlated with consensual national stereotypes of these nations across the thirty facets, moderate agreement was found ($Mdn\ r = .46$; McCrae, 2017). Perhaps national stereotypes are influenced by knowledge of the customs, values and institutions of the nation.

Aggregate Personality Traits

The question of most interest, however, is whether consensual national stereotypes are accurate, or at least contain a grain of truth. This would seem to be a straightforward research problem: Does the judged personality profile of the “typical” citizen correspond to the assessed national mean profile? Thus, we need only compare, across a wide range of cultures, national stereotypes with aggregate (or averaged) personality traits.

Such a comparison assumes several conditions. First, the trait constructs must be the same. If, for example, differences in Introversion–Extraversion were meaningless in collectivistic countries such as China and Botswana, then comparisons with these cultures would not

be possible. But there is ample evidence that the traits of the FFM are found in virtually every culture (McCrae, Terracciano & 78 Members, 2005). Next, there must be reason to think that scores are numerically comparable – a property called scalar equivalence (van de Vijver & Leung, 1997). That is, each score must represent the same level of the trait in each culture. That requirement can be problematic when different translations of an instrument are used, or when members of one culture have different approaches to test-taking than those of another. Without scalar equivalence, a scale may be perfectly good when used to compare two members of the same culture, but useless for comparing people across cultures.

How does one establish scalar equivalence? As with construct validity, it is necessary to examine a pattern of evidence from multiple sources. One approach is to consider the internal evidence – the way in which items contribute to a scale, or facets to a factor. Such analyses suggest caution in comparing FFM measures across samples (e.g., Church et al., 2011).

But if there were no comparability of scores at all, then culture-level correlations (where aggregate personality traits are correlated with other features of cultures, such as gross domestic product or national life expectancy) would never be significant. Yet many significant and meaningful results have been reported from such analyses. For example, nations whose citizens are, on average, higher in O (and thus xenophilic and investigative) have greater financial investments in foreign countries (Niszczoła, 2014) and higher scientific outputs (Rossberger, 2014). High aggregate A and O are predictors of progressive environmental policies (Hirsh, 2014).

The most direct evidence on the validity of aggregate personality scores – and thus of the scalar near-equivalence of the instruments – comes from correlations across a range of cultures of aggregate scores themselves. Four studies (Bartram, 2013; McCrae, Terracciano & 79 Members, 2005; McCrae et al., 2010; Schmidt et al., 2007) have compared aggregate scores at the factor level, using both self-reports and observer ratings, adolescent and adult samples, and three different instruments. Unfortunately, the number of overlapping cultures was very limited, ranging from sixteen to twenty-eight, so statistical power was low. Nevertheless, of the forty convergent correlations reported, nineteen (48 percent) were statistically significant; the mean correlation was $r = .43$. Agreement across studies was not, however, uniform for the five factors: N was significant in every comparison, whereas A never reached significance.

Two of the studies (McCrae, Terracciano & 79 Members; McCrae et al., 2010) also examined agreement for the thirty facets of the NEO Inventories. These comparisons involved three sets of samples: self-reports from college students and adults; observer ratings of college students and adults; and observer ratings of adolescents aged twelve to eighteen on a revised version of the NEO-PI-R. Cross-observer agreement at the individual level is

typically higher for the longer and more reliable factor scales than for the brief facet scales, so one might expect that a lower proportion of facet scales than of factors would show significant agreement. In fact, however, the opposite was true. Of ninety comparisons, sixty-nine (77 percent) were significant; the mean correlation was $r = .48$. Of particular importance is the fact that good agreement was found for all six facets of A – fourteen of eighteen comparisons (78 percent) were significant, mean $r = .52$ – despite the fact that there was never significant agreement on the A factor. It remains a mystery why aggregate scores are apparently more valid at the facet level than at the factor level; studies including much larger samples of cultures will probably be needed to resolve that issue. But one clear implication is that researchers who wish to understand the country-level correlates of personality traits ought to analyze facets as well as factors. Facet scores for a number of countries are tabulated for researchers in McCrae (2002) and McCrae and Terracciano (2008).

Personality profiles based on facet scores form the basis of one of the most striking pieces of evidence in favor of the validity of aggregate scores: their geopolitical coherence. Figure 9.2 shows the results of a multidimensional scaling of the similarity of aggregate profiles across the thirty NEO Inventory facet scales, based on observer ratings. Cultures near each other in the figure have similar profiles. Note that the left side of the figure (associated with introversion) contains almost exclusively African and Asian cultures; the right, extraverted, side is dominated by English-speaking cultures. Germans are found at the bottom of the figure; French and Italians at the top, where Neuroticism is generally high. Very similar results have recently been reported in a sample of sixty-two countries based on self-report data (Allik et al., 2017), except that the German-speaking samples are found in the upper portion of the figure in that analysis. In both analyses, the main contrast is between Western cultures (on the right) and non-Western cultures (on the left).

Similarities are more closely related to ethnicity than to geographical proximity: South African Whites are found on the right; South African Blacks on the left (Allik et al., 2017). Similarly, ethnicity is more important than the language in which the test was administered. As Figure 9.2 shows, Ugandans, who completed the NEO Inventory in English, are closer (i.e., more similar in personality profiles) to Burkinabé, who completed the French version, than they are to English or Americans.

Definitive maps of personality profiles and definitive country-level scores for use in research would require larger and more representative samples from a very broad sample of cultures. Multiple measures of the FFM, and both self-reports and observer ratings should be gathered in each sample. This large-scale project would provide social scientists with a valuable tool for understanding personality and culture.

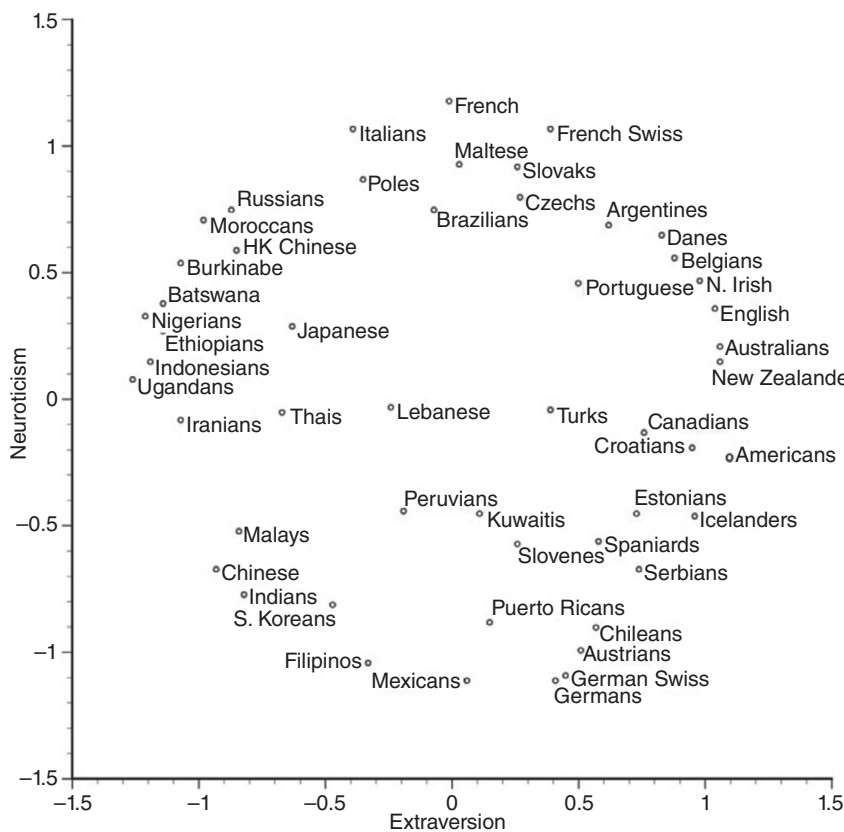


Figure 9.2 Multidimensional scaling plot of fifty-one cultures based on a distance matrix of $(1 - \text{Pearson } r)$ for the thirty Revised NEO Personality Inventory facet scores, standardized across cultures. The vertical axis is maximally aligned with N (Neuroticism), the horizontal axis with E (Extraversion). From McCrae, Terracciano & 79 Members, 2005

The (In)Accuracy of National Character Stereotypes

Given the pattern of evidence for the reasonable validity of aggregate personality scores, we can return to the question of the accuracy of national character stereotypes. The result is straightforward: There is essentially no relation between the two indicators of a nation's personality. In this case, stereotypes appear to be almost completely misleading (Terracciano et al., 2005). Different as Canadians and American are perceived to be, in fact they have very similar trait profiles. The British are almost universally regarded as being reserved, when in fact they are among the most extraverted of peoples (see Figure 9.2). These null findings, however counterintuitive, have been replicated in other studies using more sophisticated measures of national stereotypes (Hřebíčková & Graf, 2014; McCrae et al., 2013).

The fact that national character stereotypes are not accurate reflections of aggregate personality does not mean that they are unimportant. Such stereotypes influence people's perceptions of strangers, the treatment of ethnic groups, and even international relations. Understanding stereotypes and their determinants remains a key issue for social scientists.

CONCLUSION

The FFM is a comprehensive hierarchical model of personality traits that is applicable to adolescents and adults

around the world. It can be assessed through self-reports or observer ratings, and it provides a characterization of the individual that retains its validity for many years. The FFM also provides a reasonable conceptual framework for understanding the ethos of nations; a psychometrically sound way to quantify the (largely erroneous) stereotypes of national character; and a useful tool for research on the aggregate personality traits of human groups and these traits' social consequences. It may someday prove as useful in the broader social sciences as it has shown itself to be in psychology.

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10 Personality and Intelligence

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INTRODUCTION

What are intelligent people like? The goal of this chapter is to outline the relationships between personality and intelligence. First the correlations between personality and intelligence at the phenotypic (observed) level will be described. This section will include personality trait and factor studies as well as recent research examining the relationship between general intelligence and the General Factor of Personality (GFP). Then we discuss how intelligence and personality may be jointly influenced developmentally and we conclude with a summary of behavior genetic studies which have examined the correlations between personality and intelligence at the genetic and environmental levels. This chapter concludes with a review of how each construct influences responses to the other measures, in particular, how personality is more differentiated (variable) at higher levels of intelligence and how intelligence score variability possibly differs for individuals with certain personality profiles.

RELATIONSHIPS BETWEEN PERSONALITY AND INTELLIGENCE

Before delving into the correlations found between personality and intelligence, it should be noted that robust relationships between the two constructs should not be expected because of the fact that the two dimensions are measured using different types of instruments. While both constructs are complex and multi-factorial, intelligence is typically assessed using maximum ability/performance measures in which the responses are scored as correct or incorrect. This scoring system then suggests that the greater the number of questions answered correctly, the higher the intelligence score. In contrast, personality is assessed by asking participants to self-report how they typically behave, act, think and feel about certain conditions they may experience in the environment. For example, asking an individual how much they enjoy the feeling of sand between their toes while standing on a beach is face valid when assessing a personality construct

such as sentience (Jackson, 1989), but does not have a correct or incorrect answer. Therefore, because the two dimensions are measured with different types of scales, the consistency in findings, as opposed to the magnitude of the correlations, is typically of interest.

Personality has been found to be related to certain dimensions of intelligence such as: a positive relationship between introversion and spatial abilities (Gormly & Gormly, 1986); assertiveness and tough-mindedness with spatial abilities (Cooper, 1974); introversion and verbal abilities (Robinson, 1982, 1985, but see Eysenck, 1993; Paisley, 1983; Saklofske & Kostura, 1990 for contradictory findings); visual spatial abilities and verbal intelligence in women (Ozer, 1987); extraversion and emotional stability with intelligence (Ley, Spelman, Davies & Riley, 1966); extraversion and verbal intelligence (across grades 4 to 8 in children, see Jensen, 1973); extraversion and intelligence in children (Anthony, 1973; Lynn, Hampson & Magee, 1983); moderate levels of venturesomeness and intelligence (Rawlings & Skok, 1993); a negative relation between psychoticism and intelligence (Eysenck, 1993; Lynn et al., 1983); a negative relation between verbal intelligence and social desirability response styles (Evans & Forbach, 1982); and a positive relationship between intelligence and assertiveness and self confidence in men and women (Samuel, 1980). Furnham, Forde and Cotter (1998) have reported that intelligence is positively related to neuroticism. In contrast, Windholz (1968) found that university students who were higher in intelligence were more emotionally stable, suggesting low neuroticism scores. Austin, Deary and Gibson (1997) as well as Holland, Dollinger, Holland and MacDonald (1995) found that intelligence is positively related to agreeableness, although Austin et al. (1997) only found this relationship with verbal intelligence and Holland et al. (1995) reported that agreeableness was significantly related to full scale and performance intelligence and not verbal intelligence. In contrast, Allik and Realo (1997) found a negative correlation between agreeableness and intelligence.

Turner, Willerman and Horn (1976) reported that for adult men and women, full scale, verbal and performance

intelligence had significant positive correlations with a personality factor called Temperamental Independence. This personality factor has also been given the label of field independence (see also Cattell, 1987, p. 445) and includes personality traits such as dominance, unconventionalism, radicalism and self-sufficiency. In addition, full scale, verbal and performance intelligence in men and performance intelligence in women were found to be significantly correlated with a personality factor labelled Cortertia, a factor which includes the personality traits of cheerfulness, alertness and low sensitivity. Bolton (1980) was able to replicate the results found by Turner et al. (1976) with the Independence and Cortertia personality factors with the exception of nonsignificant correlations between Cortertia and intelligence in their sample of women. Recently Schermer and Goffin (2018) also found that independence had a significant positive correlation with general intelligence and that submissiveness correlated negatively with intelligence.

In an effort to combine the mixed results, Ackerman and Heggestad (1997) conducted a meta-analysis of the correlations between personality and intelligence. The results of general intelligence with the Five-Factor Model of personality (openness to experience, conscientiousness, extraversion, agreeableness and neuroticism) demonstrated a positive correlation with openness to experience, a negative correlation with neuroticism (which was labelled as "stress reaction"), a small but significant positive correlation with extraversion, and nonsignificant correlations with conscientiousness and agreeableness. Since their meta-analysis, there have been many studies examining the personality and intelligence relationship question. Commonly found are significant positive correlations between openness to experience and intelligence (DeYoung, Quilty, Peterson & Gray, 2014; Kretschmar, Spengler, Schubert, Steinmayr & Ziegler, 2018). Furnham and Chamorro-Premuzic (2006) reported significant positive correlations between openness and conscientiousness with intelligence in one of three studies of student participants. Moutafi, Furnham and Crump (2003) examined how personality may predict intelligence scores. High openness to experience and low scores on extraversion, neuroticism and conscientiousness were found to predict intelligence scores in a sample of adults undergoing occupational assessments. In a sample of university students (Rikoon et al., 2016), openness to experience and agreeableness were found to correlate positively with intelligence, and neuroticism was found to correlate negatively with intelligence. Major, Johnson and Deary (2014) reported that intelligence was negatively correlated with social closeness and tidiness in adolescents. Furnham and Thorne (2013) reported that the personality dimension, need for cognition, correlated significantly with intelligence. Openness to experience was also found to have a positive correlation with intelligence and a significant negative correlation between intelligence and conscientiousness was also reported (Furnham & Thorne, 2013).

When the conscientiousness factor was assessed at the lower facet level, Rikoon et al. (2016) found that although conscientiousness as a factor had only small positive correlations with intelligence, facets such as perfectionism and cautiousness had slightly higher positive correlations with intelligence.

When examined at the scale level, similar to the facets described above, more robust correlations with intelligence tend to be found. Harris (2004) examined scales assessing openness to experience and need for achievement with measured intelligence. Spatial intelligence was moderately correlated with scales assessing ideas, endurance and innovation. Verbal intelligence had more significant correlations with personality and was found to correlate with ideas, achievement, endurance, understanding, breadth of interest, complexity and innovation. Furnham and Moutafi (2012) reported a similar pattern between scales and intelligence in a sample of managers. In particular, intelligence was found to have moderately high correlations with the personality dimensions of perceiving, control, capacity for status, sociability, social presence, self-acceptance, independence, empathy, tolerance, intellectual efficiency, mindedness, flexibility, realization and achievement. Negative correlations were found between intelligence and sensing, internality and norm-favoring. Powell and Nettelbeck (2014) examined scales assessing intellectual curiosity and intelligence, and found positive correlations between intelligence and conscientiousness, openness to ideas, typical intellectual engagement, epistemic curiosity and need for cognition. Kornilova and Novikova (2012) found a positive correlation between intelligence and tolerance for uncertainty and a negative correlation between intelligence and faith in intuition in a sample of students. Djapo, Kolenovic-Djapo, Djokic and Fako (2011) reported the correlations between intelligence and two personality scales in a sample of students. Positive correlations were found between intelligence and reasoning, being private and self-reliance. Negative correlations were reported between intelligence and warmth and rule conscientiousness. Interestingly, when tough-mindedness was examined, a positive correlation was found with fluid intelligence but a negative correlation was found with crystallized intelligence. These results do suggest that the relationship between personality and intelligence may be better explored at the scale levels for both constructs.

In contrast to examining personality at the scale level, recently there has been an interest in the correlations between general intelligence and the GFP. The GFP has been defined, by some, as the pinnacle of personality, reflecting a meaningful construct of human character (Dunkel, van der Linden, Beaver & Woodley, 2014; Rushton, Bons & Hur, 2008). In contrast, others have defined the GFP as a statistical artifact or response style dimension of little value (de Vries, 2011; Holden & Marjanovic, 2012; MacCann, Pearce & Jiang, 2017; Revelle & Wilt, 2013; Schermer, Holden & Krammer, 2019; Schermer,

Krammer & Goffin, 2019). In their meta-analysis of the Big Five measures of personality (openness to experience, conscientiousness, extraversion, agreeableness and neuroticism), van der Linden, te Nijenhuis and Bakker (2010) concluded that high GFP individuals were “open-minded, hard-working, sociable, friendly, and emotionally stable” (p. 316), suggesting that the GFP reflects almost the best of human character.

In general, the correlations between the GFP and general intelligence have had mixed results. Schermer, Carswell and Jackson (2012) found nonsignificant correlations between intelligence and the GFP and only a small significant negative correlation with extraversion and verbal intelligence. Neither the GFP nor the personality factors were found to correlate significantly with intelligence in a sample of job recruits reported by Schermer and MacDougall (2013). In contrast, Dunkel et al. (2014) reported a small positive significant correlation between a GFP and general intelligence. Schermer and Vernon (2010) also found a significant positive correlation between general intelligence and a GFP. In possibly the only behavior genetic study, Loehlin, Bartels, Boomsma, Bratko, Martin, Nichols and Wright (2015) concluded that the correlation between the GFP and intelligence was not due to common genetic factors. In general, the correlation between the GFP and general intelligence does seem to be higher when the GFP is mainly composed of openness dimensions (and reflects the correlations reported by Ackerman & Heggestad, 1997).

DEVELOPMENT OF PERSONALITY AND INTELLIGENCE

Intelligence has been suggested to influence the development of personality and in how an individual functions and is treated by others in society (Baron, 1984; Block & Kremen, 1996; Donahue & Satter, 1971; Kandel, Mednick, Kirkegaard-Sorensen, Hutchings, Knop, Rosenberg & Schulsinger, 1988). Lohman and Rocklin (1995) proposed that personality and intelligence may be interrelated constructs in that they may represent control processes or strategies people employ when behaving. Chiu, Hong and Dweck (1994) have suggested that the processes involved in personality and intelligence never act independently of each other or in isolation, and should be considered as two components of a single process. Plant and Minium (1967) reported that for college students, individuals higher in intelligence develop more socially desirable characteristics over time, such as decreases in authoritarianism and dogmatism, than do individuals lower in intelligence.

In a longitudinal study of fifty men and sixty women, who were first tested at the age of twenty-one months and again at regular intervals over forty years, Honzik and Macfarlane (1973) reported that intelligence in adulthood was stable (correlations for verbal intelligence were .69 and .78 for men and women and .58 and .62 for men and women in performance intelligence from age eighteen to

age forty) and that certain personality characteristics were associated with intellectual gain. In particular, those individuals who gained intelligence (scored higher on intelligence tests at age forty when compared to age thirty) were described at childhood as being neither extremely masculine nor feminine and were not gregarious. Significant correlations were also found between intelligence gains and personality characteristics at age thirty. Individuals who gained on the intelligence test were rated, as adults, as having a high intellectual capacity, as verbally fluent, as valuing cognitive matters, as having high aspirations for themselves, as being concerned with philosophical problems and as feeling guilty. Men, but not women, who gained intelligence points were described as introspective, unsatisfied with their physical appearance, as being unresponsive to humour, as having preoccupying thoughts, and as adults, not being cheerful. Women, but not men, who gained intelligence points were described, at age thirty, as having a wide range of interests and as not being nurturing. In general, Honzik and Macfarlane (1973) described the highly intelligent individuals as self-critical, as introspective and as not being interested in other people. Interestingly, in a separate longitudinal analysis across forty years, Spengler, Brunner, Damian, Lüdtkke, Martin and Roberts (2015) reported that childhood intelligence negatively correlated with a sense of inferiority and pessimism in adulthood which is in contrast, somewhat, to the self-critical and introspective characteristics found by Honzik and Macfarlane (1973).

In a recent longitudinal study, Wettstein, Tauber, Kuźma and Wahl (2017) examined how two groups of adults, one in their mid-forties and the second in their sixties, changed in their personality and cognitive abilities across twelve years. When the Big Five factors were examined as possible predictors of changes in cognitive scores, openness to experience was found to correlate with increases in crystallized ability scores, suggesting that the inquiring person may increase their knowledge over time. In the older group only, agreeableness predicted greater information processing speed. Conscientiousness predicted an increase in processing speed in the younger group only and in both groups, conscientiousness predicted a decrease in crystallized ability. Neither extraversion nor neuroticism significantly predicted changes in cognitive abilities. When examined in reverse, some ability measures assessed at the first test time predicted changes in personality twelve years later. Significant consistent findings were found for neuroticism, extraversion and openness to experience, but not for agreeableness and conscientiousness. In particular, both crystallized and fluid intelligence predicted a later increase in extraversion and a decrease in neuroticism. A decrease in information processing speed predicted an increase in neuroticism, suggesting greater anxiety being expressed by individuals when it takes them longer to process information. Openness to experience scores increased over time for individuals higher in the three ability measures of information

processing speed, and both fluid and crystallized intelligence. Furnham and Cheng (2016) also examined intelligence and openness to experience in a longitudinal data set. In their study, Furnham and Cheng (2016) reported that intelligence in childhood predicted openness to experience scores in adulthood. These results, in conjunction with the results reported by Honzik and Macfarlane (1973) suggest that although personality and intelligence are fairly stable characteristics over adult years, the two constructs may influence each other. Described below are examples of studies which have examined the relationship between personality and intelligence in younger samples.

Personality and intelligence scores of parents have also been suggested to influence the personality and intelligence development, and resulting test scores, of their children (see Bouchard, 1995, for a review). This hypothesis is grounded in the view that both of these major individual difference constructs have a significant genetic basis. Johnson, Nagoshi, Ahern and Wilson (1983) investigated personality and intelligence correlates in 118 families. Across individuals, intelligence was found to correlate positively with stability, a trusting personality, extraversion, masculinity, dominance, imaginativeness, artless (versus shrewd), placidness and self-sufficiency. Across generations, parents of higher intelligence tended to have children who were orderly and emotionally stable, and children who were higher in intelligence tended to have parents who were rebellious and who scored low on energy level.

Harris, Vernon and Jang (2007) examined the relationship between measured intelligence of young children (four- to six-year-old twins) and their caregiver's ratings of the child's personality. Personality was assessed using 130 adjectives and the data were found to best fit a five-factor solution. Intelligence was assessed using a standardized intelligence test. In general, a similar pattern of correlations was found between rated personality and intelligence for verbal, performance and full scale intelligence scores. Children who scored higher on intelligence were rated as being agreeable, conscientious, introverted, emotionally stable (not neurotic) and warm (not psychotic). Of interest was that some of these observed (phenotypic) correlations were also found to have common genetic and environmental (both unique and common) correlations, suggesting that there may be genetic factors which may influence the relationship between personality and intelligence in addition to the effects due to the home (common environment).

Bratko, Butkovic, Vukasovic, Chamorro-Premuzic and von Stumm (2012) assessed the phenotypic (observed), genetic and environmental correlations between intelligence and the Big Five personality factors in a sample of young adult twins. Both at the phenotypic and genetic levels, intelligence had positive correlations with openness to experience and negative correlations with extraversion. Bartels, van Weegen, van Beijsterveldt, Carlier, Polderman, Hoekstra and Boomsma (2012) also examined the

phenotypic, genetic and environmental correlations between measured intelligence and the Big Five personality factors in a sample of young adult twins. Intelligence was found to correlate positively and significantly with agreeableness and openness to experience, and negatively with neuroticism. These phenotypic correlations were reported to be almost entirely due to common genetic factors.

In two bivariate genetic analyses of adult twins, fairly consistent patterns were found for the observed phenotypic correlations between measured intelligence and personality assessed using a questionnaire (Harris, Vernon & Jang, 1998) and adjectives (Harris, Vernon, Olson & Jang, 1999). In both studies, intelligence was found to be significantly correlated with autonomy (questionnaire scale) and an independent adjective factor. Possibly intelligence provides an individual with the skills to be more self-sufficient. In particular, Harris et al. (1998) found that there was a negative correlation between intelligence and succorance which is defined as seeking sympathy from others (a dimension which is negatively correlated with independence). Also across the two studies, intelligence was positively correlated with inquiring (adjective) and a need for understanding (questionnaire) suggesting that intelligent people have a desire to know about their environment. In contrast with the personality rating study of young children, many of the phenotypic correlations found in the adult twin studies had significant genetic and unique environmental correlations but no significant common environmental correlations. Possibly the difference in twin ages explains the reduction in common environment effects. Young twins may be more influenced by their parental environment, as described above in the family study by Johnson et al. (1983). As children age, the influence of the common (family) environment decreases in explaining individual differences and factors such as peers have a greater influence (Harris, 1995; Scarr, 1996).

The suggestion from all of the above findings is that intelligence and personality are not independent dimensions, and that by looking at how the two areas relate, a further understanding of individual differences can be obtained. This argument is similar to the positions taken by researchers such as Allport (1961), Anastasi (1968), Brand (1994) and Maciel, Heckhausen and Baltes (1994). Further research had examined how personality may differ based on a person's level of intelligence and how intelligence scores may differ for people based on their personality profiles. These two related questions are discussed below.

DIFFERENTIATION OF PERSONALITY BY INTELLIGENCE HYPOTHESIS

A major impetus behind exploring the relationship between personality and intelligence is that the structure of personality, and of intelligence, may differ for

individuals at different levels of intelligence. In addition, the structure of intelligence, and of personality, may differ for individuals at different ends of some personality traits.

Spearman (1927) reported that the influence of 'g', or general intelligence (Spearman, 1904) is less noticeable for individuals higher in intelligence. In Spearman's model, *g* is regarded as the first unrotated factor when a battery of ability tests are factor analyzed. Spearman (1927) found that for certain individuals, such as with older adults, the factor loadings for the first unrotated factor (the *g* factor) were smaller than the factor loadings for children. Spearman suggested that when individuals mature, they become more differentiated in their intellectual abilities such that performance on specific factors will increase thereby reducing the factor loadings on the *g* factor.

A possible explanation of the differentiation of intelligence is posited by Ferguson (1954) who suggested that this increase in differentiation of intellectual abilities is due to specific learning situations. In Ferguson's model, the positive inter-correlations among ability measures are due to the transferring of knowledge, in the sense that an individual's ability to perform certain tasks, such as manipulating symbols, is used (or transferred) to some degree in most ability tests. It is the unique learning experiences of the individual, over time, which cause specialization in abilities. These areas of specialization explain why individuals who are older show greater differentiation in their abilities than younger people, who have not had as many unique learning experiences and have not developed specialized areas of ability. A similar explanation of the differentiation of intelligence is presented by Anderson (1992) who suggests that people develop specific skills which they can execute quickly, hence causing more variation in their scores on a battery of ability tests, resulting in lower *g* factor loadings.

Multiple studies have been conducted on age and the differentiation of intelligence. Burt (1954) reported that the first unrotated factor (a general intelligence factor) accounted for less variance in scholastic ability tests when older boys were compared to younger boys. Garrett (1946) reviewed past findings, available at that time, of the differentiation of intelligence with increasing age. One of the criticisms common to the differentiation studies was that different ability tests were used for the young groups versus the older groups (see also Carroll, 1993). Garrett (1946) reported that even when the same test battery is used, the average inter-correlations among the ability tests decrease for the older samples.

In another review of studies investigating the differentiation of intelligence with age, Anastasi (1970) reported results which suggest that differentiation of intelligence does increase with age when the test participants consist of students. When adult groups are compared, in terms of the inter-correlations among ability measures, the results suggest that those groups with the greater amount of education show the greatest degree of differentiation in their

intellectual skills (lowest inter-correlations among ability tests). These findings support Ferguson's (1954) suggestion that specific learning situations increase intellectual differentiation.

The differentiation of intelligence has also been examined for groups of people differing on other characteristics such as sex and socioeconomic status (Anastasi, 1970). For example, Filella (1960) examined the factor structures of an ability test battery in groups of boys and girls of the same age who attended technical, public and private schools. Type of school was characteristic of different socioeconomical levels, with government funded (technical/ public) schools of a lower level than private schools. The results of the factor analyses found that intelligence was more differentiated in the upper socioeconomic status groups (the private schools) than in the lower level groups (technical and public schools). Girls were also found to be more differentiated than were boys.

The differentiation of intelligence has also been examined for people differing in intelligence, based on the hypothesis that people higher in intelligence will show greater differentiation (lower *g* factor loadings) than will people who have lower intelligence scores. Detterman and Daniel (1989) compared the average ability test inter-correlations for groups of people divided into five intelligence groups based on their vocabulary test scores. The vocabulary test was chosen because of the high factor loading this scale has on a general intelligence or *g* factor. The results demonstrated that the inter-correlations among the intelligence scales were higher for individuals who had lower vocabulary scores than for individuals with higher vocabulary scores. This pattern was found to be repeated when groups were constructed based on their information scale scores (another scale which demonstrates a high factor loading on a general intelligence factor). The results support the hypothesis that individuals higher in intelligence have more intellectual differentiation than do individuals lower in intelligence.

The results found by Detterman and Daniel (1989) were then replicated by Lynn (1992) in a Scottish sample and by Deary and Pagliari (1991) who re-analyzed a dataset collected originally by Spearman (1904). Deary, Egan, Gibson, Austin, Brand and Kellaghan (1996) also reported evidence that individuals higher in intelligence had more intellectual differentiation than did individuals lower in intelligence based on data from school children. These studies, which support an increase in intellectual differentiation for individuals who are higher in intelligence have led Detterman (1991) to ironically suggest (in jest) that the *g* factor should be regarded as 'stupidity' because the first unrotated intelligence factor accounts for more variance in a battery of ability measures for individuals with lower intelligence scores.

The study of the differentiation of intelligence has not been limited to investigations based on age, sex, socioeconomic status or level of intelligence. The structure of intelligence may also differ in people with certain

personality characteristics. Eysenck and White (1964) reported a different factor structure of intelligence for children based on their neuroticism scale scores. Children who were stable (had low scores on a neuroticism test) were found to have three intelligence factors and neurotics (labile children) were found to have two intelligence factors when the same intelligence test battery was analyzed for the two groups separately using the same procedure for factor extraction and rotation. The influence of neuroticism on intelligence was further investigated by Austin, Deary and Gibson (1997) with a sample of adults who had completed two intelligence measures. The correlation between the two intelligence measures was higher for those individuals who were more neurotic than for those who were less neurotic. In a follow-up study with two large samples, Austin, Hofer, Deary and Eber (2000) replicated their findings and suggested that there was greater differentiation in ability for the less neurotic sample. Austin et al. (2002) further examined the relationship between personality and intelligence in four data samples. Openness to experience was found to correlate positively with intelligence. Because other personality dimensions were also investigated, Austin et al. (2002) further reported that adaptive personality traits, such as hard driving, were positively correlated with intelligence and maladaptive traits, such as hostility, were negatively correlated with intelligence. When neuroticism was examined, the intercorrelation between intelligence scales was found to increase (become less differentiated) with higher neuroticism scores.

In contrast to the findings reported above, Bonaccio and Reeve (2006) tested the differentiation of intelligence by neuroticism hypothesis and found no evidence to support the hypothesis in two different datasets. Escorial, García, Cuevas and Juan-Espinosa (2006) also concluded that personality, based on the Big Five factors, did not influence the structure of intelligence. For each personality factor, three subgroups of students were created, representing low, medium and high scorers. Escorial et al. (2006) reported no differences in the variability of cognitive ability tests across the personality subgroups. From these contradictory findings, how the structure of intelligence may or may not differ for individuals based on their personality is an area requiring further research.

In addition to assessing how the measurement variability of intelligence may differ across intelligence and personality dimensions, the differentiation of personality by intelligence hypothesis has been assessed in a few studies. Shure and Rogers (1963) demonstrated that the factor structure of personality scales differed for individuals with different levels of intelligence. In particular, three ability groups, low, medium and high, were generated, each with 100 male university students. Individuals completed a multidimensional personality scale which was factor analyzed within each ability group. Although five factors appeared in each group, both the percentage of variance accounted for by each factor and the nature of the factors

(defined by which personality scales loaded onto the factor) differed across the ability groups. For example, an integrity personality factor accounted for more variance in the high ability group, suggesting that the personality factor was more robust for that sample. Individual personality scales, such as achievement, were found to load onto different factors depending on the ability level of the group. Based on these findings, Shure and Rogers (1963) suggested that if samples are drawn from different ability groups, personality factor definitions could change dramatically, even if the same battery of personality scales is used.

McLarnon and Carswell (2013) examined how each test item related to the factor structure of the six-factor personality model (openness to experience, methodicalness, industriousness, extraversion, agreeableness and neuroticism) for individuals grouped by intelligence (low, medium and high intelligence scores). For all six factors, the items did not demonstrate factorial invariance across the intelligence groups and concluded that intelligence influences how people respond to personality items. Murray, Booth and Molenaar (2016) also examined the factor invariance of personality scales, looking not at the factors across measured intelligence, but across self-report intelligence levels, in particular, reasoning abilities. Only one personality scale, anxiety, showed differentiation whereas the other fourteen scales assessed did not show differentiation. These results should be taken with caution as self-report intelligence was employed to generate the "intelligence" groups, which would represent the individual's assessment of their own abilities and not measured intelligence. Although some researchers have reported small but significant correlations between self-assessed intelligence and measured intelligence (for example, see Paulhus, Lysy & Yik, 1998), ideally intelligence would be assessed using standardized measures.

Harris, Vernon and Jang (2005) tested the differentiation of personality by intelligence hypothesis by first generating high and lower intelligence groups based on a median split of the intelligence scores. Because the sample of adults examined had also completed a personality scale measuring twenty traits, the two intelligence groups were compared across these personality traits as well as the five higher-order personality factors generated from the twenty traits. Examined were both possible differences in personality variance and mean differences for the two intelligence groups. For the twenty traits, significant variance differences were only found for cognitive structure, endurance and play, each with greater personality variability in the higher intelligence group. At the factor level, the higher intelligence group was more variable on the extraversion and conscientiousness factors. With respect to mean score differences, the higher intelligence group also scored higher on achievement, autonomy, change, dominance, exhibition, sentience, social recognition, need for understanding and the factors of extraversion, aggressiveness and openness. The lower intelligence group

scored higher on harm-avoidance and succorance and the personality factor labelled defensiveness suggesting a less independent personality profile than for the higher intelligence group.

In a follow-up study, Harris, Steinmayr and Amelang (2006) tested personality differences, both mean scores and variability, in adults and children each separately grouped into three intelligence groups (high, medium and lower intelligence). Although some of the findings with the adults suggested greater variability in personality in the higher intelligence group, the results with the children failed to support the differentiation of personality by intelligence hypothesis. In terms of mean differences, for both adults and children, neuroticism was highest in the lower intelligence group. Extraversion and affiliation had a reverse pattern across intelligence groups for the adults versus children. The higher intelligence group for adults tended to be more social but for children, the lower intelligence group was the more social.

Blas and Carraro (2011) examined the differentiation of personality by intelligence hypothesis in a sample of children. Used were ability test scores and a measure of interpersonal behavior from the children as well as their personality characteristics, as rated by their parents. Intelligence was found to correlate with the children's self-reported benevolence. Parents who rated their children as conscientious and imaginative were also found to have higher intelligence scores. When children were grouped based on their intelligence, into low, medium and high groups, the correlations between personality scores were found to be lower in the higher intelligence group, suggesting more unique variability.

Lechner and Rammstedt (2015) examined the differentiation of personality by intelligence hypothesis in a sample of older adults. Adults lower in intelligence and who were older were found to engage in more acquiescence responding, suggesting that acquiescence may explain some of the differentiation effects. If individuals do not understand the questions well due to lower intelligence or age-related cognitive decline, then they may agree to items regardless of the content which would result in a reduction of variance, which in turn, reduces possible covariance among personality scales. If the personality structure differs for people at different intelligence levels and if the structure of intelligence differs for individuals based on their personality, then studying the relationship between personality and intelligence has major implications, such as in the definition of factors extracted from test batteries. Brand, Egan and Deary (1994) have suggested that individuals higher in intelligence may show greater differentiation in personality similar to the greater degree of differentiation of ability for individuals with different intelligence scores. Although Brand et al. (1994) did not report any supporting evidence for their theory, some researchers have found that the correlations between personality traits differ for individuals at different levels of intelligence. Allik and Realo (1997) reported that different personality dimensions correlated

with intelligence when the inter-correlations of a high ability group were compared to a low ability group. For example, Allik and Realo (1997) report that for individuals scoring lower on an intelligence test, intelligence correlated significantly with excitement seeking and openness to fantasy. For a group of individuals scoring higher on the intelligence test, Allik and Realo (1997) reported that intelligence correlated significantly, and in the negative direction, with conscientiousness, agreeableness, warmth, positive emotions and openness to fantasy. These results support the theory that intelligence may be related to different personality traits for individuals differing in abilities, although the differentiation of the personality traits was not directly examined in the study.

CONCLUSION

We return to the question at the start of the chapter, "what are intelligent people like?" From the evidence reviewed above, intelligent people tend to be open to experiences as found in the meta-analysis by Ackerman and Heggestad (1997). Intelligent people tend to be critical of themselves as found in the longitudinal study by Honzik and Macfarlane (1973) but also more adaptive, as reported by Austin et al. (2002). Intelligent people are also inquiring, ambitious and need to understand their worlds, as demonstrated in the twin analyses by Harris et al. (1998, 1999). The differentiation research has demonstrated that both the structure of intelligence may vary for some personality dimensions, such as neuroticism (Eysenck & White, 1964; but see Bonaccio & Reeve, 2006), and that the structure of personality may differ across people depending on their intelligence scores. Possibly, from combining the research findings, the conclusion may be reached that intelligent people are more "quirky" when compared to less intelligent people both in their personality characteristics and in their intellectual abilities.

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PART III

**DEVELOPMENT,
HEALTH AND
CHANGE: LIFE SPAN
AND HEALTH
OUTCOMES**

11

Temperament and Brain Networks of Attention

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INTRODUCTION

Temperament is linked to the structure and function of the nervous system and to the experience of the organism. When we measure the person's readiness to anger, to seek reward, to focus and switch attention, etc., we are measuring temperament and these in turn are linked to brain networks. Hyperreactivity to an unexpected, novel or intense stimulus, is also a measure of temperament important in understanding the development of behavior problems in children and psychopathologies of stress and attention in adults (Rothbart, 2011; Zentner & Shiner, 2012). Studies of resting state MRI have allowed tracing humans brain changes from birth (Gao et al., 2016), allowing examination of the development of attention and other networks early in life. The advance of epigenetic studies (Meaney, 2010) has offered a framework for thinking about the how the environment and gene expression work in concert to produce the pattern of connectivity unique to the individual.

It is important to separate temperament tendencies from more general personality traits, because temperament allows for an understanding of the developmental processes that shape personality and provides particularly close links with neuroscience. We have defined *temperament* as constitutionally based individual differences in emotional, motor, and attentional reactivity and self-regulation, showing consistency across situations and relative stability over time (Derryberry & Rothbart, 1997; Rothbart & Derryberry, 1981). The term "reactivity" refers to the latency, rise time, intensity and duration of the person's responsiveness to stimulation. "Self-regulation" refers to processes that serve to modulate reactivity, including orienting and effortful attention, along with motor tendencies toward actions of approach, withdrawal, inhibition, and self-stimulation.

Temperament does not refer to a single system, but to multiple systems that may inhibit or facilitate each other's expression (Rothbart & Sheese, 2007). Consider, for example how fear inhibits approach tendencies and withdrawal inhibits fear. We are increasingly finding

mechanisms of individual differences in reactivity and self-regulation at levels ranging from genes to culture. We do not expect temperament to remain stable across a life (Rothbart & Derryberry, 1981). If temperament is defined as reactivity and self-regulation, then the expression of temperament is in relation to some situational change. Experiences in strange situations with varying social demands and challenges require different adaptations. These depend on the constitution of the child, so that some children, when approached by a stranger, cry out in fear while others treat physical contact with pleasure. However, if the child is not confronted by these kinds of stimuli, any tendency to react will not be experienced and practiced. There is now strong evidence that abuse and neglect can increase distress proneness in children, and that traumatic experiences of military combat also lead to disruptions of reactivity and self-regulation. A developmental analysis would be most helpful here. A child may have a disposition to distress to overstimulation that is exacerbated by trauma occurring in both childhood and adulthood.

Temperament also influences children and adults through their perceptions of how people see them. Given the social construction of the self, temperament thus influences how we see, describe and behave toward others, and ourselves. Temperament also is pivotal in the study of the development of psychopathologies of behavior, stress and attention across the lifespan (Rothbart, 2011; Zentner & Shiner, 2012).

Recent personality research has often employed the Big Five or Five-Factor models of personality. The five (or three to seven) factors are extracted from multivariate analyses of trait descriptive adjectives and other personality items (Digman & Inouye, 1986). The Big Five approach has been based on the premise that all significant variations in personality are represented in language. Although of considerable interest, these models are incomplete. An infant personality researcher is immediately confused by the titles of the factors: Have you ever seen a conscientious infant? A neurotic infant? The traits

do not describe individual differences in early life, nor do they support the study of a person's complex adaptations during the course of development.

We have found particularly helpful the work of theorists and researchers with closer links to temperament and the nervous system, including Pavlov, Eysenck, Neblitsyn and Gray, and those in their research traditions. In the first short historical section of this chapter, we discuss these psychobiological traditions. We also provide a brief history of more recent temperament concepts and research. We then move to consider the biology of temperament in the structure of brain networks and their genes as exciting possibilities for the future.

HISTORICAL PERSPECTIVES

Temperament has been recognized since ancient times (Feng & English, 1972; Rothbart, 2011) in China and India. In this section however, we start with the typology of temperament described by Greco-Roman physicians, who linked temperamental characteristics to Hippocrates' model of the humoral constitution of the body (Diamond, 1974). In this fourfold typology, the *melancholic* person, quiet and moody, was seen as having a predominance of black bile; the *choleric* person as touchy, aggressive and active, with a predominance of yellow bile; the *sanguine* person as sociable and easygoing, with a predominance of blood, and the *phlegmatic* person, calm and even-tempered, with a predominance of phlegm. The typology was also related to psychopathology, with links between melancholia and depression, and the choleric temperament and aggression. Use of the fourfold typology persisted throughout the Middle Ages and the Renaissance, and can be found in the writings of Kant (1798/1978) and continues to be linked to temperament and personality research.

Pavlovian Efforts

In more recent times, a psychobiological research tradition on temperament has developed in both Eastern Europe and the West. The Eastern European tradition had its roots in Pavlov's (1935) laboratory, where temperamental differences were observed in studies of conditioning. Individual dogs given personal names were repeatedly observed in a variety of experimental settings. The researchers observed consistent differences in the temperament of the animals, which Pavlov linked to qualities of the central nervous system identified in their conditioning research. Pavlov proposed that dogs who could continue to increase the strength of a conditioned response under high intensity or prolonged exposure to stimulation possessed "strong" nervous systems; those who easily lost it had "weak" nervous systems.

Later research by Neblitsyn and Gray (1972), using laboratory and drug studies of humans, observed that individuals with weak nervous systems also showed lower

sensory thresholds than those with strong nervous systems. Problems developed for the tradition, however, when the nervous system properties thought to have been general proved to be highly dependent on the specific stimuli used and the specific responses measured in the laboratory (Strelau, 1987).

Questionnaire Studies

Early studies of temperament in the West, however, focused on identifying the structure of individual differences through analysis of questionnaire items. For example, Heymans and Wiersma (1906) asked 3,000 physicians to each observe a family (parents and children) and to fill out a questionnaire on each family member. Using the factor analytic procedures of the day, they identified three general factors and posited eight types of temperament. Webb (1915) and Burt (1939) also applied early forms of factor analysis to questionnaire items written to measure the individual's emotionality, self-qualities and intellect. Their work yielded factors of Extraversion–Introversion, Emotional Stability–Instability (later called Neuroticism by Hans Eysenck) and, in Webb's research, a factor of volition or Will, foreshadowing the later temperamental construct of Effortful Control.

Hans Eysenck (1947), like Pavlov, posited a physiological basis for temperament. His model first related Extraversion–Introversion to cortical excitation and inhibition, and Neuroticism to limbic system functioning. He later (Eysenck, 1970) offered a revised model of temperament based on the ascending reticular activating system and individual differences in arousability. Gray (1978) further revised Eysenck's theory by positing individual differences in dimensions of behavioral activation and inhibition, and in tendencies toward fight or flight. Gray's model continues to be one of the major psychobiological models of adult temperament, along with models put forward by Cloninger and colleagues (1993), Depue and Iacono (1989), Panksepp (1998), and Zuckerman and colleagues (1988). These models have been influential for contemporary research by drawing connections between temperament and personality although they say little about development.

Observations of Children's Development

Observational studies of children came later than adult work. Gesell's (1928) and Shirley's (1933) longitudinal studies established the normal sequences of motor and mental development. At the same time they noted striking temperamental variability among the children they observed (Gesell, 1928, as cited in Kessen, 1965; Shirley, 1933). In mid-century, Bergman and Escalona (1949) identified children who were strongly reactive to low intensities of stimulation in one or more sensory modalities, especially sight, hearing and touch, and Escalona's (1968) powerful concept of "effective experience" argued

that simply characterizing an environmental event does not accurately portray a child's experience of it. The social world is not experienced in the same way for all children, as can be seen when a vigorous hug from a visitor brings active pleasure to some infants but distress to others. The child's temperament also tends to evoke different responses from adults depending on the adult's attitude and expectations about proper child behavior. Temperament is further linked to the child's adaptations to the physical and social world (Rothbart, 2011).

In Europe, observation studies of temperament in infancy were also underway. Beginning in 1950, Meili studied three- to four-month-old Swiss infants' responses to unfamiliar stimuli and coded infants' reactions from filmed recordings. The three- to four-month-old infants' muscle tension and emotional distress to the unfamiliar objects predicted later reticence and shyness at seven and fourteen years (Meili-Dworetzki & Meili, 1972; Zentner, 2008).

Given these early advances in the study of child temperament, it is surprising that by the mid-twentieth century in the US, temperament was rarely discussed. Instead, social learning theories stressed the influence of reward and punishment in shaping individual differences, and cognitive development researchers stressed changes in children's thought and judgment. This situation was to change with the publication of the New York Longitudinal Study.

Thomas, Chess and the New York Longitudinal Study

It is difficult to overstate the influence of Thomas, Chess and their colleagues in the New York Longitudinal Study (NYLS; Thomas, Chess, Birch, Herzig & Korn, 1963). Chess and Thomas, themselves parents of adopted children, were convinced of the existence and importance of temperament in development. They undertook a study of a wide range of individual differences in infancy, collecting interviews on parents' observations of their children's actions and reactions. Beginning with a sample of twenty-two infants at three-six months of age, parents were interviewed at length about their child's behavior in varying situations such as feeding, the bath and play. The interviewer's goal was to get beyond general descriptions of the child to specific behaviors that would make observations more comparable.

Herbert Birch, who agreed to help the NYLS group make sense of their large body of data, asked that the situation and each infant's reaction to it be typed on a separate sheet of paper. He then inductively sorted the descriptions into categories that later would be called temperament dimensions (Chess & Thomas, personal communication, May 1992; Thomas & Chess, 1977). These dimensions were: (1) Activity level; (2) Rhythmicity (predictability of sleep, hunger, feeding and elimination); (3) Approach/withdrawal (response to novelty);

(4) Adaptability (ease of modification of child's response in desired directions); (5) Threshold of response; (6) Intensity (energy level); (7) Mood (negative versus positive); (8) Distractibility; and (9) Attention span/persistence. Notable among the identified dimension were two representing individual differences in attention. Although these are powerful networks in affecting responses like inhibition and activation, they have roles in fearful inhibition that need to be taken into account in understanding how brain networks relate to temperament.

The NYLS contributions have been extremely useful to the field, but an unfortunate aspect of the strength of their contribution is that the dimensions they identified over fifty years ago often appear to have been cast in stone. They are used in research and clinical work without revision, even when the need for their revision has been repeatedly demonstrated (Rothbart, 2011). Two other problematic contributions of the NYLS were their concept of the difficult child (Thomas & Chess, 1977) and their definition of temperament as style, i.e. the "how" of children's behavior (e.g. threshold, intensity, adaptability) rather than its links to specific emotions and attention. These views have been little changed.

Five of the NYLS temperament dimensions were used to categorize infants as "difficult" or "easy" (Thomas et al., 1963, 1968). Difficult children were described as withdrawing, mostly negative in mood, unadaptable, intense and irregular. Infants at the opposite pole of these dimensions were described as "easy." A "slow-to-warm-up" child was described as withdrawing at first but with low intensity reactions, and adaptable to the situation over time. The term "difficult" has been applied to a large and varied set of findings and continues to be used in developmental research (Rothbart & Bates, 2006).

Kagan's Research on Behavioral Inhibition

Beginning with the doctoral research of Cynthia Garcia-Coll, Kagan and his colleagues have studied individual differences in behavioral inhibition and uninhibition (later called exuberance) (Coll, Kagan & Reznick, 1984; Kagan & Fox, 2006). Behavioral inhibition has been defined as fearful inhibition to the unfamiliar. Individual differences in fearful inhibition are predicted by four-month infants' distress and motor reactivity to the presentation of novel objects. Longitudinal research has reported some stability of fearful inhibition from two to eight years and from the preschool period to age eighteen. Behavioral inhibition has also shown relations with neural networks, specific genes, and the development of internalizing disorders such as anxiety (Fox et al., 2005; Kagan, Snidman, Zentner & Peterson, 1999). Kagan's work has powerfully influenced research on the psychopathology of anxiety, along with much neuroscience research.

Kagan has also been a persistent and influential critic of the questionnaire approach to assessing temperament, arguing that personal bias or lack of knowledge yields

invalid measures. Direct observation in the laboratory is the standard for acceptable measurement. Recently many researchers (sometimes pushed by funding agencies, sometimes not) have avoided using parent-report questionnaires because they were deemed invalid. Nevertheless, parent informants have been invaluable to the NYLS and many other studies, including Kagan's early ones.

Convergence between parent reports and independent observation has been frequently reported (Rothbart & Bates, 2006), and it must also be remembered that laboratory observations have their own limitations (Goldsmith & Rothbart, 1991). For example, it is very difficult to collect repeated information about children's emotionality in the laboratory when one emotional experience has carry-over effects that influence another. Because temperament reflects dynamic interactions between affective and cognitive processes and there are limitations to both questionnaire and observational methods, many of us look for converging results from different methods. Also, because the behavioral inhibition approach involves just one, sometimes two, temperament variables, it can limit our view of multiple temperament influences.

CURRENT ISSUES IN THE MEASUREMENT OF TEMPERAMENT

Current research on temperament in childhood makes use of parent report questionnaires, laboratory assessments of children's behavioral response to standardized stimuli, and observations of children's behavior in the home or school. Measures of temperament have also been related to psychophysiological measures, cognitive task performance and assays of the developing personality.

The study of behavioral inhibition also reminds us that a continuing problem in research is terminological. In naming constructs, different terms are used to describe very similar constructs, or one term is used to apply to quite different constructs. Behavioral inhibition is by definition very close to fear and anxiety, yet the construct is narrower than Jeffrey Gray's Behavioral Inhibition System (BIS), which is linked to cues of punishment and non-reward as well as novelty. This is a common problem, both within the level of psychological analysis, and in making connections with brain and nonhuman animal research.

Rothbart's Revisions of Temperament Dimensions

Revisions of the NYLS Dimensions from varying laboratories are reviewed in Rothbart (2011), but in this chapter we focus on questionnaire development at Oregon. Here we took advantage of Thomas and Chess's painstaking interviews, and other conceptually and empirically derived research, involving nonhuman animals, and adult temperament research and we did further interviews and home observation of our own. Our approach used rational psychometric analysis of parent-report questionnaires (Rothbart, 1981, 2011). We followed the lead of the NYLS

in asking about concrete behaviors, items were based on the observed relative frequency of specific behaviors in specific situations and the results were very interesting. The dimensions that proved psychometrically sound (that is they allowed reliable measurement) were not the stylistic ones posited by Thomas and Chess, but instead they measured reactivity of primary emotions, self-regulation by attention and individual differences in activity level, and soothability. The NYLS dimensions of intensity, threshold, etc. did not yield homogeneous scales, in part because responses to items varied depending on the behavior system under study. Although we found that fear, distress to limitations (frustration) and soothability were positively related in infancy, we have found that more passive fear and more active anger, the latter related to infants' activity level, predict different outcomes as a child grows older.

In factor analytic studies of parent-reported temperament in childhood, three to four broad factors have been frequently found (Rothbart & Bates, 2006). The first factor we called Surgency, with high scores reflecting high levels of activity, sociability, impulsivity and enjoyment of high intensity pleasure. The second factor is Negative Affectivity or Negative Emotionality, including fear, anger/frustration, discomfort and sadness. The third factor is Effortful Control, including high attentional focusing, efficiency of shifting, inhibitory control, perceptual sensitivity and low intensity pleasure. Effortful Control reflects the ability to inhibit a prepotent response and to activate a nonprepotent response. As executive attention skills develop in the second or third years of life and beyond, individuals can voluntarily deploy their attention, allowing them to regulate their more reactive tendencies (Posner & Rothbart, 2007; Rothbart & Derryberry, 1981; Ruff & Rothbart, 2001).

There is some stability of individual differences in effortful control during childhood. For example, the number of seconds delayed by preschool children while waiting for rewards that are physically present predicts parents' reports of children's attentiveness and ability to concentrate as adolescents and adults (Casey et al., 2011; Mischel, Shoda & Peake, 1988). Lack of self-regulation in pre-school and middle-childhood has also been identified as a predictor of life-course persistent antisocial behavior (Moffitt et al., 2011) and of the inattentive-disorganized symptoms of Attention Deficit Hyperactivity Disorder (ADHD) (Nigg, 2006).

Effortful Control positively predicts the development of prosocial behavior and is related to low levels of behavior problems (Eisenberg & Fabes, 1998). In research with adults, temperamental Effortful Control is positively related to "Big Five" *Conscientiousness*, Surgency to *Extraversion*; Fear to *Neuroticism*; and Frustration/Anger to *low Agreeableness*. In addition, temperamental Orienting to Low Intensity Stimuli was unexpectedly related to the personality factor *Openness to Experience* (Evans & Rothbart, 2007). These findings suggest a temperament

formulation for some of the broad factors, but the studies that detail the steps between temperament and personality descriptions would be of considerable value.

TEMPERAMENT AND BRAIN NETWORKS

The effort to understand how emotion, attention and action are represented in the brain is central to our understanding of temperament. Studies often use simple stimuli to evoke emotions or cognitive tasks to examine attention. EEG and MRI methods are used to provide links to brain networks. One question has been whether the primary emotions are individually separable or whether they are simply derived from broader dimensions of variability such as arousal and valence (positive or negative). Recent studies using multi-voxel pattern analysis methods have begun to differentiate the neural activation in the primary negative emotions including fear, sadness, anger, disgust and positive emotions, such as pleasure and pleasant surprise.

In a study using music and film clips, Kragel, Knodt, Hariri and LeBar (2016) found widespread cortical and subcortical activation that differed for each of the six primary emotions. These findings were confirmed in resting state observations of brain networks and were related to subjective reports of the feelings of the participants (Kragel et al., 2016). The correlations were also stronger for predictions from nonoverlapping areas of activation, suggesting the importance of unique brain areas in an emotion. While the primary emotions could be detected in these activation patterns, classifications based on valence and arousal strength did less well, supporting the position that primary emotions are represented separately in brain structure.

The difficulty of separating the valence of emotion by MRI may be due to different emotions activating separate neurons within the same brain area. Recent work in mice has shown distinctive activation within the basolateral amygdala complex between the two valences. Within this structure, separate neurons are activated by positive reinforcement (reward) or punishment that evokes fear, with reward linked to the nucleus accumbens and punishment to the central medial amygdala (Namburi et al., 2015). Human research also reveals activation of the amygdala for both positive and negative primary emotions, with each emotion revealing a different set of connected areas in addition to the amygdala activation (Diano et al., 2017). Monkey studies indicate that social interaction is increased when the amygdala is suppressed, but that the effect is not entirely due to the reduction in fear produced by amygdala suppression (Wellman, Forcelli, Aguilar & Malkova, 2016).

ATTENTIONAL CONTROL NETWORKS

Emotional and motor activity is strongly linked to temperamental tendencies for focusing and shifting attention. The anterior cingulate is a complex structure that forms

an important node of the executive attention network (Posner & Rothbart, 2007). The anterior cingulate cortex (ACC) and the anterior insula are the two parts of the human brain that contain projection cells with particularly long connections to other brain structures (Allman et al., 2010). More ventral parts of the ACC and adjacent areas of the ventral midfrontal cortex are related to control of both positive and negative emotion networks (Bush, Lou & Posner, 2000; Beckmann, Johansen-Berg & Rushworth, 2009), and there is also some evidence of overlap of emotional and cognitive control in more dorsal areas of the cingulate (Smith et al., 2009).

We have used parent-report questionnaires to assess temperament in children (Rothbart, 2011) and have linked effortful control to cognitive methods by use of the Attention Network Test (ANT; Fan et al., 2002). The ANT assesses conflict resolution by the executive attention network through use of flankers that point in a direction either congruent or incongruent with the target. Effortful control, as measured by questionnaire, correlates with the difference in reaction time between congruent and incongruent flankers when tested with the ANT (Rothbart & Rueda, 2005; Rueda, Pozuelos & C6mbita, 2015). This research relates an important aspect of control as observed by parents to underlying brain networks and genes (Fan et al., 2003).

It is important to understand the psychological mechanisms by which effortful control is exerted. Two of these mechanisms are distraction and reappraisal of the current input (Kanske et al., 2011). When pictures were used to induce negative affect as recorded in amygdala activation, both distraction and reappraisal strategies were successful in reducing subjective emotional state ratings and lowered activity in the bilateral amygdala. However, distraction showed a stronger decrease in amygdala activity when compared with reappraisal. A follow up study (Kanske & Kotz, 2011) used the flanker task to induce cognitive and emotional conflict. Conflict between the target and surround activated the dorsal ACC, while a combination of conflict and negative emotion activated the amygdala and the ventral ACC. These results generally support control of emotion by the ACC, with different parts of this structure related to cognitive conflict resolution (more dorsal) and to emotion (more ventral), although there is also some overlap and interaction between the two (Smith et al., 2009). The midfrontal cortex and ACC actually increase in their connectivity with the amygdala in the course of typical child development (Gabhard et al., 2014). There is also enhanced functional connectivity within the ACC and between the ACC and amygdala during emotional control.

GENETICS AND EPIGENETICS

The bulk of molecular genetic studies have examined how a small number of genetic variations (candidate genes) are related to some aspect of temperament or pathology. While the findings using the candidate gene approach are

interesting and warrant further exploration, the history of studies linking temperament to candidate genes suggests caution in making conclusions from the existing literature. One problem is the bias in selecting which genetic polymorphisms should be considered as candidates. Another caution is the likelihood of very small effects produced by any one polymorphism. These and other factors have led to a lack of replicability in many observations.

In an effort to remedy the problem with selection of candidate genes, a frequent pressure exists that bigger will be better. Following this rule, greater and greater numbers of measures, research sites and participant subjects are needed. The argument for large sample, cross-site studies has been strongly applied in genetic research. We argue that theoretically chosen variables based on a good research question can help improve replicability. Big data research requires much effort in organizing cross-site measures and there is no guarantee of success. A good research question is likely to serve the field better than a huge budget directed to an undeveloped question.

Attention and Emotion in Genes and Environment

The executive attention network has been linked to a number of dopamine and serotonin genes (Posner et al., 2014), and it has been possible to determine how some of these genes influence development. We first discuss our previous work with adults that has identified specific genetic variations with each of the networks (Posner et al. 2014). Each network has a dominant neurotransmitter and thus polymorphisms particularly related to that transmitter system have been shown to influence efficiency of performance in tasks using the ANT to examine each attention network individually. While these studies are subject to the cautions raised above, the predictions relating the polymorphism to networks have been mainly confirmed by experiment (Green et al., 2008; Posner et al., 2014). These variations can be related to aspects of temperament and personality discussed in this chapter, since the executive network has been related to the control of both negative and positive affect as well as to effortful control (Rothbart & Rueda, 2005).

We now examine three candidate genes that have received substantial attention for their theoretical or empirical links to temperament in childhood and beyond. Some of these genetic effects have been already shown to be modified by environmental influence perhaps through the epigenetic effects discussed above or other mechanisms. Some of these same genes including DRD4 and COMT have also been identified in a recent study of attention in a large sample of nine–sixteen year old children (Lundwall, Dannemiller & Goldsmith, 2017). There are many additional genes that we touch on only briefly or do not cover here. We refer readers to Saudino and Wang (2012) and Posner (2012) for more comprehensive reviews.

COMT

The catechol-O-methyltransferase (COMT) enzyme is encoded by the *COMT* gene. COMT val158met (rs4680) is an example of a single nucleotide polymorphism (SNP) within the *COMT* gene where adenine is substituted for guanine. The substitution results in changes in the efficiency of the COMT enzyme in degrading dopamine and other catecholamines (Lachman et al., 1996; Lotta et al., 1995). It is believed that in adults, adenine carriers have more dopamine available in the prefrontal cortex due to less efficient dopamine degradation and are consequently more efficient on tasks dependent on prefrontal cortical activation (Meyer-Lindenberg & Weinberger, 2006).

COMT val158met has been linked to executive functions, temperament and personality (Dickinson & Elvevåg, 2009; Voelker et al., 2009), including Sensation Seeking and Extraversion (see Calati et al., 2011 for a review). There have been inconsistencies in results linking COMT to cognitive functions and to date, meta-analytic results have not always supported the association (Barnett, Scoriels & Munafo, 2008). However, the COMT literature continues to grow rapidly and more comprehensive COMT genotyping approaches may help address inconsistencies in the literature (e.g., Wacker, Mueller, Hennig & Stemmler, 2012). Evidence linking COMT to other temperament-related processes such as reward learning (Corral-Frías et al., 2016) may also provide new avenues for understanding the mechanisms by which COMT influences variability in temperament.

Another avenue for exploration is a more developmental examination of COMT. Effects of COMT appear to vary over the life course. As dopamine availability declines throughout adulthood, the association between val158met and cognitive functioning also changes, with variations in val158met becoming more important over time (Nagel et al., 2008). This suggests that the relation between genotype and phenotype may be exquisitely dependent on development. In the first years of life, COMT enzymatic activity may be as much as half that of adult levels (Tunbridge et al., 2007), suggesting that dopamine may be overly abundant. Due to the inverted U-shaped relation between dopamine and cognitive functioning, the relation between COMT val158met and cognitive functioning may even be reversed in childhood.

DRD4

Five different types of dopamine receptors have been identified. One that has received much attention in the temperament literature is the Dopamine D4 receptor (DRD4). There is a common repeat polymorphism in exon 3 of the DRD4 gene which varies the receptor length and function. Most individuals have between two and eleven repeats of forty-eight base pairs at this location. Longer alleles (more repeats) appear to alter the D4 receptor's ability to mediate

signal transduction (Asghari et al., 1994). The 7-repeat variant in exon 3 (DRD4 7-repeat) is the primary focus here, but there are other known variations within DRD4, including SNPs outside exon 3 and variations within the repeats themselves that may also be important for dopamine signaling (Grady et al., 2003; Wang et al., 2004).

The DRD4 7-repeat has garnered attention for its association with higher levels of Sensation Seeking (Benjamin et al., 1996; Ebstein et al., 1996) and ADHD (Swanson et al., 2000). Sensation Seeking is thought to reflect sensitivity to reward and motivation to seek it out. The construct appears to contribute to adult Extraversion (Rothbart & Bates, 2006). The hyperactivity component of ADHD can be conceptualized as dysfunctionally high levels of Sensation Seeking, and consistent with this notion, a number of studies have shown links between temperament and ADHD (Nigg, 2006).

Animal research, including studies using knockout models, appears to confirm an association between DRD4 and exploratory behavior, novelty seeking and risk taking (Bailey, Breidenthal, Jorgensen, McCracken & Fairbanks, 2007; Grandy & Kruzich, 2004; Livak, Rodgers & Lichter, 1995). Consistent with these studies, Ebstein and colleagues (1998) found that DRD4 and 5-HTTLPR interact to influence orienting to stimuli and motor organization in two-week olds. Follow-up studies with the same sample showed that DRD4 and 5-HTTLPR were associated with Negative Emotionality and Distress to Limitations (anger) at two-months of age (Auerbach et al., 1999) and to physical activity and anger at twelve-months of age (Auerbach, Faroy, Ebstein, Kahana & Levine, 2001). An alternative interpretation is that the DRD4 7-repeat confers less motor inhibition via Negative Affect or anxiety rather than greater approach. Consistent with this idea, DRD4 and a haplotype of 5-HTTLPR (including rs25531) were found to interact in predicting negative affect, particularly Falling Reactivity, in infancy, such that infants with the 7-repeat allele and highest expressing 5-HTTLPR haplotype had the highest levels of parent-reported negative affect (Holmboe, Nemoda, Fearon, Sasvari-Szekely & Johnson, 2011).

As discussed previously, inconsistencies in findings between age groups may reflect predictable changes in brain networks and functions during development. A potential source of variability is interaction of genes with environmental factors. It has been proposed that DRD4 may actually confer greater susceptibility to environmental influences (Belsky, Bakermans-Kranenburg & van IJzendoorn, 2007; Belsky et al., 2009; Sheese, Voelker, Rothbart & Posner, 2007; Van IJzendoorn & Bakermans-Kranenburg, 2006). If this is the case, then the role of DRD4 in predicting any given phenotype would be critically dependent on the environment in which the child develops.

Consistent with the differential susceptibility concept, low maternal sensitivity combined with the 7-repeat has been linked to increased externalizing behaviors in

preschoolers (Bakermans-Kranenburg et al., 2006), and parent training has been shown to be most effective in reducing externalizing behavior in children with the 7-repeat allele (Bakermans-Kranenburg et al., 2008). A meta-analysis conducted by Bakermans-Kranenburg & van IJzendoorn (2011) provides evidence that children with alleles associated with less efficient dopamine signaling do worse in negative environments, but better in positive environments than children without the 7-repeat.

A DRD4 7-repeat x parenting quality interaction predicting Effortful Control in early childhood has been replicated in several samples. Smith et al. (2009) used behavior assessments of Effortful Control and both positive and negative parenting in 382 three-year-olds. They found that negative parenting was associated with lower Effortful Control, but only for children with the 7-repeat. However, this pattern was more consistent with a diathesis stress model, in which the 7-repeat children are more at risk for a negative outcome when there is a negative environment, than a differential susceptibility model, in which the 7-repeat allele would also be associated with positive outcomes in more positive environments.

This study is notable in that it shows how molecular genetic studies of temperament can help more clearly delineate the contributions of environmental factors. An association between Effortful Control and positive parenting has been shown in previous studies (e.g., Kochanska, Murray & Harlan, 2000). Smith and colleagues (2009) have also found an association between Effortful Control and positive parenting, but which was no longer significant when negative parenting and the negative parenting X DRD4 interaction were controlled; however, they also found an association between inhibitory control and parenting was moderated by DRD4.

Beyond parenting, additional evidence that DRD4 may be linked to susceptibility to environmental factors comes from studies of preschool children. Berry et al. (2013) found that children who were 7-repeat carriers and who also experienced fewer hours in daycare showed greater attention and inhibitory control on laboratory tasks. They were also rated less inattentive and impulsive in the classroom. For children without a copy of the 7-repeat, hours in daycare was unrelated to attention and self-regulation abilities.

5-HTTLPR

The serotonin transporter (5HTT) plays an important role in the regulation of serotonin (5-hydroxytryptamine) signaling. The *5HTT* gene has a common repeat polymorphism in its promotor region, 5HTTLPR, which influences the expression level of this gene and, subsequently, the capacity of its product to transport serotonin from the synapse back into presynaptic neurons. Individuals with the 14-repeat version of 5HTTLPR are referred to as short allele carriers while those with 16-repeats are long allele

carriers. The short version is believed to result in less protein production and less transport (Heils et al., 1996; Lesch et al., 1996). Consequently, individuals with the short version are believed to have higher concentrations of serotonin in the synapse.

The short allele of 5-HTTLPR has been studied extensively as a contributor to major depression, mood disorders, stress reactivity and neuroticism in adults (e.g., Gotlib, Joormann, Minor & Hallmayer, 2007; Lesch et al., 1996; Sen, Burmeister & Ghosh, 2004). To date, however, research on 5-HTTLPR, including meta-analytic reviews, has yielded inconsistent support for the association. Notably, a study by Willis-Owen et al. (2005) examined two very large samples ($N = 88,142$, and $20,921$) and failed to find any association between 5-HTTLPR and either major depression or neuroticism.

While studies with adults have focused on neuroticism and depression, studies with infants and children have generally examined 5-HTTLPR in relation to behavioral inhibition, fearfulness, and/or shyness. In rhesus monkeys, 5-HT receptor density has been linked to anxious temperament (Oler et al., 2009) and it has also been linked to indicators of distress and negative affect in early childhood (Arbelle et al., 2003), but not consistently so (Battaglia et al., 2005; Hayden et al., 2007; Schmidt et al., 2002).

Several studies have examined 5-HTTLPR in relation to attentional bias to threat in infancy and early childhood. This bias is thought to reflect amygdala activity and temperamental fearfulness and anxiety (Etkin et al., 2004; Pérez-Edgar et al., 2010; Schwartz et al., 2011; see White et al., 2012 for a review). Perez-Edgar et al. (2010) found in adolescents that 5-HTTLPR was associated with attentional bias to both angry and happy faces. Overall, the 5-HTTLPR literature with children is even less tractable than the literature with adults. There have been fewer studies examining 5-HTTLPR in children and studies have employed a great diversity of assessment methods and age-groups, making differences among findings difficult to reconcile.

Consideration of 5-HTTLPR in combination with other genes may help clarify findings. Recently, Green et al. (2016) found that both DRD4 and 5-HTTLPR status influenced how exposure to prenatal maternal depression was associated with higher negative emotionality during the first three years of life. Maternal depression was associated with higher negative emotionality when children had both the S/LG allele of 5-HTTLPR and longer variants (6–8 repeats) of DRD4. While the two genes had individual effects, their analyses suggest that considering both genes in combination will show a stronger influence on the link between maternal depression and the child's negative emotionality.

MTHFR

While an individual's genes are relatively stable, their expression varies with development. Epigenetic changes refer to processes like methylation that do not change the

DNA itself but can create lasting alterations in the expression of genes. Research suggests that “environmental” factors like toxins or psychological stress can trigger mechanisms that ultimately alter genetic expression through epigenetic processes (Meaney, 2010). If methylation does play a role, important genetic variations might be modified and their associations obscured or enhanced through epigenetic effects. Consequently, findings that link genes and temperament may also vary across age groups and environmental conditions.

There have been recent intriguing findings on Methylene-tetrahydrofolate reductase (MTHFR) as a key enzyme of folate metabolism. It participates in epigenetic modulation by influencing the production of a metabolite required for the methylation of DNA. Polymorphisms of this gene are frequent in humans and have often been linked to health problems and mental disorders such as schizophrenia, bipolar disorder and ADHD as well as aspects of temperament and performance (for a review, see Wan, Li, Zhang, Sun, He & Li, 2018).

The MTHFR gene's polymorphisms are related to both general forms of negative affect, the internalizing and externalizing qualities (Rothbart & Bates, 2006), which in turn are related to the development of pain and disorder in a large proportion of humans. This is especially important because the polymorphisms are quite common in human populations, although they vary with geographical area and gender. Any advances in understanding may thus have a broad influence on psychology and medicine.

There is some initial evidence that methylation of DNA may affect temperament in infancy (Fuemmeler et al., 2016). Measures taken in newborn cord blood are related to aspects of temperament. In a study of 158 such samples it was found that, after controlling for many other factors, higher methylation, in differentially methylated regions of DNA, was significantly related to internalizing and surgency as reported in parent questionnaires (Fuemmeler et al., 2016).

A rather different approach, concerned with the same alleles of MTHFR related to mental disorders are studies of learning and performance in both typically developing children and adults (Voelker, Rothbart & Posner, 2016; Voelker, Sheese, Rothbart & Posner, 2017). These studies found that children with the 677C allele of MTHFR together with 158A (Met) allele of COMT, known to influence executive attention, showed greater improvement in overall reaction time and resolution of conflict when performing the ANT. An adult study, using a speeded reaction time task (Curran & Keele, 1993), found a similar result to the child finding. A possible mechanism for these changes in performance is that the efficiency of methylation could be related to changes in white matter also found to result from several forms of learning in mice and humans (Wang & Young, 2014).

FUTURE DIRECTIONS

The current chapter highlights how temperament serves as a construct for examining individual differences across

multiple levels of analysis, using methods and evidence from an array of fields. Advances in our understanding of the brain and advances in our understanding of genetics and developmental processes have deepened and expanded how we think about and study the development of temperament.

Temperament as a construct continues to gain traction as a tool for studying individual differences outside the confines of traditional temperament labs. A brief survey of this chapter's references finds a remarkable number of references to psychiatry, psychopathology, pharmacology and neuroscience publications. The number and breadth of publications in these areas making use of temperament constructs is remarkable. Although at one time temperament was viewed primarily as a niche area within social development, recent research suggests those days are well past.

The breadth and volume of research on temperament in the last decade also makes it challenging to keep abreast of developments in the field. The variety of methods and theories employed is a strength of the field, but also a liability in that there are few direct replications and it is often not clear to what extent findings generalize across samples or methodologies. Concerns about methodological heterogeneity are commonly expressed by authors conducting meta-analyses of temperament and personality research. There are currently no signs of a narrowing of focus in temperament research, and we hope that the multi-level approach we have advocated here will help organize and focus future research efforts.

There are many opportunities to enlarge the study of temperament still further. For example, the study of temperament in animals has so far had too little influence on the study of human temperament, although it was used to generate behavioral items in our early research and Rothbart has reviewed it regularly (e.g. Rothbart, 2011). This should further change as new methods such as optogenetics (Deisseroth et al., 2006), available only for studies in animals, allow researchers to control the activity of cells to make more precise tests on the causal nature of brain networks. By turning on or off cells in different brain areas, it is possible to test the function of these areas in a more precise way. Emotions such as fear or anxiety are expressed in the brain in similar areas in humans and animals, allowing at least some level of understanding of humans through the study of animal models.

The future should bring improved connections between subscales of broad temperament categories, brain systems and pathologies. For example, we have already learned that fear and anger tendencies (subconstructs of Negative Emotionality) are likely to set up different routes or trajectories for the development of behavior problems (see Rothbart, 2011; Rothbart & Bates, 2006). As we have seen, recent brain studies have increasingly differentiated specific networks related to emotion. The future should bring increased relationships between more highly differentiated dimensions of temperament and the networks involved in the expression of emotion.

As temperament is increasingly linked to brain structure and function, our understanding of both temperament and neuroscience will be enriched. An important research question is how social and nonsocial temperament reactions can be differentiated at different ages. How, for example, does anger/frustration come to be differentiated from fear? How does the developing concept of self affect social and nonsocial fear? Aksan and Kochanska (2004) distinguished between the positive emotion expressed toward objects and toward people in infancy, and more differentiated measures related to surgency and affiliation will be helpful in further addressing these research questions.

Our understanding of temperament has progressed rapidly (Rothbart, 2011, Zentner & Shiner, 2012); new methods for differentiating temperament from other aspects of development and linking genes to specific environmental events can improve this progress further.

Temperamental variables such as self-control measured early in childhood have increasingly been found to predict adult outcomes (Moffitt et al., 2011). This ability to predict should be employed by interventions to see if manipulating the network involved in effortful control can improve both child and adult outcomes (Rueda, Rothbart, McCandliss, Saccomanno & Posner, 2005; Rueda, Checa & Combata, 2012). We have distinguished between network training using cognitive tasks and state training using methods such as meditation and physical exercise (Tang & Posner, 2014). There is evidence that both kinds of training can enhance executive attention, but exactly who benefits from the training and the specific brain mechanisms involved remain open.

CONCLUSION

In this chapter we have outlined some of the history and current results of efforts to develop specific dimensions of temperament. We have examined brain networks related to the important dimensions of surgency and negative affect. We considered how these networks are controlled by an executive attention brain network. Both emotionality and effortful control differ among individuals in part because of genetic variation together with experiences that modify expression of genes. There is much still to learn and we point to some directions of potential advance. In studies of the plasticity of temperament we benefit from better understanding of our own basic tendencies, and from how temperament and experience work together to develop the skills, coping methods and perceptions of others. The varied forms of psychopathology can also be anticipated, with support for more individualized approaches to child rearing, school, medical and work situations.

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12 Development of Personality across the Life Span

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INTRODUCTION

Questions about the development of personality have captured people's attention and generated controversy for centuries. Aristotle devoted three chapters of Book II of his *Rhetoric* to describing the characteristics of individuals at different phases of the life span. Aristotle's student, Theophrastus, created poignant character sketches of thirty personality types (e.g., "The Surly Man" and "The Man of Petty Ambition") and noted interesting continuities and discontinuities in these characters over time and across contexts (e.g., at home versus at the public baths). As Gordon Allport said:

every personality develops continually from the stage of infancy until death, and throughout this span it persists even though it changes.

These abiding concerns about the consistency of personality have continued to the present. The research literature provides a fairly clear picture about how personality changes across the lifespan, but vigorous debate continues about the degree to which stability and change in personality stems from intrinsic biological maturation, major life transitions and associated changes in social roles, or self-initiated desires to change personality. These debates make the field of personality development one of the most active, contentious and intellectually vibrant areas of personality psychology.

We focus this chapter on the development of basic traits rather than other important personality constructs such as goals, motives and life stories (McAdams, 2013). We begin by drawing on the well-known "Big Five" personality taxonomy to describe the basic trait domains that can be studied across the life span. We then describe different ways that researchers conceptualize questions about stability and change, and summarize what is known about stability and change in the Big Five in childhood, adolescence and adulthood. Finally, we outline some of the processes that promote personality stability and change across the life span, and highlight some emerging issues.

USING THE BIG FIVE TO ORGANIZE THE STUDY OF PERSONALITY TRAIT DEVELOPMENT

Personality traits are typically organized into five broad domains (i.e., the "Big Five"): Extraversion (e.g., sociable, gregarious, dominant), Agreeableness (e.g., warm, kind, cooperative), Conscientiousness (e.g., responsible, organized, self-controlled), Neuroticism (e.g., anxious, depressive, emotionally volatile), and Openness to Experience (i.e., imaginative, creative, curious) (John & Soto, 2020). The Big Five personality domains (often measured in adulthood) have a high degree of overlap with temperament dimensions (often measured in childhood). For example, the major dimensions of childhood temperament identified by Putnam, Ellis and Rothbart (2001) closely correspond with the Big Five domains with the exception of Openness to Experience. Specifically, the temperamental traits of Effortful Control, Negative Emotionality and Positive Emotionality typically map onto the Big Five traits of Conscientiousness, Neuroticism, and Extraversion/Agreeableness, respectively, in adolescence and adulthood (Soto & Tackett, 2015). Although Openness to Experience is difficult to assess in very young children (Caspi & Shiner, 2006; John et al., 1994), researchers have recently established the validity of Openness to Experience in children as young as nine years old (Herzhoef & Tackett, 2012), which echoes previous insights that Openness may not become developmentally relevant until middle childhood (Caspi & Shiner, 2006; John et al., 1994). Researchers have also found evidence for the "Little Five" (John et al., 1994) and "Little Six" (Soto & John, 2014; Soto, 2016) dimensions of personality in childhood and adolescence, which converge with both temperament and personality traditions.

The degree of correspondence between child temperament and adult personality dimensions is consistent with Allport's (1937) proposal that personality traits are "neuropsychic entities," and his observation that "behind all confusion of terms...there are none the less *bona fide* mental structures in each personality that account for the consistency of its behavior" (1937, p. 289). In keeping

with Allport's convictions about the biological basis of traits, there has been considerable interest in identifying the neurobehavioral systems that underlie the basic dimensions of personality (DeYoung, 2020; Zuckerman, 2005).

DeYoung (2010) provides a general overview of research on the intersection of the Big Five personality traits and neurobehavioral systems. For instance, Extraversion/Positive Emotionality seems to map onto the biological system governing incentive motivation and approach behavior, whereas Neuroticism/Negative Emotionality seems to correspond well to the biological system governing withdrawal behavior, anxiety and the detection of threat. These approach and avoidance systems are rooted in Gray's biopsychological theory of personality (1987). Further, a separate system governing the enjoyment of social bonds and affection may be linked with aspects of personality captured by Agreeableness (i.e., the affiliative system; DeYoung, 2010). Finally, Conscientiousness, particularly the Effortful Control aspects of this domain, has been linked to systems associated with executive control and related regions of the prefrontal cortex. In contrast to the other four Big Five domains, the biological underpinnings of Openness are not as well understood; however, aspects of Openness related to sensation seeking and exploratory behavior may also be related to the approach system, similar to Extraversion (DeYoung, 2010).

In sum, there is compelling evidence that the fundamental features of both temperament dimensions and the Big Five are rooted in neurobiological systems. This downward extension of the Big Five helps to curb the jangle fallacy (i.e., if two traits have different names then they must be different; Block, 1995) and focuses attention on a core set of trait domains that are broadly relevant for adapting to the challenges that individuals face throughout the life span (Ozer & Benet-Martínez, 2006; Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007). Consequently, we will use temperament and personality trait terms interchangeably when reviewing research on personality development across the life course.

DEFINING TYPES OF STABILITY AND CHANGE

How stable is personality? Do shy children become shy adults? Do ill-tempered adolescents become ill-tempered adults? There are no simple answers to these questions because there are multiple ways of conceptualizing and measuring stability and change in personality. The broadest conceptual and methodological distinction is between heterotypic and homotypic stability.

Heterotypic Stability

Heterotypic stability refers to the stability of personality traits that are theorized to have different manifestations at different ages. Heterotypic stability broadly refers to the degree of personality coherence across development.

Shyness is a good example of the challenges of studying heterotypic continuity because shyness is expressed differently by toddlers and young children than by adults. The shy toddler might cling to a caregiver in a crowded setting and burst into tears during bouts of separation. The shy adult, on the other hand, may avoid making eye contact with strangers and seem aloof and distant at social gatherings. It would be highly unusual to observe an adult burst into tears in a crowded setting. The observable behaviors typically associated with shyness "look" different at different ages; however, there is an underlying commonality with respect to how the individual responds to social situations. Individuals who act shy as children often act shy as adults, but the degree of correspondence is far from perfect because many things can intervene between childhood and adulthood to alter how an individual develops. Nonetheless, the important point is that the patterns of behavior observed in childhood, such as shyness and aggressiveness, sometimes foreshadow adult personality attributes (Caspi, Bem & Elder, 1989).

Homotypic Stability

Homotypic stability refers to the stability of the *same* thoughts, feelings and behaviors across time. In other words, in comparison to heterotypic stability, the assessment of homotypic stability is less conceptual and more statistical. Homotypic stability concerns the evaluation of different kinds of change using the *same* measure of personality across time, or across age groups. Four types of stability and change are typically examined: (a) absolute stability (i.e., mean-level change), (b) differential stability (i.e., rank-order consistency), (c) structural stability, and (d) ipsative stability.

Absolute stability refers to consistency in the amount, degree or intensity of a given trait. Absolute stability can be examined in cross-sectional designs by comparing mean levels of traits across different age groups, or in longitudinal designs by following the same sample of individuals over time. Assuming that birth cohort differences are not an issue, cross-sectional differences in means can provide insight into the personality characteristics of the so-called "typical" person at different ages. On the other hand, longitudinal trends in mean-level change provide more of a developmental perspective about how the average individual changes with age and how different individuals change over time.

Research on absolute stability (mean-level change) provides an understanding of *normative* personality differences because it tells researchers something about broad developmental trends. One caveat is that overall *average* trends may obscure absolute changes evident at the level of the *individual*, so there is increasing interest in examining how individuals change over time, either by modeling individual change trajectories (Mroczek, 2007), by identifying the percentage of individuals who conform to or deviate from the sample-level trend (Robins, Fraley,

Roberts & Trzesniewski, 2001), or by examining the variance in average growth over time (Schwaba & Bleidorn, 2018). A small absolute increase in a trait could indicate that the entire population is increasing a little bit, which is a common interpretation of mean-level change. However, other patterns of individual change can create a small mean-level change as well. For example, a small average increase could result when some individuals are increasing substantially, some are increasing only slightly, and some are actually decreasing.

Differential stability reflects the degree to which the relative ordering of individuals on a given trait is consistent over time. This type of stability is theoretically and statistically distinct from absolute stability. For example, a population could show mean-level increases on a trait, but the rank ordering of individuals would be maintained if everyone increased by exactly the same amount. Conversely, the rank ordering of individuals could change substantially over time, but without any aggregate increases or decreases (e.g., if the number of people that increased offset the number of people that decreased). Differential stability is typically investigated by calculating the correlation between the same personality measures administered across an interval of a sufficient length to be interesting (e.g., perhaps months in childhood, and years in adulthood).

Structural stability refers to similarity over time in patterns of covariation among traits, or items on a personality scale. For example, one can use structural equation modeling techniques to test whether the intercorrelations among the Big Five domains are the same at the beginning versus the end of college (Robins et al., 2001). Likewise, investigations of structural stability often include tests of measurement invariance (Atherton, Zheng, Bleidorn & Robins, 2019; Widaman, Ferrer & Conger, 2010). This process establishes that the same latent attribute is being measured in the same way on different occasions (Horn & McArdle, 1992). The concern is that if measures change in their psychometric properties over time, then comparisons “may be tantamount to comparing apples and spark plugs” (Vandenberg & Lance, 2000, p. 9). Despite the intuitive nature and simplicity of this idea, methodologists have yet to determine precisely when slight differences in psychometric properties render mean-level comparisons meaningless (Millsap & Meredith, 2007).

Ipsative stability refers to continuity in the patterning of personality characteristics *within* a person and how well the relative salience (or extremity) of these attributes is preserved over time. For example, a researcher might investigate the degree to which an individual’s Big Five profile is stable over time – if an individual’s cardinal (i.e., most characteristic) trait in adolescence is Openness to Experience, then is this also likely to be true in adulthood? Examinations of these kinds of questions are fairly rare and often use methods that quantify the similarity of personality profiles such as within-person correlation coefficients (Bleidorn et al., 2012; Ozer & Gjerde, 1989).

In sum, questions about stability and change are addressed in several conceptually and statistically distinct ways. An examination of all types of stability provides a more complete description of personality development. A great deal of confusion can occur when terms like “stability” and “change” are used without further specification. In the next section, we review research on the absolute and differential stability of the Big Five because these are the most commonly investigated types of stability and change. Table 12.1 provides a summary of findings from this body of research.

ABSOLUTE STABILITY OF THE BIG FIVE ACROSS THE LIFE SPAN

Until recently, most research on personality development has focused on absolute stability (mean-level change) during *adulthood*, with less research examining absolute stability in personality earlier in development. Personality trait development in childhood and adolescence has been understudied, in part, because taxonomies were not well-agreed upon (i.e., temperament versus personality), the data are difficult and time-consuming to collect, and researchers need creative and/or multi-informant methods for measuring personality. However, over the course of the last decade, researchers have dedicated increasing attention to understanding personality stability and change across childhood and adolescence. Below, we review what we know (and do not know) about mean-level changes in personality across the lifespan.

Childhood

Childhood is a time of profound growth in social, cognitive, emotional and motor skills, and such changes may reflect concomitant development in personality tendencies. In general, traits related to Positive Emotionality/Extraversion, Negative Emotionality/Neuroticism, and Imagination/Openness to Experience tend to decrease across childhood (de Haan et al., 2017; Slobodskaya & Akhmetova, 2010; Soto, 2016; Van den Akker, Deković, Asscher & Prinzie, 2014; Wangqvist, Lamb, Frisen & Hwang, 2015). On the other hand, both Effortful Control/Conscientiousness (Eisenberg, Duckworth, Spinrad & Valiente, 2014; Li-Grining, 2007; Van den Akker et al., 2014; Vazsonyi & Huang, 2010; Wangqvist, Lamb, Frisen & Hwang, 2015) and Agreeableness (De Fruyt et al., 2006; Prinzie & Deković, 2008; Wangqvist, Lamb, Frisen & Hwang, 2015) tend to show mean-level increases across the course of childhood.

Adolescence

Adolescence was once regarded as one of the most critical periods of development (e.g., Hall, 1904). Indeed, recent findings on adolescent personality development suggest

Table 12.1 Summary of stability and change in the Big Five personality domains across the lifespan

Trait domain	Absolute stability	Differential stability
<i>Extraversion</i>	Childhood: decreases Adolescence: decreases (though some evidence to suggest increase or no change) Adulthood: remains stable/small decreases	Retest coefficients for all traits increase across the life span, from about .30 in childhood to a plateau in the .70s around age 60, and then declines into old age
<i>Agreeableness</i>	Childhood: increases Adolescence: decreases (though some evidence to suggest increase or no change) Adulthood: increases until old age and then decreases	
<i>Conscientiousness</i>	Childhood: increases Adolescence: decreases Adulthood: increases until old age and then decreases	
<i>Neuroticism</i>	Childhood: decreases Adolescence: increases Adulthood: decreases and then increases in old age	
<i>Openness to Experience</i>	Childhood: decreases Adolescence: decreases Adulthood: remains stable/small decreases	

Note. Absolute stability findings are based on mostly longitudinal studies of mean-level change (with some cross-sectional studies of age differences); differential stability findings are based on longitudinal studies of rank-order (i.e., test-retest) stability.

that we have a great deal to learn about consistency and change during this period, and the implications it has for the rest of the life course. Given the developmental tasks and challenges that adolescents face, some findings have highlighted the importance of gender differences in personality trajectories during this period (Branje, van Lieshout & Gerris, 2007; Borghuis et al., 2017; Van den Akker et al., 2014), as well as reporter discrepancies (adolescent versus parent-reports) of mean-level changes in personality (Gollner et al., 2017; Van den Akker et al., 2014). The nuances to personality development during adolescence have yet to be fully explored and are an important part of future research in the field.

The Roberts et al. (2006) meta-analysis suggested that there were general mean-level increases in socially-desirable traits across the course of adolescence. This might be true when simply comparing the beginning and the end of the period. However, researchers are moving toward consensus that Conscientiousness, Emotional Stability and Openness to Experience show mean-level *decreases* from early to mid-adolescence, but then resume mean-level *increases* in late adolescence and young adulthood (Atherton, Lawson & Robins, 2020; De Fruyt et al., 2006; Denissen, Van Aken, Penke & Wood, 2013; Lacuelle et al., 2012; Prinzie & Deković, 2008; Slobodskaya & Akhmetova, 2010; Soto et al., 2011; Soto & Tackett, 2015; Van den Akker et al., 2014). This u-shaped pattern of findings has been referred to as the *disruption hypothesis*, in that individuals experience declines in socially desirable traits

throughout adolescence (Soto & Tackett, 2015), which may be due to the number of biological, social and psychological changes that occur during adolescence. Fortunately, these disruptions are temporary, given that on average, youth resume mean-level increases in socially desirable traits, like Effortful Control, in late adolescence and early adulthood (Atherton, Lawson & Robins, 2020). The developmental trajectories of Extraversion and Agreeableness are more mixed, with some studies showing mean-level decreases throughout adolescence (Branje et al., 2007; De Fruyt et al., 2006; Denissen, Van Aken, Penke & Wood, 2013; Lacuelle et al., 2012; Prinzie & Deković, 2008; Soto et al., 2011; Soto & Tackett, 2015; van den Akker et al., 2014), and other studies showing mean-level increases (Borghuis et al., 2017; Klimstra et al., 2009; Lacuelle et al., 2012) or no change at all (De Fruyt et al., 2006; Denissen et al., 2013).

Adulthood

The Roberts et al. (2006) meta-analysis found mean-level increases across adulthood in Agreeableness, Conscientiousness and Emotional Stability. These trends indicate increasing levels of maturity, and consequently have been labeled the *maturity principle* of personality development. In contrast, Extraversion and Openness show little mean-level change across adulthood. Since 2006, the meta-analytic findings have been replicated by a number of longitudinal studies using twin-designs (e.g., Bleidorn

et al., 2009), nationally-representative samples (e.g., Lucas & Donnellan, 2009; Wortman, Lucas & Donnellan, 2012), and samples from a variety of countries (e.g., Bleidorn et al., 2013).

In contrast to the voluminous literature on personality change during adulthood, we know little about personality trajectories that extend well into old age. The research to date suggests general declines in all of the Big Five domains, which may be due to the physical and social limitations that older adults face nearing the end of life (e.g., Wortman, Lucas & Donnellan, 2012). However, more research is needed before robust conclusions can be reached about how personality changes beyond age sixty-five.

DIFFERENTIAL STABILITY OF THE BIG FIVE ACROSS THE LIFE SPAN

Differential stability concerns the degree to which people who are high (versus low) on a trait at one point in time maintain their relative ordering over time. An initial meta-analysis showed that the Big Five become increasingly stable across the lifespan (Roberts & DelVecchio, 2000), a pattern often referred to as the *cumulative continuity principle*. Moreover, with the surge of research in personality development across all developmental periods, there are several intriguing patterns worth highlighting that corroborate Roberts & DelVecchio's findings from almost twenty years ago.

First, when standardized to a common interval of about seven years, Roberts and DelVecchio found that the test-retest correlations of the Big Five increased from .31 in childhood to .54 in early adulthood and kept gradually increasing until the stability estimates reached a plateau in the .70s between the ages of fifty and seventy. This general pattern held for all of the Big Five domains and for both men and women. More recent research has replicated these findings by showing increasing rank-order stability estimates from toddlerhood through middle childhood (e.g., Neppl et al., 2010), early adolescence to mid-adolescence (e.g., Borghuis et al., 2017; Klimstra et al., 2009), late adolescence to young adulthood (e.g., Ludtke, Roberts, Trautwein & Nagy, 2011), and from young adulthood to middle adulthood (e.g., Wortman, Lucas & Donnellan, 2012).

Second, and relatedly, a recent extension of the findings from Roberts and DelVecchio (2000) suggests that the differential stability in the Big Five may not increase linearly across the *entire* lifespan, but rather, differential stability peaks around age sixty and then begins to decline into old age (Lucas & Donnellan, 2011). These results support the claim that personality stability shows an inverted u-shaped pattern across the lifespan (Ardelt, 2000). The decline in differential stability in old age was evident for all five Big Five domains and not attributable to the effects of increased measurement error in older ages (Lucas & Donnellan, 2011). Contrary to William James's

claim that personality is "set like plaster" by the age of thirty, the accumulation of empirical evidence shows that differential stability peaks between the ages of fifty and seventy (Lucas & Donnellan, 2011; Roberts & DelVecchio, 2000). The current evidence indicates that traits become increasingly stable after age thirty, but never reach the point where change no longer occurs. That is, no matter how old an individual is, it is possible that his/her standing relative to others can fluctuate with the passage of time. Moreover, even across test-retest intervals of fifty years (Damian, Spengler, Sutu & Robins, 2018), the differential stability of traits is remarkably high, suggesting that even across long spans of time individuals show an appreciable amount of relative consistency.

Third, empirical research has countered the claim that personality shows minimal, if any, stability during childhood and adolescence (e.g., Lewis, 2001). In fact, there is accumulating evidence that individual differences in children and adolescence show an appreciable degree of stability across these periods (Atherton, Lawson & Robins, 2020; de Haan et al., 2017; Neal, Durbin, Gornik & Lo, 2017; Roberts & DelVecchio, 2000). Individual differences in children are not ephemeral qualities. Even by three years of age, personality traits demonstrate comparable levels of differential stability to later developmental periods (e.g., Durbin, Hayden, Klein & Olino, 2007). Relevant to personality development research in childhood and adolescence, it is worth pointing out that parents' views of their children are much more stable than the child's perceptions of themselves (Gollner et al., 2017), which suggests that parents may be: (a) better able to aggregate information about their child's behavior, (b) more likely to see continuities in personality, and/or (c) seek to confirm consistency in child personality over time.

In sum, the general patterns of differential stability are well established. It is now important to empirically investigate why these patterns of differential stability exist. Generally speaking, differential stability is expected to be relatively low during periods of development marked by large numbers of changes. For example, adolescence has long been considered a period of "storm and stress," in that youth undergo biological changes associated with puberty, the acquisition of more sophisticated cognitive abilities, the transformation of social and romantic relationships, and major role changes and autonomy. Similarly, the end of the life span once again brings changes in older adults' physical capacities, cognitive stamina, and participation in social domains. Thus, an important next step is to investigate which factors are responsible for personality consistency and change, a topic we will cover in the next section.

PROCESSES RESPONSIBLE FOR PERSONALITY STABILITY AND CHANGE

Now that the field has produced replicable descriptive findings about trait development across the life span, it is

important to better understand the processes that are responsible for absolute and differential personality stability. That is, why do individuals become increasingly *consistent* in their personalities across the life course? Why (and how) do individuals undergo personality *change*? In general, processes of personality stability and change can be broken down into three dominant explanations: the *intrinsic maturational perspective*, the *environmental perspective*, and the *self-reflective perspective*. Broadly, the *intrinsic maturational perspective* holds that personality stability and change are driven by processes related to genetic and biological maturation (e.g., Five-Factor Theory; Costa & McCrae, 2006), whereas the *environmental perspective* posits that personality stability and change are a result of contextual factors including social interactions, life experiences, investment in social roles and major life events (e.g., Social Investment Theory; Bleidorn, Hopwood & Lucas, 2018; Roberts & Nickel, 2020, *Handbook of personality*). The *self-reflective perspective* suggests that personality stability and change are due to a set of internal processes that stem from self-insight, self-knowledge, perceptions of the self in relation to others and volitional (self-driven) factors (e.g., Robins, 2020). Although no single perspective can solely explain personality stability and change, each approach makes a unique contribution in understanding personality development across the life course. Below we discuss each perspective in more detail and briefly review some of the empirical research being conducted in these areas.

The Intrinsic Maturational Perspective

Ontogenic approaches to personality development, such as the Five Factor Theory (Costa & McCrae, 2006), suggest that stability and change in personality are mainly influenced by genetic factors. Under a strict version of the *intrinsic maturational perspective*, the heritability of personality should not change across the lifespan (Costa & McCrae, 2006). However, recent research suggests that the heritability of personality *decreases* across the lifespan, whereas environmental influences on personality *increase* over time (Briley & Tucker-Drob, 2014), which directly conflicts with the assumptions of a strict ontogenic approach to personality development. Despite findings to the contrary, utilizing longitudinal twin designs to understand the proportion of genetic and environmental influences on personality development has changed how the field thinks about stability and change in a number of ways.

It was initially thought that genes would be responsible for personality stability, whereas environmental influences were likely to be responsible for personality change. However, accumulating research suggests that both genes and nonshared environmental influences contributed to the stability of nearly all of the Big Five domains (Bleidorn, Kandler & Caspi, 2014; Briley & Tucker-Drob, 2014; Krueger & Johnson, 2020). Furthermore, genes and the

nonshared environment contribute to both personality stability and change (Bleidorn, Kandler & Caspi, 2014; Blonigen et al., 2008; Ganiban et al., 2008). Specifically, changes in Neuroticism, Agreeableness and Conscientiousness are largely due to genetic effects whereas changes in Openness and Extraversion are almost completely due to nonshared environmental influences (Bleidorn et al., 2009). We now know that genetic factors influence personality development, in part, because they influence the kinds of environmental contexts that individuals find themselves in (e.g., Kandler et al., 2012). For example, individuals may be exposed to, evoke, or select into environments on the basis of their genetically influenced characteristics, which in turn, affect the development of these characteristics. The transactional dynamic between genes and the environment highlights the importance of understanding how nature shapes nurture and, in turn, how the nurturing environment influences the expression of genetically influenced traits (Plomin, 1994). Such a perspective helps to move the field beyond the simplistic “nature versus nurture” debate.

Moreover, recent research has spurred a flurry of findings on physiological maturation in relation to stability and change in personality. Most of the work done in this area has focused on the period of adolescence, given the complex maturational processes that youth undergo, including changes in brain function/structure and pubertal development. For example, we know that adolescents are at a higher risk for engaging in a number of risky behaviors including delinquency, substance use, aggression, etc. (e.g., Moffitt, 1993). Recent findings suggest that self-control (and the engagement in risky behaviors, more broadly) may be best defined as a dual-systems model, where the impulse (reward-seeking) can be separated from one’s ability to control one’s behaviors (regulation). Research on brain development has suggested that adolescents may be at a relatively high risk for engaging in problem behaviors because brain regions that are associated with reward-seeking develop earlier than brain regions associated with control (Casey & Caudle, 2013; Shulman, Harden, Chein & Steinberg, 2016), which provides an imbalance of impulses in relation to control. These intriguing findings point toward the idea that brain development may, in part, be related to concomitant changes in personality development (e.g., via *disruption* effects like decreases in Effortful Control/Conscientiousness during adolescence; Atherton, Lawson & Robins, 2020).

Further, researchers have also begun to examine how pubertal development is associated with personality development during adolescence. Klimstra, Hale, Raaijmakers and Meeus (2012) examined the relation between pubertal timing and personality “hypermaturity” (i.e., twelve-year olds with a personality profile of an average twenty-year old), and found that there was no association between pubertal timing and hypermature personality profiles. Research has also combined aspects of genes, the

environment and pubertal timing in order to better understand girls' engagement in violent and nonviolent delinquency during adolescence (Harden & Mendle, 2012). The results from this study suggest that for girls who experience puberty earlier in development, nonshared environmental influences on delinquency are particularly magnified, even after accounting for the genetic association between pubertal timing and delinquency. These intriguing findings notwithstanding, it is clear that research on genetic, biological and physiological changes in relation to personality consistency and change is only beginning.

The Environmental Perspective

The *environmental perspective* posits that personality stability and change are a result of contextual factors including social interactions, life experiences, social roles and major life events. One central message conveyed by contemporary work in personality development is that stability and change result from complicated transactions between persons and situations. Therefore, strong forms of both dispositionalism (the view that behavior is determined largely by factors internal to the person) and situationalism (the view that behavior is determined largely by factors external to the person) are difficult to reconcile from a developmental perspective, in which personality characteristics and situations are seen as increasingly interdependent over time (similar to how we described processes relating to nature and nurture transactions in the previous section). Understanding the factors that influence personality consistency and change can help researchers better understand the mechanisms underlying personality development.

Personality Consistency and Transactional Processes

During times when individuals experience dramatic environmental and/or maturational changes, personality consistency tends to be lower. For example, the transition from childhood to adolescence is a fairly volatile transition that involves rapid maturational changes, shifting societal demands, the exploration of new identities and roles, and the initiation of new peer and romantic relationships. These changes may impact individuals in relatively unique ways, thus shifting their relative ordering on a trait and thereby, reducing the stability of personality. However, as individuals make the transition into adulthood, maturational changes are reduced, social roles begin to stabilize, environmental changes are increasingly subject to individual control and a more stable sense of self is formed; thus, leading to increased personality stability. Typically, personality researchers think about several (potentially interrelated) mechanisms of person-situation transactions that promote personality continuity.

First, individuals play an active role in selecting and manipulating their own social experiences (*selection*

effect). Given enough agency, individuals will seek out, modify or even create environments that are consistent with their individual characteristics. For example, individuals who are outgoing and sociable may choose careers that fit well with these tendencies and shun solitary occupations with limited potential for social interaction. Second, the social experiences one has may subsequently promote personality continuity, in part because positive interactions may then reinforce dispositions to be friendly and outgoing (*socialization* effect). Last, personality traits may "draw out" or elicit particular responses from the social environment, which can promote personality continuity (*evocation* effect). For instance, individuals who are kinder and friendlier may evoke more pleasant and supportive responses from their peers and this may contribute to more positive social interactions, and then those positive interactions lead the individual to be more sociable. The consequence of all three of these processes is a match between personality traits and characteristics of the situation. It seems as if many life experiences accentuate and reinforce the personality characteristics that were partially responsible for the particular environmental elicitation in the first place. This is often referred to as the *corresponsive principle* of personality development (Caspi et al., 2005).

In childhood, for example, researchers have examined the codevelopment of preschoolers' temperament and social play relationships over the course of an entire school year (Neal, Durbin, Gornik & Lo, 2017). Findings from social network analyses showed that children's traits shaped the formation of play relationships, and the traits of children's playmates shaped the subsequent development of children's own traits. Specifically, although Positive Emotionality and Effortful Control were not predictive of forming social play relationships, preschoolers who were higher in Negative Emotionality were *less* likely to form social play relationships over time. Preschoolers were also more likely to form social play relationships with peers who were similar to their own levels of Positive Emotionality. However, there was no evidence for preschoolers' choice of play partners being influenced by their Negative Emotionality or Effortful Control. Last, over the course of the school year, preschoolers' levels of Positive Emotionality and Effortful Control changed such that they became more similar to their social play partners levels on these traits. These findings are particularly compelling because they show that dynamic influences between persons and situations occur even in early childhood.

In adolescence, researchers have also examined personality trait co-development among friends, but during this developmental period, it appears that individuals change independently from their friends and siblings (Borghuis et al., 2017). Researchers have also begun to examine longitudinal *selection* and *socialization* effects that exist between personality and other types of interpersonal transactions, like being a victim or perpetrator of

relational aggression (e.g., Atherton, Tackett, Ferrer & Robins, 2016). For instance, adolescents who were high on Negative Emotionality and low on Effortful Control showed increases in victimization by their peers (*evocation* effect), and being victimized more by peers led youth to have subsequent increases in Negative Emotionality and decreases in Effortful Control (*socialization* effect). On the other hand, youth who were lower on Effortful Control were more likely to show increases in perpetrating relational aggression over time (*selection* effect), and perpetrating relational aggression led to subsequent increases in Negative Emotionality and Surgency (*socialization* effects). Furthermore, outside of interpersonal transactions, researchers have also looked to the importance of personality in school contexts, which is a particularly salient environmental context during this period. For example, Atherton, Zheng, Bleidorn and Robins (2019) used longitudinal data to examine the codevelopment of temperamental traits, like Effortful Control, and school behavioral problems (e.g., classroom misconduct, absences and suspensions). They found that steeper *decreases* in effortful control were related to steeper *increases* in school behavioral problems.

In adulthood, individuals are granted more agency to select into a broader range of environments consistent with their personalities (Scarr & McCartney, 1983), leading to an increasing amount of personality stability. Wrzus, Wagner and Riediger (2016) conducted a rigorous experience sampling study where they examined whether personality–situation transactions in daily life are different across age cohorts. They found that while some personality–situation transactions (e.g., association between extraversion and time spent with friends) were only evident among younger cohorts, many personality–situation transactions were evident in all age cohorts, which suggests that dynamic influences between personality traits and the environment may promote personality continuity similarly across the life course. Additionally, researchers have found examples of person–environment transactions in multiple domains of functioning in adulthood. Specifically, Bleidorn (2012) found that higher levels of conscientiousness were associated with greater investments in achievement behavior, and these investments in achievement behavior were related to subsequent increases in conscientiousness in young adulthood. Moreover, marrying someone who has a similar personality to oneself leads to higher personality consistency across adulthood, presumably because similarities in personality between spouses further reinforces existing traits and behaviors (Caspi & Herbener, 1990). Recent research has also shown that higher Openness to Experience leads individuals to engage in more cultural activities (e.g., visiting a museum, going to concerts), and engaging in more cultural activities leads to subsequent increases in Openness to Experience across adulthood (Schwaba, Luhmann, Denissen, Chung & Bleidorn, 2018).

Personality Change and Transactional Processes

Although studies in the previous section show how environmental factors can reinforce and strengthen existing personality traits, a different set of mechanisms may explain personality *changes* (Caspi & Roberts, 2001). Typically, personality psychologists have thought of personality “change” as including more dramatic and lasting shifts in stable patterns of thoughts, feelings and behaviors. Virtually no research has examined environmental influences on personality change in childhood, and very little research has been conducted in adolescence (e.g., Laceulle et al., 2012). Often, researchers have examined environmental influences on personality change in adulthood by investigating phenomena associated with *Social Investment Theory*. Social Investment Theory posits that normative age-graded changes in the Big Five across adulthood occur because of the investments in new social roles that many individuals experience in adulthood (Caspi, Roberts & Shiner, 2005; Helson et al., 2002). By investing in new social roles and experiencing related life events, like entering the workforce, getting married, becoming a parent, losing a spouse and retiring from work, individuals are required to meet specific contingencies in the environment (Bleidorn, Hopwood & Lucas, 2018; Corker & Donnellan, 2017; Hutteman et al., 2014; Luhmann et al., 2014; Senia & Donnellan, 2018). If individuals are responsive to the rewards, punishments and contingencies of a given setting, it is possible that long term exposure to, and changes in contingencies, may produce lasting personality changes (e.g., Laub & Sampson, 2003). Further, recent research has extended this line of work by suggesting that life goals may play an important role in explaining the link between personality and social roles. Although certain personality traits and life goals predict who will enter into certain social roles (*selection* effects), such as spouse and parent, many researchers have looked to these major life events as factors that may alter traits in lasting and life-changing ways (not necessarily reinforcing personality continuity). That is, events, such as entering the work force, marriage or parenthood, launch individuals into more restricted and tightly monitored, goal-relevant environments that have new and salient reward and punishment structures. These clear contingencies may produce enduring changes in personality.

A study of sixty-two nations and about 880,000 people (aged sixteen to forty) examined evidence for Social Investment Theory across cultures (Bleidorn et al., 2013), testing the idea that individuals from cultures that transition into adult social roles (e.g., workforce, marriage, parenthood) earlier should show earlier personality maturation, compared to individuals from cultures that transition to adult social roles later. The findings not only showed that personality maturation in socially desirable ways is a universal phenomenon, but also that common life events (i.e., workforce, marriage, parenthood) predicted personality maturation depending on the timing of transition to the social role. Transitions to the

workforce showed stronger influences on personality change than family role transitions, which suggests that transitions to family roles may be marked by fewer environmental contingencies and more freedom in how to behave, whereas transitions to the workforce may have very strict environmental conditions that clearly reward (or punish) certain personality tendencies.

Additionally, research has also shown the unique effects of military training on personality change, where military trainees showed persistently lower levels of Agreeableness over time, when compared to a control group and while controlling for *selection* effects (Jackson et al., 2012). Further, researchers have also begun to rigorously test the effects of the transition to parenthood on personality change (van Scheppingen et al., 2016). Contrary to what was expected, parents did not show more pronounced changes in Emotional Stability, Agreeableness or Conscientiousness compared to nonparents. Last, compared to nonretirees, individuals who retired from work in older adulthood showed changes in Openness, Agreeableness and Emotional Stability (Schwaba & Bleidorn, 2019). These studies demonstrate the increasing attention that is being given toward studying the influence of life events on personality change in young, middle and older adulthood (see Bleidorn, Hopwood & Lucas, 2016 for a comprehensive review).

Furthermore, a recent meta-analysis demonstrates robust influences of interventions (e.g., experimental and therapeutic) on personality change (Roberts et al., 2017). Impressively, longitudinal follow-up of the samples suggested that the personality changes persisted six months to more than one year after the intervention. Not surprisingly, Emotional Stability was the primary trait showing changes as a result of therapy, followed by Extraversion. Together, this emerging body of work suggests that it is possible for environmental influences to lead to lasting personality change. Future work is needed to pinpoint which experiences and events have the most systematic influences on personality stability and change.

The Self-Reflective Perspective

Aside from genetic, biological and environmental influences on personality development, volitional (self-directed) processes can also influence personality consistency and change. These *self-reflective processes* may promote personality consistency, in part, because we want to see ourselves (and others want to see us) act consistently across situations and over time, a motivational pattern referred to as the “Consistency Seeker” metaphor of the self (Robins, 2020). This consistency-seeking motive also shapes how individuals construe situations. For example, an extraverted person may perceive virtually all situations as requiring a high level of sociability, whereas introverts will perceive only a limited range of situations as necessitating sociability, thus promoting personality stability.

However, very little empirical research has examined how self-related constructs (e.g., self-concept, self-insight) are related to personality consistency and change.

One area that has gained an increasing amount of attention is research on volitional (self-directed) personality change. Recent research has shown that a majority of college students want to change aspects of their personality (Hudson & Roberts, 2014); 87 percent of college students reported wanting to be more extraverted, and 97 percent of college students reported wanting to be more conscientious. Although these desired trait changes were slightly less prevalent among older adults, at least 78 percent of people at any age wanted to have higher levels of the socially desirable dimensions of the Big Five (Hudson & Fraley, 2016). These findings suggest that people generally view their current self as discrepant from their ideal self, and consequently often have a desire to change aspects of their personality. This motivation toward self-improvement may be a necessary catalyst for personality change. Indeed, a belief in the power of self-reflection to promote change is the essence of insight-oriented psychotherapy; that is, therapy is most successful when people want to change core aspects of themselves. An intensive longitudinal experiment recently showed that college students who expressed goals to change their personality traits reported actual changes in their personality traits and daily behaviors over sixteen weeks when they deliberately attended to changing the self (Hudson & Fraley, 2015). Furthermore, the researchers found that desired trait change was particularly likely to occur for students in an experimental condition in which they were asked to generate specific implementation intentions (e.g., “If I feel stressed, then I will call my mom to talk about it”) to reach their personality goals (Hudson & Fraley, 2015).

EMERGING ISSUES AND FUTURE DIRECTIONS IN PERSONALITY DEVELOPMENT RESEARCH

We see four main issues impeding further progress in the study of personality development. First, we know little about the relative importance of different developmental periods – childhood, adolescence, adulthood, and old age – on personality consistency and change. Some researchers have argued that young adulthood is the crux of personality development, in part, because this is a time when many life transitions occur (e.g., workforce, marriage, having children) (Roberts & Davis, 2016). Yet, few would argue that childhood, adolescence and even old age are replete with profound maturational, socio-emotional, relational and social-contextual changes that rival, if not exceed, those occurring during young adulthood. However, due to the dearth of longitudinal research tracking participants across multiple developmental periods, the relative influence of these life stages on personality development remains largely a mystery. Recent work has begun to systematically examine the influence of antecedents from

multiple levels of analysis (i.e., individual, familial, social influence, school, neighborhood, cultural) on personality development from late childhood to young adulthood (Atherton, Lawson & Robins, 2020), but research that spans multiple developmental periods (especially earlier in the lifespan) remains rare.

Second, personality researchers have spent a significant amount of time describing mean-level and rank-order trends in personality across the lifespan. However, in moving forward, it will be particularly useful to dedicate attention toward understanding when, why, and for whom these trends occur. Understanding the general conditions, as well as the mechanisms, responsible for personality stability and change will likely require personality psychologists to consider factors other than traits – including broader environmental contexts like culture and socioeconomic status, in addition to micro-level aspects of traits like goals, motives, identities and emotions. Relatedly, it will be important for researchers to consider personality development across the entire lifespan when developing unifying theories to explain stability and change in personality. The most common theoretical approach used to explain personality development is a contextual perspective such as Social Investment Theory; however, Social Investment Theory primarily focuses on life experiences that occur predominantly in adulthood (without consideration of childhood and adolescence). Thus, there is room for researchers to develop theories that encompass lifespan personality development, and/or to refine existing theories, like Social Investment Theory, to include specific explanatory hypotheses of personality development processes.

Third, an increasing amount of attention has been dedicated toward understanding normative and nonnormative development by examining the intersection of personality and psychopathology. Recent work suggests that psychopathological symptoms are better organized as a set of continuous dimensions (e.g., externalizing problems), rather than as distinct disorders (e.g., Attention Deficit Hyperactivity Disorder [ADHD], Oppositional Defiant Disorder [ODD], Conduct Disorder [CD]), and furthermore, that personality traits may lie on the same underlying continua as psychopathological symptoms (Kotov et al., 2017). Much of the work to date has focused on cross-sectional data with adult samples; however, recent work has begun to use longitudinal data to delineate the boundaries of personality and psychopathology in adolescence (e.g., Atherton, Lawson, Ferrer & Robins, 2020; Mann et al., under review). This work has found, for example, that ADHD, ODD and CD symptoms all share a common externalizing trajectory (i.e., they develop similarly over time), and that greater *decreases* in effortful control are related to greater *increases* in externalizing symptoms over time (Atherton, Lawson, Ferrer & Robins, 2020). Moreover, effortful control had few unique associations with the individual disorders above and beyond their common externalizing trajectory, highlighting the importance of

conceptualizing these disorders as part of the same underlying continuum.

Last, recent research has identified limitations with existing statistical models of change, including cross-lagged regression model, bivariate latent growth curve model, random intercept cross-lagged panel model, latent change score model and trait-state-error models (Berry & Willoughby, 2017; Clark, Nuttall & Bowles, 2018; Hamaker, Kuiper & Grasman, 2015; Orth, Clark, Donnellan & Robins, 2020). In our view, there is no single correct model to use, but rather, researchers should select the longitudinal model that is best suited to their particular research question. For example, does the research question revolve around between-person or within-person effects? Is the researcher interested in relative or absolute change? How many waves of data are available? How far apart are the intervals between assessments? The answers to these types of questions can help researchers determine which longitudinal model (or set of models) is most appropriate for answering their questions of interest. In some cases, researchers may want to report the results of more than one model to provide a more comprehensive picture of longitudinal change patterns (e.g., Atherton, Zheng, Bleidorn & Robins, 2019; Harris et al., 2015; Orth et al., 2018).

CONCLUSION

We have summarized below the five major take home messages of this chapter in a list, based on our reading of the current literature. In closing, we wish to acknowledge that one of the biggest challenges facing the study of personality development is the fact that the field tends to take a “trait’s eye view” of development. However, *individuals*, not isolated traits, engage in dynamic transactions with social situations over time. Thus, there is an inherent tension between the units of analysis favored by personality psychologists and the reality of human development. The trick for future studies is to find ways to maintain personality psychology’s traditional focus on the person while maintaining its dedication to empirical rigor. Nonetheless, over the past decade, the field has witnessed a dramatic accumulation of new knowledge about the ways that personality changes across the lifespan, and we believe that there is every reason to be optimistic about the future of the scientific study of personality development. A summary of core themes in personality development is as follows:

Table 12.2 Summary of core themes in personality development

1. Temperament and personality trait taxonomies have a high degree of overlap, which facilitates research on personality trait development across the entire lifespan.

Continued

Table 12.2 (cont.)

2. A complete understanding of personality development requires attention to several conceptually and statistically distinct types of stability and change, including absolute stability (i.e., mean-level stability), differential stability (i.e., rank-order consistency), structural stability and ipsative stability.
3. Absolute changes in personality traits reflect increasing psychological maturity with age, with the exception of several *disruption* effects in adolescence (where some socially desirable traits may show temporary declines).
4. Differential stability increases across the life span and peaks at around age sixty, before declining in old age. Contrary to the idea that personality traits are ephemeral in children, an appreciable degree of differential stability is also evident during this phase of the life span.
5. The processes responsible for personality development (both stability and change) can be best understood through three perspectives: the *intrinsic maturational perspective* (e.g., genes, biology, physiology), the *environmental perspective* (e.g., social interactions, life experiences, social roles, major life events) and the *self-reflective perspective* (e.g., volitional or self-driven factors). Each perspective has a unique contribution to our understanding of personality development across the life course.

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13

Personality Traits and Mental Disorders

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INTRODUCTION

The hypothesis that personality and mental health are linked is very old. Ancient Greeks, Hippocrates and Galen, theorized that four humors explain personality type and specific health problems. Ever since these early speculations there has been a wide interest on the topic, and a number of theoretical models have been proposed to explain the association between personality and health, including mental disorders. To date, a number of systematic meta-analyses (Gomez & Corr, 2014; Jeronimus, Kotov, Riese & Ormel, 2016; Kotov, Gamez, Schmidt & Watson, 2010; Malouff, Thorsteinsson & Schutte, 2005; Ohi et al., 2016; Ormel et al., 2013) and narrative reviews (Andersen & Bienvenu, 2011; Klein, Kotov & Bufferd, 2011; Widiger, 2011; Widiger & Smith, 2008) have been published on the topic.

Personality is an umbrella term referring to a large number of variables at different levels of personality functioning. Currently, a three-level description of personality functioning has gained much scientific support (McAdams & Pals, 2006). At the first level are personality traits, which are a comprehensive description of individuals' differences in patterns of thoughts, feelings and behaviors (for more details, see Chapters 2 and 9). Characteristic adaptations at the second level describe motivational and social-cognitive details of personality functioning. Life narratives at the third level describe an idiographic and constantly evolving life story. We focus on personality traits from these three levels as most of the research conducted on the topic has focused on these. This does not mean that other levels of personality functioning would not be of importance. On the contrary – it is likely that effects of personality traits on mental health are also reflected at the other levels of personality functioning. For example, a diagnosis of major depressive disorder or schizophrenia is likely to have a major influence on motivational aspects of personality as well as life narrative of an individual. Research in this field is, still emerging (Adler et al., 2015).

From the different models of personality traits, the Five-Factor Model of personality (i.e., Big Five) has attracted

substantial research attention. It includes five personality traits, extraversion, neuroticism, agreeableness, conscientiousness and openness to experience. The Big Five is currently the most widely used theory of personality traits (Digman, 1990; John, Naumann & Soto, 2008), although the traits neuroticism and extraversion have also been included in other trait-theories before the Big Five (Digman, 1990) and thus most of the published studies have concentrated on these two traits. As the Big Five personality model is described in great detail elsewhere in this volume (see Chapter 9), we summarize the key features of these traits only briefly here.

Individuals high on the *neuroticism* scale tend to be worrying, impulsive and experience more distress than others. *Extraversion* is defined as a tendency to be sociable and warm, and extraverted individuals prefer the company of others to being alone. Characteristics of *openness* are originality, independence and intellectual curiosity. *Conscientiousness* is described as a tendency to be well-organized, reliable and persevering, and people high on the conscientiousness scale are thought to be more capable of self-discipline than others. *Agreeableness* is characterized as a tendency to be sympathetic and forgiving, and an agreeable person usually trusts others.

Now we have given a brief overview of personality, we move on to describe the classification models of mental disorders, and then review the empirical evidence for the relation between personality and these different models, especially in relation to mental health outcomes. Since there are a high number of publications on the field, we concentrate primarily on published meta-analyses and theoretical reviews. After that we discuss some of the key problems in the literature and highlight ideas for further research. We conclude this chapter by discussing the practical implications of this line of research.

CLASSIFICATION OF MENTAL DISORDERS

Research on personality and mental health has always been related to the development of classification systems.

The need for a comprehensive classification system for mental disorders has been apparent for nearly a century. The Diagnostic and Statistical Manual of Mental Disorders (DSM) in 1952, and later DSM-II in 1968, were among the first attempts to classify mental disorders in a systematic way. However, a clear breakthrough in producing a more comprehensive picture of psychiatric classification and pushing the field forward occurred when the DSM-III was published in 1980 (Wilson, 1993). Later revisions, DSM-III-R (APA, 1987) and DSM-IV (APA, 1994), made incremental improvements to the system but maintained the basic framework and focus of the DSM-III.

Another widely used psychiatric taxonomy is the International Classification of Diseases (ICD) published by the World Health Organization. This classification covers physical illnesses. Mental disorders were first included in the sixth version of the ICD-6, published in 1949, and more comprehensive definitions were provided in the ICD-8, published in 1974. Although there was some collaboration between the developers of the early ICD and DSM versions, concerted efforts have only been made in recent decades to align the ICD and DSM. The 10th edition of the international manual (ICD-10; World Health Organization, 1992) corresponds closely with the DSM-IV. Thus, the modern approach to the diagnosis of mental illness is now established across the world.

The chief achievement of these approaches is the uniformity of diagnostic practices that resulted from improved reliability and widespread acceptance of the manuals. However, operational criteria of the DSM-IV have become the standard in mental health research, whereas ICD-10 is more commonly used in the everyday clinical work (Reed, Correia, Esparza, Saxena & Maj, 2011). For a detailed review of the development of DSM and ICD classification systems, see Clark, Cuthbert, Lewis-Fernández, Narrow and Reed (2017).

However, the current psychiatric classification systems are not without problems. Starting from the DSM-III, mental disorders have been categorized using a specific list of observable signs, self-reported symptoms, and by several types of specific thresholds, such as number of signs and symptoms, an approach that has attracted criticism for a number of reasons. First, it is unclear whether mental disorders are better represented by categories or dimensions. Although current evidence points out that in many mental disorders, such as mood and anxiety disorders, dimensions describe mental disorders better than categories (Haslam, Holland & Kuppens, 2012), there is a lack of comprehensive dimensional models of mental disorders. In addition, categorization is seen as essential for communication and clinical decision making, and at the moment all current versions of DSM and ICD have followed categorical models. Second, comorbidity is a major problem for diagnostic taxonomies. It has been demonstrated in a wide number of studies that individuals diagnosed with one mental disorder have

increased odds of meeting the criteria for at least one other disorder, and many individuals can meet the diagnostic criteria for three or more disorders. This high co-occurrence of mental disorders can be seen as evidence that existing classifications do not adequately classify mental disorders. In addition, it also points out that in many instances the nature of mental disorders is not very well understood.

Although classification taxonomies are not often updated, the revision of ICD has been recently published, and will be in use 2022. In the ICD-11 for certain disorders, mainly personality disorders, depressive disorders and psychotic disorders, a dimensional model has been adapted. In addition, the US National Institute of Mental Health has introduced a Research Domain Criteria Initiative (Cuthbert & Insel, 2013), which proposes that future research should be targeted across broad domains that reflect impaired brain functioning and that it should incorporate a strong translational perspective where analysis is targeted at the dimensional level of mental disorders.

In addition to these developments, new theoretical models of mental disorders are likely to contribute to our understanding of mental disorders. The theory of the general factor of psychopathology, also known as *p* factor, postulates that a general latent factor explains most of the variance across different mental disorders (Caspi et al., 2014; Lahey et al., 2012). It has been argued that *p* factor could represent a useful way of studying mental disorders because it reflects the comorbid and “hidden” dimensionality of mental disorders. To date, higher *p* factor scores have been associated with a greater number of etiological factors as well as increased social and cognitive problems in later life (Caspi et al., 2014), indicating the potential usefulness of the *p* factor concept. More recently, a new classification system for mental disorders, the Hierarchical Taxonomy of Psychopathology (HiTOP) (Kotov et al., 2017), which incorporates many of the dimensional models of psychopathology, was introduced. HiTOP postulates that, first there are extremely broad dimensions, such as the *p* factor, which describe vulnerability to all mental disorders. After this, there are three broad domains of internalizing, externalizing and thought disorder, describing vulnerability to more specific patterns of abnormal feelings and behavior. After these broad domains, another five, more specific, domains (detachment, antagonistic externalizing, disinhibited externalizing, thought disorder and internalizing) are seen to describe different core symptoms of mental disorders. Interestingly, the HiTOP dimensional model of psychopathology suggests that personality provides a foundation for the whole model (Widiger et al., 2018), indicating that personality provides a general structural framework for psychopathology. However, although *p* factor and HiTOP are based on a growing number of individual studies and the integration of previous research, the usefulness of these models requires more research.

THEORETICAL MODELS EXPLAINING THE ASSOCIATION BETWEEN PERSONALITY AND MENTAL DISORDERS

A number of theoretical models have been proposed to explain the association between personality trait and mental disorders, particularly between neuroticism and depression (Klein et al., 2011; Ormel et al., 2013), but also those between other personality traits and mental disorders in general. These models are listed in **Table 13.1** and described briefly.

The *Vulnerability model* postulates that personality traits represent a risk or protective factor for the onset of mental disorder. For example, high neuroticism could either cause the development of mental disorder or enhance the impact of other mental risk factors, such as stressful life events. Evidence on prospective associations between personality traits and mental disorders after adjustment for baseline mental disorder or symptoms is seen as a necessary condition for the validity of the vulnerability model.

The *Common Cause* model posits that common determinants explain the association between personality traits and mental disorders. According to this model, there is no direct relationship between personality and mental disorders, rather a third variable explains the association between them. Findings where, for example, genetic or environmental factors are associated with both personality and mental disorders would provide support for the Common Cause model.

In some theoretical models, a common cause is suggested to explain part of the correlation between personality and mental disorders while specific factors help to explain how the manifestations of the common cause may diverge into different types of mental disorders. The *Tripartite model* of anxiety and depression has played a

major role explaining the role of personality in depression and anxiety disorders (Clark & Watson, 1991). Originally, the Tripartite model postulated that both anxiety and depression are characterized by high levels of negative affect (neuroticism). In addition, they are distinguished from each other by two specific factors: positive affect (extraversion), which is low in depressive disorders, and hyperarousal, which is high in anxiety disorders.

The *Spectrum model*, also known as the Continuum model, postulates that certain personality traits and mental disorders are different manifestations of the same underlying processes. A good example of this is neuroticism and depression, where a diagnosis of depression is seen to identify those individuals who have highest scores on neuroticism. In addition, in the Spectrum model the association between personality traits and mental disorders is hypothesized to be fairly specific and also non-linear, which indicates that nobody under threshold in a certain personality trait will receive a diagnosis. The *Scar model* postulates that the direction of causation flows from mental disorders to personality, that is, that mental disorders cause persistent changes in personality traits. The *State model* is similar to the Scar model but suggests that changes in personality traits are only temporary.

In addition to these models, Durbin & Hicks (2014) proposed the Co-development model where the Vulnerability and Common Causes models are incorporated to describe personality development over the life course (Durbin & Hicks, 2014). The Co-development model also postulates that the personality traits are dynamically associated with mental disorders and that these associations can differ at different life point or environment (Durbin & Hicks, 2014). An example of this kind of dynamic relationship is the association between personality traits, life events and mental disorders, where a reciprocal relationship has been demonstrated (Spinhoven et al., 2011).

Table 13.1 Major theoretical models explaining the association between personality and mental disorders

Model	Explanation
Vulnerability	Personality traits represent a risk or contributing factor for the onset of mental disorder
Common cause	Common factors explain the association between personality traits and disorders
Spectrum	Similar etiology and the association is fairly specific and also nonlinear
Scar	Mental disorders cause persistent changes in personality traits
State	Mental disorders cause temporary changes in personality traits
Co-development	Personality traits and mental disorders develop together

Evidence on Associations between Personality Traits and Mental Disorders

Hundreds of studies have been conducted where the association between personality traits and mental disorders have been examined (Gomez & Corr, 2014; Kotov, Gamez, Schmidt & Watson, 2010; Malouff et al., 2005). Whereas the main focus of these studies has often been on the role of personality in depressive disorders, there is also a wide literature on the relation between personality and anxiety, substance abuse, schizophrenia and other psychoses. Although a majority of these studies have been cross-sectional, there are an increasing number of studies with several follow-ups where the dynamic relationship between personality and mental disorders has been examined.

Depression and Anxiety Disorders

In a comprehensive meta-analysis of the Five-Factor Model of personality with depressive and anxiety disorders, Kotov and colleagues (Kotov et al., 2010)

combined 175 studies published between 1980 and 2007. Their results showed that individuals with depressive disorder had high neuroticism (mean correlation coefficient [r] range between 0.36 and 0.49) and low conscientiousness (mean r range between -0.27 to -0.30), and that also individuals with anxiety disorder had high neuroticism (mean r range between 0.28 to 0.45) and low conscientiousness (mean r range between -0.16 to -0.34). In addition, individuals with depressive or anxiety disorder had lowered levels of extraversion (for depressive disorders mean r between -0.18 to -0.29 ; for anxiety disorders mean r between -0.07 and -0.37). The two other major personality traits, agreeableness and openness to experience, were not associated with depressive or anxiety disorders (Kotov et al., 2010). Although there were some differences in the strength of the associations between diagnostic groups, these differences were generally quite small. Taken together, strongest effect sizes are found for high neuroticism, which has been consistently associated with all depressive and anxiety disorders.

Jeronimus and his colleagues (Jeronimus et al., 2016) examined the prospective associations between neuroticism and mental disorders, and their meta-analysis included fifty-nine longitudinal studies with nearly 450,000 participants. In their study, neuroticism was associated with future anxiety or depression diagnosis with a moderate effect (Cohen's d around 0.50). An association with substance abuse was also found, but the effect size was considerable weaker (Cohen's $d = 0.20$). Interestingly, adjustment for baseline mental disorders reduced the effects sizes by around 50 percent for anxiety and depression disorders, but not for substance abuse disorder. Moreover, prospective associations were considerably larger over short rather than long follow-up intervals when adjustment for baseline mental disorders was not done. However, when baseline symptoms were adjusted, the effect sizes were only slightly larger. Interestingly, there is also some evidence that neuroticism is differently associated with subtypes of depression.

Khazanov and Ruscio (Khazanov & Ruscio, 2016) examined in their meta-analysis the prospective association between positive emotionality – an umbrella term that includes extraversion, positive affect and behavioral activation – with depression and anxiety symptoms. Although low extraversion was associated with both depression (mean $r = -0.26$) and anxiety (mean $r = -0.19$), these associations diluted considerably when baseline depression or anxiety were controlled. In addition, low extraversion predicted changes in depression and vice-versa (Khazanov & Ruscio, 2016), indicating that extraversion could explain the course of depression. This finding is in line with evidence from a longitudinal cohort study, where individuals with chronic depression had lower levels of extraversion when compared to individuals with nonchronic depression (Wiersma et al., 2011). However, it seems that the association between extraversion and depression might considerably weaken after

neuroticism is controlled (Kendler, Gatz, Gardner & Pedersen, 2006).

We are not aware of meta-analyses of prospective associations between the three other Big Five personality traits and depression and anxiety disorders, and there is also a lack of large scale longitudinal cohort studies conducted on the topic. However, there is some preliminary evidence that baseline high conscientiousness could be associated with better outcomes and lesser comorbidity of depression and anxiety over time (Anderson & Mclean, 1997; Spinhoven, De Rooij, Heiser, Smit & Penninx, 2012), indicating that high conscientiousness could affect the course of depression or anxiety disorder.

In addition to clinical studies where patients with mental disorders and healthy controls have been examined, there are a number of survey studies that have examined the association between the Big Five personality traits and depressive symptoms. In an individual-participant meta-analysis by Hakulinen and colleagues (Hakulinen et al., 2015a), longitudinal prospective cohort studies with a total of over 50,000 participants were pooled together. In this study, high neuroticism, low extraversion and low conscientiousness were associated with higher levels of depressive symptoms in the cross-sectional analyses and also in the longitudinal analyses where baseline symptoms were taken into account. In addition to these findings, depressive symptoms predicted change in personality traits; depressive symptoms were associated with personality change in extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience (Hakulinen et al., 2015a). Other studies have also shown that the association between personality and depression symptoms is partly reciprocal. In a sample of 1,739 Finnish men and women, a two-way relationship between neuroticism – but not with extraversion – and depressive symptoms was found over fifteen years with four follow-up waves (Elovainio et al., 2014).

These findings suggest that of the five major personality traits, neuroticism is clearly a vulnerability factor for depressive and anxiety disorders (Jeronimus et al., 2016; Kotov et al., 2010). In addition, studies of individuals have shown that neuroticism enhances the impact of negative life events on people with mental health problems (Riese et al., 2014), supporting the vulnerability model. Importantly, both personality traits and mental disorders have been shown to be moderately heritable (for more, see Chapter 19) (Polderman et al., 2015), although there is some heterogeneity in the heritability of mental disorders. A number of twin studies – and more recently studies using genome-wide association data – have shown that neuroticism and mental disorders share the same genetic background (Kendler et al., 2006). The genetic correlation between neuroticism and depression has been estimated to be considerably higher than that between neuroticism and thought disorders (Smith et al., 2016). For example, genetic factors explained around half of the association

between neuroticism and internalizing disorders indicating that common environmental factors may have a less marked role in explaining association between personality and mental disorders. For other personality traits, there is also evidence of common determinants for personality and mental disorder. For example, low childhood socioeconomic position has been associated with low extraversion and low conscientiousness in adulthood (Sutin, Luchetti, Stephan, Robins & Terracciano, 2017). Again, these associations are considerably weaker than those between personality and mental disorder. In sum, the etiology of personality trait neuroticism and mental disorders appears to share common determinants, supporting the Common Cause model.

The association between depressive symptoms and future personality trait change supports both the Scar and Complication models. Whereas some individual clinical studies have found support for the Scar hypothesis (Rosenström et al., 2015), others have not (Ormel, Oldenhinkel & Vollebergh, 2004). Thus, it seems that there is a two-way relationship between depressive symptoms and neuroticism, but it remains unclear whether changes demonstrated in neuroticism are permanent or not.

Finally, shared underlying processes have been associated with neuroticism and depressive disorders, which can be seen as support for the Spectrum model (Jeronimus et al., 2016). Nonetheless, it is unlikely that the Spectrum model can be seen as the dominant explanatory model as it cannot explain the bidirectional association between personality and mental disorders, and it has also been criticized for statistical reasons (Durbin & Hicks, 2014).

Substance Abuse

When it comes to substance abuse disorders, the role of personality has been hypothesized and examined especially with regard to alcohol consumption and smoking. In the largest meta-analysis to date (Kotov et al., 2010), individuals with substance abuse disorder are characterized by high neuroticism ($r = 0.36$) and low conscientiousness ($r = -0.44$), which is in line with the findings concerning personality traits and anxiety and depressive disorders. Agreeableness was also found to be low among individuals with substance abuse disorder ($r = -0.27$), whereas extraversion and openness to experience were not found to be associated with substance abuse disorders (Kotov et al., 2010). The association between personality traits and substance use disorders was slightly stronger for mixed substance use disorders, which included both alcohol and drug use diagnoses (e.g., the correlation between neuroticism and alcohol use disorder was 0.28, whereas the correlation between neuroticism and mixed substance use disorder was 0.42).

From the studies examining the role of personality traits in smoking, a meta-analysis of nine published cross-sectional studies with over 4,500 participants demonstrated that smokers are characterized by higher neuroticism, lower agreeableness and lower conscientiousness

(Malouff, Thorsteinsson & Schutte, 2006). In a meta-analysis of twenty studies with over 7,500 participants, alcohol consumption was higher in individuals with low conscientiousness, low agreeableness and high neuroticism (Malouff, Thorsteinsson, Rooke & Schutte, 2007). These two literature-based meta-analyses suggest that the association concerning personality traits and smoking and alcohol consumption are similar in terms of three personality traits, i.e., neuroticism, agreeableness and conscientiousness. However, these meta-analyses are rather small in scale, and additionally they included both clinical and community samples.

More recently, large scale population-based cohort studies have been conducted on personality and substance abuse, mainly smoking and high alcohol consumption. Hakulinen and his colleagues (2015b) examined the association between the Big Five personality traits and smoking behaviors in a large-scale meta-analysis using individual participant design with nine mainly population-based cohort studies ($n = 80,000$). The study demonstrated that (1) smokers were characterized by higher neuroticism and lower conscientiousness, (2) higher neuroticism and lower conscientiousness were associated with smoking initiation, and (3) lower neuroticism predicted higher probability of smoking cessation (Hakulinen et al., 2015b). Moreover, individuals who had quit smoking had lower levels of agreeableness (Hakulinen et al., 2015b).

In another individual-participant meta-analysis using similar design, heavy alcohol users were characterized by high extraversion, high neuroticism, low agreeableness and low conscientiousness when compared to moderate alcohol users in a cross-sectional analysis (Hakulinen et al., 2015c). In addition, individuals who abstained from alcohol use were characterized by low extraversion, high agreeableness and low openness to experience. In the longitudinal analyses, however, only high extraversion and low conscientiousness were associated with increased risk of transitioning from moderate to heavy alcohol consumption. Moreover, low extraversion, high agreeableness and low openness to experience were associated with higher probability transitioning from moderate to abstinence over time.

Taken together, individuals with substance use disorders are mainly characterized by high neuroticism, low agreeableness and low conscientiousness. Although in general these findings support the notion that high neuroticism is a vulnerability factor for substance abuse disorders, there is clearly a lack of longitudinal studies that have examined the association between personality traits and substance abuse. In respect of individual studies, one, using the Minnesota Twin Family Study data, showed that young adults who had an alcohol use disorder demonstrated a lower normative decline in neuroticism over time (Hicks, Durbin, Blonigen, Iacono & McGue, 2012), which supports the Scar and Codevelopment models. More recently, pooled analysis of six cohort studies with over 35,000 research participants demonstrated that high

alcohol use (measured as average alcohol consumption, frequency of binge drinking and symptoms of alcohol use disorder) was associated with increasing extraversion and neuroticism, and also decreasing agreeableness and conscientiousness (Hakulinen & Jokela, 2019). The associations were mostly robust across different measures of alcohol use and across studies from different countries, suggesting that there is an association between alcohol use and change in personality traits. In sum, the association between alcohol use and personality traits is very likely to be reciprocal, and it can be hypothesized that this reciprocity starts for most individuals at early adulthood.

Schizophrenia and Other Psychoses

Traditionally, individuals suffering from schizophrenia have been described as lacking emotion and capacity for hedonic experiences, and prone to experience negative emotions. In addition, it has been hypothesized that individuals with schizophrenia have abnormal personalities before the onset of the actual disease (Andersen & Bienvenu, 2011). Studies examining associations between more severe mental disorders – mainly schizophrenia – have produced similar findings as compared with studies examining the association between personality with common mental disorders. In a recent systematic meta-analysis of 460 patients with schizophrenia and 486 healthy subjects from nine studies, patients with schizophrenia had higher neuroticism, lower extraversion, lower conscientiousness, lower agreeableness and lower openness (Ohi et al., 2016). Effect sizes were large for neuroticism and extraversion, and moderate for other traits.

There are some longitudinal studies that have examined the relationship between premorbid personality and schizophrenia or other psychoses. In a register-based study of over 200,000 Finnish military conscripts, Lönngqvist and colleagues (Lönngqvist et al., 2009) found that high neuroticism and low extraversion predicted onset of schizophrenia, but that the association between extraversion and schizophrenia diminished considerably when the statistical models were adjusted for general intelligence. There was a similar finding from a recent Swedish registry study where 1 million men were followed from late adolescence to adulthood; high neuroticism and low extraversion were associated with increased risk of schizophrenia and other psychoses (Hayes, Osborn, Lewis, Dalman & Lundin, 2017). Interestingly, the association between extraversion and bipolar disorder was more nuanced, both high and low extraversion being risk factors for incidence of bipolar disorder (Hayes et al., 2017). Van Os and Jones showed in a birth cohort study of over 5,362 men and women that high neuroticism and low extraversion measured at the age of sixteen years predicted the later risk of schizophrenia when symptoms of anxiety and depression were taken into account (Van Os & Jones, 2001). Similarly, in two other studies the association between neuroticism and schizophrenia has also been shown (Bogren et al., 2010; Krabbendam et al., 2002),

indicating that premorbid neuroticism is a risk factor for future schizophrenia.

Multiple studies of personality change because of schizophrenia have also been conducted. The hypothesis in this line of research has been that onset of schizophrenia *scars* personality over time. A review of these studies concluded that although there is evidence for scar effects in schizophrenia, it has also been shown that there are common factors in both abnormal personality and schizophrenia (Andersen & Bienvenu, 2011). In addition, high agreeableness and low conscientiousness are likely to alter the course of schizophrenia (Andersen & Bienvenu, 2011). However, more recent clinical studies have indicated that personality trait stability in individuals suffering from psychotic disorders is similar to personality trait stability in healthy individuals (Boyette, Nederlof, Meijer, de Boer & de Haan, 2015).

To sum up, the association between personality traits and schizophrenia may be reciprocal. High neuroticism and low extraversion can be regarded as vulnerability factors for schizophrenia, and it also seems that onset of schizophrenia modifies many, if not all, personality traits. It must be noted, however, that there are few large scale studies that have included measures of psychosis continuum, and thus it remains unclear whether similar effects can be found for other diagnoses of psychosis than schizophrenia.

Attention Deficit Hyperactive Disorder (ADHD)

ADHD is a mental disorder characterized by deficits in attention and symptoms of hyperactivity/impulsivity. Although these domains are often put together, studies typically examine these symptoms separately. In a meta-analysis of up to forty studies, high neuroticism, low agreeableness and low conscientiousness were associated with both domains of ADHD (Gomez & Corr, 2014). However, these associations were considerably stronger for the domain of inattention than for hyperactivity/impulsivity. These findings are in line with the Spectrum model where ADHD can be seen as the endpoint of personality trait continuum. In addition, these findings also partly support the vulnerability model where personality traits can be seen as a risk factor for developing ADHD. There are, however, no longitudinal studies where possible scar or state effects would have been examined and thus it remains unclear what the prospective associations between personality traits and ADHD would look like.

Eating Disorders

Eating disorders refers to a set of disorders that are characterized by irregular eating habits and concern or distress about body weight or shape. Anorexia Nervosa, Bulimia Nervosa and Binge Eating Disorder are the most common eating disorders and they affect both men and women. It has been hypothesized that personality traits influence the onset, symptom expression and maintenance of eating disorders. To date, two studies have reviewed the

association between personality traits and eating disorders (Cassin & Von Ranson, 2005; Lilenfeld, Wonderlich, Riso, Crosby & Mitchell, 2006). Although there are a number of studies where the association between the Big Five personality traits and eating disorders has been examined, most of the studies on the topic have explored narrower personality traits, such as perfectionism or drive for thinness (Cassin & Von Ranson, 2005; Lilenfeld et al., 2006). In addition, there are very few longitudinal studies and most cross-sectional studies are small in scale (Cassin & Von Ranson, 2005). However, high neuroticism, low conscientiousness and low agreeableness are associated with eating disorders (Cassin & Von Ranson, 2005; Lilenfeld et al., 2006), and thus traits can be considered as vulnerability factors. It is also likely that onset of an eating disorder will affect personality trait development (Lilenfeld et al., 2006), and thus have a scar or a state effect on personality traits, but more research on this topic is needed.

IMPLICATIONS AND FUTURE DIRECTIONS

The above-reviewed evidence clearly demonstrates that from the five major personality traits, neuroticism is a risk or vulnerability factor for future mental disorders. The findings are consistent across clinical studies and cohort studies using clinical interviews or different types of symptom measures. Thus, it may be argued that neuroticism is a central element or general factor of psychopathology that has been shown to explain comorbidity between different mental disorders (Caspi et al., 2014; Lahey et al., 2012). Although it seems that these associations are stronger for depressive, anxiety and substance abuse disorders than for schizophrenia and other psychoses, information of neuroticism cannot be used to distinguish disorders from one another.

With regard to the other personality traits, low conscientiousness was associated with most of the mental disorders, but the strength of the association is considerably weaker than that between neuroticism and mental disorders. Thus, low conscientiousness can also be characterized as a vulnerability factor of mental disorders. In addition, low conscientiousness has emerged as the only major personality trait that is consistently associated with poor physical health outcomes (Bogg & Roberts, 2004; Jokela et al., 2014a; Jokela, Pulkki-Råback, Elovainio & Kivimäki, 2014) and all-cause mortality (Jokela et al., 2013). Thus, low conscientiousness may be considered as an overall risk factor for poor physical and mental health.

Regarding extraversion, individuals suffering from depressive or anxiety disorders seem to be characterized by low extraversion. Although low extraversion is associated with future anxiety or depression, these associations considerably dilute when baseline depression or anxiety is taken into account. In addition, and contrary to these

findings, low extraversion is not associated with substance abuse disorders, but high extraversion is associated with current substance abuse in prospective cohort studies. Thus, association between extraversion and substance abuse seems to be mixed. Low agreeableness, in turn, is associated only with substance use disorders and alcohol consumption, but not with major mental disorders. Last, current evidence clearly demonstrates that openness to experience is not associated with mental disorders.

Recently, a meta synthesis study that combined thirty meta-analyses with over 500,000 participants, suggests that the association between the Big Five personality traits is larger when examining outcomes related to mental health than when examining outcomes related to physical health or health-related behaviors (Strickhouser, Zell & Krizan, 2017). The average reported correlation coefficients between individual Big Five personality traits and mental health outcomes were 0.11 for extraversion, 0.27 for neuroticism, 0.21 for agreeableness, 0.22 for conscientiousness, and 0.06 for openness to experience. These findings, with the individual studies and meta-analyses reviewed earlier, suggest that the effect size between personality traits and mental health related outcomes is from weak to moderate.

Regarding practical utility of the Big Five personality model, it must be noted that although Big Five personality inventories are commonly used by psychologists in their clinical practice, they are not used by doctors or other health professionals in primary care or other day-to-day health care. However, some studies suggest that the Big Five personality model may be useful in defining normal and abnormal personality functioning and it has been shown that the Big Five is useful in clinical practice. Whether the Big Five personality will become mainstream remains to be seen. In addition, there is some evidence that so-called personality tailored interventions could be useful as part of precision medicine approaches. For example, interventions for alcohol and drug misuse may be more effective when targeted at individuals with certain personality dispositions (Conrod, Castellanos-Ryan & Mackie, 2011). Thus, information on personality may contribute to optimal allocation of prevention and treatment resources, but more studies on this topic are definitely needed.

New cross-sectional studies are unlikely to provide more understanding of the personality-mental disorders association. Longitudinal studies with several repeated measurements, however, are still needed to examine the dynamic relationship between personality and mental disorders. It is also likely that the association between personality and mental disorders could vary in subpopulations. For example, a recent study using a large sample of adults from the USA showed that the association between neuroticism with mental health problems was amplified among individuals with physical limitations, social problems and low socioeconomic status (Vittengl, 2017).

Studies using family-designs are also needed to better untangle the common environmental and genetic architecture of personality and mental disorders. Recent genome wide-association studies have identified a number of different genetic loci for different personality traits, and especially for neuroticism (see [Chapter 19](#)). Thus, studies using genetic information for studying causality in observational studies are likely to provide new information about the relationship, and possible causality, between personality traits and mental disorders.

A further important aspect of personality–mental disorders research are studies that examine the role of personality traits in recovery from mental disorders. In a recent large scale meta-analysis of over 200 studies, personality traits were found to change over the course of intervention (Roberts et al., 2017). Whereas the largest effect sizes were found for decreasing neuroticism (Cohen's $d = 0.57$) and increasing extraversion (Cohen's $d = 0.23$) and conscientiousness (Cohen's $d = 0.19$), little difference between the type of intervention (e.g., pharmacotherapy) (Roberts et al., 2017). This indicates that all kind of interventions in general produce a positive effect of personality, and it also highlights how psychological interventions such as psychotherapy can be seen as tools for changing those aspects of personality that likely cause distress and problems for the individual. This said, studies are needed where change in major personality traits – or in more specific facets of personality traits – are examined. This would give us a better understanding of how personality patterns alter as a result of an intervention.

CONCLUSION

The role of personality in mental disorders has been hypothesized for a long time. Current evidence shows that major personality traits – describing inter-individual differences in behavior, thoughts and emotions – are important in terms of mental health. From the major personality traits, associations between neuroticism with mental health have received consistent support. Neuroticism can be seen as a risk factor (or a vulnerability factor) for poor mental health and this vulnerability can materialize through interactions between person and environment. For example, individuals high on neuroticism may have more prolonged and intensive reactions of negative life events. It is also clear that the etiology of neuroticism and mental disorders partly overlaps. Of the other personality traits, association between low conscientiousness and poor mental health is consistently found. This association is, however, considerably weaker than that of neuroticism and mental disorders.

This review reflects the current status of literature. Further research on the relationship between personality traits and mental disorders may complement the picture by examining how personality traits and mental disorders are related over the life course.

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14 Models of Physical Health and Personality

DIETLINDE HEILMAYR AND HOWARD S. FRIEDMAN

INTRODUCTION

Personality helps account for much of the variation in who stays well and who succumbs to illness. The idea that dispositions relate to health in important, systematic ways dates back to Galen, the Greek physician in the Roman Empire who proposed that bodily imbalances are associated with specific temperaments. For example, an excess of yellow bile – choler – was thought to produce cycles of excess anger, aggressive behavior and damage to internal organs (Friedman & Adler, 2011). Today, cycles of hormones, emotions, behaviors and health remain of keen interest but are informed by modern understandings of psychophysiology and personality.

Although observations of personality–health relationships originated in ancient times, it was not until the early 1900s that such relationships were studied empirically. The best known psychosomatic research comes from Alexander (1950) – working in the neo-analytic framework – who proposed that specific underlying unconscious conflicts predisposed individuals to seven distinct psychosomatic diseases (Suls & Rittenhouse, 1987). This type of theory, known as the specificity approach – in which specific illnesses result from specific traits or conflicts – led to confusing, unreplicated results. Because the studies were usually retrospective, it was impossible to tease apart whether the diseases were causes, or consequences, or correlated outcomes of third variables. Moreover, with flawed measures, models and outcomes, it was impossible to determine if particular unconscious conflictual patterns were specific to certain diseases (Friedman & Adler, 2011).

What followed was a broader approach to uncovering psychological predictors of disease, developed around explicit causal models. Instead of looking for correlations between specific dispositions and specific diseases, researchers began focusing on processes that increased susceptibility to many different illnesses – what Friedman and Booth-Kewley (1987) termed the “disease-prone personality.” This shift coincided with a greater emphasis on environmental stressors. For example, researchers used a Medical Syndrome Model to propose that

bereavement produces a chronic hopelessness (the “giving-up–given-up complex”) that is accompanied by physiological reactions that cause decreased immune functioning and increased susceptibility to illness (Engel, 1968; Engel & Schmale, 1967). However, it was still unclear why loss and severe challenge only negatively impact the health of some and not others. To investigate these types of individual differences in personality–health processes, a multi-trait multi-method approach was needed.

The Type A behavior pattern (TABP) – exhibiting competitiveness, hostility, and being in a constant struggle for more time – became a focal point of health psychology research in the 1970s and 80s (Rosenman & Chesney, 1980; Friedman, 2011) bringing the rigor of personality measurement and the need for more comprehensive causal models. Though research into TABP and coronary heart disease ultimately failed to reveal a consistent causal pattern, the topic was a major impetus to the development of health psychology as a distinct discipline (Houston & Snyder, 1988). Thus grew psychological research on cardiovascular reactivity and on conditioned immune function, associated health behaviors and physical health – termed the *biopsychosocial* model because it examined the reciprocal and interacting elements of psychophysiology, individual thoughts/feelings/behaviors and the psychosocial environment (Engel, 1989; Stone et al., 1987).

The rapid growth of the field of health psychology in the 1980s complemented the resurgence of personality psychology in this time frame, providing new theories, methods, and measures. The relatively small predictive power of life events (such as loss or bereavement) for health outcomes motivated research into mediating and moderating variables, especially including personality traits, coping responses and stress reactivity. One of the first programmatic efforts using this paradigm to study personality, life stress and physical disorder focused on the concept of hardiness (Kobasa, Maddi & Courington, 1981; Kobasa, 1979). Hardy individuals, it was proposed, have a sense of control; commitment to self, work and other values; and

expectations that change is normal and promotes development. Hardy people cope with threatening or stressful situations in ways that promote health: Men high in hardiness are less likely to become ill after stressful life events than men low in hardiness (Kobasa, Maddi & Courington, 1981; Kobasa, 1979). Although there is disagreement about the stress-buffering effect of hardiness (Cohen & Edwards, 1989) – that is, it is an oversimplification to focus predominantly on stress – such approaches stimulated further research into personality-coping-health relationships (Folkman & Lazarus, 1988; Friedman, 1990; Suls & Rittenhouse, 1987). Personality psychology, too, was adopting a biopsychosocial model, integrating internal states, psychological processing and socioenvironmental influences.

Today, personality science helps us understand why some people become ill or die prematurely, while others thrive, as much of the variation in life span, health and thriving can be explained by antecedent and recurrent *patterns* of reactions, interactions and behaviors – in other words, personality. Most individuals will not contract an illness without exposure to harmful or infectious agents or environments and/or a biological susceptibility, but the likelihood of exposure, the likelihood of getting sick after exposure and the speed at which a person recovers vary considerably (Friedman, 2011). Several decades of research have shown how and why psychosocial components are critical to a full understanding of health, illness and recovery, and personality psychology is often an ideal framework to employ in research and in the development of causal models of health and longevity (Kern & Friedman, 2011b).

METHODOLOGIES AND SEMINAL FINDINGS

In health psychology research, the Five-Factor Model of personality, an assessment of broad traits, has been most frequently used as a framework for studying the links between personality and health (Kern & Friedman, 2017; Smith & Williams, 1992). A key advantage of using this model – with factors typically labeled extraversion, neuroticism, agreeableness, conscientiousness and openness – is that personality traits can be more reliably measured and compared within and across studies, including recasting of archival studies (Martin & Friedman, 2000). Moreover, the Five-Factor Model facilitates studying and linking multiple personality traits with multiple health outcomes. Although personality has been consistently linked to important health-relevant life outcomes (including longevity, education, occupational success, marital stability and wellbeing; Kern & Friedman, 2011a; Ozer & Benet-Martínez, 2006; Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007), inconsistent findings for some traits and outcomes (see especially the section on neuroticism) highlight the complexity, as well as the opportunity for new insights that come with studying personality and health – two dynamic variables with multiple causes and outcomes.

Measuring Health Outcomes

In the outdated biomedical model, health was defined simplistically as absence of disease. Today, researchers apply a broader definition of health that emphasizes mental, physical and social wellbeing. Consistent with this definition and based on conceptual and empirical work, Friedman and Kern (2014) propose using longevity alongside five other core outcomes to reliably and validly measure health (see also Kern, Della Porta & Friedman, 2014). These core outcomes are physical health (physician or medically assessed), subjective wellbeing, social competence, productivity and cognitive function.

Although all six health outcomes are important, research in personality and health most frequently focuses on physical health and subjective wellbeing. However, the causal pathways to these correlated outcomes are often muddled. Physical health centers around the ability to successfully carry out daily tasks without interference from disease or injury, and can be assessed by a medical practitioner or using certain self-reports (such as the SF-36) that *include limitations* on daily activities and work (McHorney, Ware & Raczek, 1993; Ware & Sherbourne, 1992). Self-report measures of physical health, however, can be problematic in the study of personality and health, as sometimes relationships due to common-method bias arise – an issue described in more detail later in this chapter. Mortality is an excellent measure of health as it is highly reliable and valid: Generally, birth and death dates are accurate; and when dead, one can be assumed to be in very poor health. Thus, longevity rates are the most common and important public health measure, used worldwide.

Example Measures

Subjective wellbeing involves both emotional components (positive mood) and cognitive components (life satisfaction; Diener, Inglehart & Tay, 2013). Wellbeing is frequently measured using self-report measures such as the Positive and Negative Affect Scale (PANAS), the Subjective Happiness Scale, and Flourishing scales, which include emotional, psychological, and social wellbeing (Diener et al., 2010; Lyubomirsky & Lepper, 1999; Watson, Clark & Tellegen, 1988). *Social competence* includes the ability to successfully engage in activities with others, maintain close relationships, and to both receive and provide support to others. Social health is often measured using self-reports that focus on isolation and loneliness (e.g., Hughes, Waite & Cacioppo, 2008), perceived social support (e.g., Procidano & Heller, 1983), or quality and quantity of social relationships (sometimes known as social capital; Harpham, Grant & Thomas, 2002). *Productivity* is defined as contributions that have monetary, intellectual, cultural or humanitarian value. This outcome is more difficult to measure, but can be assessed by examining the degree to which individuals are contributing to society and achieving daily and long-term goals. Finally,

cognitive function – the ability to think clearly and remember – is effectively measured with clinical screenings or task performance tests (Cullen, O'Neill, Evans, Coen & Lawlor, 2007). Cognitive health is of increasing importance in the study of personality and health, with the aging populations and rapidly rising numbers of individuals with dementia. The US Department of Human Health Services provides access to the NIH Toolbox, a set of neurobehavioral measures to assess cognitive, emotional, sensory and motor functions, as well as to PROMIS, a set of measures to evaluate physical, mental and social health in both children and adults. These are popular measures as they are available in multiple formats and have been designed to be used in diverse settings.

Issues in Measurement

When health is measured using only self-report measures (e.g., SF-36 [McHorney, Ware & Raczek, 1993; Ware & Sherbourne, 1992]; RAND-36 [Hays, Sherbourne & Mazel, 1993]), relationships between personality and health that arise may be caused by common-method variance rather than meaningful relationships. For example, items that measure neuroticism and agreeableness are very similar to measures of subjective wellbeing and self-reported health. So, correlations here say little about causal relationships, and even less about the role of personality in achieving wellbeing or living a healthy, thriving life. Another problem arises due to individuals high in neuroticism being more likely to seek medical care and to report symptoms compared with people who are less neurotic (Friedman, 2019). Individuals high on neuroticism are not necessarily objectively unhealthier (e.g., Almada et al., 1991; Iwasa et al., 2008; Jokela et al., 2013; Korten et al., 1999). In short, self-reports of how well one feels are useful for pointing toward disease burden or for exploring possible links between personality and health, but to develop a comprehensive and valid model, we need objective, multimethod outcome measures of health.

More “objective” indicators of health are not foolproof either. Measures of biomarkers such as serum cholesterol, immune response or blood pressure have significant limits. Though ongoing assessments of biomarkers that indicate *chronic* dysregulation are important to study and include in models of personality and health, all too often individual biomarkers are used as endpoints in health interventions. That is, the goal becomes changing a biomarker as opposed to improving health – these are not necessarily the same. For example, taking niacin to reduce cholesterol works, but does not reduce risk of death (Friedman & Kern, 2014). The causal pathways are more complex. Biomarkers must rise and fall over time, as complex processes of homeostasis are at work. Overreliance on biomarker measures can lead to reduced quality of life (and high expenses) via overdiagnosis and burdensome treatments (Welch, Schwartz & Woloshin, 2011). Still, biomarkers are a growing area of study in health psychology and hold promise in understanding certain

mediational processes: Long term studies linking personality to disease *via* biomarkers have the potential to elucidate the processes through which personality leads to (objectively measured) disease.

Ultimately, to develop a comprehensive understanding of personality and health, we need multiple methods of measuring personality, health-relevant behavior, biomarkers, and objective multifactor measures of health. Random assignment of individuals to personality (or to stable or unstable biopsychosocial patterns) is impossible, and so to test comprehensive lifespan models of personality and health, research needs to track individuals across time, employing advanced statistical techniques that can analyze trajectories. Latent-growth curve models, latent-transition analysis and survival analysis are all relevant statistical tools. Such analyses require longitudinal data sets but allow researchers to assess personality and health as dynamic variables.

PATHWAYS FROM PERSONALITY TO HEALTH

Personality and health are linked through several core pathways that work together to keep individuals on a trajectory toward health or illness (See Figure 14.1 for a partial conceptual model). Although a comprehensive lifespan model has yet to be tested, such a model is an important next step in personality and health research, and is necessary to not only develop effective personality and health interventions, but also to avoid misguided ones (Kern & Friedman, 2011b; Shanahan, Hill, Roberts, Eccles & Friedman, 2014).

The most direct causal pathway from personality to poor health involves health behaviors and habits – physical inactivity, smoking, risky sex, drug abuse, dangerous driving, impaired sleep and poor diet. Importantly, it is the accumulation of these behaviors that has the biggest effect on long-term health and longevity (Friedman & Hampson, in press). For example, the occasional fudge sundae indulgence will not shave years off your life, but a long-term *pattern* of unhealthy decisions likely will. There are exceptions – a single drug overdose can kill instantly – but in general, it is repeated absence of healthy behaviors and frequent engagement in unhealthy behaviors that set an individual on a pathway toward poor health and early death. The clearest personality example here comes from meta-analysis showing that conscientiousness is strongly and reliably negatively related to risky behaviors, and positively related to healthy behaviors (Bogg & Roberts, 2004). However, health behaviors do not account for the full variation in the personality-health relationship (Kern & Friedman, 2011b).

A second causal pathway is stress reactivity and coping patterns. Physiological stress is a natural reaction to a threatening situation; it is not inherently unhealthy. It is how we react to and cope with stress that has important implications for health (Carver & Vargas, 2011). A degree

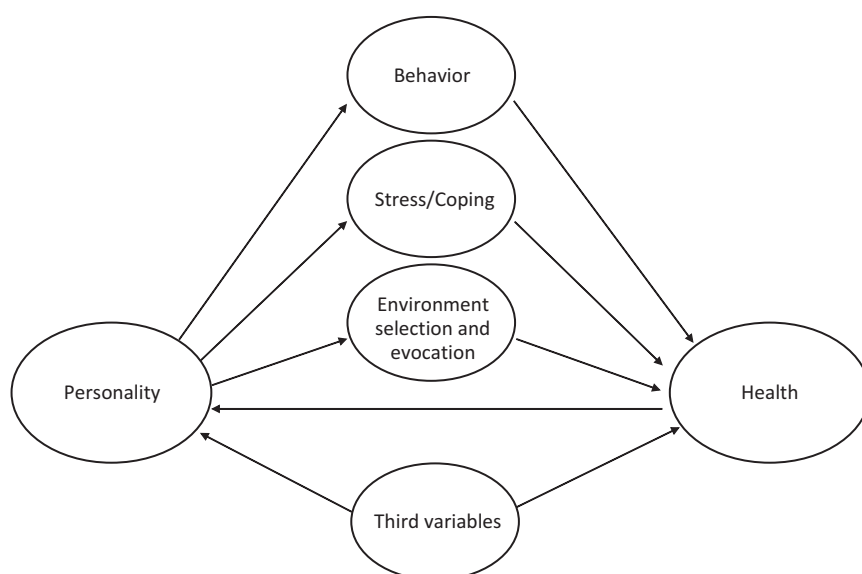


Figure 14.1 Conceptual model of multiple mediators and moderators between personality and health. These relationships unfold over time; thus, a lifespan approach is needed.

of the between-persons variation in stress sensitivity and coping reactions can be predicted by personality (Carver & Connor-Smith, 2010). For example, people high in extraversion or conscientiousness are more likely to employ problem-solving or cognitive restructuring coping responses, while people high in neuroticism are more likely to engage in wishful thinking, withdrawal, and emotion-focused coping (Connor-Smith & Flachsbart, 2007). The full pathway from personality to stress to coping to health is still unclear. For example, it may be that some individuals are highly sensitive to stress but recover quickly, while others have a lower, but chronic, stress response. These kinds of patterns are likely important to understand disease processes, and the pathways have yet to be fully explored (Kern & Friedman, 2011a).

Not only are there individual differences in stress reactivity, but personality also predicts the frequency and type of stressors one will be exposed to in the first place (Vollrath, 2001). This highly important causal pathway is often referred to as selection and evocation. Individuals do not randomly find themselves in situations. Instead, people often self-select into situations that fit their personality – a highly extraverted individual who is low in conscientiousness, for example, is more likely to attend wild parties than is an introverted, conscientious, highly neurotic individual. Moreover, individuals often evoke reactions from others that are in line with their own personalities – hostile (choleric) people, for example, are more likely to be met with negativity than are highly agreeable people. These processes of selection and evocation reinforce individual differences, and also partially mediate the relationship between personality and health (Kern & Friedman, 2011b). Of note, selection and evocation are highly relevant to social relationships, the quality and quantity of which relate to quality of life, physical health, and mortality risk (Taylor, 2007). For example,

conscientious people are more likely to select into and maintain stable marriages (Sbarra, Law & Portley, 2011; Tucker, Friedman, Wingard & Schwartz, 1996; see also Friedman & Martin, 2011).

Noncausal but important pathways tying personality and health include those involving genes and early experiences. Underlying biological third variables may predict both personality and health, making it appear (falsely) that personality is causing health. For example, there is evidence that genes that predict bipolar disorder, schizophrenia and major depressive disorder also predict some individual variation of neuroticism (de Moor et al., 2015). Common genetic factors also predict susceptibility both to depression and to cardiovascular disease (Cerri et al., 2010; Taylor, Aizenstein & Alexopoulos, 2013; Wong, Dong, Maestre-Mesa & Licinio, 2008). In these cases, personality is not causing outcomes; rather, genetic third variables are explaining both personality and outcomes. In-utero and childhood experiences also sometimes predict both personality and health. For example, experiencing parental divorce during childhood predicts poorer social relationships, riskier health behaviors, and ultimately poorer mental and physical health as well as reduced longevity (Martin, Friedman, Clark & Tucker, 2005). Early experiences can set children on a trajectory that develops specific dispositions and ways of acting that may be further reinforced via selection and evocation.

Finally, in many cases, correlations between personality and health arise from disease-caused personality change – that is, reverse causation. In such cases, it may appear as though personality precipitates a health decline, when in reality, the development of a disease such as Alzheimer's or Parkinson's causes personality to change (Terracciano, An, Sutin, Thambisetty & Resnick, 2017). Similarly, prescription medications and other disease treatments may also influence personality (Temel et al., 2006). Such

bidirectional influences may seem obvious when noted this way, but are often overlooked in cross-sectional studies of personality and health, again highlighting the importance of lifespan studies. We will now turn to some of the seminal findings in the field that help to illustrate how the complex relationships unfold across the lifespan.

HOW SPECIFIC TRAITS RELATE TO HEALTH

Conscientiousness

The most reliable finding in the field is the relationship between conscientiousness and health. Individuals who are dependable, persistent and self-disciplined – that is, conscientious – stay healthier and live longer. Friedman and colleagues first discovered that childhood conscientiousness is related to mortality across the lifespan using data from the Terman Gifted Children Study that began following children in 1921, and continued through adulthood and death (Friedman et al., 1993). Not surprisingly, adult conscientiousness was also found to be related to mortality risk, but the link from childhood remained robust when adult conscientiousness and certain behavioral variables were controlled (Martin, Friedman & Schwartz, 2007). This finding that conscientiousness across the lifespan is predictive of and likely causally related to health has been replicated multiple times, and meta-analysis clearly links higher conscientiousness to lower mortality (Jokela et al., 2013; Kern & Friedman, 2008; Shanahan et al., 2014), the effect of which is similar in magnitude to socioeconomic status and IQ (Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007).

The reason conscientiousness so strongly and reliably predicts mortality harkens back to the multiple pathways linking personality and health (Friedman & Kern, 2014; Hampson, Edmonds, Goldberg, Dubanoski & Hillier, 2015). That is, mounting evidence suggests that conscientiousness relates to multiple core health-relevant biopsychosocial pathways. First, conscientious people are more likely to engage in a range of healthy behaviors (Artese, Ehley, Sutin & Terracciano, 2017; Bogg & Roberts, 2004; Lodi-Smith et al., 2010; Sutin, Ferrucci, Zonderman & Terracciano, 2011). Second, conscientious people are likely to initiate and evoke healthier environments: They select into and maintain healthier friendships and marriages; they acquire more education; they seek out and stay in meaningful careers; and they obtain higher salaries; all of these are linked to a healthy, thriving life (Hampson, Goldberg, Vogt & Dubanoski, 2007; Ozer & Benet-Martínez, 2006; Poropat, 2009; Roberts, Caspi & Moffitt, 2003). Third, conscientiousness is associated with better coping skills, thus dampening the effects of stressors such as career failures (Carver & Connor-Smith, 2010; Connor-Smith & Flachsbart, 2007; Kern, Friedman, Martin, Reynolds & Luong, 2009). Finally, there is evidence that genetic patterns that affect the self-control

aspects of personality also help regulate some bodily functions (Carver, Johnson, Joormann, Kim & Nam, 2011; Caspi, Hariri, Holmes, Uher & Moffitt, 2010; Cicchetti & Rogosch, 2012).

Although these core pathways from conscientiousness to health are straightforward at their core, the dynamic nature of lives and personality across time adds dimension and complexity (Leszko, Elleman, Bastarache, Graham & Mroczek, 2016). Drawing from developmental psychology, accumulation models inform relationships between personality and health (Hampson & Friedman, 2008). In the case of conscientiousness, a conscientious child might make decisions and behave in ways that channel her into a future set of particular environments and situations. For example, a child who shows promise in the classroom may be selected for gifted classes in adolescence, which may lead to the decision to seek out higher education, which teaches further skills for self-monitoring and responsibility: The path toward a successful, challenging and satisfying career can be set from childhood as behaviors and environments *accumulate* over time (Caspi, Elder & Bem, 1987). Moreover, as noted, an individual's interactional style may perpetuate a pathway via evocation from others.

The principle of critical periods is also relevant to conscientiousness and health. That is, experiences during specific times of development have longer-lasting and more pronounced effects than experiences at less “critical” times of development (Hampson & Friedman, 2008; Shanahan et al., 2014). For example, low conscientiousness during adolescence could increase the likelihood of drug abuse, thus affecting grades, peer influences and relationships, and ultimately the likelihood of going to college and having a successful career, and later mental and physical health. Research into critical periods as they relate to personality and health deserves further attention.

Aside from conscientiousness, not enough is yet understood about how and why various core aspects of personality are relevant to health and longevity. To illustrate the challenges and approaches, we will now consider optimism, hostility and neuroticism.

Optimism

In 1979, Norman Cousins published a bestselling book outlining his battle against and recovery from a life-threatening disease. Cousins' recovery program involved enormous amounts of Vitamin C and laughter, the latter of which was brought on by humorous television shows and films (Friedman & Kern, 2014). Though Cousins' account spurred greater interest in the science of mind-body connections, it also reinforced certain quack treatments and errant beliefs.

There is good evidence that people who are generally in good moods are also healthier over the short term (Boehm & Kubzansky, 2012; Pressman & Cohen, 2005), but this is a correlation; the relationship is complex and involves

many mediating and moderating mechanisms. That is, belly laughs will not reverse a cancer diagnosis, nor will being carefree necessarily set you on a path toward a healthy, long life (Friedman & Kern, 2014; Sloan, 2011).

Optimism is the tendency to expect positive future outcomes, and is associated with lower all-cause mortality risk (Brummett, Helms, Dahlstrom & Siegler, 2006; Groszardt, Bower, Geda, Colligan & Rocca, 2009; Maruta, Colligan, Malinchoc & Offord, 2000). Optimists may have more developed coping skills that promote resiliency in the face of stress (Ryff & Singer, 2003), which could explain some of the association between optimism and lower mortality risk (Giltay, Geleijnse, Zitman, Hoekstra & Schouten, 2004). Optimism may also promote health through greater engagement (Carver & Scheier, 2014). However, good cheer is not associated with lower mortality risk across all studies (e.g., Martin et al., 2002), and the protective effect of optimism likely depends on situations or other traits; if the situation is uncontrollable (e.g., the disease will progress regardless of treatment), positive coping and optimism may promote a higher quality end of life. However, if the situation is controllable, blind optimism may lead an individual to ignore symptoms and simply hope for the best – a case in which good cheer can become dangerous (Colvin, Block & Funder, 1995; Coyne, Tennen & Ranchor, 2010). Thus, it is also likely that conscientiousness moderates the effects of optimism on health (Segerstrom, 2005).

High subjective wellbeing – the relatively stable tendency to experience positive emotions, minimal negative moods and high life satisfaction (Diener, Suh, Lucas & Smith, 1999) – also involves a more complex picture than is usually assumed. Though it is clear that subjective wellbeing is associated with better self-reported health, lower rates of disease, pain and all-cause mortality (Chida & Steptoe, 2008; Danner, Snowdon & Friesen, 2001; Diener & Chan, 2011; Lyubomirsky, King & Diener, 2005; Pressman & Cohen, 2005; Veenhoven, 2008; Xu & Roberts, 2010), interventions to promote health by increasing positive emotions are not presently justified – there is no well-controlled evidence that increasing happiness directly and substantially improves health (Friedman & Kern, 2014). For example, treating depression in cardiovascular patients does not extend life (Berkman et al., 2003; Rutledge, Redwine, Linke & Mills, 2013; van Melle et al., 2007). Happiness may have minimal effects on health and longevity independent of risk factors such as self-rated health, treatment for illnesses, and lifestyle factors (Liu et al., 2016). Similarly, cross-lagged relations between health and life satisfaction showed that health predicted changes in satisfaction, but not the reverse (Gana et al., 2013).

Hostility

Hostility refers to cognitive (e.g., cynicism and suspicion), affective (e.g., contempt and anger) and behavioral (e.g., aggression and competition) phenomena, all of which are

distinct but interrelated (Barefoot & Williams, 2010). There is conflicting evidence in relation to health: Sometimes hostility is a risk factor for all-cause mortality (Aldwin, Spiro III, Levenson & Cupertino, 2001; Barefoot, Dahlstrom & Williams, 1983; Barefoot, Larsen, von der Lieth & Schroll, 1995; Dembroski & Costa, 1987; Iribarren et al., 2005), but sometimes it is not (Hearn, Murray & Luepker, 1989; Kaufmann et al., 1999; Ketterer et al., 1998; McCrae, Watkins, Bardsma & Sisson, 1986; Surtees, Wainwright, Luben, Day & Khaw, 2005). Digging deeper into these discrepancies suggests that aggressive responding, chronic hostile affect, and cynicism are risky, while other components of hostility such as hostile attributions and social avoidance are not (Barefoot et al., 1987; Barefoot, Dodge, Peterson, Dahlstrom & Williams, 1989; Boyle et al., 1989; Chapman, Roberts & Duberstein, 2011; Houston, Babyak & Chesney, 1997; Kaplan, Everson & Lynch, 2000; Lemogne et al., 2010).

Analogously to conscientiousness, the reliable link between cynical hostility and health and longevity is likely due to the multitude of pathways. Cynical people not only perceive the intentions of others to be more hostile, causing negative physiological and behavioral reactions (Larkin, Martin & McClain, 2002; Smith, Glazer, Ruiz & Gallo, 2004), but also receive lower levels of social support (Benotsch, Christensen & McKelvey, 1997; McCann, Russo & Benjamin, 1997), an important coping mechanism that can buffer these adverse experiences. Moreover, hostile people evoke hostile reactions from others, causing them, when all else is held equal, to be in more stressful situations and environments more often than less hostile individuals (Barefoot & Williams, 2010). Hostility is also associated with a variety of risky health behaviors such as smoking and alcohol use (Bunde & Suls, 2006), and related biomarkers such as higher body mass index, unhealthy lipid ratios (Siegler, Peterson, Barefoot & Williams, 1992) and shortened telomeres (Lek et al., 2017). Hostility also seems to be especially relevant to suicide, homicide and accidents (Lemogne et al., 2010).

Neuroticism

Neuroticism, the tendency to experience negative emotions such as worry, anxiety, and emotional instability, is widely believed to be associated with poor health, but here again the scientific evidence about causality is mixed. Some studies have found that neuroticism is a risk factor for early mortality (Roberts et al., 2007; Shipley, Weiss, Der, Taylor & Deary, 2007; Weiss, Gale, Batty & Deary, 2009), but other studies have found no link (Almada et al., 1991; Iwasa et al., 2008; Jokela et al., 2013), or have found neuroticism to be protective against early mortality (Korten et al., 1999; Weiss & Costa, 2005; Weiss, Gale, Batty & Deary, 2013).

There are several possible explanations for these conflicting results, though these possibilities have yet to be fully explored empirically. It is likely that neuroticism is sometimes adaptive, and sometimes maladaptive. Friedman (2000)

proposed the potential for two different life pathways for neurotics. On the unhealthy pathway, an individual might distract herself from distressful emotions with alcohol and cigarettes, be too anxious to follow medical advice and fail to maintain healthy relationships. “Healthy neuroticism,” on the other hand, involves caution and treatment adherence (Friedman, 2000; Gardner & Oswald, 2004; Korten et al., 1999; Weston & Jackson, 2015). A healthy neurotic is hyper-vigilant about health – on a lookout for symptoms to discuss with their doctor and too anxious to engage in risky behaviors. The idea is that a healthy neurotic will engage in healthy behaviors while avoiding unhealthy ones, and seek treatment for symptoms more quickly, thus leading to earlier diagnosis and treatment. (Indeed, people high in neuroticism use more health care services; Cuijpers et al., 2010.) In other words, some neurotics behave in unhealthy ways, and others behave healthfully. But how do we distinguish a healthy neurotic from an unhealthy one?

One possibility is that environments and situations moderate the effect of neuroticism on health. For example, Weston and Jackson found that after a chronic illness diagnosis, people who were high in conscientiousness and neuroticism were more likely to quit smoking (2015). Similarly, neuroticism has been found to be health protective in individuals who have been diagnosed with a chronic condition such as heart disease or diabetes (Brickman, Yount, Blaney, Rothberg & De-Nour, 1996; Ragland & Brand, 1998). Finally, there is evidence that neuroticism protects health in times of bereavement, perhaps because the personality trait keeps individuals vigilant about maintaining a healthy lifestyle and health-relevant routines such as medical checkups, even while experiencing grief (Taga, Friedman & Martin, 2009). It may be that when the situation warrants anxiety and worry (e.g., in the case of a medical diagnosis), high neuroticism drives individuals to engage in health protective behaviors.

Relatedly, the perception of poor health may also promote adoption of health protective behaviors, which may improve objective health outcomes. People who are neurotic are more likely to report lower self-rated health (Benyamini & Idler, 1999; Ganna & Ingelsson, 2015; Idler & Benyamini, 1997), but when adjusted for self-rated health, higher neuroticism is associated with lower mortality (Korten et al., 1999; Weiss & Costa, 2005), possibly driven by the individuals who rate their health as fair or poor (Gale et al., 2017). Perhaps people who are high in neuroticism and report poor self-reported health become more vigilant about their health – seeking healthcare promptly or adhering to treatments out of heightened concern for their health.

The seemingly conflicting associations between neuroticism and health are further clarified by evidence that the effects of neuroticism likely vary across the lifespan (Korten et al., 1999; Weiss & Costa, 2005). There is evidence that neuroticism is protective in older adults (seventy years and above, Korten et al., 1999; sixty-five years and above, Weiss & Costa, 2005), but is predictive of self-reported physical

health conditions in young-to-middle age (Charles, Gatz, Kato & Pedersen, 2008). Perhaps higher anxiety and symptom sensitivity is a warning sign of imbalance at a young age when one is less likely to contract a disease, but becomes health protective as the risk for disease increases (Moffitt, Belsky, Danese, Poulton & Caspi, 2017). That is, it may be that heightened anxiety (e.g., high neuroticism) is harmful when objective threats are low, but helpful when threats are high. Studies of the differential effects of personality (by context and life stage) – in particular neuroticism – across the lifespan are needed (Graham et al., 2017; Weston, Hill, Edmonds, Mroczek & Hampson, 2018).

It is also likely that different facets of neuroticism are differentially related to mortality. For example, there is evidence that worry and vulnerability are related to reduced mortality risk (Gale et al., 2017); that impulsivity, suppressed anger and depressive symptoms are related to increased mortality risk (Weiss & Costa, 2005; Wilson, Bienias, de Leon, Evans & Bennett, 2003); and that tenseness is unrelated (Gale et al., 2017). Evidence for anxiety is mixed (Gale et al., 2017; Wilson et al., 2003). There is surprisingly little research that attempts to explore the facet-level relations of neuroticism to health.

Finally, there is some evidence that conscientiousness moderates the effect of neuroticism on health. For example, when paired with high conscientiousness, high neuroticism is associated with lower levels of inflammatory biomarkers (Turiano, Mroczek, Moynihan & Chapman, 2013), lower mortality in women (but not men; Friedman, Kern & Reynolds, 2010), and, as previously mentioned, less smoking after disease onset (Weston & Jackson, 2015). The idea here is that, when paired with specific environments and traits (e.g., conscientiousness), neuroticism is healthy (Friedman, 2000). However, whether conscientiousness mitigates the negative health correlates of neuroticism, or if and when it reverses them, remains to be determined (Turiano, Mroczek, Moynihan & Chapman, 2013; Weston, 2017).

In sum, neuroticism as an independent predictor is likely to function inconsistently as a predictor of health, and may not be amenable to salutary interventions, especially as compared with conscientiousness. Although neuroticism sometimes predicts disease, it would be unwise to treat it as if it is a toxic agent. Instead, we need to understand when neurotic thoughts, behaviors and emotions can be appropriate and meaningful (Luong, Wrzus, Wagner & Riediger, 2016). There is as yet no comprehensive understanding of how, when and to what degree neuroticism may affect health (Friedman, 2019), and more research into the mediating and moderating factors of the relationship is required.

CRUCIAL ISSUES IN HEALTH AND PERSONALITY RESEARCH

The case of neuroticism provides a good example of some key issues in the field of personality and health. One important but challenging concern is the use of self-

reported health measures. As noted, individuals high in neuroticism are more likely to report physical symptoms and poor health, even without differences in objective physical health measures (Costa & McCrae, 1987). Not only do many self-report scales of health ask for subjective ratings of symptoms and pain, but measures of personality frequently rely on very similar items of measurement. “Have you been a very nervous person?” “Have you felt downhearted and blue?” and “Have you been a happy person?” are all questions on the SF-36, a common measure of health (Ware & Sherbourne, 1992). Similarly, items that measure neuroticism on the BFI-2, an updated version of the original Big Five Inventory, include “Is relaxed, handles stress well,” “Tends to feel depressed, blue” and “Worries a lot” (John, Donahue & Kentle, 1991; John, Naumann & Soto, 2008; Soto & John, 2016). Studies of personality and health will need to go well beyond using self-reported measures as both predictors and outcomes to avoid artifactual findings (Kern & Friedman, 2011a).

A second longstanding but still core issue is what is known as the “all-cause dilemma” (Friedman & Kern, 2014). This occurs when studies focused on a specific health outcome (e.g., breast cancer survival) identify individuals as recovered or cured, when in fact that individual recovered from the specific disease, but was diagnosed with another deadly disease or died. Such individuals are not healthy, and researchers who do not make the proper distinctions in their claims can distort the image of the relationships in personality and health (Friedman & Kern, 2014). This does not mean that studies should ignore how personality patterns relate to specific diseases; to the contrary, such studies are sometimes necessary to understand the underlying biological processes. For example, knowing a personality trait predicts heart disease but not cancer is important to providing clues about causal mechanisms, but only the proper, circumscribed conclusions should be drawn.

Finally, the field of personality and health needs more prospective studies that follow individuals throughout life, measuring potential moderators and mediators throughout. To develop effective health interventions – a key reason for uncovering the links between personality and health – an understanding of how the complex relationships unfold over time is necessary. True experiments (with random assignment) usually are not feasible, except for small parts of the associations. Thus, research in which we can establish temporal precedence and common developments (thereby uncovering pathways) are fundamental to the study of personality and health. This does not mean that all health and personality researchers should only conduct long-term prospective studies with objective outcomes. Cross-sectional studies and studies that employ self-report are helpful to uncovering possible links, but it is not until a multitrait multimethod matrix of longitudinal studies converges on an understandable pattern – as happened for the link between conscientiousness and health – that causal conclusions can be drawn. One likely

complementary approach pools existing and newly refined longitudinal data from various studies. For example, an integration of data from the Terman Life Cycle Study and the Hawaii Personality and Health Longitudinal Study (two long-term archival prospective studies) revealed that data from different cohorts can be integrated to examine lifespan theories of personality and health (Kern, Hampson, Goldberg & Friedman, 2014; see also Graham et al., 2018).

EMERGING ISSUES FOR PRESENT AND FUTURE RESEARCH

In the past several decades, research in personality and health has revealed which personality traits are linked with health or disease, and why these correlations may appear. Much of the work now shows predictive utility, especially regarding conscientiousness (Chapman et al., 2018). The most important and helpful next step in moving the field forward is to understand why, when and how these observed relationships exist. By uncovering the mediators and moderators that drive the complex personality-health links, and discerning the strength of their effects across contexts and across the lifespan, we will likely be able to begin to develop and implement valuable, powerful interventions that promote health and thriving. This may require further exploration of the relationship between facets of higher-order traits and health (Sutin, Stephan & Terracciano, 2018).

Until recently, researchers usually have looked at personality traits as stable predictors of health. But growing evidence that (1) personality is dynamic (Roberts & Mroczek, 2008); and (2) changes in personality have the potential to influence important life outcomes (Mroczek, 2014), calls attention to the likelihood that changes in personality are also important in predicting mental and physical health (Turiano et al., 2012). For example, in a ten-year study of personality change and health, changes in extraversion, conscientiousness and agreeableness were all associated with health, independent of baseline trait levels (Turiano et al., 2012). Understanding normative patterns of personality change also may be informative to further investigation of personality change and health. Mean level personality changes across the lifespan have been documented (Caspi, Roberts & Shiner, 2005; Roberts & DelVecchio, 2000; Roberts & Mroczek, 2008; Specht, Egloff & Schmukle, 2011). We now need to understand the individual variation, especially as related to health.

Normative changes may be associated with increases in self-rated health across time (Letzring, Edmonds & Hampson, 2014; Mund & Neyer, 2016). One study found that individuals who increased in neuroticism as opposed to decreased (i.e., followed a nonnormative pattern) were at an increased mortality risk (Mroczek & Spiro, 2007), but the mechanisms are still unclear – was the heightened risk due to nonnormative changes, or due to increases in neuroticism, independent of the normative patterns?

Importantly, not all studies have found this pattern for neuroticism and health (Turiano et al., 2012).

Given that associations between personality and health differ across the lifespan (Shanahan, Hill, Roberts, Eccles & Friedman, 2014), it seems likely that the associations between personality *change* and health will also differ across the lifespan. In a four-year study of personality change and health, the effect of personality change significantly varied by cohort, but only for certain traits – the effect of changes in neuroticism and extraversion were moderated by cohort, while changes in conscientiousness, agreeableness and intellect were not (Magee, Heaven & Miller, 2013). Moreover, assessment of personality change depends on the time between assessments, the number of assessments, the total length of the study and the instruments of measurement, all of which can alter estimates of change (Jackson & Allemand, 2014). This means that, depending on the study, it can be unclear whether a change in one trait is a reflection of a change in another trait, or whether there is a common mechanism driving change in multiple traits. Change collapsed across all traits may be more associated with health than change in a single trait (Human et al., 2013). Again, clarifying these links will involve studies of mediators and moderators. Explicit causal models will be a key to progress.

Personality Interventions

Studies of interventions that focus on changing personality to promote health are critical for both the advancement of basic knowledge about personality-health relationships, and also for application of research insights. One promising avenue involves targeting behaviors that are core to personality traits, producing new habits, and hence shifting psychosocial patterns over time (Javaras, Williams & Baskin-Sommers, 2019). Ultimately, these new patterns can translate into lasting trait-level change (Roberts & Mroczek, 2008).

Researchers studying interventions should be especially mindful of the full nuanced complexity of personality and health research. For example, the link between depression and coronary heart disease (Nemeroff & Goldschmidt-Clermont, 2012) precipitated many interventions to ease depression in an effort to reduce deaths from coronary heart disease. But, as noted, although there is evidence that treating depression reduces depression and may reduce certain cardiac events (Davidson et al., 2010), it does not decrease mortality risk (Berkman et al., 2003; Rutledge, Redwine, Linke & Mills, 2013; van Melle et al., 2007). To create an effective intervention, the mechanisms relating depression and mortality risk need to be uncovered. Perhaps the process begins in childhood, making adult interventions less effective; perhaps treating depression does not change key health behaviors; or, perhaps there is much more attention needed to underlying biological third variables that affect the likelihood of depression as well as mortality risk.

One promising place to start involves already-extant common health promotion programs and community activities. Studies of holistic experiences, that is, activities that involve many components known to influence personality and be important to health, need exploration. For example, community gardening requires persistence, dedicated work, physical activity and cooperative social interactions (Heilmayr & Friedman, 2018). It may be that fully engaging in such an experience shifts life pathways toward engagement, purpose and health. Moreover, immersive interventions with specific requirements related to personality and health may change traits and health simultaneously, with changes in one influencing the other. That is, community gardening may shift facets or traits, which may subsequently influence health, and the reverse is also true. Other similar holistic interventions worthy of study include community volunteer efforts, theater groups and cohesive sports teams. Additionally, personality and health researchers may find collaboration with therapists, whose work often focuses on shifting individual levels of a personality trait, to be productive and insightful.

It may be particularly important to study such experiences during times of transition; periods of transition are often ideal for adopting new habits and hobbies, and can be particularly formative (Shanahan, 2000). Further, intervening at a young age can set individuals onto a lifelong healthy pathway. That is, instead of battling the accumulation of fifty years of unhealthy habits in middle to old age, it is likely more effective to set children and young adults on a lifelong path of healthy habits and reaction patterns. It is unlikely for successful interventions to be one-size-fits-all. Instead, it may be necessary to identify groups of individuals who benefit from specific interventions, or to tailor interventions for specific individuals – another area in the field that necessitates research attention.

CONCLUSION

Personality psychology allows researchers and clinicians to understand and address health from a dynamic biopsychosocial approach, which turns the focus from curing disease to understanding longer-term pathways toward health and quicker recovery from illness. Personality captures the social, cultural, biological and psychological components that work dynamically to lead individuals toward certain outcomes, and so personality lends us the core concepts and methods to study and describe relationships to health (Ferguson, 2013; Hampson & Friedman, 2008).

Can research on personality and health be applied effectively to the real world? For the medical field to take the complex but significant developments in personality and health seriously, researchers must be precise in their methods and in the dissemination of results, and also communicate directly with health practitioners. As the

field of health psychology grows larger and deeper, there is an impetus to help train the next generation of medical workers, thus broadening the impact of our research.

Meanwhile, we must further disentangle the causal relationships between personality and health. Doing so will require more prospective lifespan studies that posit clear causal models and use multiple methods to measure health, personality, and moderating and mediating factors across time. We have achieved a basic understanding of which aspects of personality meaningfully relate to health and wellness, and an understanding of how, why and when these traits relate to health is within reach. Clarifying the mechanisms will allow the field to test personality-based health interventions – one of the driving forces of the field in the first place. With conscientiousness proving to be the strongest and most reliable personality predictor of health (Bogg & Roberts, 2013; Friedman, Kern, Hampson & Duckworth, 2014; Kern & Friedman, 2008), it provides a good initial framework for development of interventions. A better understanding of personality-health relationships will allow us to understand individual differences in the likelihood of disease, and develop tailored health interventions that focus on shifting individual life pathways via personality change.

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15 Attachment Theory

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INTRODUCTION

Attachment theory, created by British psychoanalyst John Bowlby (1973, 1980, 1982) and initially operationalized by Mary Ainsworth and colleagues (e.g., Ainsworth, Blehar, Waters & Wall, 1978), began its intellectual life as a modest attempt on Bowlby's part to understand why separations from mother early in life later cause so much psychological difficulty for children, adolescents and adults (e.g., Bowlby, 1958). As Bowlby worked his way deeper and deeper into this problem area, he eventually created a broad alternative to psychoanalytic theory, one much more solidly grounded in primate ethology, cognitive developmental psychology and clinical research. Ainsworth et al. (1978) added important ideas and assessment procedures, which allowed her and Bowlby's theory to be rigorously tested, revised and expanded for more than forty years. Today, because of this auspicious theoretical and psychometric foundation, attachment theory has generated a large and complex literature comprising thousands of empirical studies, a literature that continues to reflect Bowlby's psychoanalytic origins. As a personality theory, attachment theory combines psychoanalytic, evolutionary, developmental, social-cognitive and personality trait constructs in a systematic framework that transcends the usual typologies of personality traits.

In this chapter, we review attachment theory and research in terms of the fundamental questions that personality theories typically deal with: What motivates and guides attachment-related behavioral tendencies? How do people differ in these tendencies and how can these differences be measured? How are these differences rooted and represented in a person's mind? How are these tendencies shaped over the life span and to what extent are they resistant to change? What fears, anxieties and psychological defenses are associated with these tendencies? And are individual differences in attachment patterns relevant to psychological growth and mental health? Our account is based on the recently updated and expanded second edition of our book, *Attachment in Adulthood* (Mikulincer & Shaver, 2016), which comprehensively

reviews and integrates the sprawling attachment literature. Because Bowlby's initial efforts were aimed at conceptualizing motivation differently from Freud's drive theory, we begin with attachment theory's motivational components.

MOTIVATION CONCEPTUALIZED IN TERMS OF BEHAVIORAL SYSTEMS

Bowlby (1982) rejected Freudian and object relations versions of psychoanalytic theory that conceptualized human motivation in terms of "drives" and viewed the mind as powered by "psychic energy." Instead, he created a "behavioral systems" model of motivation, borrowed from ethology and cybernetic control theory, according to which human behavior is organized and guided by species-universal, innate neural programs (*behavioral systems*). These systems facilitate the satisfaction of fundamental human needs (e.g., attachment, exploration, sex) and thereby increase the likelihood of survival, adjustment and reproduction. Bowlby (1982) viewed each system as a servomechanism that could be turned on, or "activated," by certain stimuli or situations and "deactivated" or "terminated" by other stimuli and situations (basically, by the attainment of what Bowlby called "set-goals"). Behavioral systems move a person toward set-goals by encouraging him or her to monitor, appraise and evaluate goal-relevant internal and external cues, and to learn new means-end associations and stimulus-response contingencies that increase the likelihood of goal attainment and facilitate need satisfaction.

In the case of the attachment behavioral system, Bowlby (1982) focused on the fundamental need for care and protection and the innate predisposition to search for and maintain proximity to protective others in times of need. The set-goal of the attachment system is the attainment of actual or perceived protection and security; hence, the system is automatically activated when a potential or actual threat to one's sense of security is detected. Under these conditions, a person tends automatically to

turn for protection and comfort to supportive others (whom Bowlby called *attachment figures*), and to maintain proximity to these “stronger and wiser” figures until a sense of security is attained. Proximity to these figures is a source of positive emotions (e.g., joy, gratitude, relief), whereas separation and distance from these figures is a source of anxiety and distress. Although the attachment system is most important early in life (a matter of life or death), Bowlby (1988) believed it is active across the life span and is manifest in thoughts and behaviors related to seeking proximity in times of need. This claim provided the impetus for subsequent theorists and researchers, including ourselves, to conceptualize and study attachment-related processes in adulthood.

During infancy, primary caregivers (usually one or both parents but also grandparents, older siblings, daycare workers) are likely to occupy the role of attachment figure. During adolescence and adulthood, other relationship partners also become targets of proximity and support seeking, including close friends and romantic partners. Teachers and supervisors in academic settings or therapists in clinical settings can also serve as real or potential sources of comfort and support, and therefore can be viewed as attachment figures. Moreover, groups, institutions and symbolic personages (e.g., God, the Buddha, or the Virgin Mary) can also be recruited as attachment figures. All of these real and symbolic care providers form what Bowlby (1982) called a person's *hierarchy of attachment figures*.

In addition to their actual, physical presence, mental representations of attachment figures and self-subroutines that develop through the internalization of caring and soothing behaviors of attachment figures can serve as symbolic sources of support, comfort and protection (Mikulincer & Shaver, 2004). They can also provide models of effective, loving behavior that influence the way a person regards and treats him- or herself in the temporary absence of an actual attachment figure. Nonetheless, although Bowlby (1982, 1988) assumed that age and psychological development result in an increased ability to gain comfort from attachment-related mental representations, he also assumed that no one of any age is completely free of reliance on actual others when confronting illness, death of loved others, aging, and other disasters and traumas.

Bowlby's ideas about the predisposition to seek proximity to others to obtain care and protection have received extensive empirical support. In times of need, infants show a clear preference for their familiar caregiver, engage in intense proximity-seeking, and are soothed by a caregiver's presence and support (e.g., Ainsworth, 1991). Conceptually parallel research with adults has shown that people are likely to turn to others for support while, or immediately after, encountering stressors (see Mikulincer & Shaver, 2016, for an extensive review).

Using cognitive research techniques, we (Mikulincer, Birnbaum, Woddi & Nachmias, 2000; Mikulincer, Gillath

& Shaver, 2002) have found that adults react to even minimal threat cues with activation of proximity-related thoughts and mental representations of security-providing attachment figures. In these studies, subliminal priming with a threat word (e.g., illness, failure) was found to heighten the cognitive accessibility of attachment-related mental representations, indicated by faster lexical-decision times for proximity-related words (e.g., love, closeness) and the names of people nominated as providing protection and security (e.g., the name of a parent, spouse or close friend). Interestingly, these effects were specific to attachment-related representations and were not found for attachment-unrelated words or the names of people other than attachment figures, including family members who were not nominated as security-providing attachment figures. Similar findings have been obtained in subsequent studies, where threat primes have automatically increased representations of symbolic sources of attachment security, such as a person's pet or God (Granqvist, Mikulincer, Gurwitz & Shaver, 2012; Zilcha-Mano, Mikulincer & Shaver, 2012). These findings support Bowlby's core claim that the mind turns automatically to attachment figures when threats loom.

Following up these findings, Beckes, Simpson and Erickson (2010) reasoned that the repeated automatic activation of representations of a comforting relationship partner following encounters with threats would be enough to transform this partner into a security-enhancing attachment figure. Beckes et al. (2010) used a classical conditioning procedure to test whether participants would be more likely to develop security-related associations with the faces of people who displayed genuine smiles if those faces were repeatedly paired with subliminally presented threatening stimuli (e.g., a picture of a striking snake or a mutilated accident victim) rather than with neutral stimuli. As compared to smiling faces paired with neutral subliminal stimuli, smiling faces paired with threatening subliminal stimuli did indeed decrease lexical-decision response times for security-related words (e.g., “belong”) while lengthening lexical-decision response times to insecurity-related words (e.g., “betray”). Importantly, the learning process did not have this effect when neutral, unresponsive faces were used. Thus, responsive faces preceded by potential threats promote implicit associations between those responsive faces and mental representations of security. This evidence fits with Panksepp, Solms, Schl pfer and Coenen's (2014) ideas concerning the linkage between stress-related neural circuitry and attachment-system activation in rodents and other mammals.

There is also extensive evidence that separation from and loss of attachment figures is a powerful source of pain and distress. Ethological observation of infants separated from their mothers (e.g., Heinicke & Westheimer, 1966; Robertson & Bowlby, 1952) revealed early in the history of attachment research that absence of an attachment figure causes intense distress, anxiety, anger, protest and

yearning. In adulthood, bereavement research has also found that loss of a close relationship partner is one of the most painful experiences a person can endure, one that typically elicits extreme sorrow, despair and painful longing for the deceased partner (see Fraley & Shaver, 2016, for a review). Similar emotional reactions have also been observed following experiences of others' disapproval, criticism or rejection (see Gerber & Wheeler, 2009, and Rotge et al., 2015, for systematic reviews and meta-analyses) and the breakup of romantic relationships (see Amato, 2010, and Sbarra, 2012, for reviews).

Researchers have also documented the positive neural effects of gaining proximity to attachment figures. For example, Coan, Schaefer and Davidson (2006) scanned the brains (using functional magnetic resonance imaging) of married women who were undergoing a laboratory stressor (threat of electric shock) while either holding their husband's hand, the hand of an otherwise unfamiliar male experimenter, or no hand at all. The findings indicated that spousal handholding reduced physiological stress responses, as seen in brain regions associated with distress (e.g., right anterior insula, superior frontal gyrus, and hypothalamus). Moreover, Eisenberger and colleagues (Eisenberger et al., 2011; Master et al., 2009) found that holding the hand of a romantic partner or viewing his or her photograph reduced pain-related brain responses to heat stimuli.

Conceptually similar findings were obtained when experimentally priming security-related mental representations (*security priming*). For example, Mikulincer, Hirschberger, Nachmias and Gillath (2001) found that subliminal presentation of the names of participants' security providers, compared with the names of close others or mere acquaintances who were not nominated as attachment figures, led to greater liking of previously unfamiliar Chinese ideographs even in a threatening context. Subsequent studies have found that security priming accelerates emotional recovery and reduces negative thoughts after recalling an upsetting event (Selcuk, Zayas, Günaydin, Hazan & Kross, 2012), inhibits the reconsolidation of traumatic memories (Bryant & Chan, 2017), soothes pain-related brain responses following social rejection (Karremans, Heslenfeld, van Dillen & van Lange, 2011), and counteracts amygdala reactivity in response to threatening stimuli (Norman, Lawrence, Iles, Benattayalah & Karl, 2015).

ATTACHMENT-RELATED INDIVIDUAL DIFFERENCES

As explained thus far, attachment theory provided an alternative psychodynamic framework for conceptualizing human motivation and socioemotional bonds, but it might not have captured the attention of developmental, personality, social and clinical researchers if it had done only that. What captured research psychologists' attention were the patterns or styles of attachment emphasized in Bowlby's (1973, 1980) theory and operationalized in

Ainsworth's research on mother-infant dyads (Ainsworth et al., 1978). Most of the research inspired by the theory focuses on these individual differences.

According to Bowlby (1973), the ability of a behavioral system to achieve its set-goal depends on a person's transactions with the external world. Although behavioral systems are innate intrapsychic mechanisms, they are manifested in actual behavior, guide people's transactions with the social world, and can be affected or shaped by others' responses. Over time, social encounters mold the parameters of a person's behavioral systems in ways that produce fairly stable individual differences in strategies and behaviors. That is, a person's neural and behavioral capacities become "programmed" to fit with major close relationship partners, or attachment figures. Bowlby (1973) assumed that the residues of such social encounters are stored as mental representations of person-environment transactions, which he called *working models of self and other*, and that these representations shape the functioning of a person's behavioral system and the way he or she behaves in particular social situations.

According to Bowlby (1973), individual differences in attachment-system functioning are a result of the availability, responsiveness and supportiveness of attachment figures in times of need. Interactions with attachment figures who are available and responsive facilitate optimal functioning of the attachment system and promote a core sense of *attachment security* – a sense that the world is generally a safe place, that attachment figures are helpful when called upon, and that it is possible to explore the environment curiously and engage effectively with other people without being hurt. When attachment figures are not reliably available and supportive, a sense of security is not attained, negative working models of self and others are formed and secondary strategies of affect regulation come into play. According to Cassidy and Kobak (1988), these secondary strategies are of two kinds: *hyperactivation* and *deactivation* of the attachment system.

Hyperactivation (which Bowlby, 1982, called "protest") is characterized by energetic, insistent attempts to get a relationship partner, viewed as insufficiently available or responsive, to pay more attention and provide better care and support. Hyperactivating strategies include clinging, controlling and coercive responses; cognitive and behavioral efforts to establish physical contact and a sense of "oneness"; and overdependence on relationship partners as a source of protection (Shaver & Mikulincer, 2002). Hyperactivation keeps the attachment system chronically activated and constantly on the alert for threats, separations, and betrayals; it therefore unintentionally exacerbates relational conflict, heightens distress associated with attachment-figure unavailability, and reinforces doubts about one's ability ever to attain a sense of security (Mikulincer & Shaver, 2003, 2016).

Deactivation refers to inhibition of proximity-seeking inclinations and actions, suppression or discounting of threats that might activate the attachment system, and

determination to handle stresses alone (a stance Bowlby, 1982, called “compulsive self-reliance”). These strategies involve maintaining physical and emotional distance from others, being uncomfortable with intimacy and interdependence, ignoring or downplaying threat- and attachment-related cues, and suppressing threat- and attachment-related thoughts (Cassidy & Kobak, 1988). These tendencies are bolstered by a self-reliant attitude that decreases dependence on others and discourages acknowledgment of personal faults (Mikulincer & Shaver, 2016).

In examining these individual differences in attachment-system functioning, attachment researchers have focused on a person’s *attachment style* – the pattern of relational needs, cognitions, emotions and behaviors that results from satisfactory or frustrating interactions with attachment figures. These styles were first described by Ainsworth (1967; Ainsworth et al., 1978) based on her observations of infants’ responses to separations from and reunions with mother in a laboratory “Strange Situation” assessment procedure. Ainsworth classified infants into one of three style categories: secure, anxious or avoidant. Main and Solomon (1990) later added a fourth category, “disorganized,” characterized by odd, awkward behavior and unusual alternations or mixtures of anxiety and avoidance.

In the 1980s, researchers from different subdisciplines (developmental, clinical, personality, and social psychology) constructed new measures of attachment style to extend attachment research into adolescence and adulthood. Based on a developmental and clinical approach, for example, Main and her colleagues (George, Kaplan & Main, 1985; Main, Kaplan & Cassidy, 1985; see Hesse, 2016, for a review) devised the Adult Attachment Interview (AAI) to study adolescents and adults’ mental representations of attachment to their parents during childhood. In the AAI, interviewees answer open-ended questions about their childhood relationships with parents and are classified into categories paralleling Ainsworth’s infant typology. Despite the richness of AAI narratives, which are particularly useful in clinical settings, the interview is costly to administer and score, and it deals exclusively with memories of child–parent relationships. It does not directly measure attachment orientations in peer or romantic relationships.

Working from a personality and social psychological perspective, Hazan and Shaver (1987, 1990) developed a self-report measure of adult attachment style suitable for use in experiments and surveys. In its original form, the measure consisted of three brief descriptions of feelings and behaviors in close relationships that were intended to characterize adult romantic analogues of the three infant attachment styles identified by Ainsworth et al. (1978). Participants were asked to read the descriptions and then place themselves into one of the three attachment categories according to their predominant feelings and behavior in romantic relationships.

Hazan and Shaver’s seminal studies were followed by hundreds of others that used the simple forced-choice self-report measure to examine the interpersonal and intrapersonal correlates of adult attachment style (see reviews by Crowell, Fraley & Roisman, 2016, and Mikulincer & Shaver, 2016). Over time, attachment researchers largely agreed that attachment styles are best conceptualized as regions in a two-dimensional (anxiety-by-avoidance) space, because these two dimensions are consistently obtained in factor analyses of attachment measures (e.g., Brennan, Clark & Shaver, 1998). Moreover, dimensional representations of attachment style are more accurate than categorical representations (Fraley & Waller, 1998). The first dimension, attachment-related *avoidance*, is concerned with discomfort with closeness and dependence on relationship partners, preference for emotional distance and self-reliance, and the use of deactivating strategies to deal with insecurity and distress. The second dimension, attachment-related *anxiety*, is concerned with a strong desire for closeness and protection, intense worries about partner availability and one’s own value to the partner, and the use of hyperactivating strategies for dealing with insecurity and distress. People who score low on both dimensions are said to be secure or to have a secure attachment style.

The two attachment-style dimensions, which are considered to be the two major kinds of attachment insecurity, can be measured with the 36-item Experiences in Close Relationships inventory (ECR; Brennan et al., 1998), which is reliable in both the internal-consistency and test–retest senses and has high construct, predictive and discriminant validity (Crowell, Fraley & Roisman, 2016; Mikulincer & Shaver, 2016). This scale can be used to assess a person’s global attachment orientations in a range of close relationships as well as his or her attachment orientation in a particular relationship or on a particular occasion (Mikulincer & Shaver, 2016). Studies using self-report measures of adult attachment style have found them to be coherently related to relationship quality, mental health, social adjustment, ways of coping, emotion regulation, self-esteem, interpersonal behavior and social cognitions (see Mikulincer & Shaver, 2016, for an extensive review). Importantly, these attachment-style variations are usually not well explained by less specific, more global personality traits such as extraversion, neuroticism or self-esteem, although there are predictable and meaningful associations between attachment orientations and personality traits (see Mikulincer & Shaver, 2016, for a review).

ATTACHMENT-RELATED MENTAL STRUCTURE

Bowlby (1973, 1988) believed that individual differences in attachment style can be explained in terms of storing experiences of significant interactions or relationships with attachment figures in an associative memory network. This stored knowledge allows a person to predict

future interactions with relationship partners and adjust proximity-seeking attempts without having to rethink each one from the ground up. As reviewed earlier, Bowlby (1973) called these cognitive structures *working models* and viewed them as the core of stable attachment-style differences (e.g., Collins & Read, 1994; Shaver, Collins & Clark, 1996).

Adult attachment research has provided extensive evidence concerning the role of attachment working models in a person's appraisals of the self and others (see Mikulincer & Shaver, 2016, for a review). Numerous studies have shown that individuals who score higher on attachment anxiety or avoidance have more negative explicit and implicit views of others, hold more negative expectations concerning their relationship partners' behavior and tend to explain a partner's negative behavior in more catastrophic terms (e.g., Chavis & Kisley, 2012; Collins, Ford, Gichard & Allard, 2006). Research has also consistently shown that people who score higher in attachment anxiety tend to have lower self-esteem and view themselves as less competent and efficacious (e.g., Otway & Carnelley, 2013; Schmitt & Allik, 2005). Moreover, people scoring higher on attachment anxiety or avoidance tend to score higher on self-criticism and maladaptive perfectionism and to base their self-appraisals on unstable, conditional sources of self-worth, such as others' approval (e.g., Chen, Hewitt & Flett, 2015; Dunkley, Berg & Zuroff, 2012; Hepper & Carnelley, 2012).

Because working models, at least initially, are based on the internalization of specific interactions with a particular attachment figure, a person can hold multiple working models that differ in the outcome of the interaction (success or failure to attain security) and the strategy used to deal with insecurity in that interaction (hyperactivation or deactivation of the attachment system). Like other mental representations, these working models form excitatory and inhibitory associations with each other (e.g., experiencing or thinking about security attainment activates memories of congruent episodes of gaining protection and security), and these associations favor the formation of more abstract and generalized representations of self and others. Thus, models with a specific attachment figure (relationship-specific models) are constructed, and through excitatory and inhibitory links with models representing interactions with other attachment figures, even more generic working models are formed to summarize or abstract from different relationships. The end result can be conceptualized as a hierarchical associative memory network that includes episodic memories, relationship-specific models, and generic models of the self and others. As a result, with respect to a particular relationship and across different relationships, most people can sometimes think about interpersonal interactions in more secure terms and at other times think about them in less secure terms.

In a pioneering study, Overall, Fletcher and Friesen (2003) provided evidence for this hierarchical cognitive

network of attachment working models. They asked people to complete attachment measures for three specific relationships within each of three domains – family, friendship and romantic – and then examined the structure of these nine relationship descriptions. Confirmatory factor analyses revealed that a hierarchical arrangement of specific and global working models best fit the data, indicating that models of specific relationships (e.g., with a particular family member) are nested within relationship-domain representations (e.g., family members), which in turn are nested within more global models.

The neural network of attachment-related models has all of the usual properties of any cognitive network – e.g., differentiation, integration, and coherence among various models (Collins & Read, 1994). In addition, each working model within the network differs in cognitive accessibility (the ease with which it is activated and used to guide the functioning of the attachment system in a given social situation). As with other mental representations, the strength or accessibility of each model is determined by the amount of experience on which it is based, the number of times it has been applied in the past and the density of its connections with other working models (e.g., Collins & Read, 1994; Shaver et al., 1996). At a relationship-specific level, the model representing the typical interaction with a particular attachment figure has the highest accessibility in subsequent interactions with that person. At a generic level, the model that represents interactions with major attachment figures (e.g., parents and romantic partners) typically becomes the most chronically accessible attachment-related representation.

Consolidation of a chronically accessible working model is the most important psychological process accounting for the enduring effects on personality functioning of attachment interactions during infancy, childhood and adolescence (Bowlby, 1973). Given a fairly consistent pattern of interaction with primary caregivers during infancy and childhood, the most representative or prototypical working models of these interactions become part of a person's implicit procedural knowledge, tend to operate automatically and unconsciously, and are resistant to change. Thus, what began as representations of specific interactions with primary caregivers during childhood become core personality characteristics, tend to be applied in new situations and relationships, and shape one's attachment style in adulthood.

Although activation of a particular working model depends on the history of attachment-related interactions, attachment theory also emphasizes the importance of contextual factors that contribute to this activation (e.g., Collins & Read, 1994; Shaver et al., 1996). Experimental studies have shown that priming thoughts of an available and supportive attachment figure has immediate positive effects on mood, self-views, and appraisals of relationship partners, and this happens even if these thoughts are incongruent with a person's chronically accessible

insecure models (see Mikulincer & Shaver, 2015, for a review). In fact, these chronically accessible models coexist with less typical working models in one's memory network, and these nondominant models can be activated by contextual factors in a given situation.

DEVELOPMENT ASPECT OF THE THEORY

As with other psychodynamic theories, one of the pillars of attachment theory is the claim that childhood experiences play an important role in forming what will become a person's adult personality (Bowlby, 1973). This does not mean, however, that attachment theory can simply be equated with psychoanalysis. In fact, attachment theory offers a unique perspective on the development of working models and their interplay with contemporary interpersonal contexts as determinants of adult feelings and relationship outcomes. Specifically, Bowlby (1973) believed that the developmental trajectory of working models is not linear or simple and that these mental representations in adulthood are not exclusively based on early experiences. Rather, they can be updated throughout life and affected by a broad array of contextual factors, such as current interactions with a relationship partner, the partner's attachment style and dynamics, and a person's current life situation, which can moderate or even override the effects of mental residues of past experiences. Thus, attachment theory does not assert that a person's current attachment orientation must mirror or match his or her attachment orientations with parents during childhood. Rather, the current orientation is a complex amalgam of historical and contemporary factors, and it can be changed by updating and reworking mental representations of self and attachment figures.

Borrowing from Waddington's (1957) epigenetic landscape model, Bowlby (1973) emphasized that the development of adult attachment patterns is constrained by two forces: (a) "homeothetic forces" that buffer changes in attachment patterns from infancy to adulthood, making it less likely that they will deviate from early working models, and (b) "destabilizing forces" that encourage deviation from early working models given powerful experiences that demand revision and updating of attachment representations. Attachment research has provided evidence for both homeothetic and destabilizing forces. With regard to homeothetic forces, numerous studies have found that attachment patterns tend to remain stable over time (see Mikulincer & Shaver, 2016, for a review). Pinquart, Feußner and Ahnert (2013) meta-analyzed results from 127 samples ($N = 21,072$) in studies that examined the stability of attachment patterns at 225 different time intervals, ranging from two weeks to twenty-nine years. The overall stability coefficient for attachment security was .39 regardless of time interval. However, lower stability coefficients were found in intervals larger than fifteen years.

Some of the longitudinal studies that have assessed attachment patterns at different ages have also provided

evidence of the action of destabilizing forces. In these studies, researchers gathered data concerning stressful attachment-unrelated events (e.g., war, natural disasters, financial crises) and stressful attachment-relevant events (e.g., death of a parent, parental divorce, physical or sexual abuse by a family member) and found that occurrence of these events during childhood or adolescence destabilizes the trajectory of attachment patterns. Specifically, they increased the likelihood that what were once securely attached infants would be classified as insecure. For example, Becker-Stoll et al. (2008) found that adolescents classified as securely attached at both age one and age sixteen experienced significantly fewer stressful events than adolescents with unstable attachment patterns. Pinquart et al. (2013) reached a similar conclusion in their meta-analysis of studies of attachment stability. Specifically, they found that secure infants with a history of stressful events were less likely to maintain security during adolescence than secure infants who grew up in less stressful environments.

In line with these findings, van Ryzin, Carlson and Sroufe (2011) re-analyzed longitudinal data from the Minnesota Study of Risk and Adaptation, and found a wide variety of attachment pathways across time that were closely associated with stressful events occurring during childhood or adolescence. They concluded that early attachment security does not imply invulnerability to later insecurity and that continuity in attachment security over time is not only a function of the power of early parental caregiving in shaping the developing child's working models. In fact, the presence of stressful events seems to disrupt family stability and thereby increase vulnerability to insecurity, even in those with early security.

According to Simpson, Collins, Salvatore and Sung (2014), these findings suggest that continuity of attachment patterns from infancy to adulthood is a dynamic process resulting from successive transactions between the person and the environment across the lifespan. Infant attachment working models are carried from one time point to another by attachment representations that are also responsive to socioemotional functioning in a wide variety of settings (family, school, peer relationships) and current attachment-relevant experiences, so that later attachment representations are always a reflection of the early prototype and the accumulated subsequent experiences. This dynamic developmental process has been found to explain the observed long-term contribution of infant attachment to social competence in adolescence and young adulthood (e.g., Englund, Kuo, Puig & Collins, 2011) and the quality of romantic relationships and parenting in young adulthood (e.g., Oriña et al., 2011; Raby et al., 2015; Simpson, Collins, Tran & Haydon, 2007).

ATTACHMENT-RELATED DYNAMICS

Attachment theory addresses the fears and conflicts that characterize the various forms of attachment insecurity (anxiety, avoidance) as well as the psychological defenses

that are activated to manage these conflicts. According to Mikulincer, Shaver and Pereg (2003), the pain caused by the unavailability of attachment figures in times of need can be experienced in different ways and result in different kinds of fears and defenses. Mikulincer et al. (2003) described two kinds of psychological pain: (a) the distress caused by failing to achieve or maintain proximity to an attachment figure and (b) the sense of helplessness caused by ineffective coregulation of distress and the appraisal of oneself as alone and vulnerable. Although these two kinds of painful feelings are related, their relative strength may vary across situations, relationships and individuals. Moreover, each kind of pain predisposes a person to adopt particular kinds of psychological defenses.

One state of mind is based on the failure of attachment behaviors to achieve a positive result (closeness, love or protection) and on being punished (with inattention, rejection or hostility) for enacting these behaviors. In such a state, seeking proximity to an attachment figure is likely to become a major source or threat of psychological pain. A person in this predicament tends to appraise closeness and intimacy as aversive and to fear being in a needy position and involved in close and interdependent relationships that can end in separation or rejection. As a result, such a person is more or less compelled to rely on avoidant, deactivating defenses. A very different state of mind emerges from emphasizing the failure to coregulate distress and worrying that one does not have the capacity to deal with threats alone. This state of mind encourages a person to work harder to gain attention, cooperation, and protection from an attachment figure – i.e., to hyperactivate the attachment system. Under such conditions, distance from an attachment figure is perceived as threatening and as a source of psychological pain, and the person becomes afraid of what will happen if one attempts to cope with the situation and regulate distress alone.

These states of mind are manifested in the ways in which anxious and avoidant people construe their interpersonal goals and interactions and regulate their emotions. At the interpersonal level, anxious hyperactivation forces people to select interpersonal goals that decrease distance from others and the probability of being alone while confronting stress and distress; avoidant deactivation requires that people organize their interactions around desires for optimal distance, self-reliance and control. Whereas attachment-anxious people fear rejection and aloneness, avoidant ones are averse to closeness and interdependence. Indeed, there is evidence that more avoidant people are more likely to prioritize distance-related goals, whereas more anxious people are more likely to prioritize closeness-related goals (e.g., Greenwood & Long, 2011; Locke, 2008; van Petegem, Vansteenkiste & Beyers, 2013). For example, van Petegem et al. (2013) found that anxious attachment among adolescents predicted lower levels of autonomy goals within their family context one year later. In another study, Fraley and Marks

(2011) found that avoidant people implicitly preferred distancing in a motor task in which participants were instructed to push or pull a lever in response to lexical stimuli. More avoidant participants were faster to push the lever away from themselves when presented with the word “Mom.”

Attachment-related differences in interpersonal goals are especially relevant in interpersonal contexts that activate attachment-related fears and defenses. For example, Mashek, Le, Israel and Aron (2011) found that more avoidant people reported wanting less closeness in their current relationship mainly after being primed with distance-related words. Spielmann, Maxwell, MacDonald and Baratta (2013) found that avoidant attachment was associated with less positive appraisals of opportunities for intimacy when a romantic partner was likely to activate attachment goals (i.e., when the current romantic partner was salient) but not when a partner was unlikely to activate these goals (i.e., when the person in question was an ex-partner). Using a diary methodology, Overall and Sibley (2009) found that when more avoidant people felt they had insufficient independence or control in their relationships on a given day, they tended to inhibit closeness goals and withdraw emotionally from their partners during that day. Thus, it seems that avoidant people circumvent attachment-system activation by inhibiting closeness goals when there is a potential for closeness or a threat to autonomy.

There is extensive evidence that avoidant attachment is associated with greater fear of intimacy (e.g., Doi & Thelen, 1993; Rowe & Carnelley, 2005). However, Slotter and Luchies (2014) found that avoidant people’s tendency to prefer emotional distance from a romantic partner was lessened following positive and harmonious couple interactions, thereby indicating that avoidant people’s goals can be flexibly adjusted to relational circumstances. Several studies have shown that people scoring higher on attachment anxiety also score higher on scales measuring rejection sensitivity – the tendency to anticipate and overreact to rejection (e.g., Årseth, Kroger, Martinussen & Bakken, 2009; Scharf, Oshri, Eshkol & Pilowsky, 2014) and fear being single (Spielmann et al., 2013). Moreover, they are quicker to recognize rejection-related words in lexical decision tasks and have difficulties inhibiting rejection-related thoughts (Baldwin & Kay, 2003; Baldwin & Meunier, 1999). However, Westphal, Bonanno and Mancini (2014) found that more anxious individuals diverted attention away from closed-mouth, rejecting faces in a dot probe task, probably reflecting an automatic defensive response against the threat of rejection.

Nevertheless, the attachment-anxious mind is not simply motivated to gain proximity to a relationship partner or avoid rejection. Research has shown that attachment-anxious people suffer from a strong, ambivalent conflict between approach and avoidance tendencies (e.g., MacDonald, Locke, Spielmann & Joel, 2013; Mikulincer, Shaver, Bar-On & Ein-Dor, 2010). On one hand,

they place strong emphasis on gaining a partner's attention and love. On the other hand, they suffer from intense fear of rejection and harbor serious doubts about their ability to gain a partner's love. These fears and insecurities can cause anxious individuals to inhibit approach tendencies when they sense the possibility of disapproval or rejection. Being caught in an approach-avoidance conflict, they are likely to ruminate obsessively about how to react during interpersonal interactions, thereby interfering with relationship quality.

According to attachment theory, insecure people's fears and defenses are evident in the ways they regulate emotional experiences and expressions (Cassidy & Kobak, 1988; Mikulincer & Shaver, 2016). For example, the deactivating strategies used by avoidant individuals are aimed at defusing or suppressing negative emotions, because these emotions can arouse unwanted attachment-related needs and are viewed as signs of weakness or vulnerability incompatible with the desire for self-reliance. This tendency was notable in Fraley and Shaver's (1997) study of thought suppression. Participants wrote continuously about whatever thoughts and feelings they were experiencing while being asked to suppress thoughts about a romantic partner leaving them for someone else. Avoidant attachment was associated with greater ability to suppress separation-related thoughts, as indicated by less frequent thoughts of loss following the suppression task and lower skin conductance during the task. In contrast, attachment anxiety was associated with poorer ability to suppress separation-related thoughts, as indicated by more frequent thoughts of loss following the suppression task and higher skin conductance during the task. Gillath, Bunge, Shaver, Wendelken and Mikulincer (2005) reported that these attachment-related variations are also evident in patterns of brain activation and deactivation when people are thinking about breakups and losses and attempting to suppress such thoughts. However, Mikulincer, Dolev and Shaver (2004) found that when a high cognitive demand was imposed, avoidant people's ability to suppress negative thoughts was disrupted and the suppressed material resurfaced in experience and behavior.

ATTACHMENT, ADJUSTMENT AND "OPTIMAL FUNCTIONING"

Although attachment theory is similar to Freudian and other psychoanalytic theories in focusing on defenses and pathology, it also includes ideas about the path to "optimal functioning" that have much in common with humanistic and self-actualization theories of personality (e.g., Maslow, 1968; Rogers, 1961) and today's "positive psychology" (e.g., Seligman, 2002). As reviewed in the previous sections, research consistently shows that the sense of attachment security is associated with positive mental representations of others, a stable sense of self-efficacy and self-esteem, and reliance on constructive ways

of coping, which in turn facilitate mental health and psychological functioning even in times of stress. Moreover, there is strong evidence that people who are more secure with respect to attachment are more likely to possess growth-oriented personality characteristics emphasized in "positive psychology," such as resilience, optimism, hope, positive affectivity, curiosity and exploration, healthy autonomy, a capacity for love and forgiveness, feelings of interconnectedness and belongingness, tolerance, and kindness (see Mikulincer & Shaver, 2016, for a review). According to attachment theory, experiences of being loved, accepted, and supported by others provide a foundation for confronting adversity and maintaining equanimity and effective functioning in times of stress without interrupting natural processes of growth and self-actualization.

Attachment security allows people to devote mental resources that would otherwise be employed in preventive, defensive maneuvers to more growth-oriented, promotion-focused activities that contribute to the broadening of their perspectives and capacities, and to their attainment of what Rogers (1961) called a fully functioning personality and Maslow (1968) called self-actualization. According to Bowlby (1982), the unavailability of security-providing attachment figures inhibits the activation of other behavioral systems, because a person who feels unprotected in the face of threats tends to be so focused on attachment needs that he or she lacks the attention and resources necessary to engage in other activities. This causes insecure people to be less tolerant of outgroup members (Mikulincer & Shaver, 2001), less humane in their values (Mikulincer et al., 2003), and less compassionate and altruistic (Mikulincer, Shaver, Gillath & Nitzberg, 2005). Only when a sense of attachment security is achieved or restored can a person devote full attention and energy to other behavioral systems, such as exploration and caregiving.

Research supports the claim that secure individuals are more likely to exhibit Rogers' (1961) defining features of the fully functioning person: openness to experience, existential living, organismic trust, experiential freedom and creativity. Secure people are able to experience and acknowledge their thoughts and feelings deeply, and they are open to disclosing these feelings to significant others, even if the thoughts and feelings are threatening or painful (e.g., Dykas, Woodhouse, Jones & Cassidy, 2014; Garrison, Kahn, Sauer & Florczak, 2012). Moreover, attachment security facilitates authenticity, cognitive openness, and adaptive revision of knowledge structures, without arousing strong fears of disapproval, criticism, or rejection (e.g., Gillath et al., 2010; Lattifian & Delavarpour, 2012; Mikulincer, 1997). Attachment security also facilitates relaxed and nonjudgmental engagement with one's flow of experience, as manifested in measures of mindfulness (e.g., Bourne, Berry & Jones, 2014; Goodall, Trejnowska & Darling, 2012; Pepping, O'Donovan, Zimmer-Gembeck & Hanisch, 2015), and it fosters savoring good moments and

capitalizing on experiences of positive affect (e.g., Gosnell & Gable, 2013; Sadikaj, Moskowitz & Zuroff, 2011). Moreover, people who are relatively secure with respect to attachment are more likely than insecure individuals to engage in creative exploration and participate fully in the wider world while remaining sensitive and responsive to others' needs (e.g., Mikulincer, Shaver & Rom, 2011; Mikulincer, Shaver, Sahdra & Bar-On, 2013).

CONCLUSION

Beginning as a psychoanalyst in World War II Britain, with eminent colleagues such as Anna Freud, Melanie Klein and Donald Winnicott, John Bowlby gradually created a more empirically oriented psychodynamic theory that can be integrated with the rest of scientific psychology. Ironically, this caused his version of what was then called "object relations" theory (because Freud had conceptualized attachment figures as "objects" of "instincts") eventually to outshine its contemporary competitors, making it today the most completely researched and influential psychodynamic theory.

Attachment theory is now the leading theory of love and bereavement; it is a mainstay of both developmental and personality/social psychology, and its major constructs are still being measured and refined through hundreds of studies involving self-report questionnaires, clinical interviews, behavioral observations, social-cognition experiments and neuroimaging techniques. Its insights are being applied clinically with both individuals and couples (see Obegi & Berant, 2008, and Brassard & Johnson, 2016, for reviews), and it is beginning to be examined in the context of organizational dynamics and leadership (e.g., Davidovitz, Mikulincer, Shaver, Ijzak & Popper, 2007). At present, there is no end in sight to the theory's generativity and potential for integration with other theoretical approaches to personality.

Attachment theory's generativity is manifested in the many conceptual and research issues that emerge from attachment research and that deserve careful and systematic consideration in future empirical studies. For example, we need to explore in greater depth the interplay between attachment and other behavioral systems (e.g., exploration, sex, caregiving, power/dominance). From developmental research, we know that individual differences in attachment system functioning can affect other behavioral systems (see Mikulincer & Shaver, 2016, for a review). However, from a personality perspective, changes in the functioning of the other systems (e.g., failure to learn new skills and then doubting one's competence and value; volunteering to help others and becoming more socially self-confident as a result) can feed back on attachment security. At present we know relatively little about the extent to which other behavioral systems affect the attachment system (e.g., Gillath, Mikulincer, Birnbaum & Shaver, 2008; Mizrahi, Birnbaum, Hirschberger, Mikulincer & Szepeswol, 2016). Future research should

explore more systematically the ways in which other behavioral systems shape the functioning of the attachment system and identify the psychological mechanisms underlying these effects. It should also examine reciprocal relations between caregiving, power, exploration and sex.

Future developmental and personality research should also explore in greater depth interrelations between attachment orientations and other personality traits and character strengths and virtues (e.g., honesty, fairness, curiosity, courage). In addition, researchers should attempt to delineate the complex gene-environment relations and interactions that shape attachment-system functioning. Finally, more research is needed to understand how to avert or resolve attachment injuries and create a relational climate, in couples, families, friendships and workplaces, that promote positive emotions, attachment security and personal growth.

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PART IV

**BIOLOGICAL
PERSPECTIVES:
EVOLUTION, GENETICS
AND NEUROSCIENCE
OF PERSONALITY**

16 Evolutionary Personality Psychology

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INTRODUCTION

Historically, psychology has been characterized by a dichotomy between branches that focus on human nature and those that focus on individual differences. Initial “grand theories” of personality, such as those advanced by Freud, Maslow and others, were interested in universal psychological features. For Freud, the emphasis was on sexual and aggressive “instincts” and a universal sequence of psychosexual stages. For Maslow, the focus was on a hierarchy of universal psychological needs, from immediate physiological demands to “self-actualization.” Historically, personality psychology has been the primary branch that has aspired to such broad conceptualizations of human nature.

Over the past few decades, personality psychology has retreated from this grand goal. Most empirical research on personality deals with individual differences, not with human nature, let alone the links between the two (e.g., McCrae & John, 1992). By focusing largely on individual differences (Larsen & Buss, 2018), modern personality psychology has implicitly ceded the study of human nature to other branches such as social psychology. Personality psychology’s restricted focus on individual differences has led some to identify this as a defining feature of the field: “that branch of psychology which is concerned with... the ways in which individuals differ from one another” (Wiggins, 1979, p. 375). Grand theories of human nature that once characterized the field are now regarded primarily as historical relics. The central argument of this chapter is that personality psychology should reclaim its grand goals, and that an evolutionary framework will be central to achieving these goals.

This chapter is organized into three sections. First, we present a conceptual tool – the psychological mechanism – that dissolves the unnecessary (and often false) dichotomy between “human nature” and “individual differences.” Second, we elucidate the multiple evolutionary processes that have operated on the human mind and the different types of products that these processes yield, which include both species-typical psychological phenomena and

individual differences. Finally, we offer a series of suggestions for how these tools can be incorporated into personality research. In offering these recommendations, we hope this chapter contributes to personality psychology by moving toward a more comprehensive framework that uses an understanding of evolved psychological mechanisms to explain and predict the origins of individual differences.

HUMAN NATURE: PSYCHOLOGICAL MECHANISMS

“Individual differences” and “human nature” are two major themes that have pervaded most efforts at grand personality theorizing (Buss, 1984). But what *does* human nature refer to? This term is often underspecified and used in ways that are incongruent with modern psychology. For Freud, human nature was defined by “instincts.” For Maslow, it was psychological “needs.” However, a central contribution of the cognitive revolution – which began over fifty years ago – is that the human mind can be best understood in terms of information-processing mechanisms.

In psychology, the term mechanism has been used in different ways, often sowing confusion. We use the term “psychological mechanism” to refer to an *information processor*. A three-component processor can be used to illustrate this concept. The first component of a psychological mechanism is that it takes cues from the environment as *input*. Second, it processes these inputs through algorithms, decision rules or other computational procedures. Third, it produces physiological responses, psychological states and/or manifest behavior as *output*.

This model captures two crucial concepts. First, it highlights that psychological states and manifest behavior are *not* psychological mechanisms themselves. Rather, they are potential *outputs* of psychological mechanisms. Second, the outputs of psychological mechanisms are not fixed, but rather are contingent on the inputs into the mechanisms. This makes psychological mechanisms flexible and highly sensitive to context (see Al-Shawaf, Lewis, Wehbe & Buss, 2019).

The term “human nature” refers to characteristics of humans that are species-typical. If psychological states and behaviors are the *outputs* of psychological mechanisms, and the production of these outputs is contingent on environmental inputs – which vary both across individuals and within individuals across time and space – then psychological states and manifest behavior are not viable candidates for defining universal human nature. By contrast, the psychological mechanisms – the underlying information processors responsible for producing these outputs – *do* meet the criterion of being a shared characteristic common to all humans. To understand why these psychological mechanisms are species-typical, we turn to evolution by selection.

Evolved Psychological Mechanisms

The process of evolution by selection produces (1) morphological, physiological, and psychological characteristics that (2) interact with the environment in ways that (3) promoted the reproduction of the genes of the individuals who possessed those characteristics (Dawkins, 1982; Hamilton, 1964; Williams, 1966). These characteristics are called *adaptations*. Adaptations that are psychological in nature are called *evolved psychological mechanisms*.

An adaptation exists in the form that it does because it helped to solve a specific problem relevant to survival or reproduction recurrently through evolutionary history (see e.g., Lewis, Al-Shawaf, Conroy-Beam, Asao & Buss, 2017 for a discussion of adaptive problems and heuristics for identifying them). Stated differently, *each adaptation was shaped by a specific survival- or reproduction-related problem*. Consequently, each adaptation is designed (1) to be activated by input signaling the adaptive problem, and (2) to produce output that typically helped solve that problem in ancestral environments. For example, our callus-producing adaptations are mechanisms that evolved to solve the problem of potential tissue damage caused by repeated friction (input) by producing additional cell layers (output) that protect underlying tissues.

Consider a psychological example. Witnessing one's romantic partner interacting intimately with a potential interloper activates the adaptation of evolved psychological mechanisms for sexual jealousy.

Imagine that you go to a party with your romantic partner. At one point, you see your partner seated very close to someone in a secluded corner of the room. The two are laughing and smiling, the other person's hand is on your partner's thigh, and your partner is touching the other person.

There are several cues to potential infidelity in this situation (Shackelford & Buss, 1997). Such infidelity would have been costly for both ancestral men and women. Consequently, selection has favored anti-infidelity adaptations in both sexes, including psychological adaptations that respond to infidelity cues (input) by motivating behaviors to solve this adaptive problem (output). Psychological

mechanisms for producing sexual jealousy are a part of universal human nature.

The *outputs* of sexual jealousy mechanisms are a coordinated suite of cognitions, emotions and behaviors. This can include gathering further information about the potential threat (Schützwohl, 2006); experiencing negative emotions in response to one's mate's interactions with potential interlopers (Buss, 1989, 2000); or aggressive responses to fend off these mating rivals (Buss, 1993, 2000; Buss, Larsen, Westen & Semmelroth, 1992; Daly et al., 1982; Symons, 1979).

These defenses, however, “are hypothesized to lie dormant until they are activated by cues signaling that [the] adaptive problem is being confronted” (Buss & Shackelford, 1997, p. 348). That is, we should not expect the outputs of sexual jealousy mechanisms (e.g., behavior) unless the mechanisms are activated by input signaling the adaptive problem. This central property of psychological mechanisms – that their output is dependent on environmental input – has the potential to unify propositions of human nature with individual differences.

UNIVERSAL HUMAN NATURE CAN PRODUCE INDIVIDUAL DIFFERENCES

Between-sex differences. Because both sexes faced the adaptive problem of mate retention, both sexes should be equipped with sexual jealousy mechanisms. Consistent with this, empirical evidence suggests that the sexes do not differ in the frequency or intensity of their jealousy (Buunk & Hupka, 1987). However, because fertilization occurs internally within women, only ancestral men faced the adaptive problem of “paternity uncertainty.” Since a man's paternity certainty would have been threatened by his mate's sexual infidelity, jealousy mechanisms in men are hypothesized to be particularly attuned to cues of their partner's *sexual* infidelity. This threat did not exist for ancestral women, but they did face the risk of losing their mate's commitment and support – a concern predicted by their partner's emotional involvement with another woman. As a consequence, women's jealousy mechanisms are hypothesized to be particularly sensitive to cues of their partner's *emotional* infidelity.

A substantial body of evidence provides empirical support for these hypothesized sex differences (Buss & Haselton, 2005; Edlund & Sagarin, 2017). In forced-choice dilemmas, men report that they would experience greater distress in response to a partner's sexual infidelity than to a partner's emotional infidelity, whereas women report the opposite (Buss et al., 1992). These results have been replicated by independent researchers (Wiederman & Allgeier, 1993), using different methods (Buss et al., 1992), and across a large variety of western and non-western cultures (Buunk, Angleitner, Oubaid & Buss, 1996). These sex differences have also been found using memory tests; physiological measures; and fMRI, which has documented different patterns of brain activation in response to sexual

versus emotional infidelity (see Buss & Haselton, 2005; and Edlund & Sagarin, 2017 for summaries of this evidence).

Within-sex differences: individual differences among men. As discussed previously, selection would have favored anti-infidelity adaptations in men. Considering the features of evolved mating strategies reveals why we might expect these universal psychological mechanisms to be differentially activated among men – and thereby produce individual differences.

Women's evolved mating strategies and infidelity threat. Ancestral women could have increased their reproductive success by both (1) producing high-quality offspring and (2) securing long-term investment from their mates. To produce offspring of high genetic quality, a woman had to copulate with a man of high genetic quality. However, desirable, high genetic quality men could have increased their own reproductive success by short-term mating with multiple women. Consequently, some women would not have been able to reliably secure both “good genes” (Gangestad & Simpson, 2000) and long-term investment from the same man. On this basis, researchers have hypothesized that selection favored a female dual mating strategy of (1) long-term mating with men willing to commit and (2) seeking high genetic quality men for short-term sexual liaisons, or extra-pair copulations (EPCs; Gangestad & Simpson, 2000). Abundant empirical evidence is consistent with this idea of a dual mating strategy in women (e.g., Gangestad, Thornhill & Garver-Apgar, 2005; but see Buss, Goetz, Duntley, Asao & Conroy-Beam, 2017, for an alternative view).

An ancestral woman could have reaped genetic and other benefits from an EPC (see Greiling & Buss, 2000), but she would have faced substantial potential costs in doing so. These include potentially losing her long-term partner, as well as reputational damage and a decrease in her desirability as a long-term mate (Forstmeier, Martin, Bolund, Schielzeith & Kempenaers, 2011). Selection therefore would have favored extra-pair mating mechanisms in women that were only activated under conditions in which the potential costs were outweighed by the potential benefits.

This cost-benefit calculus depends on the mate value of a woman's long-term mate. A woman with a high-value mate would have gained little genetic benefit from an EPC; the “good genes” (Gangestad & Simpson, 2000) she could have obtained for her offspring from an affair would have been, at best, minimally higher in quality than those from her long-term mate. On the other hand, a woman mated to a low-value man could have reaped substantial benefits by short-term mating with someone of higher genetic quality.

We should therefore expect extra-pair mating mechanisms to be activated more frequently among women with lower-value mates. In other words, throughout human evolution, the mates of low-value men would have been more likely to be unfaithful (see Cerda-Flores et al., 1999). These differences between men in the likelihood of their

partner's infidelity should result in differential activation of jealousy mechanisms, thereby producing individual differences in manifest sexual jealousy despite the universality of the mechanism itself.

Individual differences in the activation of men's sexual jealousy mechanisms. Infidelity itself is rarely directly observable, but it may be accompanied by numerous observable cues (Shackelford & Buss, 1997). If the mates of low-value men are more likely to have an affair, lower-value men should be exposed to a greater number of these cues. Being exposed to more of these cues should result in greater activation of mechanisms for jealousy – and consequently higher levels of jealous thoughts, emotional responses and behavior. For these reasons, we should expect universal psychological mechanisms to produce individual differences in sexual jealousy among men. Specifically, we should expect to observe greater activation of jealousy among lower-value men.

The examples presented in this section show how human nature – universal jealousy-producing mechanisms – can produce individual differences in jealousy.

What about “Nonevolved” Psychological Mechanisms?

So far, we have presented a model of psychological mechanisms (input→processing→output) and provided an illustration of how universal evolved mechanisms can produce individual differences. But what about *nonevolved* psychological mechanisms?

The concept of a nonevolved psychological mechanism is deeply problematic for the following reason. Selection is the only known process capable of producing the complex functional design observed in organisms (Williams, 1966). In other words, there is no known causal process – besides selection – capable of fashioning complex functional mechanisms in the body and mind.

For this reason alone, any psychological theory, including any theory of personality, must fit within a broader evolutionary framework. Stated differently, all psychological theories are implicitly or explicitly evolutionary (Symons, 1987). Although many psychologists do not specify their assumptions about the evolution of the mind, not one has ever proposed a psychological theory that has presumed some other causal process to be responsible for creating human nature.

And yet most personality psychologists have ignored evolution in their domains of study. Approaches to personality based on motives, which have obvious evolutionary relevance, historically have ignored evolution. Researchers studying the “self” have created mini-theories such as self-verification theory, self-enhancement theory, and social identity theory in a theoretical vacuum, uninformed by the evolutionary processes that created the psychological mechanisms in question. Trait psychologists typically have the goal of identifying the statistical structure of individual differences, without an interest in

how or why evolution might have shaped that particular structure of personality. Description is often an important first step in science, but we suggest that the time is ripe for the scientific maturation of personality psychology. The remainder of this chapter will present a set of explanatory conceptual tools that an evolutionary framework can offer to personality psychology.

EVOLUTIONARY PERSONALITY PSYCHOLOGY: SELECTIVE AND NONSELECTIVE MODELS

Selection is only one of several evolutionary processes, but it is often regarded with special privilege, and for good reason: It is the only known causal process capable of producing complex functional design in organisms. Selection is therefore an indispensable tool for understanding the design of the human mind.

Nonetheless, we do not want the reader to conflate “selection” with “evolution,” which includes both selective and nonselective processes (see Al-Shawaf, Zreik & Buss, 2018, for a discussion of this misunderstanding). These *nonselective evolutionary processes* are also important in understanding human personality. We therefore outline both selective and nonselective evolutionary models for individual differences in personality.

Selective Models: Directional and Balancing Selection

Evolutionary Model 1: Directional selection and universal psychological mechanisms. *Directional* selection is the most familiar form of selection. It refers to a process in which one genetic variant that leads to greater reproduction (relative to extant competing variants) is passed down to succeeding generations in greater numbers than competing variants. Over many generations, the variant associated with greater reproduction increases in relative frequency in the population, displacing less successful variants. This process results in a shared genetic architecture: a universal human nature.

Psychological mechanisms are activated by cues ancestrally linked to the particular problem they were designed to solve. Because of this, they will only be activated in particular contexts. Crucially, this suggests that human nature will express itself not as invariant impulses, but rather in variable and context-dependent ways (see Al-Shawaf et al., 2019). Here, we outline several ways in which evolved psychological mechanisms can be activated differentially across individuals as a function of differing environmental inputs, thereby resulting in individual differences in personality.

I. Different inputs into universal mechanisms: early developmental calibration. Humans with the same psychological mechanisms can experience different events in their development. These different events can serve as inputs into those shared mechanisms, channeling those

individuals into alternative, developmentally stable strategies with different outputs.

For example, Belsky, Steinberg and Draper (1991) propose that resource scarcity, parental unpredictability or father absence during early development serve as key inputs into evolved psychological mechanisms that produce, as output, developmentally stable differences in mating strategy. According to Belsky and colleagues, the presence of a father in the home during the first five to seven years of life is a reliable cue that adult pair-bonds are enduring and levels of paternal investment are high. In such an environment, pursuing a committed, long-term mating strategy is more beneficial than a strategy of short-term mating. Accordingly, selection would have shaped psychological mechanisms to take the environmental cue of father presence as input, and to calibrate individuals’ mating strategy accordingly. Research has borne out certain aspects of this hypothesis: Individuals reared in father-present homes exhibit delayed sexual maturation, later onset of sexual activity, a focus on long-term adult relationships, perceptions of others as trustworthy, expectations that relationships will endure, and heavy investment in a small number of children. Conversely, individuals reared in father-absent homes exhibit earlier sexual maturation, earlier sexual initiation, and frequent partner-switching; perceive others as untrustworthy and relationships as transitory; and pursue uncommitted sexual liaisons.

Belsky and colleagues did not explicitly use the concept of evolved psychological mechanisms, but all theories of environmental influence ultimately rest on a foundation of evolved psychological mechanisms, whether this is made explicit or remains implicit (Tooby & Cosmides, 1990). In Belsky and colleagues’ case, the implicit psychological mechanisms are designed to take as input information about the reliability of paternal investment, and process that input to produce distinct mating strategies as output.

Some variants of this hypothesis have received only mixed empirical support, whereas others have been more clearly substantiated (see Del Giudice, 2009; Ellis, Schlomer, Tilley & Butler, 2012, and Mendle et al., 2009). Whatever the eventual empirical outcomes, this illustrative example highlights how selection can favor species-typical mechanisms that shunt individuals toward different adult strategies in response to critical inputs during development. In other words, shared mechanisms combined with differential developmental inputs can lead to individual differences in personality.

II. Different inputs into universal mechanisms: stable situational evocation. If individuals stably occupy different environments or different niches, evolved psychological mechanisms can produce what seem to be stable individual differences (Buss & Greiling, 1999). Imagine a man, Matthew, whose mate frequently flirts with other men. Such frequent flirting may elicit frequent “mate poaching” attempts from rivals. Such events serve as inputs into jealousy mechanisms that produce suspicions,

distress, and mate guarding as outputs. By contrast, Matthew's brother, Michael, possesses the same psychological mechanism of jealousy, but is not exposed to any of these cues in his romantic relationship. Consequently, Michael does not exhibit these cognitive, affective or behavioral facets of jealousy. Observers might be misled into concluding that Matthew has the "stable trait" of jealousy, whereas Michael does not. In fact, however, Matthew's recurrent displays of jealousy – and the apparent trait difference between Matthew and Michael – are in fact attributable to Matthew's recurrent exposure to jealousy-activating inputs (Buss & Greiling, 1999).

In short, stable occupancy of different environments or niches can produce stable individual differences that appear trait-like, even though their causal origin lies in a universal mechanism that is sensitive to environmental inputs.

III. Different inputs into universal mechanisms: the individual's own phenotype. Any fitness-relevant feature of the environment can serve as an input into an evolved psychological mechanism (Tooby & Cosmides, 1990, p. 59). This can even include features of an individual's own body. Indeed, selection should have favored the evolution of psychological mechanisms that (1) take as input aspects of the individual's own phenotype and (2) produce output calibrated to those features. Evolved psychological mechanisms that regulate their output according to cues from the individual's own phenotype are called *condition-dependent* psychological mechanisms.

Evolutionarily informed research on anger and aggression illustrates this idea. Because a mesomorphic man can more successfully pursue an aggressive strategy than can an ectomorphic man (Sell, Tooby & Cosmides, 2009), selection should have shaped aggression-producing mechanisms to be sensitive to (i.e., take as input) the individual's own body type (modified from Tooby & Cosmides, 1990, p. 58). Research on anger empirically substantiates this idea (Sell et al., 2009).

The heritability of personality differences. Many aspects of an individual's phenotype, including physical attractiveness and strength, are highly heritable (Rowe, Clapp & Wallis, 1987; Silventoinen, Magnusson, Tynelius, Kaprio & Rasmussen, 2008). This is important because on the surface, the notion of species-typical personality mechanisms seems to be inconsistent with the heritability of personality traits (Penke, Denissen & Miller, 2007).

A number of scholars have interpreted the heritability of *manifest personality* as evidence for variation in the genes coding for the *mechanisms* responsible for producing personality (Nettle, 2006; Penke et al., 2007). However, personality models based on genetic polymorphisms leave the lion's share of individual differences in personality unexplained (e.g., see Westberg et al., 2009). Furthermore, it is unclear whether these genetic polymorphisms are associated with (1) differences in the psychological *mechanisms* that produce personality, or (2) differences in *inputs* into personality mechanisms. For example, the number of

nucleotide repeats at the androgen receptor locus is associated with individual differences in attractiveness and strength, which predict individual differences in extraversion above and beyond genetic polymorphism (Lukaszewski & Roney, 2011). This relationship between attractiveness, physical formidability and extraversion shows how species-typical psychological mechanisms can produce heritable personality outcomes. If the costs and benefits of extraversion vary as a function of individuals' heritable attributes such as physical attractiveness and strength, and extraversion-producing mechanisms regulate their outputs based on these attributes, then we should expect extraversion to show up as heritable in behavior genetics studies – but only because it is dependent on physical attractiveness and strength, which are themselves heritable (see Tooby & Cosmides, 1990, for their seminal discussion of this concept, which they coined "reactive heritability"). In this case, heritable individual differences in physical formidability and attractiveness provide input into evolved psychological mechanisms that then produce, as output, different levels of extraversion in different individuals.

More generally, if the psychological mechanisms that produce personality take, as input, cues ancestrally linked to the costs and benefits of alternative personality strategies, and those costs and benefits vary as a function of individuals' heritable attributes (such as strength and physical attractiveness), then personality would show heritability in behavioral genetics studies *despite being the output of species-typical psychological mechanisms*. This example illustrates how universal mechanisms, combined with different inputs from individuals' own bodies, can produce (1) individual differences in personality that are (2) stable and (3) appear heritable.

Species-typical psychological mechanisms can produce individual differences that are consistent with the heritability of personality, but so can other evolutionary models. These include both selective and nonselective evolutionary models. We touch on both.

Balancing Selection

Balancing selection is a process in which selection maintains genetic variation because different environmental conditions favor different levels of a trait. There are several forms of balancing selection, but the two most relevant forms for personality appear to be *environmental heterogeneity in fitness optima* and *frequency-dependent selection* (Penke et al., 2007).

Evolutionary Model 2: Balancing selection – fluctuating selection pressures over time and space. If environments vary, then selection can favor different optima in different environments. Consider variations in the abundance of food. Where (or when) food is scarce, selection might favor boldness and risk-taking that impel an individual to venture out into unknown territory to find food. Under such circumstances, risk-aversion and timidity may

lead to starvation. By contrast, when food is abundant, exploratory behavior could needlessly put an individual at risk. If some environments favor boldness and others favor cautiousness, then this variation in selection pressures across environments can maintain both boldness and cautiousness. In short, environmental heterogeneity can maintain heritable individual differences in personality. This is a form of balancing selection.

Both empirical and simulation-based research support this idea. Camperio Ciani, Veronese, Capiluppi & Sartori (2007) assessed the personality of people living on the mainland and a number of small islands in Italy. Families that were long-time inhabitants (at least twenty generations) of the islands scored lower on extraversion and openness to experience than those from the mainland. Such families also scored lower on extraversion and openness than recent immigrants to the islands. These findings are circumstantial, but they are consistent with the notion that different environments can select for different personality trait levels.

Molecular genetic studies provide further evidence for the idea that balancing selection can maintain heritability in human personality. Chen and colleagues (1999) hypothesized that the 7R allele of the DRD4 gene, which is associated with novelty-seeking (Munafo, Yalcin, Willis-Owen & Flint, 2008), is favored by selection when people migrate to new environments or inhabit resource-rich environments. Chen et al. provided empirical support for this hypothesis by studying the migration patterns of 2,320 individuals from thirty-nine groups. They showed that migratory populations had a far higher proportion of long-allele DRD4 genes than did sedentary populations. Moreover, independent research has shown that the 7R allele of the DRD4 gene is more advantageous among nomadic than settled populations (Eisenberg, Campbell, Gray & Sorenson, 2008). This suggests that environmental heterogeneity can select for different optimum personality trait levels in different environments, leading to the evolutionary maintenance of heritable variation on that trait.

Evolutionary Model 3: Balancing selection – frequency-dependent selection. Strictly speaking, *frequency-dependent selection* is not a second “type” of balancing selection, but rather is a particular case of balancing selection due to environmental heterogeneity. However, for conceptual clarity, and continuing the precedent in the literature, we treat it separately.

Frequency-dependent selection occurs when multiple strategies exist in a population, and the fitness of each strategy depends on its relative frequency in the population. The outcome of frequency-dependent selection is that multiple strategies are maintained in a population at particular frequencies relative to each other.

Biological sex is the most obvious example of frequency-dependent selection. As the ratio of males-to-females in a population increases, the average fitness of males decreases, and vice versa. That is, the approximately equal ratio of males to females in many species is a result of *frequency-dependent selection*.

Some researchers have suggested that frequency-dependent selection may explain psychopathy (see Mealey, 1995). The hallmarks of psychopathy include egocentrism, impulsivity, an inability to form lasting relationships, superficial social charm, and deficits in emotions such as love, shame, guilt and empathy (Cleckley, 1982). Because over 95% of both men and women do *not* exhibit psychopathy, the “cheating” strategy of psychopathy has a large pool of resources to exploit: the typical human strategy of cooperation. As long as the frequency of psychopaths remains relatively low, psychopaths tend to experience relatively high fitness. In other words, frequency-dependent selection can maintain psychopathy in a population composed primarily of cooperators (Mealey, 1995).

There is some indirect evidence consistent with this hypothesis. First, psychopathy is moderately heritable (see Willerman, Loehlin & Horn, 1992). Second, some psychopaths appear to pursue an exploitative short-term sexual strategy, which could be the primary route through which genes for psychopathy are maintained in the population (Rowe, 1995). Third, psychopathic men tend to be more sexually precocious, have sex with a larger number of women, have more children out of wedlock and are more likely to separate from their wives (Rowe, 1995). Finally, psychopaths tend not to target their genetic relatives, suggesting that psychopathy may be an evolved strategy rather than a dysfunction or pathology (Krupp, Sewall, Lalumière, Sheriff & Harris, 2012).

There are challenges to this hypothesis, including the questions of whether psychopathy represents a distinct category or a continuum (Baldwin, 1995; Eysenck, 1995), whether its frequency is sufficiently high to be maintained by frequency-dependent selection, and whether it represents a recently developed cluster in modern populations or an ancestral evolved strategy (Wilson, 1995). Despite these complications, Mealey’s hypothesis nicely illustrates how frequency-dependent selection can maintain different heritable personality strategies in a population.

Nonselective Models: Selective Neutrality and Mutation-Selection Balance

A widespread misconception is that “evolution” refers to one specific evolutionary process: directional selection. In reality, evolution consists of both selective and nonselective processes. Here, we discuss several nonselective evolutionary models for personality variation.

Typically, selection reduces genetic variation by purging less successful genetic variants from a population. However, selection is constantly accompanied by an influx of new mutations that continuously introduce variation into the population. Mutations can occur on any of the approximately 20,000 genes of the human genome or on any of the regulatory parts of the genome. Recent molecular genetic evidence suggests that approximately seventy new mutations are introduced per individual per

generation (Keightley, 2012). This is how new genetic variation is constantly introduced into a population – through mutation.

Generally speaking, selection “uses up” heritable variation. That is, heritable variants that have greater replicative success tend to increase in frequency in the population, displacing less successful genetic variants. However, there are constraints on selection’s tendency to decrease genetic variation, including by winnowing out these less successful variants. These constraints include *selective neutrality* and *mutation-selection balance* (see Al-Shawaf & Zreik, 2018 for a discussion of additional constraints on selection).

Evolutionary Model 4: Selective neutrality. Some mutations neither disrupt nor improve an organism’s overall functioning. Because these mutations have no impact on reproductive success, selection will neither systematically increase nor decrease their relative frequency in the population – they are *selectively neutral*.

Early evolutionary thinking identified selective neutrality as one candidate explanation for the heritability of personality differences (Tooby & Cosmides, 1990). However, selective neutrality with respect to personality traits carries the implausible assumption that different trait levels are unlinked to reproductive fitness. This is at odds with what is known about the relationships between personality and life outcomes (Nettle, 2006; Ozer & Benet-Martinez, 2006; Roberts, Kuncel, Shiner, Caspi & Goldberg, 2007). Many personality traits are systematically linked with fitness (Buss & Greiling, 1999; Nettle, 2006; Ozer & Benet-Martinez, 2006; Roberts et al., 2007), ranging from the link between conscientiousness and longevity (Deary, Weiss & Batty, 2010) to the link between extraversion and number of sex partners (Nettle, 2005; Schmitt, 2004). The key point is that many personality traits have clear links to survival and reproductive success (e.g., Alvergne et al., 2010; Jokela, Hintsala, Hintsanen & Keltikangas-Järvinen, 2010). Selective neutrality is therefore unlikely to be an important explanation for most heritable individual differences in personality.

Evolutionary Model 5: Mutation-selection balance. The models we have presented thus far are based on two different classes of mutations. The first class consists of mutations that are favored by selection. The second class consists of mutations that do not have an impact on reproductive success. There is a third and final class of mutations: those that are deleterious and therefore selected against. Despite their detrimental effects, selection is sometimes unable to work fast enough to eliminate these mutations from the population.

Recent evidence suggests that each human is born with approximately two new deleterious mutations (Keightley, 2012). Selection eventually weeds out harmful mutations (see Fu et al., 2012), but those that are only mildly harmful can take many generations to purge. These heritable mutations can therefore accumulate across generations despite their deleterious effects. Conservative estimates suggest that

the average human carries at least 500 brain-disruptive mutations (Fay, Wyckoff & Wu, 2001; Keller & Miller, 2006).

Nonetheless, people vary tremendously in the number of harmful mutations they carry, called their “mutation load” (Penke et al., 2007). Recent work suggests that individual differences in mutation load might explain the heritability of some individual differences. These include general intelligence (Penke et al., 2007; Deary, Penke & Johnson, 2010) as well as schizophrenia and autism (Keller & Miller, 2006), although these hypotheses require further empirical study.

Molecular genetic evidence consistent with mutation-selection balance. The last few years have witnessed an explosion of molecular genetic findings relevant to evolutionary models of personality. The most significant change was from analyzing individual genes or small sets of genomic markers to genome-wide approaches, where researchers investigate hundreds of thousands of genetic markers that are representative of common variation in the genome. More recently, there has been another shift to whole-genome sequencing of all the nucleotide letters in the DNA of individuals under study. While the existing evidence is not yet conclusive and a detailed review is beyond the scope of this chapter, we provide a brief summary of the current state of the evidence here.

The last decade has greatly altered our view of the molecular genetics associated with personality. Meta-analyses of individual genes have yielded null or weak results (Munafo & Flint, 2011). At the same time, sufficiently powered genome-wide association studies (GWAS) have shown that there are no common genetic variants that explain more than 1 percent of the genetic variance associated with broad traits like those of the Five-Factor Model (e.g., Verweij et al., 2012). This means that either (1) there are thousands of genetic variants that each have very small effects on personality trait levels, or (2) there are many different, rare mutations that account for genetic variation in personality (Penke, 2011).

Recent research has attempted to estimate how much of the additive heritability of traits can be explained by all the common genetic variants used in a GWAS – regardless of how much individual variants explain. Interestingly, while this approach is able to explain almost all of the genetic variance in traits such as height (Yang et al., 2010), only a small percentage of the genetic variance in Cloninger’s (Verweij et al., 2010) and Eysenck’s (Vinkhuyzen et al., 2012) personality traits can be explained this way. Some researchers (e.g., Verweij et al., 2012) take this as evidence for personality being under mutation-selection balance, an interpretation that we discuss in the following section.

A Comprehensive Framework: Integrating Selective and Nonselective Models

We have presented five evolutionary models for the origins of variation in human personality: (1) directional selection, (2) balancing selection, (3) frequency-dependent

selection, (4) selective neutrality and (5) mutation-selection balance. A central impetus for presenting these models together in a single resource is that evolutionarily informed work to date has generally emphasized just one or a few of these models (e.g., Lewis, 2015). This narrow focus has enabled researchers to expand on individual models, but also appears to have translated into implicit and unnecessary competition between models.

This is problematic because these models are not necessarily mutually exclusive. Rather, they can offer complementary explanations, with each model accounting for a unique proportion of the variance on a given personality dimension. A central objective for personality researchers should be to integrate these distinct evolutionary models to maximize their combined ability to explain variation in human personality.

For researchers interested in pitting evolutionary models against one another, it is essential to use evidentiary criteria that can discriminate between these models. This is paramount because many criteria are consistent with *multiple* evolutionary models and therefore *not* capable of discriminating between alternative models. For example, Camperio Ciani and colleagues' finding that Italian islanders differ on major personality dimensions relative to Italian mainlanders is consistent with universal psychological mechanisms responding to different environmental inputs (Model 1) *and* with balancing selection favoring different personality levels in different environments (Model 2).

Similarly, mutation-selection balance (Model 5) and condition-dependent psychological adaptations (Model 1) lead to *identical* expected patterns of genetic variation. Consequently, molecular genetic and behavioral genetic data may be incapable of discriminating between these models.

To illustrate the issue of adjudicating between competing models, consider genetic polymorphism at the androgen receptor locus. Different alleles at the AR locus are associated with individual differences in both attractiveness and extraversion. If the AR gene is directly involved in the building of psychological mechanisms that calibrate extraversion levels, then we would not necessarily expect downstream products of the gene, such as attractiveness, to exhibit *independent* links to extraversion. Alternatively, if condition-dependent mechanisms calibrate extraversion levels according to attractiveness (Model 1), then we *would* expect links between attractiveness and extraversion over and above genetic polymorphism at the AR locus. Strongly consistent with this model, individual differences in attractiveness and strength predict extraversion levels independent of genetic polymorphism at the AR locus (Lukaszewski & Roney, 2011). This relationship between genetics, physical attractiveness and extraversion emphasizes the point that a sophisticated evolutionary approach to personality requires an integrated understanding of selective and nonselective evolutionary processes.

FUTURE DIRECTIONS FOR PERSONALITY PSYCHOLOGY

The above example illustrates that, however appropriate a particular type of data (e.g., molecular genetic) might seem for understanding the evolutionary origins of variation in personality, such evidence is sometimes consistent with multiple distinct evolutionary models. In order to discriminate between these alternatives – a key future direction for personality research – researchers need to employ evidentiary criteria capable of adjudicating between alternative models. Here, we make a few suggestions toward this goal.

Experimental Studies

The correlational nature of studies on condition-dependent models of personality does not enable researchers to draw conclusions about causation. But in order to adjudicate between condition-dependent models (Model 1) and models of mutation-selection balance (Model 5), it is necessary to design studies that can answer the question of whether the causal arrow runs from condition-linked input to personality output. A combination of experimental and longitudinal designs can help accomplish this.

Here, we outline a general experimental framework by which condition-dependent models can be tested. The overarching hypothesis of condition-dependent mechanisms is that they should output different personality trait levels as a function of differences in exposure to the adaptive problems the mechanism was designed to solve. Condition-linked differences in the frequency at which the relevant adaptive problem is faced should result in the hypothesized personality mechanisms producing differences in trait levels across individuals. Correlational studies (e.g., Lukaszewski, 2013) have shown precisely this pattern. However, in contexts that unambiguously indicate that the relevant adaptive problem is *not* being faced, the mechanisms should not produce that output – regardless of the individual's condition. Similarly, in contexts that unambiguously indicate that the relevant adaptive problem *is* being faced, the personality mechanism should produce its output in all or most individuals – again regardless of the individual's condition. Finally, it is primarily under conditions of uncertainty – which characterize most natural settings – that personality outputs should track individuals' condition (see Lukaszewski & Roney, 2011).

Lewis (2013) tested these hypotheses. His research investigated the hypothesis that evolved psychological mechanisms calibrate individuals' neuroticism levels in response to cues to social exclusion (Denissen & Penke, 2008; Nettle, 2005, 2006). Precisely as expected, if humans possess universal evolved neuroticism-calibrating adaptations, individuals exhibited lower levels of neuroticism when their inclusion in social relationships was certain, regardless of their condition. Individuals exhibited higher

levels of neuroticism when their *exclusion* in social relationships was certain, irrespective of their condition. Finally, precisely as expected under a condition-dependent model, it was only in contexts that left an individual's social status unclear that participants' neuroticism varied as a function of their condition.

The "Power of the Situation" and the "Importance of the Individual" Both Lie in the Evolved Algorithm

This finding that the situation may mediate the links between an individual's condition and personality (Lewis, 2013) may also help to shed light on the computational architecture of evolved psychological mechanisms. For an exemplary illustration of the computational architecture of an evolved psychological mechanism, we examine Lieberman, Tooby and Cosmides' (2003, 2007) "kinship estimator."

Lieberman and colleagues postulate that psychological adaptations to identify and direct altruism toward kin are designed to take, as input, cues recurrently linked to genetic relatedness in ancestral environments (Lieberman, Tooby & Cosmides, 2003, 2007). This kinship-estimating mechanism (1) takes multiple cues as input (e.g., observing a newborn nursing from one's own mother, Lieberman et al., 2003, 2007; facial resemblance, Lewis, 2011); (2) hierarchically treats these cues according to their ancestral predictive validity (i.e., their correlations with actual genetic relatedness); and (3) calibrates the outputs of kin-directed altruism and anti-incestuous sentiment according to the interaction between these cues (Lewis, 2011; Lieberman et al., 2003, 2007).

Generalizing this idea, selection would have favored psychological mechanisms that were designed to (1) take multiple cues as input, (2) hierarchically treat those cues, prioritizing those most strongly predictive of the relevant adaptive problem, and then (3) produce cognitive, affective and behavioral solutions to that problem.

Lewis (2013) provides further empirical support for this model of evolved psychological mechanisms' computational architecture. Unequivocal indicators of an adaptive problem necessarily were the most valid cues that that adaptive problem was being faced. An individual's condition would have been a less predictive cue (e.g., see Kurzban & Leary, 2001). Personality-calibrating mechanisms should therefore be expected to adjust their output according to unequivocal cues when they are available – and only use condition-based cues when unequivocal cues are unavailable. Consonant with this, Lewis (2013) found that when unambiguous indicators of the relevant adaptive problem were present, individuals' personality trait levels were calibrated according to these cues, with condition-based cues having no effect. However, when unequivocal cues were *absent*, individuals' personality trait levels were calibrated according to condition-based cues. These findings highlight the information-processing structure of these psychological mechanisms, which has

been a relatively neglected area of research. This gap is not trivial; the psychological and behavioral output of these mechanisms depends not on the cues per se, but rather on the algorithms that the evolved mechanisms employ in the processing of these cues.

To offer a more complete investigation into human personality, future research would do well to include the following. First, research should identify the specific cues that would have been recurrently linked to specific adaptive problems, as these cues are good candidates for inputs into personality-calibrating mechanisms (Buss, 1991; Tooby & Cosmides, 1990). Second, future research should articulate the hypothesized computational architecture of the proposed mechanisms. Toward this goal, researchers should consider the predictive validities of the hypothesized input cues in indicating the adaptive problem. This may provide valuable insight into the mechanism's computational architecture, which ultimately will be indispensable for explaining and predicting the mechanisms' output – in this case, human personality.

Longitudinal Studies

Experimental studies can test for causal relationships between input cues and manifest personality output. However, single-session experimental studies can only test for "snapshot" shifts in personality levels. Such data are inherently unable to speak to whether personality mechanisms calibrate individuals' "trait" levels across the lifespan in response to changes in condition, social circumstances, or other environmental conditions (see Buss & Penke, 2014). Given the temporal stability of personality, longitudinal research assessing changes in personality over time will be necessary for assessing the heuristic value of different evolutionary models and for discriminating between them.

A key focus of future research should be longitudinal studies that track within-individual changes in the phenotypic characteristics or social environments hypothesized to serve as input into personality-calibrating mechanisms. Doing this will enable researchers to assess whether these changes predict subsequent changes in individuals' personalities, permitting stronger tests of the hypothesis that personality mechanisms calibrate traits according to shifts in the cost-benefit tradeoffs of different personality strategies across the lifespan. This represents an important step toward the development of a more comprehensive and explanatory framework for variation in personality.

CONCLUSION

The field of personality psychology is currently characterized by a wealth of empirical research and a successful descriptive taxonomy. However, the time is ripe for the explanatory maturation of personality psychology. To this end, we suggest that the field of personality psychology

cannot afford to ignore evolutionary psychology: It provides the only cogent meta-theory for the broader field of psychology and provides a set of conceptual tools and models for transforming personality psychology into a more powerful explanatory science.

Comprehensive theories of personality should aspire to include both a specification of human nature and an account of the major ways in which individuals differ. An evolutionary approach to personality psychology provides both (1) a framework for explaining human nature and individual differences and (2) a theoretically anchored bridge between them. Given this early stage in the development of evolutionary personality psychology, we make no pretense that we have arrived at, or even approximated, an ultimate theory of personality. However, since the evolutionary process is the only known process capable of producing complex organic mechanisms, all theories of human nature must ultimately be anchored in the principles of evolution.

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17

Personality in Nonhuman Animals

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INTRODUCTION

Organisms have been observing the behavior of other organisms for as long as there have been organisms. As humans, we are especially good at paying attention to cues from other humans and are acutely aware that people differ from each other. Astute observers of animal behavior have long noticed that individuals behave differently from one another, and a quick scan of popular YouTube channels devoted to individual pet cats strongly suggests that interest in the uniqueness of individual animals remains strong. What might be more surprising is that individual variation in nonhuman animals is no longer considered a mere curiosity in scientific circles: Over the past fifteen and more years individual variation in nonhuman animals (so called “animal personality”) has attracted the attention of animal behaviorists, who are now pursuing it as a serious research topic.

Part of the reason why animal personality was not a serious research topic until recently is because the notion that individual variation was more than just noise seemed anthropomorphic. However, mounting empirical evidence that individual variation in behavior is repeatable (Bell et al., 2009), heritable (Stirling et al., 2002) and linked to fitness (Smith & Blumstein, 2008), along with growing theory exploring its origin and maintenance has made the scientific study of individual behavioral variation in nonhuman animals a burgeoning area of study.

There are two key elements to animal personality: among-individual variation and within-individual consistency in behavior. Different processes can give rise to among-individual variation and within-individual consistency in behavior (Stamps, 2007). For example, individuals might behave consistently due to learning (Sih & Bell, 2008) or state-dependence (Luttbeg & Sih, 2010), while individual variation might result from tradeoffs resulting from different behavioral types (Stamps, 2007), etc. Moreover, among-individual variation and within-individual consistency do not necessarily co-occur. For example, there might be behavioral variation among individuals at one point in time, such that some individuals are more

aggressive than others. But if individuals switch ranks over time, e.g. the most aggressive individual at time 1 is the least aggressive individual at time 2, then within-individual consistency is lacking.

What defines studies of animal personality is that they track individual subjects over time or across situations and focus on behavioral variation within and among individuals rather than the average behavior of the population. For example, an animal personality study might present an individual animal with a stimulus (e.g. a predator) in a controlled environment and record the behavior of the animal for a short period of time and then measure the individual again either in response to the same or different stimulus (e.g., potential competitor) after a set period of time. Another tactic common in field-based studies is to record the behavior of undisturbed individuals in the wild, e.g. time feeding offspring, or behavior at a feeding station and track the behavior of those same individuals over time.

One of the ways that the study of animal personality is influencing the way we study behavior is that researchers are increasingly concerned with capturing a representative range of behavioral variation in the population. For example, from one perspective, nonresponsive individuals that freeze or hide or otherwise refuse to participate in the experiment are a nuisance. But from an animal personality perspective, those individuals might be employing a different behavioral tactic, and are just as interesting as the individuals that exhibit high levels of behavior, or readily respond to our manipulations. Along the same lines, appreciation of behavioral variation has drawn attention to the possibility that the way we capture our subjects might lead to biased, nonrandom sampling if, for example, “bold” individuals are more likely to explore a trap (Biro & Dingemanse, 2009) and/or that different behavioral types might respond differently to being in a lab environment (Careau et al., 2008).

In this chapter, we review the study of animal personality in natural populations to date, highlighting some of the key findings that have influenced the direction of work in

this area. First, we discuss the history of the study of animal personality as interest grew in parallel across different fields and this influenced the types of questions that have been examined thus far. Second, we review some of the key topics and studies that have defined the field over the last fifteen years. Next, we briefly review theory for the evolution of personality from an adaptive perspective and conclude by highlighting some emerging topics for future work.

HISTORICAL DEVELOPMENTS

History and Terminology

Several terms have been used to describe consistent individual differences in behavior, probably because several lines of research independently converged in their interests but used different words to describe the phenomenon. The term “temperament” has its roots in psychology and was originally coined to describe the behavioral tendency of infants and children. Temperament connotes a latent, underlying inherited trait that appears early in development and causes behavioral consistency (Reale et al., 2007). The term “personality” also has its roots in psychology and often refers to consistent thoughts, feelings and behaviors. While there were early studies of “personality” in nonhuman primates, domesticated animals and model organisms (Gosling, 2001), the term was not used to describe behavioral variation in natural populations until recently (Reale et al., 2010). One potential concern with the term “personality” is that it can be accused of being anthropomorphic. The term “coping styles” has its roots in the neuroendocrine literature and emphasizes integrated ways of responding to changes in the environment, especially via the stress response axis (Koolhaas et al., 1999). The term “behavioral syndrome” has its roots in evolutionary biology, where the term “syndrome” refers to suites of correlated traits, and was first applied to behavior in Clark and Ehlinger (1987). The concept is very inclusive, and refers to correlations between behaviors, either across time or across situations (Sih et al., 2004). The term’s generality makes it applicable to any axis of behavioral variation, from choosiness to parental behavior to diet specialization (not just shy-bold). Although in the clinical literature the term “syndrome” connotes a pathological condition, behavioral syndromes do not have to result in maladaptive behavior (Sih & Bell, 2008). A syndrome is really a property of a population; individuals have a behavioral type (Bell, 2007).

The emphasis and motivation for coining these terms differs across disciplines, and each term has advantages and disadvantages. However, what they have in common is the appreciation that individuals of the same species often behave consistently, that they behave differently from each other, and that both within-individual consistency and among individual variation raise interesting

ecological and evolutionary questions. Here, we use the term “animal personality,” which has come to be associated with all of these concepts.

Grounding in Quantitative Genetics

Quantitative genetics has provided a strong conceptual basis for studying animal personality because it offers a statistical framework for partitioning trait variation and covariation within and among individuals (Dochtermann & Roff, 2010). We can study behavioral syndromes by examining how multiple behavioral traits covary with one another phenotypically (in a phenotypic variance-covariance matrix or P-matrix) or genetically (in a genetic variance-covariance matrix or G-matrix).

Quantitative genetics also provides a framework for studying behavioral consistency and its flip-side: phenotypic plasticity. The behavioral response of different genotypes to the environment can be visualized as “reaction norms” (DeWitt et al., 1998). We can compare the reaction norms of different individuals or genotypes to examine genotype $\times$ environment interactions (G $\times$ E), which occur when different genotypes respond differently to the environment. Studies of personality are capitalizing on new statistical methods that provide a framework for comparing the reaction norms and behavioral plasticity of individuals rather than genotypes, so called “behavioral reaction norms” (Dingemanse et al., 2009; Martin et al., 2011; Nussey et al., 2007).

Recent informational models of development (Dall et al., 2015; Stamps & Krishnan, 2014) offer a different perspective on how to integrate the concepts of plasticity and variation. Whereas a typical quantitative genetics experiment partitions variation among genetic versus environmental sources, recent informational models consider why, from an adaptive perspective, an organism should rely more on its genes (genetics) versus its own personal experience (environment). The starting point of these models is that an individual’s genotype can be viewed as a source of information; it is informative simply by virtue of being alive. An intuitive prediction of this line of thinking is that if an organism occurs in an environment that is novel, i.e., not experienced by its ancestors, then that organism should pay less attention to its genes and more attention to its own personal experience. In other words, environmental effects should be stronger when genes do not provide reliable information. Genotype-by-environment interactions, on the other hand, should occur when certain genotypes should rely more on their genes than their own experience, while other genotypes should rely more on their own experience rather than their genes. While these “informational” models have not been thoroughly tested yet, they offer a different way of thinking about some of the primary questions of interest to animal personality researchers, such as why, for example, some individuals are more plastic than others.

Why Are Researchers Interested in Animal Personality?

The original impetus for studying animal personality was that it raised at least three fundamental questions about behavior. First, behavior is notoriously plastic and labile, but Sih et al. (2004) pointed out that when individuals retain their rank-order differences across contexts, then individuals might be constrained by their behavioral type, and unable to produce the optimal behavior in every situation (Figure 17.1). An important early insight was the importance of distinguishing within-individual variation from among-individual variation (Dingemanse et al., 2009). Since then, researchers have been trying to understand from both a mechanistic and adaptive perspective why individuals might maintain a certain behavioral type. Is an individual's behavioral type constrained by their genotype, their social group, or by the costs of switching, for example? The second fundamental question about behavior raised by animal personality is that it is difficult to explain the maintenance of behavioral variation within populations that is heritable and related to fitness because natural selection typically removes rather than preserves variation within populations. Perhaps the types of selection that can maintain variation (e.g., negative frequency dependence, variation in selection over time or space) are more powerful and/or more common than we used to think, but hard to detect with existing methods (Hedrick, 2006). Finally, if individual behavior is domain-general, i.e., correlated across contexts forming "behavioral syndromes" (Sih et al., 2004), then this raises fundamental questions about how behavior evolves and how we study it, i.e., if we want to understand foraging behavior in a particular organism, that might require considering whether the way an individual forages is related to how that same individual behaves as a parent, or as a competitor for mates, for example.

Relation between Studies of Nonhuman Animal and Animal Personality

While animal personality is influencing the way we study the behavior of nonhuman animals, surprisingly, there has been little interplay between studies of human and nonhuman animal personality. This is unfortunate because human personality psychologists have been studying individual differences for longer, and the study of animal personality could benefit from the lessons learned. Moreover, because we are interested in many of the same questions (e.g., proximate mechanisms leading to the development of different personalities), there are opportunities for mutually beneficial interactions. Key theories and concepts can be more readily tested in nonhuman animal species than in humans because animal personality researchers can often carry out the kinds of manipulative experiments that are simply not possible with humans (Gosling, 2001). Moreover, nonhuman animals offer a

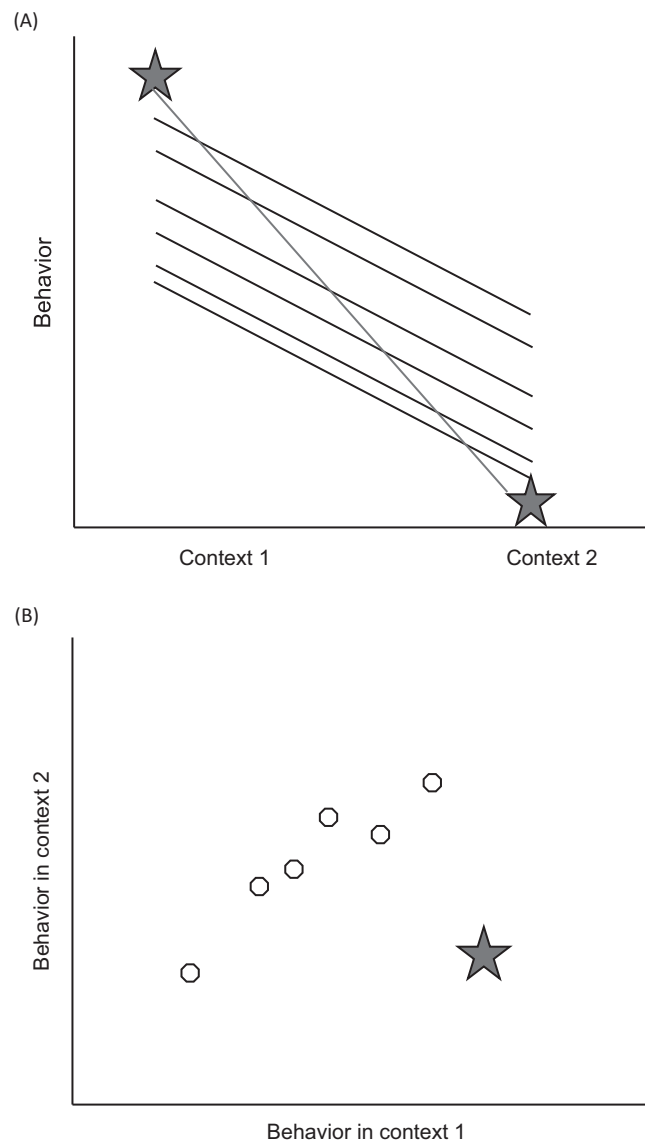


Figure 17.1 Consistent individual differences in behavior can imply limited plasticity. In this hypothetical example, the behavior of six different individuals is measured in two different contexts. (A) Individuals show higher levels of behavior in context 1 than in context 2. Each line represents the behavior of a different individual. The stars are the optima for each context. Individuals show adaptive plasticity – they decrease behavior in context 2 relative to context 1. However, no individual hits the optimum in both contexts; the individuals that are closest to the optimum in context 1 are the furthest from the optimum in context 2, and vice versa. (B) Same data as in (A), except now shown as a scatterplot. After Sih et al. (2004).

treasure trove of diversity, which provides opportunities to match key questions with the right animal model.

For example, the so-called "person-situation debate" has been lingering for decades in the human personality literature (Mischel, 1979). The central question is whether a person's behavior at a given moment reflects the individual's personality or the situation. Despite the fact that "both" is the obvious answer, this question has proven to

be contentious and difficult to study thoroughly in humans for several reasons (e.g., people choose their situations, situations cannot be controlled). In nonhuman animals, though, we can do experiments to study how they interact and to carefully tease apart their relative importance. For example, we can measure the behavior of individuals within groups, and ask whether they behave differently from one another over time. Then, we can place individuals in a new social group to ask whether they maintain their behavioral type in a new social situation. In one study, individual stickleback fish within the same social group differed in how quickly they exploited new food sources, and individuals retained their behavioral type in a new social group (Laskowski & Bell, 2013). These results suggest that in sticklebacks, behavioral type is a more important driver of behavior than the social situation. Interestingly, though, similar studies on birds (David et al., 2011; Morand-Ferron & Quinn, 2011) came to the opposite conclusion, that is, individuals behaved consistently within a group, but they changed their behavioral type in a new group. Interestingly sticklebacks are social but they form loose associations that do not last for very long. In contrast, the birds described above, individuals form enduring associations with other individuals, and how well a particular individual does in a group strongly depends on what other individuals are doing. These species-level differences in social behavior might help explain why the social situation dominates sometimes, but not always (Webster & Ward, 2011). By studying multiple species with different life histories, ecologies, selection pressures, etc. we can gain insights into the key drivers of behavioral variation, some of which might also be important in humans.

Another area of overlap between studies of human and nonhuman personality is that both fields of study are interested in understanding the relative contribution of genes, environment and their interaction to behavioral variation. At the moment, there is more genomic (e.g., GWAS (genome-wide association studies)) data on humans related to complex behavioral and mental health conditions than any other species (Peterson et al., 2017), but studies of nonhuman animals have much to offer this area because we can do experiments that control and/or manipulate environments. For example, studying personality trait development is difficult in humans because of selection effects (some individuals are more likely to undergo particular experiences than others), and because particular experiences cannot be manipulated. Moreover, ideally personality traits would be measured before and after a formative experience, with an appropriate control group to control for time/age/maturation effects, but this is difficult in humans. Additional bonuses of studying the proximate causes of personality variation in nonhuman animals include shorter generation times (good for longitudinal and genetic studies, including selection experiments; see (Drent et al., 2003; Overli et al., 2005; Trut, 1999)), the ability to “get under the skin” and into the

brain to examine underlying endocrine, neural and molecular mechanisms and the feasibility of doing genetics (i.e., to make controlled crosses between divergent phenotypes in order to identify genetic variation influencing behavioral traits).

This enterprise, however, requires that we accept that we can learn something about nonhuman animal personality from human personality and vice versa, but the scientific study of animal personality differs in several important respects from studies of personality in humans. For one, “personality” in humans includes consistent patterns of behavior, thinking and feeling, but studies of animal personality rarely (if ever) have access to their subjects’ thoughts and feelings. Second, while studies of human personality primarily rely on survey instruments and personality inventories, especially self-report, studies of animal personality rely on observations of behavior. Third, while studies of human personality typically use statistics such as factor analysis to identify constructs motivating behavior, i.e., dispositions, studies of animal personality are often less interested in the underlying constructs and are instead focused on behavior. Arguably, any behavioral trait that varies among individuals, is consistent within individuals and is important from the particular animal’s perspective (i.e., related to fitness) is of interest (Bell, 2007).

Finally, how we describe animal personality is trickier for studies of nonhuman animals than it is for studies of humans because we wish to characterize behavioral variation in many species rather than just one (humans) (Gosling, 2001), although similar issues arise in cross-cultural studies of human personality (Church, 2001). Whether different species with different life histories and ecologies exhibit similar axes of personality variation is a question that can only be tested empirically. Studies of animal personality often focus on axes of variation suspected to be deeply conserved, i.e., boldness, sociability, aggression, novelty, exploration (Reale et al., 2007), with some interest in knowing whether there is something equivalent to the well-supported Five-Factor Model in human personality (McCrae & John, 1992; see also Gosling, 2001). An important challenge is knowing whether we are studying the same axes of behavioral variation in diverse species. It is unlikely that we will comprehensively describe the structure of personality in many taxa in the near future, but in general we could do a better job of describing and naming axes of behavioral variation (Uher, 2008). Presently, there is a danger of falling into the same trap that ethologists confronted decades ago when trying to measure “drive” or “motivation” (Hinde, 1956), but then found it difficult to compare results across studies, or across species (Stamps & Groothuis, 2010). For example, studies have interpreted their subjects’ behavior as “boldness” when they emerged quickly from a refuge (Brown & Braithwaite, 2004), foraged under predation risk (Bell, 2005), or inspected a predator (Frommen et al., 2009), but we do not know if those different measures are equivalent (Sinn &

Moltschaniwskyj, 2005). Indeed, the same behavior could represent very different ends of the same axis for different species. For example, remaining stationary could be interpreted as boldness (“holding ground”) in one species, but could be an antipredator (“freezing”) response in another. A step in the right direction is to use operational definitions of behavior which focus on how the behavior is measured (e.g., latency to emerge from a refuge) rather than what we think we are measuring (e.g., boldness), and carry out complementary studies to ask if we are measuring the same “trait” in very different critters, i.e., if it serves the same function, or if it is underlain by the same neuroendocrine or molecular mechanisms.

Despite these important differences between studies of human and nonhuman personality, it is noteworthy that the two literatures often converge on similar findings. For example, effect sizes of cross-situation correlations in human and animal personality studies are comparable (between 0.2 and 0.4 (Funder & Colvin, 1991)), and stability coefficients tend to decrease as the time interval between assessments increases (Bell et al., 2009; Caspi et al., 2005).

SEMINAL STUDIES IN THE FIELD

Below we review some of the major topics and studies illustrating key insights that have been gained from the study of animal personality.

Behavioral Spill-Over and Trade-Offs

An important early insight was that when individual differences in behavior are maintained across situations or contexts, that implies that there is limited plasticity (Figure 17.1). For example, individual salamander larvae exhibit consistent individual differences in activity in the presence and absence of predation risk: Those individuals that are most active in the absence of risk are also the individuals that are most active in the presence of risk (Sih et al., 2003). While high levels of activity in the absence of risk is associated with increased food intake, individuals that are very active in the presence of risk are most vulnerable to predators, thereby yielding a tradeoff across contexts. Another potential example of limited plasticity includes precopulatory sexual cannibalism in fishing spiders (Johnson, 2001). The “spillover” hypothesis posits that the reason why some female fishing spiders consume their mates prior to mating with them (which is clearly maladaptive) is because it is beneficial for female fishing spiders to be highly voracious toward prey when they are young. High levels of voracity while a juvenile translates into greater fecundity and hence fitness as an adult (Johnson & Sih, 2005) but see (Kralj-Fišer et al., 2013). Appreciation that personality implies limited plasticity has spurred increased interest in understanding the costs and limits to behavioral plasticity (DeWitt et al., 1998; Snell-Rood, 2013).

Coping Styles

Observations of how individual animals respond to novel or challenging environments led some authors to argue that individuals vary along the proactive–reactive axis. Individuals that are bold and aggressive (proactive) are at one end of the axis while shy and environmentally sensitive (reactive) individuals are at the other end (Koolhaas et al., 1999). According to coping styles theory, this variation reflects different integrated ways of coping with the environment that is rooted in the stress response axis (Koolhaas et al., 2010). Variation along the proactive–reactive axis might be maintained by fluctuating selection pressures (Thornton & Lukas, 2012), where proactive, inflexible individuals have higher fitness in stable environments while reactive, flexible individuals who tend to be more sensitive to environmental stressors may be better suited for environments that experience moderate change (Verbeek et al., 1994). There is evidence for different coping styles in a wide variety of taxa (e.g., pigs (Bolhuis et al., 2004); great tits (Carere et al., 2001); and trout (Overli et al., 2005)), and some of the most compelling support for this hypothesis comes from artificial selection experiments which have found correlated responses to selection on the stress response (Overli et al., 2005; Pottinger & Carrick, 1999) and on aggressive behavior (Veenema et al., 2003).

Group Dynamics

A burgeoning area of study at the moment is at the interface between animal personality and social behavior. In particular, studies of water striders (Johnson & Sih, 2015) and ants (Hui & Pinter-Wollman, 2014) have shown that the mix of behavioral types in a group matters for individual and group fitness. Consistent inter-group variations in behavior have been observed that link to group performance. In other words, there are cases in which personality can be described at the group level and both the mechanisms and implications of this group-level variation are increasingly being explored. Often independent of the simple average behavior of its members, variations in group personality are linked to differences in group performance and this could have important implications for the level at which selective forces are acting (i.e., group selection).

In identifying drivers of group-level personality there has been an emphasis placed on the personality of so-called “keystone individuals,” which are individuals that disproportionately impact the collective behavior of a group. The behavioral types of keystone individuals influences groups’ collective behavior and fitness. For example, the presence of hyper-aggressive male water striders in a group lowers female accessibility to other males of the group, thereby lowering the overall fitness of that group (Sih & Watters, 2005). Therefore, inter-group performance and success can largely depend on just a few individuals.

Given the importance of the mix of behavioral types within groups, a key question has to do with how groups are initially formed by different behavioral types. The behavioral types of the initial founders of a group can drive the ultimate collective personality of the group (Bengston & Jandt, 2014). For example, honeybee colonies with more cautious workers were founded by more cautious queens (Evans & Raine, 2014). If a group is founded by a subset of behavioral types from another group, then the new group's collective personality is likely due to the collective interactions/behaviors of its initial founders.

Lab versus Field

Interest in the ecological and evolutionary implications of animal personality has led researchers to become increasingly interested in studying natural personality variation in the field. Particularly if there are behavioral trade-offs, field studies have the potential to uncover constraints on the amount of time an animal can spend doing one behavior over another (e.g., foraging versus anti-predator) that might go undetected in artificial lab environments. However, there are several challenges to studying personality in the field. For one, it is difficult to control the immediate environment experienced by individuals in the field, which makes it difficult to standardize the environment across subjects and to tease apart within- versus among-individual variation. Second, studies of personality need to measure their subjects more than once, but some behavioral types might be more readily tracked, more readily captured and/or more likely to respond to a standard stimulus (e.g., playback), all of which can lead to sampling bias.

Despite these challenges, researchers have devised a number of clever strategies for studying behavioral variation in the field. Even simple observations of individuals' responses to being captured during routine population monitoring can reflect something about their personality and their life history: Individual female bighorn sheep that struggled during capture had higher survival under predation risk compared to individuals that were relatively docile (Reale & Festa-Bianchet, 2003). It is also possible to get glimpses into individuals' personalities by recording their undisturbed behavior during day-to-day activities such as tending a nest (Stein & Bell, 2015) or visiting a bird feeder (Herborn et al., 2010).

At the same time, studying personality variation in the lab presents its own challenges. One major challenge is knowing whether the way personality is measured in the lab reflects natural behavior in the field. A few studies have asked whether individual behavior in the lab predicts behavior in the field (e.g., Herborn et al., 2014; Herborn et al., 2010), with some positive results. For example, individual great tits that explored more in a lab setting had offspring that dispersed further in the field, and in a lab assay, immigrants were more exploratory than locals (Dingemanse et al., 2003). However, other studies have

failed to predict the behavior of subjects in the field based on their behavior in a controlled environment (e.g., Laskowski et al., 2015).

Statistical Analysis

Animal personality researchers utilize a wide range of statistical methods to establish patterns between behavioral measures, identify underlying traits or compute statistics such as repeatability or heritability. To establish the relationship between different behavioral measures, techniques range from basic correlations to various regression techniques. To identify underlying traits, common strategies include multivariate statistical techniques such as multidimensional scaling and factor analysis. Clustering or discriminant analysis can be used to group individuals into different categories based on their behavior. There are a number of strategies for testing whether individual differences are consistent over time, such as basic correlations across measures over time, the intraclass correlation coefficient (repeatability) and mixed models. Repeatability is the proportion of the total phenotypic variance that can be attributed to differences among individuals (Falconer & Mackay, 1996).

One of the most influential outcomes of animal personality research to date has been the development and application of mixed modeling approaches to partition (co)variation into its within- and among-individual components (Dingemanse & Dochtermann, 2013; Westneat et al., 2015). Mixed models are flexible and powerful, allowing researchers to incorporate both fixed (e.g., body size, treatment, environment) and random (e.g., cage, population, individual) effects in the same model, thereby controlling for potential confounds and testing the importance of potential covariates. These models are especially helpful in field studies where confounding variables cannot be controlled experimentally. With a sufficiently large sample size (Martin et al., 2011), mixed models can be used to estimate complex interactions in the dataset including individual x environment interactions.

Theory

While animal personality studies have been and probably will continue to place emphasis on adequately describing patterns of behavioral variation, the field has shifted in recent years toward more emphasis on hypothesis testing. Indeed, part of what originally motivated much of the interest in animal personality was that within-individual behavioral consistency and among-individual variation were a challenge for prevailing optimality theory to explain (Sih et al., 2004). Over the past decade, the field has witnessed a surge of new theory to explain the existence of animal personalities from an adaptive perspective. This theory is well-described elsewhere (Dingemanse & Wolf, 2010; Wolf & Weissing, 2010) and, therefore, is briefly summarized here.

The challenge for animal personality theory is to explain both among-individual variation and within-individual consistency in behavior. Among-individual variation in behavior is likely to be maintained by similar mechanisms as have been proposed to maintain genetic variation (Barton & Keightley, 2002) such as negative frequency dependent selection (Wolf et al., 2008), life-history trade-offs (Stamps, 2007; Wolf et al., 2007), or selection that varies in space and/or time (Dingemanse & Reale, 2005). Within-individual consistency is a relatively newer problem in behavioral ecology, and we still have a lot to learn about its proximate (Duckworth, 2010; Ketterson & Nolan, 1999) and ultimate causes. Some models have explored if consistent behavior might be adaptive if the costs of plasticity are high (DeWitt et al., 1998) or if predictable behavior benefits individuals during social interactions (Dall et al., 2004).

Much of the recent theory invokes adaptive state-dependent behavior (Sih et al., 2015). The basic idea is that behavior is constrained by a slower-changing state variable, e.g., body size, and individuals differ in behavior because they differ in state. In behavioral ecology, the term “state” refers to features that affect the costs and benefits of behavior (Houston & McNamara, 1999), including both intrinsic (e.g., body size, condition, energy reserves, metabolic rate, morphology, social rank) and extrinsic (characteristics of conspecifics, and other external features) factors (Sih et al., 2015). Recent models have emphasized how differences among individuals are promoted by positive feedbacks between state and behavior. Learning provides a great example of positive feedback: the behavior of an individual might improve with experience (state), which in turn increases experience (Dingemanse & Wolf, 2010).

Another set of models considers how social interactions can generate positive feedback and promote variation. Repeated interactions with the same individuals can increase the benefits of predictable, or consistent, behavior (Wolf et al., 2011). The presence of other individuals might cause individuals to behave differently from each other to reduce direct competition, thereby generating between-individual variation in behavior (Wolf et al., 2008). Once individuals behave differently from each other, the presence of other individuals may increase the benefits of behaving predictably, thereby maintaining those differences through positive feedback mechanisms (Wolf et al., 2011). A simple prediction of this model is that groups comprising individuals that are familiar with each other should exhibit more among-individual variation and less within-individual variation compared to groups comprising individuals that are not familiar with each other (Laskowski & Bell, 2014). Another prediction is that social species should exhibit more among-individual variation in behavior compared to non-social species, a prediction that has some empirical support in shrews (von Merten et al., 2017).

Another popular theory is that behavioral variation reflects differences among individuals along the “pace of

life” continuum (Reale et al., 2010). The idea is that behavioral traits coevolve with life history (Biro & Stamps, 2008, 2010), and physiological traits (e.g. metabolic rate (Careau et al., 2008)). For example, high levels of aggression probably require high growth rates and an overall “fast” life history (reproduce early, die young), a prediction supported in dogs, where docile breeds live longer than bold breeds, and aggressive breeds have higher energetic needs than nonaggressive breeds (Careau et al., 2010).

EMERGING ISSUES FOR FUTURE RESEARCH

As the study of animal personality has exploded, it is influencing our understanding of diverse topics in behavioral biology, biomedicine, ecology, conservation, evolution and human development. There are many emerging issues that merit further consideration; here we review just a small set of some of them.

Individual Differences in Plasticity

Given simultaneous interest in both plasticity and variation, it is not too surprising that one of the most tantalizing questions at the moment is whether individuals differ in plasticity (Stamps, 2016; Stamps et al., 2012). Researchers have been interested in determining whether individuals differ in plasticity (Araya-Ajoy et al., 2015; Westneat et al., 2015) by measuring individuals repeatedly across an environmental gradient or through time and using statistical methods such as random regression (Nussey et al., 2007). An individual $\times$ environment interaction (Ix E) occurs when plasticity varies among individuals and some individuals are consistently more (or less) plastic than others. Importantly, these methods are exceedingly data-hungry, requiring sample sizes in the hundreds to thousands to accurately estimate effect sizes (Martin et al., 2011). Another approach for quantifying individual differences in plasticity was proposed by Stamps et al. (2012). They argued that intra-individual variation (IIV) in behavior is neglected but potentially important and suggested a metric for quantifying it, i.e., IIV. For example, over approximately five months, some individual male mosquitofish were consistently more predictable (lower IIV) than others, even after accounting for other sources of variation such as temperature and activity (Biro & Adriaenssens, 2013).

Variation in Cognition

There is growing interest in measuring variation in both domain general (i.e., variation in performance across multiple cognitive domains) and domain specific (i.e., variation in performance in a particular cognitive domain) cognition in animals. Some researchers have started to ask if variation in performance on cognitive tasks is related to variation in other traits, e.g., exploratory

behavior, neophobia (Griffin et al., 2015). Exploratory and active individuals, for example, might be more likely to readily participate in training, which could cause them to learn associations faster than more timid individuals.

At least two different, though not mutually exclusive, conceptual frameworks have been proposed to relate variation in cognition with variation in behavioral traits. First, coping styles theory posits that differences in cognitive performance are driven by differences in how individuals respond to environmental stressors (Kosten et al., 2012). Proactive (bold, aggressive, exploratory) individuals are expected to be rigid and routinized, while reactive individuals are expected to quickly respond to contingency changes and to be more flexible, a prediction that has received some empirical support. For example, selected lines of trout that varied in post-stressor cortisol levels also differed in cognitive performance: high stress reactive individuals were quicker to alter their behavior in response to food relocation during reversal trials (Ruiz-Gomez et al., 2011).

Another framework relating variation in behavior and cognition emphasizes the speed vs accuracy tradeoff (Sih & Del Giudice, 2012). The general idea is that individuals on the “fast” end of the life history continuum tend to be bold and make fast, but inaccurate, choices, while individuals on the “slow” end of the continuum opt for the opposite strategy. A study on black-capped chickadees offers some support for this hypothesis: After being trained to discriminate between stimuli for a food reward, slow-exploring chickadees performed better on reversal trials (Guillette et al., 2011).

Genetic and Molecular Basis

Studies in humans and nonhuman animals have suggested that there is often a heritable component to behavioral variation (Stirling et al., 2002). Quantitative genetic approaches such as selection experiments (Drent et al., 2003) and controlled breeding designs have been used to estimate the heritabilities of personality traits (van Oers et al., 2005). Early studies on the genetic basis of personality variation focused on candidate genes for neurotransmitters known to be important for behavior such as monamine oxidase A (MAOA; Manuck et al., 2000), the dopamine D4 receptor (DRD4; Korsten et al., 2010), and the serotonin transporter (SERT; Canli & Lesch, 2007), but these candidate genes typically just explain only a small fraction of the total phenotypic (and genetic) variation, indicating that many of the important players are still unknown.

New genomic technologies offer opportunities to expand the search for genes on a genome-wide scale (reviewed in Bengtson et al., 2018). A genome-wide approach, as opposed to cherry-picking a few candidate genes, is appealing because it is unbiased, and good for traits that are likely to be influenced by many interacting genes of small effect. Probably the best studies to date of personality on a genome-wide scale have been carried out in humans, where researchers have had access to large

sample sizes (tens of thousands of individuals) and good genomic coverage (millions of single nucleotide polymorphisms (SNPs)). The results of meta-analyses of GWAS that have attempted to identify loci and genes associated with personality traits in humans (van den Berg et al., 2016) are consistent with the rest of the GWAS literature, which is that the specific genetic variants implicated with the genetics of complex traits are likely to be of very small effect and hard for most studies to find.

Undoubtedly, there is also a sizable environmental component to personality variation both in humans and nonhuman animals, and rather than trying to eliminate it, studies might be better off explicitly studying environmental variation in order to understand the interaction between genetic and environmental influences. Influential early studies in humans focused on genotype by environment interactions with respect to particular candidate loci, e.g., whether the effect of exposure to childhood maltreatment on antisocial behavior depended on the individual's genotype at the MAOA locus (Caspi et al., 2003), but meta-analyses have since suggested that such “candidate GxE” studies were often underpowered (Munafo et al., 2009).

Other studies have started to study environmental influences on the genome by measuring gene expression relevant to behavioral variation (Bell & Aubin-Horth, 2010). By comparing genes that are differentially expressed in the brains of animals that have versus have not experienced a social interaction, for example, such studies have the potential to tell us about behavioral plasticity at the molecular level. Such studies have typically focused on average plasticity rather than individual variation, with a few exceptions focused on discrete variation (e.g., Aubin-Horth et al., 2005; Bell et al., 2016). A challenge for future work in this area is to integrate quantitative genetic approaches with studies of molecular plasticity and variation (Bell & Dochtermann, 2015). Another exciting area is to identify the molecular mechanisms (epigenetic modifications such as DNA methylation, chromatin modifications, small RNAs) by which the environment experienced by previous generations influences subsequent generations via nongenetic mechanisms (transgenerational plasticity). Research on the genetics of personality traits in nontraditional animals will also likely benefit in the future from emerging genome editing technologies such as CRISPR-Cas9 that will facilitate tests of causal links between genes and behavior.

Personality Trait Development throughout the Lifespan

Stamps and Groothuis (2010) presented a framework for studying personality trait development in nonhuman animals. This paper provided a lexicon adopted from the human personality literature that distinguishes between “mean-level consistency,” “differential consistency,”

“structural consistency” and “individual stability,” and helped to further clarify ways to think about the stability and change of personality traits.

An area that has received little study but is a promising direction for future work is to examine the development of personality traits throughout the life course. While the conventional wisdom is that early life is an especially formative time for the development of behavioral types, recent work on humans is suggesting that personality traits continue to change throughout the life course, well into adulthood (Roberts et al., 2006). For example, in a meta-analysis, emotional stability, conscientiousness, agreeableness all increased over the life course (Roberts et al., 2006), and that “emerging” adulthood (from the late teens through the twenties) (Arnett, 2000) is a particularly formative period for personality trait development. What accounts for the normative trend toward greater emotional stability and behavioral control (“maturity principle”) (Caspi et al., 2005)?

Animal personality researchers have much to offer this area because we can experimentally manipulate the opportunity for formative experiences in order to test both proximate and ultimate hypotheses for personality trait change throughout the life course. It will be fascinating for future animal personality studies to measure personality trait development before versus after an ecologically relevant life history event, along with a relevant control group. It is easy to envision both evolutionary and mechanistic reasons why we might expect risk-taking behavior, for example, to change as a function of critical events like dispersal or migration, reproduction, parenting, divorce, death of a pair-bonded mate or offspring, menopause, moving to a new social group, the beginning/end of the breeding season for iteroparous (multiple reproductive cycles) animals, sexual maturity or metamorphosis.

CONCLUSION

As judged by the proliferation of presentations and publications about the topic, the field of animal personality has arrived, but the field does have its share of skeptics. Objections include that it is too descriptive (Beekman & Jordan, 2017), it is “old wine in new bottles,” and that limited plasticity is unlikely given the power of natural selection (Neff & Sherman, 2004). A recurring objection in some circles is that the study of animal personality is anthropomorphic (Crews, 2013). The concern is that if we think that nonhuman animals are “like us,” that can prevent us from seeing the world from their point of view (umwelt), thereby leading to bad, or biased science. In addition, because the study of human personality includes persons’ thoughts and feelings, which we do not have access to in our nonhuman animal subjects, we should not claim to study “personality” in nonhuman animals. Another line of argument is that personality is too complex for nonhuman animals to have because it requires cognitive and social sophistication that is unique to humans.

For the most part, the controversy with which the study of animal personality has been greeted reflects the vitality of the field and excitement about its potential. Interest in animal personality is bringing together scientists from diverse disciplines (e.g., developmental psychology, evolutionary biology, invasion biology, behavioral genetics, neuroscience) who are converging in their interests and want to know why individuals vary and why they behave consistently. At the same time, appreciation of the implications of individual variation is starting to ripple through the social sciences, biology and biomedicine, making this an especially exciting time to work in this area.

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18

Genetics of Personality

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INTRODUCTION

Despite the early promise of behavioral genetic research, efforts to disentangle the genetic contribution to individual differences in behavior (e.g., personality traits) have been slow. Early studies relied on a candidate gene approach to identify genes influencing these traits; however, many of these failed to replicate, despite having a plausible biological mechanism. More recent studies have used whole genome approaches to investigate the genetic architecture of behavioral traits. However, unlike many other complex traits such as height (Marouli et al., 2017; Wood et al., 2014) and schizophrenia (Schizophrenia Working Group of the Psychiatric Genomics Consortium, 2014), relatively few genetic variants have been identified which are robustly associated with temperament and individual differences in personality.

It has been argued that a small number of factors can be used to account for individual differences in personality (Cloninger, 1994; Eysenck, 1991; McCrae & Costa, 1985; Tupes & Christal, 1992; Zuckerman, 1992). Although there is no universally accepted framework of personality, the proposed factors (such as those suggested by Eysenck and in the Five-Factor Model (FFM)) provide a good starting point when investigating the genetic architecture of personality (Eysenck, 1991; McCrae & Costa, 1985; Tupes & Christal, 1992; Zuckerman, 1992). It is likely that genetic effects associated with these traits will be small and large sample sizes will therefore be required to detect any association. By measuring specific traits, studies are able to harmonize phenotypes and pool analyses across cohorts. This will increase the power to detect genetic effects relevant to personality traits.

With recent advances in both computing and availability of increasingly rich data sources, there has been a surge in the number of behavioral genetic studies investigating personality traits. Behavioral genetics has the potential to both quantify genetic influences on these traits, in addition to indirectly quantifying environmental influences (Munafò, 2009). Here we provide a synthesis of these behavioral genetic studies to date. We begin by reviewing

current work investigating the heritability of personality traits. We also look at the results from genome-wide association analyses of these traits to date and discuss the implications of these findings on the potential for applying Mendelian randomization to personality traits.

ESTIMATING HERITABILITY

In order to investigate the genetic contribution to a phenotype, it is useful to first estimate its heritability (Box 1). Heritability is the proportion of variation in a phenotype which can be attributed to genetic differences; these estimates are specific to the particular context and the time-point at which they are estimated (Beam & Turkheimer, 2017; Davey Smith, 2011; Matthews & Turkheimer, 2017; Tropf et al., 2017). For example, if a trait has a heritability of 30%, then 30% of the variation in this trait is assumed to be due to genetic variation. However, although these estimates provide an idea of the size of the genetic component for a particular trait, they do not give us any information about which genes are likely to be responsible for it (Cesarini & Visscher, 2017).

Using Twin Studies to Estimate Heritability

Twin studies have been extensively used to disentangle the role of genetics and environment on human traits (Polderman et al., 2015). These models assume there are three distinct influences on phenotypic variation (V_P), these comprise additive genetic effects (V_A), shared environmental effects (V_C) and nonshared environmental effects (V_E) (Rijsdijk & Sham, 2002). Heritability estimates resulting from twin models are valid under certain assumptions. These assumptions include: (1) The twins are representative of the general population in terms of the trait, (2) environmental effects are shared to the same extent by identical (MZ) and nonidentical (DZ) twins, (3) gene-environment interactions for the trait are minimal and (4) there is no assortative mating in the population (Rijsdijk & Sham, 2002). Violations of these assumptions

Box 1 Heritability

Heritability is the proportion of variation in a phenotype (V_P) that can be attributed to genetic differences for the particular context and timepoint at which it is estimated. This can include the proportion of variance due to additive genetic effects (V_A), known as narrow-sense heritability (h^2), or the proportion due to all genetic effects (V_G), known as broad sense heritability (H^2) (Wray & Visscher, 2008). In addition to additive genetic effects, H^2 includes both between loci interactions (epistasis) and within loci interactions (dominance) effects.

Broad sense heritability: $H^2 = V_G/V_P$

Narrow sense heritability: $h^2 = V_A/V_P$

Heritability can be estimated using a number of methods. These include twin, family and adoption studies, in addition to more recent methods that use data captured by genome-wide arrays. Estimates calculated according to these family-based models can be thought of as “true” heritability. These estimates will incorporate heritability due to variants across the entire genome, including rare variants and those not captured by single nucleotide polymorphisms (SNPs) included on genotyping platforms. However, twin models, by design, use closely related individuals. These individuals are thus assumed to share a great deal of their environment, but if the equal environments assumption is violated this can impact on heritability estimates; for example, more similar treatment of identical (MZ) twins could lead to false inflation of heritability estimates.

Genome-wide methods estimate heritability using SNP-based approaches. This includes heritability due to variants robustly associated with the phenotype of interest that are identified through GWAS (h^2_{GWAS}), and heritability attributed to all SNPs captured on a GWAS array (h^2_{SNP}). h^2_{SNP} is typically larger than h^2_{GWAS} , although h^2_{GWAS} will increase with sample size as more variants are identified through GWAS, and is expected to approach h^2_{SNP} (Tropf et al., 2017). These approaches generally estimate heritability using unrelated individuals, which should minimize confounding due to shared environment, and follow the same experimental design as genome-wide association studies (GWAS; J Yang, Lee, Goddard & Visscher, 2011), but do not give an estimate of true narrow sense heritability because they do not include all additive genetic variance.

While the classic twin design can be used to estimate the proportion of phenotypic variation that can be attributed to genetic differences within a population, SNP-based methods can provide an estimate of the amount of variation that could potentially be explained using information from genome-wide arrays. These arrays tend to encompass common variation and work by genotyping a fraction of the genome, in the hope that these SNPs will “tag” the majority of the remaining SNPs. This h^2_{SNP} is an estimate of how much of the phenotypic variation could potentially be explained using the variants contained on these arrays, rather than an estimate of “true” h^2 . Any discrepancies between h^2_{SNP} and the narrow sense heritability estimated from twin studies may be attributed to variation explained by rare variants or common variation not tagged by SNPs included on the current array.

can result in biased (i.e., either increased or decreased) heritability estimates and it seems reasonable that these assumptions could impact differently depending on the trait of interest (Tropf et al., 2017).

A recent meta-analysis by Polderman and colleagues focusing on twin studies of human behavioral traits found that of all the phenotypes studied (>500 distinct traits), temperament and personality traits were among the top ten most investigated (Polderman et al., 2015). This study investigated the relative contribution of genetics and environment to a comprehensive list of traits studied over the previous fifty years, as well as assessing the presence of nonadditive genetic effects. The authors suggest that of all the studies ($N = 568$) investigating temperament and personality traits, the majority (84 percent) of published twin correlations were consistent with a simple model containing just additive genetic effects (Polderman et al., 2015). However, many of studies in the meta-analysis did not

report nonadditive variance components, since these are generally (and arguably erroneously) constrained to zero when there is no “significant” effect. This outcome is linked to sample size; thus it is possible that this lack of nonadditive effect is a result of the sample sizes analyzed (Davey Smith, 2011).

A recent meta-analysis of personality traits has combined evidence from twin, family and adoption studies (Vukasović & Bratko, 2015). Vukasović and Bratko find evidence for a heritable component to individual differences in personality, with heritability estimated at around 40 percent. The authors investigated the contribution of the different study designs, and found that heritability estimates were consistently higher among twin studies than family and adoption studies. The authors also looked at potential moderating effects of gender and personality model on heritability. Although there is some suggestion in the literature that heritability differs according to

gender (Eaves, Heath, Neale, Hewitt & Martin, 1998; Fanous, Gardner, Prescott, Cancro & Kendler, 2002; Finkel & McGue, 1997; Rettew et al., 2006), there was no strong evidence of a moderating effect when combining across all studies. Twin studies and Eysenck's theory of personality were both overrepresented in the data; however, the authors only found evidence for a moderating effect of study design.

Despite the variation across models of personality structure considered in these studies, there is clear evidence that a proportion of variation in these personality traits can be attributed to genetic variation. Vukasović and Bratko found no difference in heritability regardless of the model of personality used across studies (Vukasović & Bratko, 2015). This is somewhat reassuring given the different models considered across cohorts and the ongoing development of personality theory.

Box 2 Population Stratification

Allele frequencies can differ across populations, which can cause difficulties in association studies (Figure 18.1). These differences in ancestry, or underlying population substructure, need to be taken into account to prevent finding associations that are due to this population substructure rather than to phenotype associated variants. Methods of accounting for this include restricting samples to populations of common ancestry, adjusting results for a genomic inflation factor (λ) (Cross-Disorder Group of the Psychiatric Genomics Consortium et al., 2013), or performing principal components analysis to account for variation in the data due to population differences, and adjusting the regression model for these components (Price et al., 2006).

An additional consideration when undertaking genetic analysis is the population under investigation. In this meta-analysis, there is an underrepresentation of Asian populations, and no representation of South American or African populations. Performing genetic analyses across different samples can be difficult due to the possibility of population stratification (Box 2, Figure 18.1). Risk alleles can occur with different frequencies across populations, and this can induce spurious associations. The population from which a sample has been drawn, therefore needs to be taken into consideration to ensure that any observed association is not simply due to differences in allele frequency (see *ALDH2* Mendelian randomization example).

SNP-Based Approaches to Estimating Heritability

Although the twin studies discussed previously provide estimates of true narrow sense heritability (h^2), it can be problematic to obtain large enough samples to precisely estimate these effects. With recent advances in computing, and the increasing willingness of many cohorts to combine efforts through large scale consortia, it has been possible to create increasingly large genotyped samples with data on a wide range of phenotypic measures. Unlike twin studies which rely on assumed levels of genetic correlation between twin pairs, we are now able to measure the degree of genetic similarity between individuals in a dataset and look at the extent to which genetic and phenotypic similarity correlate. This means it is now possible to calculate heritability estimates using nonrelated individuals (Palla & Dudbridge, 2015; Speed et al., 2017; Speed, Hemani, Johnson & Balding, 2012; Yang, Lee, Goddard & Visscher, 2011, 2013). Methods have also been developed which use summary statistics from GWAS to calculate heritability estimates even when individual level data are not available. These techniques use information on the correlation or linkage disequilibrium (LD) structure

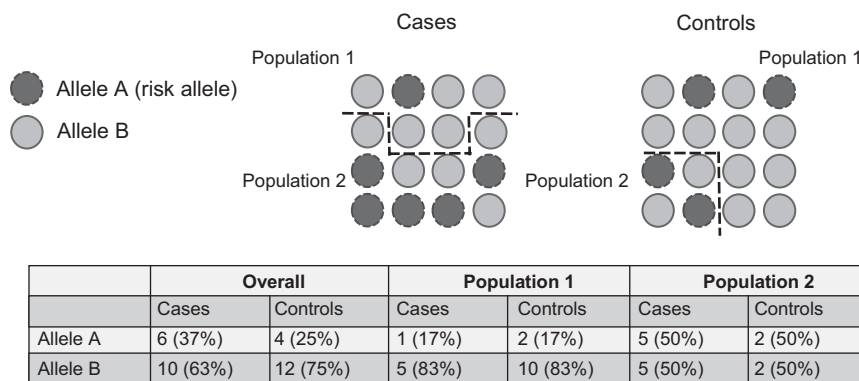


Figure 18.1 Population stratification

Note: When looking at the sample overall, there is a higher frequency of risk allele A in cases than controls. However, there are two 'hidden populations' within this sample and the risk allele has a higher frequency in one population than the other. Cases and controls are sampled disproportionately, resulting in a false positive association for this variant.

across the genome to estimate the SNP-heritability (h^2_{SNP}) of a trait from GWAS summary statistics (see [Box 1](#) for a definition of h^2_{SNP}) (Bulik-Sullivan et al., 2015). Although these approaches incorporate the LD structure among SNPs, estimates could be biased if the distribution of causal variants is non-random with respect to LD. A potential solution is to stratify SNPs jointly by minor allele frequency and LD. This approach appears to provide unbiased estimates of h^2_{SNP} (Yang, Zeng, Goddard, Wray & Visscher, 2017).

A recent study by Power and Pluess used the FFM of personality to assess heritability of these traits in a sample of 5011 participants from the 1958 National Child Development Study (NCDS) (Power & Pluess, 2015). They applied genome-wide approaches to estimate the heritability of each factor included in this model and found negligible estimates, with the exception of neuroticism ($h^2 = 0.15$, $se = 0.08$) and openness ($h^2 = 0.21$, $se = 0.08$). They also identified substantial genetic correlation (r_G) between the neuroticism and extraversion factors ($r_G = 0.82$, $se = 0.39$) and between neuroticism and openness ($r_G = 1.00$, $se = 0.50$).

Although previous studies have estimated SNP heritability estimates for various facets of personality (Verweij et al., 2012; Vinkhuyzen et al., 2012), this was the first study that attempted to estimate heritability for each of the FFM domains simultaneously. The estimates from this study are much smaller than the heritability estimated by twin studies (around 40 percent), leading the authors to suggest that common variants account for only around a quarter of causal genetic variation (Power & Pluess, 2015).

A recent meta-analysis by Lo and colleagues estimated heritability based on GWAS summary statistics and found estimates that were consistent for both neuroticism and openness, and an increased heritability estimate for extraversion (Lo et al., 2017). Power to detect smaller h^2 estimates was increased in this study which involved a sample size of around 59,000 participants.

In a recent study, Hill and colleagues used data from families and unrelated individuals in the Generation Scotland: Scottish Family Health Study to investigate genetic effects on intelligence and personality (Hill et al., 2018). When estimating heritability of neuroticism, they identified a contribution of additive common genetic effects of around 11 percent ($se = 2$ percent), and an additional contribution of pedigree-associated variants of 19 percent ($se = 3$ percent). For extraversion, they identified a contribution from additive common genetic effects of around 13 percent ($se = 1$ percent).

[Table 18.1](#) shows the h^2_{SNP} of neuroticism with increasing sample size. Heritability remains around 10 percent, with increasing precision as the sample size improves.

Identifying Genetic Associations

Despite emerging evidence that personality traits are heritable, so far relatively few individual genetic variants

Table 18.1 Neuroticism heritability estimates from recent GWAS

Study	Sample	h^2_{SNP}	N
Bae et al., 2013	LLFS	0.252, $p = 1.7 \times 10^{-15}$	4,595
de Moor et al., 2015	NTR	0.147, $p = 0.02$	3,599
	QIMR	0.157, $p = 0.18$	3,369
Power & Pluess, 2015	NCDS	0.150, $se = 0.08$	4,924
Smith et al., 2016	UK Biobank	0.136, $se = 0.015$	91,370
Okbay et al., 2016	UK Biobank	0.091, $se = 0.007$	170,910
Lo et al., 2017	23andMe	0.119, $se = 0.016$	59,206
Luciano et al., 2018	UK Biobank	0.108, $se = 0.005$	329,821
Nagel et al., 2018	UK Biobank	0.100, $se = 0.003$	449,484
Hill et al., 2018	Generation Scotland	0.107, $se = 0.020$	19,494

associated with these traits have been identified. This is likely due to the polygenic nature of these traits. Under the evolutionary neutral model, most variants with large effects will be rare; the majority of phenotypic variation is likely to be due to common variants of small effect (Munafò & Flint, 2014). Initial studies investigating the genetic basis to personality traits relied on investigating candidate genes. With advancements in computing power, it has become possible to increase the scope of analyses to take into account the entire genome rather than focusing on a single candidate locus. While candidate gene studies were purely hypothesis driven and required knowledge of the underlying biology, GWAS are instead hypothesis generating and test for associations across the whole genome ([Box 3](#)). Associations found here can inform future studies and provide valuable information on underlying mechanisms.

Candidate Gene Studies

In a candidate gene study, the association between allele frequency at a particular variant and phenotype of an individual is investigated (Lohoff, 2010). These variants are selected a priori based on some underlying knowledge of a plausible biological mechanism associated with a particular locus. In recent years, the associations between

Box 3 GWAS

GWAS use a hypothesis-free method of identifying specific common variants associated with a phenotype. Analyses are performed for each SNP in the dataset, which can be either genotyped or imputed. This assumes any causal SNPs will be either captured within the analysis, or tagged by those that are included. GWAS performs a regression for each variant, with the appropriate method determined by the format of the phenotype of interest. The regression model includes the genotype at that SNP plus any other relevant confounding variables, such as principal components, in order to adjust for population stratification, or other covariates that could account for variation in the phenotype not acting through the SNP of interest.

In order to account for the extensive multiple testing performed by running these analyses across the genome, a Bonferroni corrected p-value has been calculated which accounts for the likely number of functional variants being tested. This is the widely used $p < 0.05$ level of “statistical significance” divided by 1 million, an approximation of the number of independent tests carried out across the genome. The accepted level of genome-wide significance is therefore $p < 5 \times 10^{-8}$ (Clarke et al., 2011). This is then typically followed by replication in an independent, comparable sample.

the serotonergic and dopaminergic neurotransmitter systems have gained attention (Benjamin et al., 1996; Lesch et al., 1996; Malhotra et al., 1996); however, the evidence for these associations has been somewhat inconsistent.

Although candidate genes studies were once the norm for behavioral genetic studies, many findings failed to replicate leaving the literature awash with false positive results. A recent study investigated findings from the largest schizophrenia GWAS to date and found no evidence that variants in the most-studied candidate genes were more associated with the disorder than noncandidate genes (Johnson et al., 2017). Candidate gene studies suffered from issues such as small sample sizes and lack of power, confounding due to population stratification which was frequently unaccounted for, and selective reporting of “positive” results (Colhoun, McKeigue & Davey Smith, 2003). As a result, there has been a move away from these analyses in favor of the more agnostic GWAS approach.

GWAS

Analyses Using the Five-Factor Model (FFM) of Personality GWAS have been successful in identifying loci associated with many complex traits, for example a recent

GWAS of schizophrenia identified 108 loci robustly associated with the disorder (Schizophrenia Working Group of the Psychiatric Genomics Consortium, 2014), while over 200 susceptibility loci have been identified for inflammatory bowel disease (Liu et al., 2015). Progress with regards to personality traits, however, has been slower.

A number of early GWAS focused on the FFM (Bae et al., 2013; de Moor et al., 2012; B.-H. Kim et al., 2015; H.-N. Kim et al., 2013; Terracciano et al., 2010); however, these were generally small and the majority of reported associations failed to replicate. Recently a number of larger studies have used data from the UK Biobank to increase sample sizes (Lo et al., 2017; Luciano et al., 2018; Nagel et al., 2018; Okbay, Baselmans et al., 2016; Smith et al., 2016). The largest study to date which focuses on five broad personality domains is a recent meta-analysis of several GWAS which included data from 23andMe, Genetics of Personality Consortium, deCODE and UK Biobank ($N = 123,132$ to $260,861$) (Lo et al., 2017). This study identified six genetic loci, five of which were novel.

The majority of genome-wide analyses of personality traits have been performed in samples of European ancestry. However, studies have also investigated the genetic architecture of these factors within a Korean sample (Kim et al., 2015; Kim et al., 2013). These studies also focused on an FFM of personality traits, but used a version of the NEO-PI revised for use in the Korean population. With the exception of rs2146180, an intergenic variant on chromosome 9, which associated with the openness domain among a sample of young Korean females, there were no robustly associated genetic variants identified among these samples.

Analyses of Specific Traits In addition to studies looking at each of these five domains, other studies have focused on a particular trait. Several studies focus on neuroticism, with the largest study to date including data from UK Biobank, 23andMe and Genetics of Personality Consortium ($N = 449,484$). This study reports finding 136 independent genetic variants associated with neuroticism levels (Nagel et al., 2018). This suggests that for complex traits, for which there are likely to be many genetic effects of small size, increases in sample size are likely key to identifying genetic effects.

Other studies have focused on extraversion, although the samples for these have been smaller and to date have yielded few robust findings (Luciano et al., 2012; van den Berg et al., 2016). However, as shown in the heritability literature, there appears to be substantial genetic correlation between the traits of neuroticism and extraversion (Power & Pluess, 2015). Extraversion also appears to be one of the more heritable traits, so it is possible that these analyses are currently underpowered. As of yet, there are no phenotypic measures available in the larger cohorts (such as UK Biobank) that would allow a GWAS of similar magnitude to be carried out.

Excitement seeking and temperament were also investigated using genome-wide association analyses; however, these involved relatively small samples and did not find robust evidence of variants associated with these traits (Service et al., 2012; Terracciano et al., 2011; Verweij et al., 2010). A recent GWAS of impulsive personality traits has been conducted by Sanchez-Roige and colleagues in a sample of up to 22,861 23andMe participants (Sanchez-Roige et al., 2018). This analysis identified an association between sensation seeking and a variant located in the *CADM2* gene on chromosome 3. A gene which has previously been associated with other risk-related phenotypes including substance use (Pasman et al., 2018; Sanchez-Roige et al., 2018), risk-taking personality (Boutwell et al., 2017; Karlsson Linnér et al., 2019) and risky behavior (Day et al., 2016).

With the availability of large samples such as UK Biobank, there have been recent GWAS successes for other individual difference traits such as depressive symptoms. Progress in identifying genetic variants associated with depression had previously been slow, but in recent years, four large GWAS of major depressive disorder have been published (Howard et al., 2018; Hyde et al., 2016; Okbay et al., 2016; Wray et al., 2018). The latest of these reports 102 independent risk loci for depression (Howard et al., 2018). Reported heritability estimates for depression are similar to those reported for the FFM. It seems feasible that with similar increases in sample size, analyses of behavioral traits will be powered to detect genetic variants of small effect, and we may yet see comparable success in detecting variants that influence individual differences in personality.

Interpreting GWAS Findings

With recent advances in computing and the large number of cohorts willing to pool resources, there has been a rapid growth in the number of published GWAS and publicly available summary statistics. These studies have led to the identification of a vast number of genetic variants associated with disease outcomes in addition to health and lifestyle behaviors. Genome-wide association analyses have made a vast contribution to our understanding of the biological mechanisms unpinning many complex traits (Jostins et al., 2012; Lee et al., 2017; Marouli et al., 2017; Schizophrenia Working Group of the Psychiatric Genomics Consortium, 2014; Sullivan et al., 2017; Wood et al., 2014). However, although GWAS findings often represent direct genetic effects, the possibility that they reflect the effects of modifiable risk factors should not be overlooked (Gage et al., 2016). An illustrative example is the nicotinic receptor gene cluster *CHRNA5-A3-B4* on chromosome 15, which is robustly associated with smoking heaviness. This association was first reported in candidate gene studies (Saccone et al., 2006) and later identified through a GWAS of smoking quantity (Thorgeirsson et al., 2008) and studies of nicotine metabolite levels (Keskitalo et al., 2009;

Le Marchand et al., 2008; Munafò et al., 2012). Subsequent functional work suggests that this gene cluster plays a pivotal role in nicotine dependence by reducing the aversive effects of nicotine (Fowler, Lu, Johnson, Marks & Kenny, 2011). While this variant explains some of the biological underpinnings of this trait, the *CHRNA5-A3-B4* locus has also been identified in GWAS of lung cancer (Amos et al., 2008) and chronic obstructive pulmonary disease (Pillai et al., 2009). In the case of these traits, it is likely that the observed association with the *CHRNA5-A3-B4* locus is moderated through smoking status and mediated through the resulting tobacco exposure among smokers (Gage et al., 2016; Munafò et al., 2012).

For individual personality traits, it may also be possible to identify the effects of modifiable risk factors by dissecting the results of newly published genome-wide analyses. It is likely that any effects, either acting through biological mechanisms or via modifiable exposures, are small and large sample sizes will be required to detect these effects. With the recent release of the full UK Biobank sample, in addition to the increasingly collaborative direction that genetic research appears to be heading, it seems likely that future analyses of these personality traits will be undertaken on greater samples, thus increasing power. Despite the fact that samples may not currently be powered to detect variants associated with modifiable risk factors at a genome-wide level, it is possible to interrogate the summary statistics relating to these analyses and investigate for enrichment of variants and networks that are known to relate to exposures of interest.

GWAS of other individual difference traits such as reproductive outcomes (measured by age at first birth and number of children ever born) (Barban et al., 2016) and educational attainment (Okbay et al., 2016), have been successful in providing insight into the genetic architecture of these other behavioral phenotypes. Meta-analyses of GWAS of both age at first birth and number ever born have been conducted and several independent loci have been identified which are robustly associated with either one or both of these traits (Barban et al., 2016). The related genes have been identified as those which play a role in human reproduction and infertility. In addition, a large GWAS of educational attainment has identified 74 variants associated with years of schooling. These variants are disproportionately found in regions which regulate gene expression in the foetal brain (Okbay et al., 2016). These studies illustrate that well-powered studies can identify potentially relevant biological pathways, even for proximal phenotypes or behavioral phenotypes that at first appear to be largely environmentally driven.

Genetic Overlap – What Does This Tell Us?

Once we have estimated the heritability of a trait, we know that there is a genetic component to this phenotype,

although further work needs to be carried out to determine which genes influence this. If heritability has been calculated for multiple traits, then we know that there is a genetic component to each of these; however, we do not know if these are influenced by the same genes. Genetic correlation is a method to quantify how much genetic overlap there is between traits. It provides an estimate of the additive genetic effect shared between pairs of traits. It is possible to estimate genetic correlation using either publicly available summary statistics or individual level data. The vast number of published GWAS means that effect sizes are available for a wide range of traits on specific variants, and we can use the correlation between these to assess the genetic overlap between traits. Although these do not provide information on the causality of any potential relationship, they shed light on the amount of shared genetic architecture across traits. Any overlap here could be due to pleiotropy (genetic effects on multiple traits), shared biological mechanisms between traits, or a causal relationship from one trait to another.

There is a well-documented association between personality domains and a range of health behaviors and physical and mental health outcomes (Gale et al., 2016; Hakulinen et al., 2015; Lahey, 2009; Ligthart & Boomsma, 2012; Malouff, Thorsteinsson, Rooke & Schutte, 2007; Ormel et al., 2013; Purves et al., 2019; Sullivan et al., 2017). Recent studies have investigated the extent to which there is shared genetic architecture between personality traits and both mental and physical health (Gale et al., 2016; Luciano et al., 2018; Nagel et al., 2018; Purves et al., 2019). Polygenic risk scores based on an early meta-analysis of GWAS data found evidence of an association with both major depressive disorder and depressive symptoms in a number of studies (Genetics of Personality Consortium et al., 2015; Luciano et al., 2018; Middeldorp et al., 2011). Nagel and colleagues investigated genetic overlap between neuroticism and several mental health outcomes, anthropometric and health-related traits using previously published summary statistics. Strong evidence of genetic correlation was found for several of these outcomes, the greatest correlations observed being anxiety, depression and subjective wellbeing. There was also evidence of moderate-low genetic correlation between neuroticism and a number of other outcomes including schizophrenia, ADHD, anorexia nervosa, educational attainment and height (Nagel et al., 2018).

Mendelian Randomization

Once genetic correlation between traits has been established, it may be possible to disentangle the nature of the relationship using techniques such as Mendelian randomization (MR). MR is a method of investigating causality using observational data. Genetic variants are used as proxies, or instrumental variables, for a modifiable risk factor of interest. The principles and assumptions underlying MR have been described in detail elsewhere (Davey

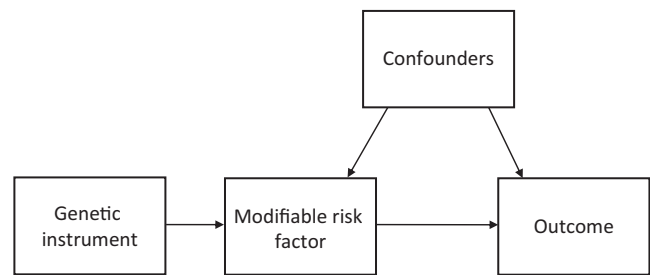


Figure 18.2 Directed acyclic graph illustrating Mendelian randomization

Smith & Ebrahim, 2003, 2005; Davey Smith & Hemani, 2014). Assuming these assumptions hold, there should be no association with potential confounders and analyses should not be subject to reverse causation (Figure 18.2). MR can therefore be used to investigate the causality and direction of observational associations where there is a strong genetic instrument for the modifiable risk factor.

For cases where there are strong genetic instruments for both the exposure and outcome, bidirectional MR methods can be used in order to provide stronger evidence of the direction of effect. Assuming the instruments are equally as strong for the exposure and outcome, if we were to observe strong evidence of an association in one direction, but not in the other, this would strengthen our confidence that this is the true direction of effect. However, MR alone is not enough to provide definitive evidence of causality, and evidence from different approaches should be triangulated. MR estimates should be compared with those from other methods to investigate whether results are consistent across different approaches and to build a more complete picture of the true effect.

To date there have been relatively few MR studies carried out using personality traits, in part due to the lack of strong instruments for these traits. However, with the publication of increasingly large GWAS for these traits, we expect instrument strength to increase and MR analyses to become more feasible. MR has provided insights into the causal effects of other individual difference traits, such as educational attainment, depression and anxiety (Taylor et al., 2014; Tillmann et al., 2017). A recent MR suggests that additional education is protective against the risk of coronary heart disease, with similar causal associations with reduced smoking, BMI and improved blood lipid profiles (Tillmann et al., 2017), while MR analyses investigating the effect of smoking behaviors on depression and anxiety have found no strong evidence of an effect in this direction (Taylor et al., 2014).

As mentioned previously, allele frequencies can differ across populations, and this information can be useful when designing MR analyses. A recent study investigating the role of alcohol use on adolescent internalizing and externalizing problems was performed within a sample of Chinese adolescents (Chao, Li & McGue, 2017). The *ALDH2*2* genotype is found almost exclusively in Asian populations and can be used as a strong instrument for

alcohol use in these samples. This study found evidence of a causal role for alcohol in adolescent aggression and attention problems.

In addition, MR can provide insight into evolutionary developmental hypotheses as it allows us to look at varying levels of genetic vulnerability to a trait, rather than focusing on an individual's phenotype. It seems likely that particular traits would be susceptible to selection; for example, individuals with a diagnosis of schizophrenia, tend to have lower reproductive success (Bundy, Stahl & MacCabe, 2011; Nettle & Clegg, 2006). However, the disorder remains at a constant prevalence in the population. This is likely due to favorable characteristics that are linked to some genetic vulnerability for the disorder in those who do not succumb to the outcome.

FURTHER RESEARCH DIRECTIONS

An alternative to increasing sample size, is to refine the phenotype being investigated. Reducing the noise in a phenotype measure may lead to a clearer genetic signal, thus fewer numbers would be required to detect this. Attempts to refine the phenotype are useful in terms of improving statistical power, but could limit the utility of any findings if results are not generalizable to the whole population. Therefore, there is a tradeoff between statistical power and clinical utility. Longitudinal cohorts have the potential to contribute to this; measurement error will be reduced for longitudinally defined phenotypes, resulting in increased power.

Although there is ongoing discussion about the best model of individual differences in personality, the factor structures suggested are a useful starting point when investigating the genetic architecture of these traits (Eysenck, 1991; McCrae & Costa, 1985; Tupes & Christal, 1992; Zuckerman, 1992). Work has been done to investigate the impact of using different personality models when attempting to unpick the genetic structure of these traits, and little evidence of a difference across models has been found (Vukasović & Bratko, 2015). There is some suggestion that a general factor of personality should be constructed (Hopwood, Wright & Donnellan, 2011; Rush-ton et al., 2009). Although there is little work that has been done to specifically investigate the genetic architecture of such a factor (Veselka, Schermer, Petrides & Vernon, 2009), the genetic correlation between various factors in the FFM provides some evidence for this theory (Power & Pluess, 2015). Further work should be done to investigate the influence of using different models of these individual differences.

To date, the majority of studies investigating underlying genetics of behavioral traits have focused on samples of European ancestry. Genetic effects are likely to be of small size and large samples will be required to identify them. There are a finite number of samples available with relevant phenotypes and genetic data available, therefore in

order to maximize power and sample size, combining samples across populations is likely to play an important role in future genetic studies. Analytical approaches that can account for underlying population stratification will be required.

As is becoming increasingly clear with the results from large scale genetic analysis, effect sizes of any single SNP relating to individual differences in these personality traits are likely to be small and will therefore require large sample sizes to reliably detect. Ideally, studies combining the large sample sizes of resources such as UK Biobank, with the detailed phenotyping of smaller cohort studies would provide the greatest power to detect genetic effects, if such effects exist.

CONCLUSION

Despite ongoing debate about the structure of individual differences in personality, there is clear evidence of a genetic component to these traits. Consistent heritability estimates have been calculated for a number of domains using both twin studies and whole genome approaches. Increasingly large GWAS have been published which identify a number of genetic variants for individual differences in behavioral traits. To date, the largest study of a personality trait focuses on neuroticism which has identified 136 variants of small effect. As the number of samples with both genetic and phenotypic data increase, it is likely that more such evidence will emerge. This has the potential to provide both insight into potential biological mechanisms and to generate instruments for use in future MR analyses investigating causal associations of these individual differences in personality.

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19 Approach–Avoidance Theories of Personality

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INTRODUCTION

Approach and avoidance theories of personality try to account for the systematic individual differences observed in reactions to classes of appetitive (“rewarding”) and aversive (“punishing”) stimuli. These individual differences reflect the operation of neuropsychological systems underpinning primary forms of motivation and emotion – accordingly, they are phylogenetically old, of evolutionary significance and of wide scale applicability (e.g., Krupić, Banai & Corr, 2018). The literature now has grown to include a *family* of approach and avoidance theories of personality. As detailed below, this literature is a culmination of research conducted over the last one hundred years, although its philosophical roots go back much further.

The importance of neuropsychological systems underlying approach and avoidance behaviors is widely acknowledged – indeed, to such an extent that they are seen as playing a major role in all forms of personality, motivation and emotion. The functional roles of these systems in survival and reproduction are easy to discern within an evolutionary context: Viability and fecundity are the key criteria of genetic success. In terms of architecture, given the polygenic nature of most psychological phenotypes, systematic individual differences in personality reflect variation in the normal distribution of the genotype – in conjunction with environmental influences, this genetic variation shapes neuropsychological development (Corr & Mobbs, 2018). (We do not discount the possibility that there may be specific evolutionary strategies underlying individual differences (e.g., Penke, Denissen & Miller, 2007); however, for current purposes, we assume the parsimonious stance that genotypic variation within an adequately adaptive range is an adequate account for the existence of systematic phenotypic individual differences.)

We refer to “approach–avoidance theories” rather than “approach and avoidance theories” – serving as a convenience. More importantly it is intended to emphasize the fact that approach motivation is best seen in the context of avoidance, and vice versa. In addition, there are hidden

complexities to consider, especially regarding: (a) the nature of eliciting stimuli; and (b) how approach–avoidance systems influence each other to shape the final behavior observed.

BACKGROUND WORK

To understand the approach–avoidance personality literature, first we need to appreciate a problem: Significant scientific progress in this field has come at a cost, specifically in respect of explanatory parsimony. The problem may be illuminated by the light of a horticultural metaphor (Corr, 2013). The *family* of approach–avoidance theories may be likened to a mature garden of many plant varieties, all intertwined and resplendent in their foliage and blossom. Yet, this surface view – as manifestly pleasing to the eye as it may be – conceals the original ground plan and the root structures from which all varieties are supported and from which all derive their sustenance. A quick perusal of the literature, indeed, reveals the proliferation of variegated approach–avoidance theories of personality, many of which seem only loosely connected to their scientific roots – these empirically anchored theoretical structures have been established over many decades of research, especially in the recondite area of experimental animal behavior. Our task in this chapter is to reveal these scientific root structures and to explore their implications for the entire field. But, first, there is plenty of conceptual spadework to be done.

Added to this first problem, a second one has the potential to block the path of scientific advance. This is the ever-present threat of *inferential hazard* – this problem is especially apparent in the absence of firmly established *a priori* theoretical and empirical foundations (Corr, 2013); or, more precisely in relation to the first problem, the failure to recognize the need for a theory of common scientific roots. One manifestation of this second problem is seen when an attempt is made to explain approach–avoidance *states* (e.g., “fear”) which, themselves, are inferred from overt behavior (e.g., avoidance/escape in typical learning

situations – active and passive avoidance), and *then* these states are employed to explain the very observed behavior that defined them in the first place. We all know that explanatory structures must be different from the phenomena they are trying to explain, otherwise nothing more than vacuous tautology is achieved. One bold, if flawed, attempt to counter this inferential hazard was to eschew the very notion of unobserved central states *causing* behavior at all – Skinner (1953) famously referred to such, apparently causal, central states as “fiction.”

Despite the problems that attend approach–avoidance theories of personality, over the passage of the last century, and increasingly in the present one, personality theory has made significant advances. This success now allows talk of the “neuroscience of personality” without fear of derision – as one piece of evidence of its official acceptance, in 2018 a major scientific publisher, Cambridge University Press, establishing a new journal devoted to the field: *Personality Neuroscience* (Founding Editor-in-Chief, Philip Corr).

Our purpose in this chapter is to review this vital field of personality psychology and to suggest ways in which more harmonious relations can be fostered between the various members of the family. We believe this is best done by focusing on the underlying scientific roots common to all approach–avoidance theories. Our presentation is structured in three main sections. In the first section, we review the history and social context of the study of approach–avoidance theories. In the second section, we discuss approach–avoidance mechanisms through the lens of the Reinforcement Sensitivity Theory (RST) of personality. Then, in the third section, we focus on the problem of taxonomy of the family of approach–avoidance personality traits and how integration at this level of analysis may be possible.

HISTORICAL AND SOCIAL CONTEXT

The issues that concern the family of approach–avoidance theories of personality are ones that have occupied the minds of philosophers for centuries. They are observed in the work of the ancient philosophers (e.g., Epicures of Samos 341–270 BC and Aristotle 384–322 BC) and, much later, similar ideas were central to philosophically inclined economic discourse (Corr & Plagnol, 2018) as well as related themes of jurisprudence – the latter is seen in the famous quote from Jeremy Bentham (1781):

Nature has placed mankind under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do as well as to determine what we shall do. On the other hand, the standard of right and wrong, on the other chain of causes and effects, are fastened to their throne. They govern us in all we do, in all we say, in all we think; every effort we can make to throw off our subjection, will serve but to demonstrate and confirm it. In words a man may pretend to abjure their empire: but in reality he will remain subject to it all the while.

The imagination does not need to be stretched too far for us to say that, in one form or another, everyday life is regulated: (a) by striving to obtain the “good” things (e.g., safety, food, drink, sex, and fulfilling social, personal and occupational pursuits); and (b) avoiding the “bad” things (e.g., dangerous animals, rotting food, and criticism from other people). Central to the notion of (dis)incentives is the assumption that behavior has the overarching goal of reducing costs (loss) and maximizing benefits (gain), and this is achieved by some form of cost-benefit analysis in any given choice situation. According to this general perspective, individual differences in loss and gain processes are fundamental to all areas of life – according to the 2002 Nobel prize winner in economics, Daniel Kahneman (2011, p. 242):

...rewards and punishments, promises and threats, are all in our heads. We carefully keep score of them. They shape our preferences and motivate our action...

It is against this intellectual backdrop that the scientific literature on the “sovereign masters’ pain and pleasure” is presented, especially as they play-out in the behavioral choreography that reflects the trait stabilities in approach–avoidance personality.

SCIENTIFIC ORIGINS OF APPROACH-AVOIDANCE THEORIES

The philosophical roots of reward/approach and punishment/avoidance may be seen by some to be little more than idle historical curiosity. However, they continue to reverberate throughout society (e.g., in economics and the justice system). By inclination, personality researchers are more interested in the scientific roots of modern-day approach–avoidance theories and usually have little time for historical and philosophical digression. However, it is instructive – and for our current purpose, highly relevant – to trace the scientific routes of theory development, particularly as they throw light on present-day problems.

Modern scientific accounts of approach–avoidance theories of personality trace their origin to learning theory, especially those approaches that challenged the Hullian theory of a single process of an aversive-state “drive,” which was once deemed to be the most important factor underlying reinforcement-based behavior (Hull, 1952) – this theory said that any stimulus associated with drive *reduction* served as a reinforcer and, as such, acquired the power to influence subsequent behavior when presented. In the place of this single-factor theory of behavior, two-process (learning: classical and instrumental) and two-factor (reinforcement: reward and punishment) theories came to the fore. Following Mowrer’s (1960) seminal work, pioneers in the field (e.g., Konorski, 1967) made significant headway, all of which culminated in the late 1960s and early 1970s with the work of Jeffrey Gray (1967, 1970, 1972a,b, 1975, 1976, 1977, 1982). Important in this

respect, this two process/factor perspective displaced one-factor personality theories, most notably Hans Eysenck's (1967) biological model of introversion–extraversion and neuroticism (see McNaughton & Corr, 2018a; discussed below).

Gray's work had a major influence on the current-day notion that there exist only a small number of fundamental *state* systems that mediate reactions to specific classes of reinforcing stimuli (i.e., “rewards” and “punishments” of various kinds; or more accurately, “attractors” and “repulsors”; Corr & McNaughton, 2012, see below) which shape approach–avoidance behavior (see Corr & Krupić, 2017). These behaviors are best seen as instrumental devices that interface with the world to satisfy motivational goal states. Personality psychology tries to link the activity of these *state* systems to *traits*, as measured by conventional psychometric means (e.g., questionnaire). How the distribution of states may be used to define the nature of traits is explained by such theories as William Fleeson's (2001) State Density Distributions framework. Among other scientific spinoffs, approach–avoidance research led to links being made between states/traits and psychopathology (e.g., anxiety and depression), as well as many forms of everyday behavior (e.g., for a summary, see Corr, 2008, 2010).

Two-Process Theory

In contrast to black-box Behaviorism, crucially for these developments and especially for the emotion literature, Mowrer's (1960) idea that central states must be instantiated in specific neurophysiological systems, discoverable by the standard procedures of science, influenced all that followed. Although some years passed before the full realization of this vision, it entered personality psychology through Gray's work, especially his 1975 book, *Elements of a Two-Process Theory of Learning* that explicitly detailed the relationships between Mowrer-type learning theory and personality. This behavioral scaffolding – derived in large measure from Donald Hebb's (1955) differentiation of the conceptual nervous system (cns) and the real central nervous system (CNS) – was complemented by parallel neurophysiological findings that pointed to specific emotion areas in the brain (e.g., the “pleasure centres”; Olds & Milner, 1954). Much later, clinical data added to the picture, as did attempts to model processes in normal human personality.

These theoretical seedlings have grown and borne fruit. Arguably as a direct result of Gray's work – at the very least, inspired by it – members of the approach–avoidance family have proliferated to include: Elliot and Thrash (2002), Cloninger (Cloninger, 1986), Depue (Depue, 2006; Depue & Collins, 1999), Davidson (Davidson, Ekman, Saron, Senulis & Friesen, 1990; Davidson, Shackman & Maxwell, 2004) and Carver (Carver, 2005; Carver & White, 1994).

JEFFREY GRAY'S CRITIQUE OF HANS EYSENCK'S BIOLOGICAL MODEL OF PERSONALITY

Before we discuss the various theories in the approach–avoidance personality family, we summarize the reasons Gray gave for challenging the major biological theory of personality at the time, namely Hans Eysenck's (1967) arousal-activation theory of introversion–extraversion (E) and neuroticism (N). This specific literature tells us a lot about the entire approach-avoidance personality field.

The revolution from one- to two-factor theory commenced with a seminal paper by Gray (1970), published by Eysenck in his own house journal, *Behaviour Research and Therapy*. (If nothing else, this attests to the open-mindedness of Eysenck, although he never appreciated the full importance of Gray's work in the field of personality; see Corr, 2016a.) It will repay us to summarize this seminal paper (for a detailed discussion, see McNaughton & Corr, 2018a). Gray's work was aimed at resolving the gross cracks he perceived in Eysenck's (1967) theory (for further detail, see Gray, 1981) – and, in turn, these cracks can be traced to the earlier learning theory literature (Hull versus Mowrer; see above). There was also a difference of opinion as to the appropriate starting point for personality theory development.

Eysenck's “top-down” statistical approach to theory construction consisted, first, in “discovering” (in factor analytical terms, uncovering) and characterizing the major dimensions of personality and, only then, providing a theoretical (biological) account for their existence. (Eysenck's work started with his 1944 factor analysis of some 700 “war neurotics” – for an account of this seminal study, see O'Connor & Corr, 2018.) As discussed elsewhere (Corr & McNaughton, 2008), multivariate statistical analysis is not equal to the task of “recovering” the separate (genotypic) causal influences that may be conflated in (phenotypic) behavior, especially as measured by questionnaire. Arguably, what is measured is the *combined* product of the operation of separate underlying causal systems – unscrambling this behavioral omelette was never going to be easy! This was the major problem facing Eysenck's top-down derived personality factors, especially when the main aim was to account for their causal bases.

As discussed in detail by McNaughton and Corr (2018a), Eysenck's model is especially problematic because it requires *two* personality factors (Introversion–Extraversion and Stability–Neuroticism) to account for *both* of two sets of disorders (internalising and externalising). Gray considered this view to lack parsimony and, instead, proposed that internalising and externalising disorders should have quite separate causes of their own: sensitivity to punishment and reward, respectively. To compound the matter further, Eysenck's model seems to confuse drive (Neuroticism related) and arousal (Introversion–Extraversion related), but as noted by Gray (1975, p. 25): The “Hullian concept of general drive, to the extent that it is viable, does not differ in any important

respects from that of arousal.” There are other specific problems with Eysenck’s theory that have already been discussed elsewhere (e.g., Corr, 2008). In its place, Gray split reward and punishment following the distinct two-process learning theory tradition. As Gray (1975, p. 176) states, his view of learning is:

...essentially the same as that proposed by Mowrer in 1960 which supposes that observed learning and behaviour is the outcome of an interaction between two underlying processes: one (a classical conditioning component) responsible for the acquisition by initially neutral stimuli of reinforcing and motivational properties, the other (the instrumental component proper) responsible for the guidance of behaviour in such a way as to maximise positive reinforcement and minimize negative reinforcement.

On reflection, what Eysenck seems to have are major *descriptive* dimensions of personality (Introversion–Extraversion and Stability–Neuroticism) that represent the *combined* effects of separate causal systems. If this conclusion is true then it is not surprising that he never got beyond the postulation of very general systems of arousal and activation – namely, the Ascending Reticular Activating System and visceral system, respectively (for a summary, see Corr, 2004). We may assume that these diffuse systems cut across specific causal systems, as contained in approach-avoidance theories of personality.

However, in one important sense, Eysenck may have captured the personality factors and processes that reflect the combined effects of reward/approach and punishment/avoidance systems as they operate on a moment-to-moment basis. (Eysenck could well argue that *this* is “personality,” at least at the behaviorally descriptive level; yet it would be inadequate as regards a causally adequate theory of personality.) By its very nature, Eysenck’s attempt to isolate descriptive dimensions of personality set a barrier to dissecting the neural bases of personality: It is the delineation of such neural systems that is needed if we are ever going to have a proper theory to explain how these combined effects arise in the first place. In retrospect, given the fundamental limitations inherent in multivariate statistical techniques (e.g., especially factor analysis; see Lykken, 1971), Eysenck’s approach never stood much of a chance of unravelling the true complexity of the biological systems unpinning personality – this is the tragedy of what was the first fully developed *biological* theory of personality. However, Eysenck’s theory was highly inspirational – Gray’s work was especially inspired.

In contrast to Eysenck’s approach, Gray (1970) was the most prominent theorist to lend the conceptual and experimental tools of *learning theory* to personality psychology. He applied learning theory constructs (especially, habit strength, drive, goal gradient, generalization and reinforcement) to provide a *tractable* means to study personality processes – something that always eluded the field. A notable feature of Gray’s approach was the attempt to dissect brain-behavioral systems by pharmacological means. His reasoning was that if a drug (or class of drugs,

e.g., anxiolytics) affects one set of behaviors (e.g., simple avoidance) but *not* another set (e.g., active avoidance and approach) then we may be confident that the former depends on a system that the latter does not. (Gray extended this reasoning to validating behavioral tasks, whether in the rat or human laboratory; e.g., in extending his work to schizophrenia, the effects of nicotine and amphetamine on latent inhibition; Thornton et al., 1996.) Like so much else of his work, Gray’s approach was inspired by Eysenck’s (1963) own “experiments with drugs.” Certainly more than anyone before and, as it turns out, since (McNaughton & Corr, 2018a), Gray sought to provide a viable “bottom-up” scientific account of personality.

A detailed examination of Gray’s (1970) work helps us to get closer to the underlying scientific root structure that supports all approach-avoidance theories of personality (for a detailed exposition, see McNaughton & Corr, 2018a).

RST OF PERSONALITY

The *Reinforcement Sensitivity Theory* (RST)¹ has been in continuous development for over fifty years. It is an attempt to explain the regulation of behavior, related to motivation and emotion, and how the neuropsychological systems underlying this regulation give rise to the personality factors that are amenable to measurement by questionnaire (for a review, see Corr, 2016b) and other means (e.g., experimental behavioral studies; for an example, see Perkins et al., 2013).

Three Systems

RST postulates three major neuropsychological systems: one positive, the *behavioral approach system* (BAS); and two negative, the *fight-flight-freeze system* (FFFS), and the *behavioral inhibition system* (BIS) (summarized by Gray & McNaughton, 2000; see also Corr & McNaughton 2012; McNaughton & Corr, 2004, 2008, 2014, 2018b).

The BAS is activated by appetitive stimuli (e.g., food and sexual partners) – more generally and accurately, *attractor* stimuli – and the FFFS by aversive stimuli (e.g., predators) – more generally and accurately, *repulsor* stimuli. (On deeper analysis “appetitive”/“rewarding” and “aversive”/“punishing” stimuli are theoretically problematic and can lead to experimental confusion; see Corr & McNaughton, 2012). In contrast, the BIS is activated by conflicting stimuli (e.g., coactivation of FFFS and BAS when motivational tendencies are opposing and of

¹ As noted by one of the originators of the name, “Reinforcement Sensitivity Theory” (Pickering, Diaz & Gray, 1995), Pickering (2008) considered alternative names: “Reinforcement Reactivity Theory” and “Motivational Input Sensitivity Theory”; Corr & McNaughton, 2012, later called it “Reinforcer Sensitivity Theory.”

approximately equal strength, as in avoidance-approach conflict seen in many social situations). BIS activation leads to rumination about the past, worry about the future, escalation of perceptions of danger, and more pronounced passive avoidance (and withholding of entrance to a potentially dangerous “field”).

In the case of the typical human environment, the specific forms taken by approach-avoidance behavior depend on context. Some contexts afford specific forms of behavior, others do not (e.g., reaction to a badgering senior colleague at work or friend in a social situation). Also, how eliciting “attractor” and “repulsor” stimuli are cognitively “framed” will affect their capacity to activate the systems – such cognitive restructuring is a major focus of cognitive-behavioral therapy – clinically efficacious drugs can impact on the systems directly.

Although reward/attractor stimuli are assumed to motivate approach behavior, and punishment/repulsor stimuli, avoidance/escape behavior, on closer inspection things get complicated, and fast. To appreciate this fact, we need to be aware of several major findings. First, at the state level, reward/attractor (controlled by the BAS) and punishment/repulsor (controlled by the FFFS) motivation subtract from each other, and these tendencies have different goal-gradients (Miller, 1944; see Corr & McNaughton, 2012). Second, in addition to these subtractive effects, the inhibition of approach by approach-avoidance BIS-related *conflict* is neurally and psychopharmacologically distinct from simple FFFS-related avoidance/escape behavior (Gray, 1977, 1982; Gray & McNaughton, 2000). An extensive literature shows that whereas the BIS is generally sensitive to anxiolytic drugs, the FFFS is *relatively* insensitive to these drugs and, instead, is preferentially sensitive to panicolytic drugs (see McNaughton & Corr, 2008, 2018b).

Separable and Joint Effects

A further complication – or, depending on viewpoint, clarity – is the interplay of reward/attractors and punishment/repulsors. Building on Gray and Smith (1969), there is now a literature on the *joint subsystems hypothesis* (JSH; Corr, 2001, 2002a; for a summary of empirical studies, see Corr, 2004). The JSH highlights that, in the prediction of human reactions as measured by personality questionnaire, attention must be paid to their combined effects (sometimes revealed by two main effects, at other times by statistical interactions; see Corr, 2001, 2002a). The hypothesis of combined effects is based on two tenets. (1) Typically in the human situation, there are varying degrees of punishing/repulsor and rewarding/attractor stimuli, often with no dominance of one (perceptions and appraisal of stimuli are important here too). (2) Behavior is often the outcome of the activation of multiple state systems (i.e., systems work together to shape the final behavior shown). An everyday example is speaking in front of a group of people, which entails mixed motivation: trying to be articulate and persuasive while at the

same time not wanting to say something foolish and embarrassing.

Arousal and Paradoxical Effects

The complexity – or clarity – does not stop there. As discussed by Corr (2002b, 2013), activation of RST systems induces arousal, but the outcome of this can be counter-intuitive. For example, a mildly punishing (and arousing) stimulus has the potential to invigorate ongoing reward-controlled approach behavior (e.g., possibly seen in sado-masochistic sexual practices). This enhanced approach outcome is expected when the arousal-induced invigoration of behavior exceeds its punishment-related inhibitory effects. Of course, the punishing stimulus is not acting as a reward/attractor stimulus, but its arousing properties lead to this outcome. This effect has been studied mainly in the rat (behavioral contrast and peak shift; Gray & Smith, 1969) and has only rarely been studied in human subjects (but see Nicholson & Gray, 1971). Such a response invigorating arousal effect is evident in everyday life (e.g., a car driver increasing speed after being angered by the actions of another driver). In passing, it is worth noting that this effect seems similar to Carver and Scheier’s (2009) view of increased effort as resulting from progress below expectation.

Psychometric and Clinical Data

There are good grounds for assuming that the findings obtained from nonhuman animal experiments are very relevant for human personality. Psychometric evidence exists for the following: the separation of FFFS-fear and BIS-anxiety, as shown in the development of questionnaires (e.g., Corr & Cooper, 2016; for a review, see Corr, 2016b); structural equation modelling of existing “fear” and “anxiety” scales (Cooper, Perkins & Corr, 2007); occupationally relevant predictive validity studies (Perkins, Kemp & Corr, 2007); and the differentiation of fear versus anxious facial expressions (Perkins, Inchley-Mort, Pickering, Corr & Burgess, 2012).

There is also supportive evidence of the structural nature of RST factors in clinical and genetic data. Structural equation modelling of psychiatric symptoms supports the existence of a higher-order externalizing factor (comparable to the BAS) and an internalizing factor (comparable to the FFFS/BIS), with the internalizing factor decomposing into lower-order factors of “fear” (FFFS) and “anxious-misery” (BIS) (Krueger, 1999). Thus, there appears to be distinct risk factors for anxiety and mood disorders, on the one hand, and phobias and panic disorders, on the other (Krueger & Markon, 2006). These two risk factors are labelled “Distress” and “Fear,” which seem to parallel BIS and FFFS sensitivities, respectively. Distress and Fear, though distinct, are strongly correlated, reflecting a more general internalizing factor that resembles a personality factor of Neuroticism (Griffith et al.,

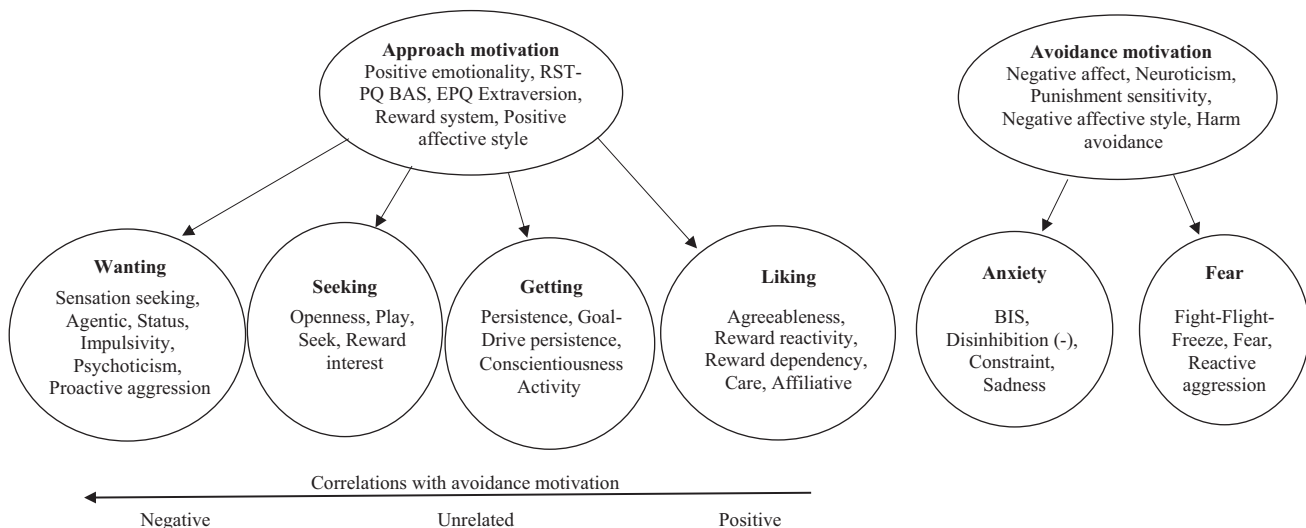


Figure 19.1 Hierarchical three-level model of approach-avoidance personality traits. General factors representing approach and avoidance motivation are placed at the highest level of the model. They represent very broad measures of approach and avoidance tendencies. At the lower level, the first group of approach-related traits consist of sensation seeking etc., which in most cases correlates negatively with avoidance-related dimensions, whereas the last group (agreeableness etc.) usually correlates positively with avoidance-related dimensions. Avoidance motivation on the lower level distinguishes anxiety- and fear-related mechanisms. Depending on the question, a researcher must decide whether to use a domain narrowed or general measure of approach-avoidance mechanism.

2010). Likewise, the general genetic risk for internalizing disorders breaks down into “anxious-misery” (i.e., depression and generalized anxiety disorder) and specific “fear” (i.e., animal and situational phobia) components (Kendler, Prescott, Myers & Neale, 2003). In these ways, comorbidity, continuity and discontinuity in clinical disorders are reflected in the personality traits associated with these disorders (McNaughton & Corr, 2016).

The perceived importance of the separation of FFFS/fear and BIS/anxiety is increasingly recognized, especially in the psychopathological literature (Bijttebier, Beck, Claes & Vandereycken, 2009). However, one major limitation has been the absence of appropriate psychometric measures of FFFS-fear and BIS-anxiety (Sylvers, Lilienfeld & LaPraririe, 2011; see Dissabandara, Loxton, Dias, Daglish & Stadlin, 2012) and much work is still needed in this important personality-psychopathology area.

Attesting to the significance of RST in the family of approach-avoidance theories, it has a surprising range of applications, among others: motivation (Corr & Krupić, 2017); neuroimaging (McNaughton, DeYoung & Corr, 2016); risk factor for externalizing disorders (Corr & McNaughton, 2015); generation of conscious awareness (Corr & Morsella, 2015); and workplace behavior (Corr, McNaughton, Wilson, Hutchison, Burch & Poropat, 2017). And, intriguingly, RST has been extended to the personality of dogs (Piotti, Satchell & Lockhart, 2018) – a pleasing parallel with Pavlov’s own work on dogs, that inspired both Eysenck’s and Gray’s theoretical orientations. This literature has led some theorists to claim that RST provides an integrative framework for the neurobiology of personality (e.g., Kennis, Rademaker & Geuze,

2013) – it would be fair to say that it is only one of several nominees for this prized accolade.

TAXONOMY OF APPROACH-AVOIDANCE PERSONALITY TRAITS

Building personality theory “bottom-up” has many advantages, but also some costs. One of the most troublesome problems facing RST for a long time has been its psychometric characterization (Corr, 2016b). We can extend this problem to other members of the approach-avoidance family. It is important to find ways to translate between the various personality theories in order to strive for a general approach-avoidance framework. However, this can only be attempted after the development of operational “communication” between the various theories. To allow us to make sense of this psychometric literature, we sketch a framework for integration (Figure 19.1). We distinguish four groups of approach-related and two avoidance-related personality scales.

Approach Motivation Scales

Approach motivation has been defined in various ways. According to content validity and, relatedly, convergent validity, we recognize four distinct, yet related groups of personality scales that reflect the different aspects of approach motivation displayed in Figure 19.1. The first aspect reflects the desire to achieve social status accompanied with desire to possessing important resources: *Wanting*. The second aspect reflects planning to start

acting in order to achieve desired goals: *Seeking*. The third aspect focuses on the self-control required to achieve desired goals: *Getting* (or *Persistence*). The last aspect reflects the emotions attached to attaining the goals: *Liking* (or *Reward reactivity*). All four aspects are important for understanding approach motivation.

In describing an individual with “high approach motivation” or “high on the BAS,” we say they have high scores on all four aspects. Although these aspects are closely related – and indeed, positively correlated, but always moderately – they possess unique features and, as such, should not be used either in isolation or together as a global index of approach motivation.

Wanting – a Reflection of Ambitiousness

The first approach-related group of scales consist of: “*I see myself as a good leader*,” from the Assertiveness Big Five Aspect Scales (BFAS; DeYoung, Quilty & Peterson, 2007); “*Would you like to be a socially powerful person?*”, from the Sensitivity to Reward scale from Sensitivity to Punishment Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Moltó & Caseras, 2001); “*How often have you had fights with others to show who was on top?*”, from the Proactive aggression scale of the Reactive–Proactive Questionnaire (RPQ; Raine et al., 2006); “*If I see something I want, I act straight away*,” from the Impulsivity scale of the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ; Corr & Cooper, 2016); “*I like to let myself go and do impulsive things just for fun*,” from the Sensation seeking from the Zuckerman Kuhlman Aluja Personality Questionnaire (ZKA-PQ; Aluja, Kuhlman & Zuckerman, 2010); and “*Do you prefer to go your own way rather than act by the rules?*”, from the Psychoticism from Eysenck’s Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975). Personality traits in this first group are usually negatively related to avoidance-related dimensions. For example, sensation seeking negatively correlates with harm avoidance (Aluja et al., 2010) and sensitivity to punishment (Torrubia et al., 2001), just as instrumental/proactive aggression negatively correlates with neuroticism and the BIS (Miller, Zeichner & Wilson, 2012).

Attaining social status is the core feature of these scales. They are related to the workings of testosterone and its impact on behavior and motivation. Specifically, testosterone is associated with domination tendency (Tajima-Pozo, Bayón, Díaz-Marsá & Carrasco, 2015) and risky choices (Cooper, Goings, Kim & Wood, 2014), which is supported by a direct relationship between testosterone and sensation seeking (e.g., Aluja, García, García & Blanco, 2016), impulsivity (e.g., Carré et al., 2017; Carré & Olmstead, 2015) and psychoticism (e.g., Turakulov, Jorm, Jacomb, Tan & Eastale, 2004).

As a caveat, although testosterone plays an important role in this group of personality traits, it is very likely that testosterone in interaction with other biological factors produces specific behavioral tendencies. For instance, status seeking has been associated with the interaction of

testosterone and cortisol in a way that individuals with high testosterone and low cortisol show the highest status aspiration (e.g., Sherman, Lerner, Josephs, Renshon & Gross, 2016).

Besides testosterone, dopamine may also play a role in explaining the underlying biological foundation of individual differences in this group of personality scales. MacDonald (1995) theorized about the existence of two domain-narrowed approach-related systems: Sensation seeking/Dominance and Nurturance/Love. The evolutionary adaptive function of Sensation seeking/Dominance is related to acquisition of material resources important for survival and mating. MacDonald related this dimension dominantly to testosterone but also to dopamine. Depue (2006) studied constructs similar to MacDonald’s Sensation seeking/Dominance and Nurturance/Love, such as agentic (domination, leadership) and affiliative (warmth, social bonding) aspect of extraversion, respectively. Depue related the agentic aspect of extraversion to the workings of dopamine. However, it is unlikely that such a variety of personality scales can be explained by a limited number of hormones and neurotransmitters. Therefore, it may be more appropriate to emphasize which biological factor has a *more* important role rather than to assume that each neurobiological personality trait is associated only with one underlying biological factor. From this particular group of traits, according to the reviewed empirical studies, we assume testosterone is the most important.

Seeking – a Reflection of Starting Initiatives

The second group of highly interrelated approach-related traits consists of RST-PQ Reward Interest; the Seek scale from the Affective Neuroscience of Personality Scales (ANPS; Davis, Panksepp & Normansell, 2003); the TCI-R Exploratory Excitability (subscale of Novelty seeking); and Openness. Some of sample items of the mentioned scales are: “*I am always finding new and interesting things to do*,” from RST-PQ Reward Interest; “*I like to solve complex problems*,” from BFAS Intellect-Openness; and “*Almost any little problem or puzzle stimulates my interest*,” Seek scale from the Affective Neuroscience of Personality Scales (ANPS).

The common features of these scales are exploratory behaviors or tendencies to seek rewarding stimuli, and we assume these factors are predominantly associated to the workings of dopamine (Costa, Tran, Turchi & Averbeck, 2014; Pessiglione, Seymour, Flandin, Dolan & Frith, 2006; Leyton et al., 2002; Ikemoto & Panksepp, 1999). In fact, dopamine is most frequently associated with the reward system (e.g., Berridge & Robinson, 2003; Blum, Cull, Braverman & Comings, 1996) or approach-related personality traits, such as novelty seeking (e.g., Ebstein et al., 1996; Benjamin et al., 1996; Hansenne et al., 2002) and openness (DeYoung et al., 2011; Peciña et al., 2013b). In terms of associations with avoidance scales, this group of scales are usually uncorrelated or low negatively

correlated to neuroticism and BIS (e.g. Aluja & Blanch, 2011; Li et al., 2015; Smits & Boeck, 2006).

Getting – As a Reflection of Persistence

The third group (consisting of TCI-R Persistence, RST-PQ Goal-Drive Persistence/BIS/BAS Drive, NEO-PI-R and BFAS Conscientiousness, ZKA-PQ Activity) is related to the persistent pursuing of important goals. Sample items of some of scales: *“I carry out my plans,”* from BFAS Conscientiousness/Industriousness; *“I put in a big effort to accomplish important goals in my life,”* from RST-PQ Goal-Drive Persistence; and *“I do not mind staying on later at work to finish something important,”* from ZKA-PQ Work compulsive/Activity.

The common feature of these scales is the endurance or persistence in attaining long-term goals. Individuals high on this factor are able to resist the temptation of immediate gratification in favor of striving for more distant goals. Individual differences in delay gratification are relatively stable during the lifetime span, but this changes over the course of life (Green, Fry & Myerson, 1994). In one fascinating study, Casey et al. (2011) found that participants who did not succeed in a delay gratification task in their preschool showed similar patterns in their mid-forties.

Delay gratification has been associated with the workings of serotonin (Bizot, Le Bihan, Puech, Hamon & Thiébot, 1999; Miyazaki, Miyazaki & Doya, 2011; Ranade, Pi & Kepecs, 2014). However, there is a scarcity of evidence on the relationship between serotonin and personality traits from this group of approach motivation measures. However, serotonin has been related to a similar measure to Goal-Drive Persistence, namely the BAS Drive from the BIS/BAS Scales (Pearson, McGeary & Beevers, 2014) and TCI-R Self-Directedness – ability to adapt and control one’s behavior (Tuominen et al., 2012).

Liking – As Reflection of Emotional Reactivity on Reward

The last approach-related group of personality traits contains two types of item content: one reflecting emotional reaction to receiving reward, and the second social warmth. Typical items of this group of personality scales: *“Sometimes even little things in life can give me great pleasure,”* from RST-PQ Reward Reactivity; *“When I get something I want, I feel excited and energised,”* from BIS/BAS Scales Reward Responsiveness; *“I sympathize with others’ feelings,”* from BFAS Agreeableness; and *“I often feel a strong need to take care of others,”* from the Care scale (ANPS).

In addition to these personality scales, other measures exist that might be used as an index of the liking component of approach motivation. For example, the Multidimensional Personality Questionnaire (MPQ) Social Closeness describes the tendency to value close and warmth relationship with others and, as such, is closely aligned to agreeableness. Somewhat differently, the TCI-R Reward Dependence measures a tendency for warm social affiliation and distress regarding social isolation (Cloninger, Przybeck & Svrakic, 1991; Svrakic, Przybeck & Cloninger,

1991). In addition, the TCI-R Cooperativeness may also be included in this category, since it encompasses similar facets as empathy, helpfulness, compassion and social acceptance.

Irrespective of the different content of items, the scales are highly interrelated and predict similar criteria. For instance, the ANPS Care scale is highly positively correlated with agreeableness and negatively with anger (Davis et al., 2003), whereas agreeable individuals are less motivated by power, status and seeking sexual partners and more dedicated toward family values (Olson, 2004). Similar findings have been found for reward reactivity (Krupić, Gračanin & Corr, 2016b) and reward responsiveness (Gooding & Pflum, 2014).

This pattern of correlations may be explained by the influence of endogenous opioids. First, according to brain opioids theory of social attachment (BOTSA; MacHin & Dunbar, 2011), the opioid system has an important role in nurturing behavior which is necessary for enhancing bonds with mates and friends. Second, Berridge and Robinson (2003) relate endogenous opioids to liking (reward responsiveness) a part of the reward system that is responsible for emotional reaction on receiving reward. Third, liking is assumed to represent a cooperative resource acquisition strategy (Krupić et al., 2016b), which is in line to MacDonald’s conceptualization of Nurture/Love (individual differences in nurturing social relationships) and affiliative (warmth, social bonding) aspect of extraversion (Depue, 2006). It represents a strategy for maintaining important resources together with other members of community, a tendency that has been also associated with the working of endogenous opioids (Depue, 2006; Depue & Collins, 1999). Some, though limited, empirical evidence supports the idea that opioids underlie individual differences in both agreeableness (Peciña et al., 2013a) and reward reactivity (Wanigasekera et al., 2012).

This group of approach motivation scales are low-to-moderately and positively correlated with avoidance-related dimensions. For instance, agreeableness (Ode & Robinson, 2007), reward responsiveness (Randles, Flett, Nash, McGregor & Hewitt, 2010) or reward reactivity (Corr & Cooper, 2016), and ANPS Care, correlate positively with avoidance-related dimensions, such as the BIS, neuroticism or negative affect. According to Ode and Robinson (2007), agreeable individuals may have higher effortful control that allows them to inhibit the potential interpersonal conflict and to self-regulate (Eisenberg et al., 1996), personality features that are a prerequisite to maintaining meaningful relationships with others. It is plausible that higher inhibition capacity might underlie the positive relationship of these traits to avoidance motivation.

Avoidance Motivation

As Figure 19.2 shows, we distinguish two separate avoidance mechanisms. This might be contentious, since the

Table 19.1 Constructs defined more closely to fear and anxiety or general avoidance motivation

Instrument	Anxiety	Fear	General avoidance
EPQ			Neuroticism
TCI			Harm avoidance
MPQ	Disinhibition versus Constraint		Negative affect
SNAP	Disinhibition versus Constraint		Negative affectivity
RST-PQ	BIS	Flight-Freeze	
ANPS	Sadness	Fear	
RPQ		Reactive aggression	
NEO-PI-R			Neuroticism
SPSRQ			Punishment sensitivity
ZKA-PQ			Neuroticism

Note: SNAP – Schedule for Nonadaptive and Adaptive Personality; RPQ – Reactive-Proactive Questionnaire; SPSRQ – Sensitivity to Punishment Sensitivity to Reward Questionnaire; Zuckerman-Kuhlman-Aluja – Personality Questionnaire.



Figure 19.2 Distinguishing anxiety from fear-related personality traits. Anxiety-related traits measure negative affective states that precede the occurrence of the threat, whereas fear-related traits reflect emotional reactions in the presence of the threat.

literature on the existence of two avoidance mechanisms is not quite clear. A number of self-report instruments developed from factor analysis (e.g., NEO-PI-R, MPQ, TCI-R, EPQ) recognize only one avoidance mechanism (e.g., neuroticism, negative affect, harm avoidance). Indeed, self-report measures of fear and anxiety-related constructs are usually highly related, leading many authors to conclude that they reflect a single factor.

However, relying exclusively on the results of the exploratory and confirmatory factor analysis (EFA) can produce a logical fallacy. First, the EFA groups items into factors on the basis of the correlation matrix. It is a logical fallacy to assume that even two highly correlated constructs are isomorphic or have the same source of variation. In many cases, this is true, but it should not be used as a general rule. To illustrate let us say that we have one variable that strongly predicts a criterion variable. For instance, we could find a strong relationship between alcohol consumption and number of traffic accidents. If we conduct the EFA on such data, these two things may load on the same factor, which would lead to an erroneous conclusion. Second, self-report instruments are just one way to observe psychological constructs, and as such we cannot completely rely on them. Last, as we saw in the case of FFFS and BIS in RST, defensive systems work together (e.g., BIS activation leads to activation of the FFFS), which can lead to a correlation even when the systems are independent and can be shown to be by, for example, their differential sensitivity to class of clinically efficacious drugs. Indeed, there is plenty of evidence for the claim of distinctiveness of anxiety (BIS) and fear (FFFS) features (e.g., Krueger, 1999).

Although the results of factor analysis of self-report measure of fear and anxiety tend to suggest one unique dimension (e.g., neuroticism or negative emotionality), a vast number of neurobehavioral, experimental and clinical studies suggest that a distinction should be made between these two highly correlated avoidance mechanisms. According to content validity, we summarized avoidance-related measures related to anxiety, fear, or as a representative of general avoidance motivation (Table 19.1). We categorized them according to the prevalence of items focusing on negative emotional states before the presence of the threat (anxiety-related scales) or on the reaction on the presence of the threat (fear-related). Those that contain both types of item equally are classified as a measure of general avoidance mechanism.

General Approach and Avoidance Motivation Measures

A researcher interested in approach-avoidance theories of personality requires a comprehensive psychometric framework. The main criterion for the development and use of such a framework is that it contains all aspects of approach and avoidance motivation. Here we will suggest how to use existing personality questionnaires for this purpose.

As the RST-PQ contains all aspects of approach motivation (see Krupić, Corr et al., 2016a; Krupić & Corr, 2017), the total sum of the BAS subscales may represent the general approach motivation tendencies. Furthermore, the Tellegen's (1982) Positive emotionality (PEM) from Multidimensional Personality Questionnaire (MPQ) could be used as a measure of general approach motivation. The lower level facets of the PEM are MPQ Social potency,

which assesses an individual's level of social aspiration and this may be used as a representative of *wanting*; MPQ Achievement taps seeking and getting while MPQ Social Closeness and Wellbeing may represent the final component of approach motivation – *liking*. Similarly, SNAP (Simms & Clark, 2006) contains Positive affectivity, comprising entitlement as representative of *wanting*, exhibitionism as *seeking*, positive temperament and detachment (reversed) as part of *liking* component, but none of these facets may represent *getting* component.

Other scales from the existing personality questionnaires may be used, but only as a partial measure of approach motivation. For instance, EPQ extraversion contains facets measuring dominance, sensation-seeking, sociability, impulsivity, risk-taking and irresponsibility, reflecting important aspects of the *wanting* component, activity as something between seeking and getting, and expressiveness as the *liking* component. As we can see, the *wanting* component of approach motivation is the most salient feature of Eysenck's extraversion, so the results of EPQ extraversion could be somewhat biased. In contrast ZKA-PQ extraversion focuses on the social aspect of extraversion, since it comprises facets labelled positive emotion, social warmth, exhibitionism and sociability. Thus, EPQ and ZKA-PQ operationalizations of extraversion emphasize different aspects of approach motivation, which could diminish the level of generalisability of findings from studies exploring approach motivation that uses these two instruments.

As we already mentioned, most personality models recognize only one avoidance dimension – they focus on emotional (in)stability reflecting the frequency to experience negative emotions. As an exception, the RST-PQ devoted much effort to design two separate scales measuring fear and anxiety-related avoidance scales. The main feature of fear-related scales are items that focus on reaction to unambiguous threat. Besides many RST questionnaires (see Corr, 2016b; Krupić, Križanić & Corr, 2016), RPQ Reactive aggression also presents fear-related constructs, since it focuses on aggressive reactions after being provoked (e.g. “Hit to defend self”); however, there is still much uncertainty about how aggression/fight, as measured by questionnaire, relates to the FFFS and BAS (see Corr, 2016b).

CONCLUSION

Approach-avoidance motivation has been studied in philosophy, psychology and neuroscience. We summarized some of the key assumptions of each of these scientific disciplines. Space prevents a detailed discussion of some important approach-avoidance theories; for instance: Davidson et al. (e.g. Sutton & Davidson, 1997; Tomarken, Davidson, Wheeler & Doss, 1992) have made significant progress in relating hemispheric asymmetric to approach and avoidance motivation; Higgins (1998, 1999) introduced regulatory focus theory where promotion and

prevention foci are postulated as fundamental mechanisms of regulation of pleasure and pain; and Elliot and colleagues (Elliot, 2006; Elliot & Thrash, 2002) proposed a framework to study underlying mechanisms of approach and avoidance motivation within goal orientations.

As we have seen, there have been significant advances in the field, especially in relation to personality processes (states) and traits. Many different perspectives have been explored, but as with the metaphor of the blind man describing the elephant, an incomplete picture has emerged. This fact motivated the proposition of the approach, as shown in Figure 19.1, which it is to be hoped will serve to synthesize and unify the field. In particular, the use of this framework affords easier generalization of findings from different studies; in turn, this has the potential to foster the accumulation of knowledge of approach-avoidance behavior and personality within a single overarching framework.

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20 Personality Neuroscience

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INTRODUCTION

Human behaviors and experiences are generated by biological processes, primarily within the brain. On this basis, we may assume that the regularities in these behaviors and experiences that constitute personality are associated with regularities in the biological functions of the brain, making *personality neuroscience* possible (Allen & DeYoung, 2017; DeYoung, 2010; Yarkoni, 2015; Zuckerman, 2005). It is increasingly easy to study psychologically relevant individual differences using neuroscientific methods, and this field is growing rapidly, as indicated by the establishment of a new journal, *Personality Neuroscience*.

Personality neuroscience endeavors to understand the proximal sources of personality in the brain and to trace those brain processes back to their distal sources in complex interactions between genes and environment. Heritability estimates for personality traits are typically around 50 percent (or even higher, when multiple raters of personality are used; Riemann, Angleitner & Strelau, 1997), indicating that the distal sources of personality lie in both the genome and the environment (Bouchard, 1994; Johnson & Krueger, 2004). Both genes and environment must make their mark on the brain, however, if they are to have a lasting influence on personality.

Personality psychology attempts to answer some of the most fundamental questions about people: Why are individuals the way they are? How and why do people differ from each other? For much of the past century, personality psychology has been more concerned with describing personality than with explaining it – that is, *how* people differ from each other rather than *why* they differ from each other. One reason for this emphasis on description rather than explanation was the immaturity of human neuroscience. In recent decades, however, tools for investigating the neurobiological underpinnings of individual differences have greatly increased in power with the rise of neuroimaging and molecular genetics.

Another reason that personality psychology tended to focus on description rather than explanation was the necessity of developing an adequate categorization system

for personality traits. Traits are relatively stable patterns of motivation, emotion, cognition and behavior (Fleeson, 2001; Pytlik Zillig, Hemenover & Dienstbier, 2002). The existence of a multitude of such patterns raises the question of whether some relatively small number of broad trait dimensions can be used to classify and organize the majority of more specific traits. By the 1990s, this question was largely resolved by the emergence of the Five-Factor Model or Big Five, which identifies five major dimensions of covariation among traits: Extraversion, Neuroticism, Agreeableness, Conscientiousness, and Openness/Intellect (John, Naumann & Soto, 2008).

Our emphasis on the Big Five should not be misconstrued as a suggestion that the trait level of analysis alone can capture everything about personality. Beyond traits, characteristic adaptations to particular situations and self-defining life narratives constitute two additional major levels of analysis that are more specific and better able to capture the rich detail and uniqueness of individual personalities (DeYoung, 2015; McAdams & Pals, 2006). Incorporating these levels can complement and enrich the trait approach. At this early stage in personality neuroscience, however, linking traits to neurobiological substrates is a promising start. Further, because traits are likely to reflect variation in mechanisms present in all human beings (whereas the other levels of personality contain constructs that are likely to be culture-specific), they are particularly amenable to explication through neuroscience.

We use the Big Five to organize our review because it is the most widely used taxonomy of personality and provides a common language for personality research, helping to ensure that results are comparable across different studies. (A six-factor model that is more replicable across languages in lexical research constitutes only a slight variation on the Big Five and does not seem to appear in relatively unbiased analyses of existing personality questionnaires; Markon, Krueger & Watson, 2005; Saucier, 2009; Waller, DeYoung & Bouchard, 2016.) The genetic factor structure of the Big Five, measured by the Revised NEO Personality Inventory (Costa & McCrae,

1992), has been shown to be invariant across European, North American, and East Asian samples of twins, suggesting the biological universality of these traits (Yamagata et al., 2006). When measures of abnormal and normal personality traits are factor-analyzed together, the standard Big Five solution appears (DeYoung et al., 2016; Krueger & Markon, 2014; Markon, Krueger & Watson, 2005), suggesting the utility of the Big Five for studying psychopathology. Finally, the Big Five appears to be an effective taxonomy of descriptors of individual differences in other species (Freeman & Gosling, 2010; Gosling & John, 1999; Weiss et al., 2015), and cross-species comparisons are often important in neuroscience. Our aims in this chapter are first to provide a brief review of the methods and history of personality neuroscience and then to attempt a synthesis of findings across the range of personality traits represented by the Big Five, focusing where possible on studies with samples large enough to suggest adequate statistical power.

METHODS IN PERSONALITY NEUROSCIENCE

Personality neuroscience reflects the conjunction of personality psychology with methods for discovering the biological correlates of individual differences. The measurement of personality is typically accomplished by questionnaire, through self-report; such measures can be improved upon by collecting additional informant reports from knowledgeable peers (Connelly & Ones, 2010; Vazire, 2010). “Personality” is sometimes taken to mean the set of variables that result from questionnaire measures, but this confuses the instruments with the constructs. Questionnaires are simply a convenient and reliable method for assessing a broad range of stable individual differences, drawing on subjects’ experiences over a far greater span of time than is available in the laboratory. Other methods can be used to measure personality, if they can be validated psychometrically (i.e., as measuring stable patterns of motivation, emotion, cognition and behavior). Measures of intelligence and of the ability to delay gratification are good examples (DeYoung, 2020; Ohmura, Takahashi, Kitamura & Wehr, 2006). The challenge with such behavioral measures, because models of personality structure like the Big Five are typically operationalized with questionnaires, is to relate them back to those models so that they may be incorporated into the larger framework of personality psychology.

Whereas personality assessment is largely dominated by questionnaires, there are a multitude of methods gaining widespread use in personality neuroscience. The general categories of neuroscientific methods that we see as currently most relevant to personality are (1) neuroimaging (e.g., magnetic resonance imaging (MRI) or positron emission tomography (PET)), (2) molecular genetics (a.k.a. genomics), (3) electrophysiological techniques (e.g., electroencephalography (EEG) or measurement of electrodermal activity (EDA)), (4) assays of endogenous

psychoactive substances or their byproducts (e.g., hormone levels in saliva or neurotransmitter metabolites in cerebrospinal fluid), and (5) psychopharmacological manipulation (e.g., drugs that affect neurotransmitter function). We will comment briefly on the first three of these, which are most widely used.

Studies of personality using structural and functional MRI are appearing at a rapid rate, increasingly with samples large enough for good individual differences research. Structural MRI (sMRI) relies upon the differing magnetic properties of various tissue types to create images of the brain, whereas functional MRI (fMRI) measures brain activity based on blood flow. Although fMRI studies involving personality for a long time focused primarily on neural activation as indicated by contrasting the blood-oxygen-level dependent (BOLD) signal (an indirect measure of neural activity based on the magnetic properties of oxygenated vs. deoxygenated hemoglobin) in a task condition to BOLD signal in a control condition, recently considerable attention is being paid to *functional connectivity*, patterns of temporal synchrony among different regions of the brain. The discovery that these patterns of synchrony are similar at rest and while completing specific tasks (Laird et al., 2011; Smith et al., 2009) has allowed for the mapping of major functional networks in the brain (Yeo et al., 2011), which can then be analyzed in relation to a variety of personality variables.

As with neuroimaging, molecular genetics has seen an explosion of personality research since the first studies of the effects of genetic variation on normal personality traits appeared in the 1990s. Nonetheless, these early studies have notable limitations. They employed a candidate gene approach, examining whether variations in specific genes, identified because of their role in specific neural systems, were associated with variation in personality traits. Unfortunately, although this approach initially seemed promising, the majority of candidate gene studies have failed to replicate, likely due to the massively polygenic nature of personality traits and other complex phenotypes (Munafò & Flint, 2011). The current review will tend to avoid discussion of candidate gene studies, given their issues with replicability and statistical power.

Genome-wide association studies (GWAS) have recently emerged as a promising alternative approach for identifying associations between behavioral phenotypes and genetic variants. Although the use of GWAS in personality research is still relatively young, some promising results are beginning to emerge (de Moor et al., 2010; Terracciano et al., 2008). The challenge with GWAS is that extremely large samples are required to detect reliable effects. Nonetheless, recent GWAS have identified genetic variants associated with intelligence, Neuroticism, Extraversion, and Openness/Intellect, and we expect that GWAS will soon begin contributing substantially to knowledge in personality neuroscience (Lo et al., 2017; Nagel et al., 2017; Smeland et al., 2017; Sniekers et al., 2017).

Electrophysiological research was the primary tool for investigating the biology of personality, prior to the advent of neuroimaging and molecular genetics. Although EEG has vastly poorer spatial resolution than fMRI and is now much less prominent in the field, it nonetheless has much greater temporal resolution (of the order of milliseconds versus seconds for fMRI) and thus continues to be a useful tool for personality neuroscience. EEG continues to be used to identify regularities in brain function on very short timescales.

INFLUENTIAL THEORIES IN PERSONALITY NEUROSCIENCE

Before presenting the specific findings of personality neuroscience research, we briefly describe the influential models of Eysenck, Gray, Zuckerman, Cloninger, Depue, Panksepp and DeYoung and relate each model to the Big Five, with the aim of translating results from different systems into a single common language. This approach is readily justified by the fact that these models have been demonstrated to fall within the same factor structure as the Big Five (e.g., Markon et al., 2005; Angleitner, Riemann & Spinath, 2004). Most of the theorists have revised their models substantially over time; in the interest of space we discuss only the latest version of each.

Eysenck (1967) can be considered the father of modern personality neuroscience. He assigned traits to three “superfactors,” Extraversion, Neuroticism and Psychoticism (Eysenck & Eysenck, 1985). Extraversion and Neuroticism are nearly identical in Eysenck’s system and the Big Five, whereas the unfortunately labeled Psychoticism reflects a roughly equal blend of low Conscientiousness and low Agreeableness (Goldberg & Rosolack, 1994). In his biological theorizing, Eysenck (1967; Eysenck & Eysenck, 1985) relied heavily on the functions of the brain’s ascending reticular activating system, associating Extraversion with the reticulo-cortical circuit and Neuroticism with the reticulo-limbic circuit. Eysenck hypothesized that extraverts have a higher threshold for cortical arousal than introverts and therefore choose more stimulating activities and experiences in order to achieve their preferred level of arousal. He also hypothesized that neurotics’ limbic systems are more easily aroused by emotion-inducing stimuli than are those of emotionally stable people. Eysenck did not develop as well-specified a biological model of Psychoticism, but at different times he hypothesized that Psychoticism was negatively associated with serotonergic function (Eysenck, 1992) and positively associated with dopaminergic function (Eysenck, 1997).

Jeffrey Gray, who was Eysenck’s student, focused more heavily on neurobiology than on personality, with an emphasis on the development of a “conceptual nervous system” describing functional systems that could be mapped onto brain systems. The main components of this conceptual nervous system are the Behavioral Approach

System (BAS), which responds to cues for reward, and the Fight-Flight-Freezing System (FFFS) and Behavioral Inhibition System (BIS), which respond to two distinct classes of threatening stimuli (Gray & McNaughton, 2000; Pickering & Gray, 1999). Purely threatening, punishing or frustrating stimuli activate the FFFS, which produces active avoidance (panic and flight) or attempted elimination (anger and attack). Stimuli that one needs or desires to approach but that also contain potential threat (thus creating an approach-avoidance conflict) activate the BIS, which produces vigilance, rumination and passive avoidance, as well as anxiety and even potentially depression (Gray & McNaughton, 2000). (Approach-approach or avoidance-avoidance conflicts are less common but can also activate the BIS, which responds specifically to any conflict between goals.) Biologically, Gray linked the BAS to the dopaminergic system, the BIS primarily to the septo-hippocampal system but also to the amygdala, and the FFFS to the amygdala, hypothalamus, and periaqueductal gray.

Gray’s model of personality, Reinforcement Sensitivity Theory (RST; see Chapter 18), describes personality traits as a function of individual differences in the sensitivities of BIS, BAS and FFFS. Gray (1982) originally described two dimensions of personality associated with BIS sensitivity and BAS sensitivity, which he labeled Anxiety and Impulsivity respectively. Gray viewed Anxiety and Impulsivity as 30° rotations from Neuroticism and Extraversion, respectively. Gray and McNaughton (2000) noted, however, that questionnaire measures of Anxiety or BIS sensitivity are, in practice, difficult to distinguish from Neuroticism. Further, they described Neuroticism as a general sensitivity to threat produced jointly by FFFS and BIS. Additionally, although it was originally conceptualized as reflecting impulsivity, BAS sensitivity has since been found to relate more closely to measures of Extraversion (Pickering, 2004; Quilty, DeYoung, Oakman & Bagby, 2014; Smillie, Pickering & Jackson, 2006). These parallels are consistent with research showing that measures of BIS and BAS sensitivity tap the same latent constructs as measures of Neuroticism and Extraversion (Elliot & Thrash, 2002; Zelenski & Larsen, 1999).

Zuckerman (2005) provided one of the first extensive reviews of personality neuroscience, in the second edition of his book, *Psychobiology of Personality*. This book is organized around a hybrid of the Big Five and Zuckerman’s own model of personality, the Alternative Five, which are Sociability, Neuroticism-Anxiety, Aggression-Hostility, Impulsive Sensation Seeking and Activity. Zuckerman identified the first four of these with Extraversion, Neuroticism, Agreeableness (reversed) and Conscientiousness (reversed), respectively, in the Big Five. Factor analyses largely bear out these associations (Aluja, Garcia & Garcia, 2002, 2004; Angleitner et al., 2004; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993), though the situation is somewhat complicated for Impulsive Sensation Seeking, which is sometimes as strongly associated with

Extraversion and Openness/Intellect as with Conscientiousness and also tends to show a moderate negative association with Agreeableness. Additionally, these factor analyses show that Zuckerman's Activity scale serves as a marker of Extraversion, Conscientiousness or both.

We cannot hope to summarize all of the biological research relevant to the Alternative Five that is synthesized in *Psychobiology of Personality*. In brief, Zuckerman (2005) linked personality traits to underlying behavioral mechanisms, which he in turn linked to the brain functions of various neurotransmitters, hormones and enzymes. One notable feature of his theorizing is that he described behavioral mechanisms (including approach, inhibition and arousal) as determined by multiple biological systems and as contributing to multiple traits. In his model, for example, approach is influenced by both dopamine and testosterone and contributes to both Sociability and Impulsive Sensation Seeking. The principle that the mapping of biological parameters to traits is many-to-many is an important one that will be evident throughout our review (Yarkoni, 2015).

In contrast, Cloninger (1987) developed a model of personality traits based on the premise that individual neurotransmitter systems might be related uniquely to specific traits. Cloninger hypothesized that the dopaminergic system was linked to a trait of Novelty Seeking, the serotonergic system to Harm Avoidance, and the norepinephrine system to Reward Dependence. Cloninger's latest model includes these three traits plus four others: Persistence, Self-Directedness, Cooperativeness and Self-Transcendence (Cloninger, Svrakic & Przybeck, 1993). He hypothesized that the original three traits and Persistence reflect dimensions of *temperament*, meaning that they should be evident early in ontogeny and strongly genetically determined. In contrast, he hypothesized that Self-Directedness, Cooperativeness and Self-Transcendence reflect dimensions of *character*, meaning that they should develop later, being determined by experience during development rather than primarily by genes.

Research has demonstrated several problems with Cloninger's model. First, a simple distinction between temperament and character appears untenable. The character traits show much the same levels of heritability as the temperament traits (Ando et al., 2004; Gillespie, Cloninger, Heath & Martin, 2003). Second, evidence has accumulated to contradict the idea that single neurotransmitter systems are responsible for Novelty Seeking, Harm Avoidance and Reward Dependence (Paris, 2005). Finally, Cloninger's seven-factor structure has not proven consistently replicable. Factor analyses have demonstrated (a) that the scales Cloninger developed do not group together in the manner that he assigned them to his seven traits (Ando et al., 2004; Ball, Tennen & Kranzler, 1999; Herbst, Zonderman, McCrae & Costa, 2000), and (b) that his instrument is best described by the five-factor structure of the Big Five (Markon et al., 2005; Ramanaiah, Rielage & Cheng, 2002). Harm Avoidance and Self-Determination

(reversed) are both markers of Neuroticism. Cooperativeness, Persistence and Self-Transcendence are markers of Agreeableness, Conscientiousness and Openness/Intellect, respectively. Reward Dependence combines Agreeableness and Extraversion. Finally, Novelty Seeking shows a pattern similar to Zuckerman's Impulsive Sensation Seeking: It is most strongly associated with Conscientiousness (reversed) but also consistently loads positively on Extraversion as well as sometimes negatively on Agreeableness and positively on Openness.

Depue describes five trait dimensions: Agentic Extraversion, Affiliation, Anxiety, Fear, and Nonaffective Constraint (Depue & Lenzenweger, 2005). Depue and Collins (1999) proposed a theory of Extraversion linking it to the network of brain systems controlling sensitivity to cues of reward and generating approach behavior in response. They focused primarily on what they called "Agentic Extraversion," encompassing assertiveness, dominance and ambition, and distinguished this from "Affiliative Extraversion," which is related to sociability and affiliative social bonding. "Extraversion" was eventually dropped from the label for the latter trait, and Depue and Morrone-Strupinsky (2005) proposed a theory of Affiliation, linking it to the brain systems controlling sensitivity to affiliative bonding and consummatory reward, focusing particularly on the endogenous opioids and sociosexual peptides like oxytocin. Finally, Depue and Lenzenweger (2005) associated Nonaffective Constraint with Conscientiousness and with the broad inhibitory functions of the serotonergic system.

Depue has typically operationalized his constructs with the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982). The MPQ scales of Social Potency and Social Closeness, used to represent Agentic Extraversion and Affiliation respectively, both load primarily on Extraversion (Markon et al., 2005). Depue associates Anxiety most strongly with the MPQ Stress Reaction scale, which is a clear marker of Neuroticism. Fear he associates with MPQ Harm Avoidance, which, unlike Cloninger's Harm Avoidance, specifically assesses aversion to physical danger and is not well described by the Big Five (Markon et al., 2005) (potentially because many of its items are forced choices between danger and boredom). MPQ Control versus Impulsivity, which Depue identifies as the best marker of Nonaffective Constraint, loads strongly on Conscientiousness (Markon et al., 2005).

Panksepp has focused primarily on animal research, but his name should be mentioned here because of his importance in the development of affective neuroscience and his advocacy of the idea that research in other mammals is strongly relevant to theories of human emotional functioning (Panksepp, 1998). More recently, he developed a personality model for human research, hypothesizing the existence of six traits reflecting distinct emotional systems: Playfulness, Seeking, Caring, Fear, Anger and Sadness. Playfulness correlates most strongly with Extraversion,

Seeking with Openness/Intellect, and Caring with Agreeableness; Fear, Anger and Sadness all correlate strongly with Neuroticism (Davis, Panksepp & Normansell, 2003).

Finally, DeYoung (2010, 2015; Allen & DeYoung, 2017) has developed the first biological theory of personality that is explicitly designed to explain the Big Five. Cybernetic Big Five Theory identifies the major psychological functions that underlie each of the Big Five and begins to identify the complex neurobiological systems that instantiate those functions. Cybernetics is the study of principles governing goal-directed, self-regulating systems, and CB5T is based on the premise that the Big Five represent variation in universal human mechanisms that evolved to enable people (and mammals generally, in many cases) to pursue their goals, including basic biological needs. Thus, traits are conceived as dimensions that can be used to describe psychological variation in any human population across human history, reflecting variation in parameters of biological mechanisms that all people share. The functions that CB5T associates with the Big Five will be described throughout the rest of the chapter.

CB5T makes use of the empirical demonstration that each of the Big Five has two major subfactors that appear to reflect the most important distinctions for discriminant validity within each of the five domains (DeYoung, Quilty & Peterson, 2007; DeYoung, Carey, Krueger & Ross, 2016; Jang, Livesley, Angleitner, Riemann & Vernon, 2002). The ten lower-level traits are described as “aspects” of the Big Five. When describing personality neuroscience research in relation to the Big Five, it is sometimes useful to identify biological associations that are specific to one of the aspects, rather than being characteristic of a given Big Five dimension as a whole.

NEUROBIOLOGICAL SUBSTRATES OF THE PERSONALITY HIERARCHY

Personality traits are arranged hierarchically, with correlated sets of more specific traits grouped together in broader traits. At each level of the personality hierarchy, there is valid genetic variance (Jang et al., 2002; Jang, McCrae, Angleitner, Riemann & Livesley, 1998; McCrae et al., 2008), indicating that there are different biological substrates for traits at different levels. This suggests that there are probably some broadly acting biological forces that act on many traits, causing them all to covary, and some more narrowly acting biological forces that act on smaller subsets of traits, differentiating them from other traits, even those grouped within the same broader dimension at the next higher level of the hierarchy (for example, differentiating Assertiveness from Enthusiasm within Extraversion).

The Big Five were originally conceived as independent traits at the highest level of the personality hierarchy, but research has shown that they are regularly intercorrelated and possess a higher-order factor structure (Chang, Connelly & Geeza, 2012; DeYoung, 2006; Digman, 1997;

McCrae et al., 2008). Neuroticism (reversed), Agreeableness and Conscientiousness form one higher-order factor or metatrait, labeled α or *Stability*, and Extraversion and Openness/Intellect form another, labeled β or *Plasticity*. Behavioral genetic analysis in twins has shown that the two metatraits have genetic origins (Jang et al., 2006; McCrae et al., 2008), and evidence is accumulating that *Stability* is related to serotonin, whereas *Plasticity* is related to dopamine (Allen & DeYoung, 2017; DeYoung, 2006, 2013; Wright, Creswell, Flory, Muldoon & Manuck, 2019). Most of the relevant evidence pertains to associations of serotonin or dopamine with individual Big Five traits and will be reviewed in the relevant sections below. Serotonin and dopamine act as diffuse neuromodulators affecting a wide array of brain systems, and their broad influence is consistent with a role in the broadest level of personality structure.

Identifying serotonin and dopamine as likely biological substrates for the metatraits begins to develop a psychobiological model of the personality hierarchy based on the Big Five. However, the correlations among the Big Five that reveal the metatraits are not very strong, and each Big Five trait describes a clearly distinct domain of personality. Biological substrates must exist that are unique to each trait, in addition to whatever shared substrates may cause them to covary. In what follows, we review evidence regarding what these substrates might be for each of the Big Five.

EXTRAVERSION

Depue’s model of Extraversion is the most thorough and promising to date, linking it to the brain systems that govern sensitivity to reward and related positive emotions (Depue & Collins, 1999; Depue & Lenzenweger, 2005; Depue & Morrone-Strupinsky, 2005). This model is largely congruent with Gray’s theory of the BAS, which has been increasingly linked to Extraversion (Quilty, DeYoung, Oakman & Bagby, 2014; Smillie et al., 2006). Multiple neuroimaging studies have found that brain activity at rest or in response to positive or rewarding stimuli is positively associated with Extraversion (or questionnaire measures of BAS sensitivity or positive emotionality) in the brain regions that both Depue and Gray identify as particularly important in the circuitry of reward and approach behavior. These include the medial orbitofrontal cortex, nucleus accumbens, amygdala, and striatum (Barros-Loscertales et al., 2006; Wu, Samanez-Larkin, Katovich & Knutson, 2014). As the chief cortical component of the reward system, the medial orbitofrontal cortex (mOFC) has been shown to positively correlate in volume with Extraversion (Cremers et al., 2011; DeYoung et al., 2010; Grodin & White, 2015; Omura et al., 2005; Urošević et al., 2012), though other studies failed to find such associations (Liu et al., 2013; Riccelli et al., 2017). Research using fMRI has shown positive associations of Extraversion with resting glucose metabolism in the mOFC and with functional

connectivity between the mOFC and other regions during reward tasks (Civai et al., 2016; Volkow et al., 2011).

Some parts of Eysenck's theory that Extraversion is associated with cortical arousal may be compatible with the reward sensitivity model. Evidence for the cortical arousal theory is complicated by the fact that EEG and fMRI studies have found that the association between Extraversion and arousal is sometimes positive and sometimes negative (Matthews & Gilliland, 1999; Zuckerman, 2005). These seemingly contradictory effects may be moderated by the type of situation in which arousal is measured and by the pattern of cortical arousal in question (Matthews & Gilliland, 1999; Wacker et al., 2006). The effect of a given situation on cortical arousal may depend in part on the situation's reward properties and may be mediated by dopamine. For example, pharmacological manipulation of dopamine D2 receptors has been shown to modulate frontal (relative to parietal) brain activity in EEG, but in opposite directions for groups high versus low in Extraversion (Wacker et al., 2006).

The role of dopamine in Extraversion is now perhaps the most robust finding in personality neuroscience. Many studies have found that Extraversion moderates the effects of pharmacological manipulations of dopamine (Chavannon et al., 2013; Depue & Fu, 2013; Depue et al., 1994; Mueller et al., 2014; Wacker et al., 2006, 2013; Wacker & Stemmler, 2006). The connection between dopamine and Extraversion is also supported by EEG research on the "reward positivity" waveform, which reflects dopaminergic signaling in the dorsal AAC and consistently appears 200–350 milliseconds after receiving feedback (Hauser et al., 2014); several studies show that Extraversion predicts the amplitude of this waveform (Bress & Hajcak, 2013; Cooper et al., 2014; Kujawa et al., 2015; Lange et al., 2012; Smillie et al., 2011).

Whereas dopamine produces a desire to pursue rewards ("wanting"; Berridge et al., 2009), the pleasure one experiences from receiving rewards ("liking") involves the endogenous opioid system (Depue & Morrongiue-Strupinsky, 2005). Thus, the dopaminergic component of the reward circuitry associated with individual differences in Extraversion may be particularly influential on the more "agentic" aspect, labeled Assertiveness (Depue & Collins, 1999; DeYoung, 2013). In contrast, the other aspect of Extraversion (Enthusiasm), which reflects sociability and positive emotionality, may be additionally associated with the endogenous opioid systems involved in the positive emotions that follow attainment of reward and that are particularly important in social bonding (Depue & Morrongiue-Strupinsky, 2005). Evidence for the role of the opioid system in Extraversion is beginning to emerge. A measure of "Social Closeness," a good indicator of Enthusiasm or affiliative Extraversion, moderated sensitivity to an opiate manipulation in one study (Depue & Morrongiue-Strupinsky, 2005). Moreover, recent PET research has found that mu-opioid receptor availability in the midbrain and frontal cortex is correlated positively

with BAS-sensitivity and negatively with avoidant attachment, the tendency to avoid closeness and commitment in intimate relationships (Nummenmaa et al., 2015; Karjalainen et al., 2016).

Finally, testosterone levels have been positively associated with Extraversion, especially with assertiveness and dominance, in a number of studies (Netter, 2004; Zuckerman, 2005). One study of more than 1,600 participants found that salivary testosterone was positively associated with Extraversion (Smeets-Janssen et al., 2015). Examination of testosterone in relation to traits describing social behavior suggests that it is probably specifically influential on the Assertiveness aspect of Extraversion (Turan et al., 2014). Zuckerman (2005) has suggested that the effects of testosterone on Extraversion may be due to interaction between testosterone and reward circuitry, particularly in the nucleus accumbens.

NEUROTICISM

Neuroticism appears to reflect sensitivity to threat and the whole range of negative emotions and cognitions that accompany experiences of threat and punishment, including anxiety, depression, anger, irritation, self-consciousness and vulnerability (DeYoung, 2015). Because Neuroticism and sensitivity to threat are so strongly implicated in psychopathology, research on their likely biological substrates has been extensive (Lahey, 2009; Shackman et al., 2016). Gray and McNaughton's (2000) model of the BIS and FFFS, which jointly determine Neuroticism, is very thoroughly elaborated. This model is reasonably compatible with Depue's model of Anxiety and Fear, although Depue believes that Fear is not well represented within Neuroticism.¹ (Depue's use of the term "Fear" is complicated by the fact that colloquial usage often treats "fear" and "anxiety" as nearly equivalent, with the result that, in the Big Five, both fall within Neuroticism.) Gray and McNaughton associated the FFFS not only with fear but also with panic and anger, and these emotions are also associated with Neuroticism (DeYoung et al., 2007).

Various brain systems associated with reactions to threat and punishments have been linked to Neuroticism. Neuroimaging studies have found that Neuroticism is associated with brain activity at rest or in response to aversive or novel stimuli, in brain regions associated with negative affect, including the amygdala (Everaerd et al., 2015; Hyde et al., 2011; Schuyler et al., 2014; Sommerville et al., 2010), insula (Kackurkin et al., 2016; Wu et al., 2014)

¹ Depue and Lenzenweger (2005) criticized Gray's theory of the BIS because they consider "behavioral inhibition" to be a marker of fear rather than anxiety; however, Gray and McNaughton (2000) clearly differentiated the general behavioral inhibition associated with anxiety and passive avoidance from the more immediate and stereotyped behavioral inhibition (which they labeled "freezing") associated with fear.

and anterior cingulate (Holmes et al., 2012). The amygdala is perhaps the structure most frequently thought of as implicated in Neuroticism, and multiple studies have found that Neuroticism correlates positively with amygdala activation during various tasks. Recent fMRI studies with samples larger than 100 individuals reported that Neuroticism predicted a slower decrease in amygdala activity after viewing aversive images (Schuyler et al., 2014), and that Neuroticism was positively correlated with amygdala activity in response to aversive images, in participants with low levels of social support (Hyde et al., 2011). One large study ($N = 875$) found positive associations between Neuroticism and cerebral blood flow in the amygdala at rest, among youth participants (Kaczurkin et al., 2016). Neuroticism is also associated with functional connectivity between the amygdala and various regions within the prefrontal cortex (PFC; Birn et al., 2014; Cremers et al., 2010; Davey et al., 2015; Jalbrzikowski et al., 2017), possibly pointing toward the importance of connectivity between areas involved in threat recognition (i.e., the amygdala) and those involved in regulation of negative emotion (e.g., regions of the PFC) for influencing individual differences in Neuroticism. This is in line with recent work suggesting that successful downregulation of emotion is negatively associated with amygdala activity (Morawetz et al., 2017).

In sMRI research, findings have been reported regarding the amygdala, hippocampus and mPFC. Amygdala volume has been shown to correlate with Neuroticism across multiple studies (Barros-Loscertales et al., 2006; Koelsch et al., 2013), including a weak positive correlation in one study with more than 1,000 participants (Holmes et al., 2012). That study also showed a weak but significant positive correlation between Neuroticism and hippocampal volume (Holmes et al., 2012). Other evidence for the importance of hippocampal activity in Neuroticism includes several resting state PET studies (Gray & McNaughton, 2000; Sutin et al., 2010) and a meta-analysis of fMRI studies (Servaas et al., 2013), all finding a positive association between Neuroticism and activity of the hippocampus. Additionally, Neuroticism has been shown to correlate with cortical thickness in the mPFC and adjacent ACC (Holmes et al., 2012).

Gray and McNaughton (2000) describe both serotonin and norepinephrine as modulators of the BIS and FFFS. Neuroticism has been associated with serotonergic function through various methods, including genomics, PET, psychopharmacological manipulation and assays of cerebrospinal fluid (Frokjaer et al., 2008; Hennig, 2004; Lesch et al., 1996; Manuck et al., 1998; Quilty, Meusel & Bagby, 2008; Schinka, Busch & Robichaux-Keene, 2004; Sen, Burmeister & Ghosh, 2004; Tang et al., 2009; Wright et al., 2019). The widespread use of selective serotonin reuptake inhibitors (SSRIs) for the treatment of anxiety and depression has obvious implications for the relation between Neuroticism and serotonin. Changes in Neuroticism have been shown to mediate response of symptoms

to treatment with SSRIs (Du et al., 2002; Quilty et al., 2008; Tang et al., 2009). Additionally, a recent large meta-analysis found that Neuroticism shows significant decreases, more than any other Big Five trait, after treatment with SSRIs (Roberts et al., 2017). A smaller body of evidence links Neuroticism to higher levels of norepinephrine (White & Depue, 1999; Hennig, 2004; Zuckerman, 2005).

Results from neuroendocrinology also inform our understanding of Neuroticism, specifically in regard to the hypothalamic-pituitary-adrenal (HPA) axis. Neuroticism has been associated also with higher baseline levels of the stress hormone cortisol (Garcia-Banda et al., 2014; Gerritsen et al., 2009; Miller et al., 1999; Nater et al., 2010; Schmidt et al., 1997; Tyrka et al., 2010), but often with lower levels of cortisol in response to specific stressors (Netter, 2004). The association of Neuroticism with cortisol function is consistent with the importance of the HPA axis in responding to threat and other stressors (McEwen, 1998). It is also worth noting that cortisol can perpetuate excitotoxic cell death, which may at least partially explain the negative association between Neuroticism and global measures of brain volume (Jackson et al., 2011; Knutson et al., 2001; Liu et al., 2013).

Finally, a number of EEG studies have demonstrated that Neuroticism is associated with greater activation of the right frontal lobe relative to the left (Davidson, 2002; Shackman et al., 2009; Zuckerman, 2005). Davidson (2002) has argued that the right hemisphere is preferentially involved in emotions and motivational states associated with withdrawal, whereas the left hemisphere is preferentially involved in approach. The one complication in linking the right hemisphere to Neuroticism is that anger is associated with approach motivation, and EEG studies have shown anger to be associated with greater relative left frontal lobe activation (Everhart, Demaree & Harrison, 2008; Harmon-Jones, 2004). Perhaps, therefore, hemispheric asymmetries may aid in differentiating the sources of the two aspects of Neuroticism, Withdrawal, associated with anxiety and depression, and Volatility, associated with anger and emotional lability (DeYoung et al., 2007).

AGREEABLENESS

Because of the relation of Extraversion and Neuroticism to emotion and to reward and punishment, and because of the long history of biological theorizing about them, there is more evidence regarding their biological substrates than there is for Agreeableness, Conscientiousness and Openness/Intellect. Additionally, fewer theories have been put forth to explain the nature of the latter three trait domains from a biological perspective (but see Allen & DeYoung, 2017; DeYoung, 2010; Nettle, 2006). Agreeableness appears to reflect the set of traits necessary for cooperation and altruism, reflecting variation in a general tendency to be interested in and considerate of others' needs,

desires and feelings and to refrain from exploiting, hurting or imposing one's will on others. Such tendencies are of particular importance for social species, which must maintain some level of cooperative stability in their social groups, and traits resembling Agreeableness are found consistently in social mammals (Gosling & John, 1999).

Agreeableness can be decomposed into two aspects, Compassion and Politeness (DeYoung et al., 2007). Whereas Politeness reflects a tendency toward conforming to social norms and refraining from aggression, Compassion encompasses traits related to empathy, sympathy and concern for the needs and feelings of others. Research shows that these two aspects of Agreeableness have differing neural substrates (Hou et al., 2017) and are differentially associated with relevant social-cognitive processes (Allen, Rueter, Abram, Brown & DeYoung, 2017). Importantly, the majority of research informing our knowledge of the neural correlates of Agreeableness has focused on Compassion and related concepts such as trait empathy, rather than Agreeableness more generally, and much less is known regarding its Politeness aspect.

Agreeableness seems likely to be supported by brain systems that are involved in social information processing; it is difficult to cooperate or to help another person if one cannot understand their concerns and goals. The growing body of neuroscience research on empathy, theory of mind, and perception of biological motion and intention is thus likely to be relevant to understanding the neurobiological substrates of Agreeableness. Brain regions associated with these forms of social information processing include the medial prefrontal cortex (Seitz, Nickel & Azari, 2006), superior temporal sulcus (Allison, Puce & McCarthy, 2000), temporal-parietal junction (Saxe & Powell, 2006), and the mirror neuron system that includes inferior frontal gyrus and rostral posterior parietal cortex (Iacoboni, 2007; Rizzolatti & Craighero, 2004). (Mirror neurons respond similarly when watching another agent perform a task and when performing it oneself.) Importantly, most of these regions are now recognized as parts of the default network, which, among other things, is involved in interpreting and understanding the mental states of others (Andrews-Hanna et al., 2014).

Several fMRI studies on empathy have reported findings that are relevant to the link between Agreeableness and social information processing. Broadly speaking, empathy refers to an ability to relate to and show concern for the emotional states of others. Empathy is conceptualized both as a social-cognitive process and as a stable personality trait related to individual differences in this process, with "trait empathy" representing a facet of Agreeableness falling within its Compassion aspect. Thus, studies of empathy and its neural correlates probably provide evidence for the substrates of Compassion, rather than Politeness or Agreeableness as a whole. In these studies, empathy was positively associated with activity in the mirror neuron system, medial prefrontal cortex, and/or

superior temporal sulcus during observation and imitation of others' actions (Kaplan & Iacoboni, 2006). In addition to regional activity, trait empathy has been shown to correlate positively with resting-state functional connectivity among key regions of the default network (Takeuchi et al., 2014a). Empathy is frequently divided into two specific sub-processes – (1) an ability to take the perspective of others and simulate their mental states and (2) "emotional contagion" or "mirroring," which involves the active experience of another person's current state. Whereas perspective taking and mentalizing involve the aforementioned regions of the default network, mirroring another's emotions seems to involve regions such as the insula and mid-cingulate cortex (Andrews-Hanna et al., 2014; Kanske et al., 2015; Lamm et al., 2011). Structural MRI studies have found the volume and cortical thickness of the latter regions to correlate positively with trait empathy and Compassion (Hou et al., 2017; Mutschler et al., 2013; Patil et al., 2018; Sassa et al., 2012; Valk et al., 2016). Agreeableness has also been shown to positively correlate with neural regions associated with behavioral measures of altruism (Hubbard et al., 2016).

One social-cognitive process strongly related to empathy is theory of mind, which refers to the ability to reason about the mental states of others and has been shown to correlate with Agreeableness (Nettle & Liddle, 2008). Recent work shows that theory of mind ability is positively correlated with Compassion (but not Politeness) and is associated with individual differences in resting state functional connectivity of the default network (Allen et al., 2017). Specifically, theory of mind ability was positively correlated with connectivity between the core of the default network, consisting primarily of the medial prefrontal cortex and posterior cingulate cortex, and its dorsal medial subsystem, specifically the temporal-parietal junction and superior temporal sulcus. Compassion showed a similar but weaker association with connectivity.

Whereas the results of functional neuroimaging studies point to positive associations between Compassion-related traits and the various default network regions associated with social information processing, structural studies looking at regional volume differences in relation to Agreeableness have been less consistent (DeYoung et al., 2010; Hu et al., 2011; Kapogiannis et al., 2013; Takeuchi et al., 2014b; Riccelli et al., 2017). This is probably due, at least in part, to failure to distinguish between the Politeness and Compassion aspects of the trait, as Compassion (but not Politeness) has been found to be positively correlated with gray matter volume in the anterior insula and anterior cingulate cortex (Hou et al., 2017).

Endogenous substances that may contribute to Agreeableness include the sociosexual neuropeptides oxytocin and vasopressin and the sex hormones testosterone and estrogen. Oxytocin is involved in social bonding (Depue & Morrison-Strupinsky, 2005), and administration

of oxytocin in humans has been found to improve ability to identify others' emotional states from facial expressions (Marsh et al., 2010). Further, trait empathy levels have been shown to moderate the effects of such oxytocin administration (Perry et al., 2015). Testosterone is linked to aggression, and evidence suggests that higher testosterone is linked to reduced Agreeableness, particularly its Politeness aspect (DeYoung et al., 2013; Montoya et al., 2012; Nguyen et al., 2016; Turan et al., 2014). Agreeableness, like Neuroticism, has been associated with serotonergic function (Canli & Lesch, 2007; Wright et al., 2019). Multiple studies have shown negative associations of serotonin function with aggression, and other traits reflecting low levels of Politeness (Hanna et al., 1995; Halperin et al., 2006; Manuck et al., 1998; Moul et al., 2013).

CONSCIENTIOUSNESS

Whereas Agreeableness is associated with the maintenance of social stability between individuals, Conscientiousness appears to reflect the tendency to maintain motivational stability within the individual, to make plans and carry them out in an organized manner. This sort of top-down control of motivation should be necessary only in species capable of formulating long-term goals that might conflict with more immediate urges. In personality studies of other species, only chimpanzees and bonobos, our nearest evolutionary neighbors, have been found to possess a trait directly analogous to Conscientiousness (Freeman & Gosling, 2010; Gosling & John, 1999; Weiss et al., 2015). Of the Big Five, Conscientiousness is typically the best predictor of positive occupational, academic, and health outcomes (Roberts et al., 2017).

Conscientiousness may represent the purest manifestation in personality of the ability and tendency to avoid distractions in favor of longer-term goals by effectively prioritizing subgoals and specific actions that support those longer-term goals. Many traits that are theoretically and statistically related to Conscientiousness, such as Cloninger's Novelty Seeking or Zuckerman's Impulsive Sensation Seeking, appear to be less specific than Conscientiousness, in that they load heavily on other Big Five factors in addition to Conscientiousness. This non-specificity may reflect the fact that problems of impulse control could be exacerbated both by weakness of whatever systems override impulses (presumably a key substrate of Conscientiousness) or by potentiation of the impulses themselves. A factor analysis of many questionnaire measures of impulsivity (Whiteside & Lynam, 2001) found four factors, only two of which (labeled *lack of perseverance* and *lack of premeditation*) mapped onto low Conscientiousness. The other two, labeled *urgency* and *sensation seeking*, map onto Neuroticism or low Stability and Extraversion, respectively, and appeared to describe strong impulses related to punishment and reward (DeYoung & Rueter, 2016). In a similar vein, Depue and

Collins (1999) argued that, although theorists have often associated impulsivity with Extraversion, impulsivity might be better conceived as a compound trait emerging from the combination of high Extraversion and low Conscientiousness.

When considering research on the biological basis of the various impulsivity-related traits, one must bear in mind that many are related to multiple Big Five dimensions. Zuckerman (2005) noted that many studies have found Impulsive Sensation Seeking and similar traits to be associated with high levels of dopaminergic function and low levels of serotonergic function. However, he argued that dopamine is associated with the approach tendencies reflected in these traits, whereas low serotonin is related to the absence of control or restraint. This conceptualization is supported by fMRI research that showed a positive relation between impulsivity, specifically lack of premeditation, and activity in the ventral striatum, likely linked to Extraversion-related variance (Forbes et al., 2009). A serotonergic contribution to impulsivity may be more relevant to variance in Conscientiousness; involvement of serotonin in control and restraint is consistent with findings that serotonin is associated with Conscientiousness (Manuck et al., 1998; Wright et al., 2019). Associations between impulsivity and activity in specific brain regions have also been noted. For example, an fMRI study (Brown, Manuck, Flory & Hariri, 2006) showed that brain activity in the ventral PFC during a response inhibition task was negatively associated with a questionnaire measure of impulsivity that is strongly negatively correlated with Conscientiousness (Whiteside & Lynam, 2001). Structural MRI research suggests a negative correlation between dmPFC volume and certain aspects of impulsivity (Muhler & Lawrence, 2015).

Research specifically on Conscientiousness, rather than impulsivity, has also implicated the PFC, a region that is highly enlarged in humans, relative to other mammals (Hill et al., 2010), and is associated with cognitive processes involving rules and goals (Bunge & Zelazo, 2006). Multiple fMRI studies have found positive associations between conscientiousness and volume of regions in dorsolateral PFC (Bjørnebekk et al., 2013; DeYoung et al., 2010; Jackson et al., 2011; Kapogiannis et al., 2013; Riccelli et al., 2017), though other studies failed to replicate these findings (Hu et al., 2011; Liu et al., 2013). If this association is real, it would be consistent with lesion studies showing that damage to the PFC is associated with lower Conscientiousness (Beldarrain et al., 2005; Forbes et al., 2014). The insula is another region that has been linked to Conscientiousness through sMRI (Farr et al., 2012; Churchwell & Yurgelun-Todd, 2013; Liu et al., 2013).

Functional connectivity research has identified a large network, combining what have been called the "ventral attention" and "salience" networks, which encompasses regions of lateral PFC, anterior insula, putamen, anterior cingulate cortex, lateral parietal cortex and posterior

temporal cortex (Choi et al., 2012; Yeo et al., 2011). This network seems to be involved in prioritizing goals and reorienting attention from distractors to goal-relevant stimuli (Allen & DeYoung, 2017; DeYoung, 2015; Fox et al., 2006). A recent functional connectivity study supported the first direct test of the hypothesis that this network is a key neural correlate of Conscientiousness (Rueter, Abram, MacDonald, Rustichini & DeYoung, 2018).

OPENNESS/INTELLECT

Openness/Intellect reflects a variety of traits associated with cognitive exploration and flexibility, which allow the generation of new interpretations of experience in terms of correlational and causal patterns (DeYoung, 2015; DeYoung, Grazioplene & Peterson, 2012). Traits related to Openness/Intellect include curiosity, creativity, imagination, artistic/aesthetic interests, unconventionality and problem-solving ability. The use of the compound label Openness/Intellect reflects the conclusion that, despite protracted debate about which was the better label for the whole Big Five dimension, *Openness to Experience* and *Intellect* simply reflect the two major aspects of a larger domain of personality (DeYoung et al., 2012; Saucier, 1992). Openness and Intellect appear to have partially distinct genetic bases and neural correlates, are differentially predictive of psychopathology and relate differently to intelligence (Chmielewski et al., 2014; DeYoung et al., 2007, 2009, 2012, 2016; Wainwright, Wright, Luciano, Geffen & Martin, 2008). Intelligence or general cognitive ability, typically measured by IQ tests, is specifically associated with Intellect rather than Openness (DeYoung, 2020; DeYoung et al., 2009, 2014; Kaufman et al., 2010). As with other Big Five traits, there are likely to be some biological substrates shared by the two aspects, as well as others that differentiate them.

CB5T hypothesizes that Openness/Intellect is associated with dopaminergic function (DeYoung, 2013, 2015). There is no perfect analog of Openness/Intellect in nonhuman animals, given that the intellectual and creative traits encompassed by this dimension do not exist in other species to any measurable degree, but curiosity, which is central to the trait, allows useful cross-species comparisons and is known to be associated with dopaminergic function (Panksepp, 1998). Openness/Intellect appears likely to be influenced by a type of dopaminergic neuron that responds based on salience, firing in response to both positive and negative information (DeYoung, 2013). These neurons are distinct from the value-coding dopamine neurons associated with Extraversion (Bromberg-Martin et al., 2010; DeYoung, 2013). Most of the evidence of the association between Openness/Intellect is indirect or based on genetic studies of questionable value (Allen & DeYoung, 2017), but some more direct evidence for the role of dopamine in Openness/Intellect was provided by an

fMRI study in which brain activity was assessed during rest and during exposure to pleasant visual and olfactory stimuli (Passamonti et al., 2015). In all three conditions, Openness/Intellect was a positive predictor of functional connectivity between the midbrain regions where the dopaminergic system originates (substantia nigra and ventral tegmental area) and the dorsolateral PFC, a region involved in voluntary control of attention.

Because Openness/Intellect is related to imagination in all its forms, the default network is another likely substrate, given its involvement in forms of self-generated thought including fantasizing, mind-wandering, future-oriented thinking, and the production of creative or innovative ideas (Andrews-Hanna et al., 2014). In line with this hypothesis, recent evidence from two independent samples showed that Openness/Intellect was positively associated with efficiency of information processing within the default network, even after controlling for intelligence (Beaty et al., 2016). Another study in two large samples found that Openness/Intellect was positively associated with functional connectivity between the default network and networks involved in cognitive control (Beaty et al., 2017).

Although substantial findings have been reported regarding Openness/Intellect in functional neuroimaging research, the majority of structural studies to date have reported no significant findings regarding correlations between Openness/Intellect and volume, cortical thickness or cortical area of local brain regions (DeYoung et al., 2010; Hu et al., 2011; Kapogiannis et al., 2013; Li et al., 2014; Liu et al., 2013), but there are a few exceptions. One longitudinal study found that Openness/Intellect was a negative predictor of age-related decline in gray matter volume of the right inferior parietal lobule, a structure involved in creativity and intelligence (Taki et al., 2013). Another large sMRI study found associations of Openness/Intellect with cortical thickness of the postcentral sulcus of the parietal lobe, as well as regions in the dorsolateral PFC and cingulate cortex (Riccelli et al., 2017); notably, these regions all contain nodes of the “cognitive control” or frontoparietal network, which plays a crucial role in working memory and intelligence (Jung & Haier, 2007; Vincent et al., 2008). Whereas Openness/Intellect as a whole appears to be associated with dopaminergic function and the default network, this frontoparietal network may be more specifically related to the Intellect aspect and related cognitive functions. One fMRI study showed that Intellect, but not Openness, was correlated with activity in the left lateral anterior PFC and posterior medial frontal cortex during a working memory task. Moreover, variation in neural activity in these regions accounted for much of the positive association between Intellect and working memory performance (DeYoung et al., 2009).

A final topic worth addressing is the relation between Openness/Intellect and positive schizotypy or psychosis proneness. Whereas Intellect is negatively correlated with schizotypy and susceptibility toward schizophrenia or

other psychotic disorders, Openness is positively correlated (Chmielewski et al., 2014; DeYoung et al., 2012, 2016). This association may help explain the differentiation between the two aspects of Openness/Intellect, including areas where they diverge, such as their respective associations with IQ and neuroanatomy. Research using diffusion tensor imaging to assess white matter structure may prove particularly important in differentiating between the neural correlates of these two aspects. White matter coherence is positively correlated with IQ (Chiang et al., 2009; Navas-Sánchez et al., 2014; Penke et al., 2012), but there are mixed results for its associations with Openness/Intellect. DTI research that fails to control for IQ or to distinguish between the Openness and Intellect aspects has produced inconsistent results, with some studies finding a positive correlation between Openness/Intellect and white matter coherence (Privado et al., 2017; Xu & Potenza, 2012) and others finding no association (Bjørnebekk et al., 2013). Research that controls for IQ, however, suggests that white matter coherence is negatively associated with the Openness aspect specifically (Jung et al., 2010; Grazioplene, Chavez, Rustichini & DeYoung, 2016). This is in line with research showing decreased frontal white matter coherence in those at risk for psychosis (Canu, Agosta & Filippi, 2015; Pettersson-Yeo, Allen, Benetti, McGuire & Mechelli, 2011). The pattern emerging suggests that Openness specifically is related to a pattern of less coherent white matter connections, especially involving the frontal lobes, that is similar to what is seen in psychosis and may reflect the risk for psychotic-spectrum disorder conferred by Openness but not Intellect.

Additionally, serotonergic function may have a role in Openness, as well as psychosis proneness, given that it plays an important role in the mechanism of most hallucinogenic drugs. In one study, levels of Openness/Intellect predicted serotonin transporter binding (Kalbitzer et al., 2009), and in another study, participants who were given psilocybin (the active agent of hallucinogenic mushrooms, which acts on the serotonergic system) showed robust increases in reported Openness/Intellect that remained present at follow-up (MacLean, Johnson & Griffiths, 2011). Similar increases in Openness have been shown after exposure to other psychoactive drugs with substantial serotonergic action, including LSD (Lebedev et al., 2016) and MDMA (Wagner et al., 2017). Moreover, Openness has been shown to correlate with reported use of psychedelic drugs (Nour et al., 2017). In summary, whereas Intellect is negatively associated with psychosis proneness and perceptual dysregulation, Openness is positively associated with such distortions, perhaps due to individual differences in certain aspects of serotonergic functioning. Continued research is needed to more fully differentiate these two aspects of the broader Openness/Intellect trait and their respective relations to neurobiology, behavior and psychopathology.

CONCLUSION

A neuroscience approach to personality research has the potential to provide personality psychology with explanatory models. The Big Five appears to be a promising broad framework for conceptualizing individual differences in personality traits in terms of basic psychobiological functions, and this approach has been most thoroughly pursued in CB5T (Allen & DeYoung, 2017; DeYoung, 2015). The Five-Factor Theory of McCrae and Costa (2008) makes a similar claim about the biological basis of the Big Five but, unlike CB5T, does not go on to elaborate specific hypotheses about the neural sources of individual traits. As the above review demonstrates, neuroscientific research on personality has advanced to the point where progress has been made for most traits (though clearly some more than others) and many additional substantial hypotheses can be formulated. The youth of the field of personality neuroscience necessitates that many of these hypotheses currently exist at a fairly low level of resolution. Much more detail regarding how different brain systems relate to specific traits will emerge as the field progresses.

Although a clear goal of personality neuroscience, moving forward, will be to further clarify the biological correlates of the hierarchy of personality traits based on the Big Five, personality neuroscience also has insight to offer for related fields, such as social neuroscience and psychopathology research. For instance, one related field of emerging research involves the use of personality neuroscience for exploring the biological basis of psychopathology (Abram & DeYoung, 2017; DeYoung & Krueger, 2018; Shackman et al., 2016). Research in the coming years may help further unify our understanding of what is shared between normal-range personality variation and various forms of psychopathology, including their biological underpinnings.

One major limitation that is beginning to be addressed but will need ongoing attention as personality neuroscience continues to grow as a field is the issue of small sample sizes and the resulting effects on statistical power. Due largely to the high monetary expense of MRI research, many studies are conducted and published with sample sizes far too small for robust research on individual differences. For instance, one analysis of more than 400 MRI studies published between 2006 and 2009 found that the median statistical power was only 8 percent (Button et al., 2013; Ioannidis, 2011), and another study found that the median sample size for MRI studies was only fifteen individuals (Carp, 2012). The average effect size in personality research has been estimated near $r = .2$ (Gignac & Szodorai, 2016; Richard et al., 2003). A sample size of roughly 200 individuals – obviously far greater than the median of 15 – would be needed to detect such an effect as significant at $p < .05$ with 80 percent power. Chronically low power in the field undoubtedly contributes to inflated Type II error rates and failure to detect the kinds of effects we would

expect in personality research. Unfortunately, it also contributes to Type I errors, as lack of power means that a larger proportion of nominally significant findings will be false positives. All research in personality neuroscience should be attentive to statistical power, in order for the field to produce the consistent, robust findings necessary for developing comprehensive and accurate theories to explain the biology of individual differences.

Traits are probabilistic constructs representing the frequencies and intensities of particular classes of emotion, cognition, motivation and behavior across situations (DeYoung, 2015; Fleeson & Gallagher, 2009). Standard personality measures provide little information about the situations that elicit these processes for any given individual, but methods exist to make such assessments (Fleeson, 2007; Roberts, 2007; Wood & Roberts, 2006). Exploring the neural mechanisms involved in linking basic tendencies to specific eliciting stimuli may become the ultimate in fine-grained analysis, as the field of personality neuroscience progresses. Such investigations, however, must be integrated with knowledge of how personality is organized at the broadest levels, where large neural networks and broadly acting neuromodulators are likely to be important across situations that share only some broad features. Psychobiological models of the Big Five and their meta-traits and aspects are a promising place to begin.

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PART V

**COGNITIVE AND
MOTIVATIONAL
PERSPECTIVES:
DYNAMIC PROCESSES
OF PERSONALITY**

21 Cognitive Processes and Models

GERALD MATTHEWS

INTRODUCTION

This chapter provides an introductory review of cognitive-psychological research on personality traits and performance. Traits correlate with objective performance measures in both laboratory and real-world settings, but observed correlations are typically open to multiple explanations. The cognitive psychological perspective is that models of performance can identify information-processing routines that determine performance, such as attention, memory and response selection. In personality research, we can then investigate relationships between traits and individual differences in such component processes that underpin the observed trait-performance correlation. One of the goals of this chapter is to illustrate some of the relationships between traits and information-processing that have been identified from empirical performance studies, and their explanation from cognitive science theory.

It is also important to place laboratory studies of individual differences in performance into the wider context of real-world adaptation. The expression of traits in performance is important in a variety of applied contexts, including personnel selection, understanding clinical disorders and mitigating risk-taking behaviors. The chapter will also address the extent to which laboratory studies provide a basis for understanding real-world performance findings.

The chapter is structured as follows. First, I survey the scope of cognitive-process studies across multiple traits, forms of processing and research aims, in historical context. Second, focusing on information-processing models, I review illustrative empirical studies of major personality traits and various aspects of performance. Third, I present a cognitive-science framework that differentiates three levels of explanation for associations between personality and behavior, including neurobiological processes, virtual information-processing and high-level self-regulative processing based on personal meaning. Next, I outline a theory of the wider significance of associations between personality and performance for adaptation to the

challenges and pressures of real life. I conclude with a summary of the accomplishments of research on personality and performance, and some remaining challenges.

HISTORICAL BACKGROUND

Personality psychologists have conducted performance studies of numerous traits for a variety of motives. Consequently, the research literature is extensive, complex and poorly integrated. An important research goal from the 1950s onwards was the use of performance measures to test psychobiological theories of personality. Pioneers of this field, notably Hans Eysenck (1957, 1967), hypothesized that variations in basic attributes of the brain such as inhibition and arousal should influence performance of simple tasks such as choice reaction time and paired-associate learning. The fundamental extraversion (E) and neuroticism (N) traits predicted performance on tasks requiring attention, memory and rapid execution of motor response. In effect, performance measures functioned as another psychophysiological index that could be used for theory-testing, akin to the electroencephalogram (EEG) or electrodermal activity (EDA). In a nice example of the synergy of theoretical and applied research, Eysenck's theory inspired studies of extraversion, arousal and performance at the Cambridge Applied Psychology Unit, with implications for real-world issues such as naval watch-keeping and shift-work (Corcoran, 1972).

Somewhat independently, anxiety became a major focus for psychology post WWII, encouraged by the development of scales for assessment of trait and state anxiety (Spielberger, 1966). Performance studies were run to determine the impact of anxiety on learning and attention. Although inspired initially by Hullian drive theory, the growing impetus of the "cognitive revolution" in psychology increasingly attributed performance deficits to constructs such as worry and cognitive interference (Sarason, 1972). Contemporary trait anxiety research (e.g., Moran, 2016) and theory (Eysenck & Derakshan, 2011) builds on these early information-processing models. Research also

seeks to uncover neural substrates for individual differences in information-processing, potentially integrating information-processing theory with neuroscience (e.g., Wacker & Smillie, 2015). Advances in psychophysiological techniques such as evoked potential (EP) recording and brain-imaging increasingly support a cognitive neuroscience account of performance correlates of traits (e.g., de Pascalis, 2004; Stelmack & Rammsayer, 2008; DeYoung, Chapter 20).

Clinical research also highlighted individual differences in the content of cognitions in emotional pathology, such as the roles of cognitive distortions and impairments in depression (Beck, 1967). In essence, personality is attributed to long-term memory. In depressed individuals, the self-schema encodes unrealistic negative self-beliefs, for example, that the person is incapable of being loved (Beck, 1967). There is also a procedural element to personality; depressives in Beck's theory use faulty rules for reasoning about the self that complement negative self-beliefs. Thus, the cognitive therapist's primary mission is to expose and correct unrealistic negative content.

Research on anxiety integrated both process and content aspects of individual differences in cognition. Test anxiety, for example, is associated with both processes such as failure to focus attention on the task performed, and cognitive content such as anticipations of failure (Ben-Eliyahu & Zeidner, Chapter 32; Sarason et al., 1995; Zeidner, 1998). Anxiety researchers also discovered that the trait is associated with bias in processing threat stimuli, shown in studies of selective attention, interpretation and other cognitive functions (Cisler & Koster, 2010; Eysenck & Holmes, Chapter 26; MacLeod & Clarke, 2015). Other broad traits might be associated with comparable content-dependent individual differences in processing; we might expect extraverts to show selective attention bias to social cues, for example. Researchers are increasingly interested in how individual differences in interests may influence selective attention (e.g., McIntyre & Graziano, 2016), but thus far most research has focused on anxiety and other traits for negative affectivity.

CONTEMPORARY PERSPECTIVES

Reflecting the complex history of performance studies, contemporary research presents a large, but poorly integrated literature demonstrating various performance correlates of numerous traits. Figure 21.1 summarizes the research landscape. Studies differ in the types of trait investigated, the type of underlying process of interest, and the purpose of the investigation.

Types of Purpose

Trait Mapping

The most straightforward purpose for using personality measures is an element of exploring the correlates of a

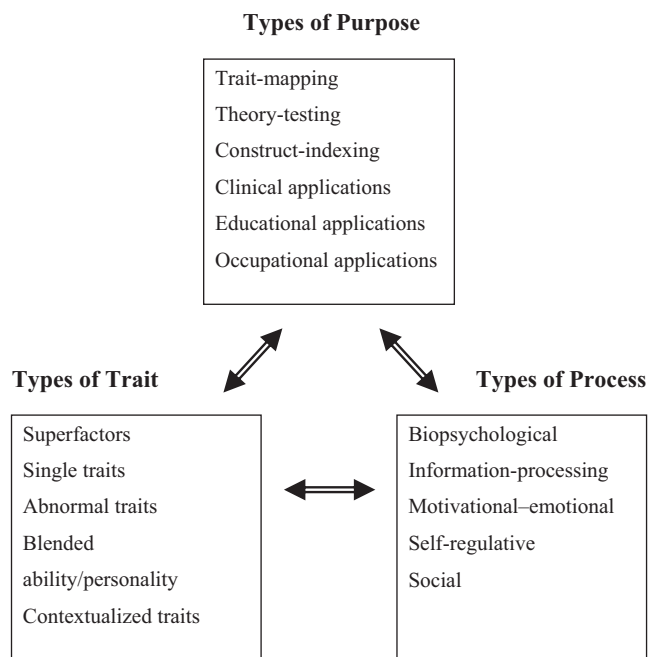


Figure 21.1 Purposes, traits and processes for performance research

trait, i.e., determining its nomological network (Cronbach & Meehl, 1955). In the early stages of trait validation, performance correlates of a trait may be anticipated with limited theory. For example, we expect impulsive individuals to respond quickly but inaccurately in reaction-time studies, and conscientious people should show greater task persistence. Applied studies can also be conducted; for example, individuals prone to thrill-seeking during vehicle driving should be more prone to crashes (Hennessy, 2011).

Theory-Testing

As in Eysenck's (1967) pioneering studies, theory may predict trait-performance relationships. Such studies often incorporate moderator factors to obtain more refined prediction; for example, level of stimulation is critical for prediction in the Eysenck theory. Psychobiological theories remain influential for such purposes; Reinforcement Sensitivity Theory (RST: Corr & McNaughton, 2008; Corr & Krupić, Chapter 19) makes a variety of predictions concerning interactive effects of basic traits and external reinforcement on learning and performance.

Cognitive theories have moved on from the broad-brush predictions of early cognitive anxiety theory (Spielberger, 1966) to develop models that identify specific processes associated with traits. Humphreys and Revelle (1984) used multiple resource theory as a basis for predicting trait interactions with various stress and motivation factors. Eysenck and Derakshan's (2011) Attentional Control Theory discriminates multiple executive control processes, and identifies anxiety with one of them, poorer inhibitory control. Cognitive neuroscience models

(Wacker, Chavanon & Stemmler, 2006) potentially integrate neural and cognitive constructs in predicting individual differences in performance. However, a challenge for both neurological and cognitive theorizing is the interpretation of individual differences in measured performance outcomes such as response latency and errors. Typically, even relatively simple tasks such as choice reaction time reflect the influence of multiple brain systems or information-processing routines (Matthews et al., 2000) and working back from observation to theory is perilous.

Construct-Indexing

The rise of implicit assessments of personality has cast performance studies in a new light. The traditional psychometric model is that latent personality constructs are inferred from measured self-reports, and the latent construct influences measurable performance outcomes. However, implicit measurement of personality requires that the latent construct is itself indexed by measured performance (De Cuyper et al., 2017). For example, the Implicit Association Test may be applied to assess standard traits such as extraversion and anxiety using reaction-time measures (e.g., Schmukle & Egloff, 2005). Thus far, researchers have shown limited interest in using implicit personality tests to predict other performance measures. Indeed, one of the emerging challenges for the area is that alternate performance measures for a trait are not necessarily strongly correlated. For example, threat sensitivity is a central attribute of anxiety that can be measured objectively, but alternate performance-based assessments of threat sensitivity do not necessarily correlate highly (McNally, 2019).

Clinical Psychology

Cognitive accounts (Beck, 1967; Beck & Haigh, 2014) attribute mental disorders to biased or faulty information-processing. It follows that data from performance tasks indexing specific processes may support theoretical understanding of trait etiology, enhancement of therapy and matching clients with the therapy most appropriate for their disorder. Research on attentional bias toward threat stimuli in anxiety is a case in point. Emotional pathology in anxious patients may in part result from their excessive sensitivity to threat stimuli. If the selective attention process plays a causal role of this kind, then reducing attentional bias should produce clinical benefits. This insight has led to experimental attention bias mitigation techniques that directly train patients to reduce bias to threat, with clinical benefits in some cases (MacLeod & Clarke, 2015; McNally, 2019). Recent work has also focused on individual differences in metacognitive processing as an influence on a range of pathologies (Wells, 2013). Dysfunctional metacognitions such as excessive attention to negative thoughts and images give rise to tendencies to engage in perseverative worry, rumination and threat monitoring (Wells, 2013).

Traits associated with such tendencies can be measured using scales such as the Metacognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997). The metacognitive theory generates predictions that can be tested against performance, along with other outcome variables such as clinical status. For example, consistent with the theory, dispositional metacognition predicts selective attention deficit in obsessive-compulsive disorder (Koch & Exner, 2015) and psychophysiological and subjective measures of resilience under stress (Matthews et al., 2019). Studies of this kind support the practical development and application of metacognitive therapy for a range of disorders (Wells, 2013; Wells & Matthews, 2015).

Educational Psychology

Educational psychologists share purposes similar to those of clinical psychologists in assessment, understanding, and remediation of abnormalities in personality that may adversely affect the student's wellbeing and academic success. In school-age children, there is a focus on both internalizing disorders such as depression, and externalizing disorders such as attention deficit disorder (Matthews, Zeidner & Roberts, 2006; Ben-Eliyahu & Zeidner, Chapter 32). The role of personality in academic performance (Poropat, 2009) brings to the fore constructs such as test anxiety for which there is a rich theoretical and applied literature (Zeidner, 1998). Educational psychologists are also concerned with exceptionally high levels of performance and giftedness (e.g., Matthews, Lin, Zeidner & Roberts, 2017).

Organizational Psychology

The workplace is fertile ground for applied use of personality assessments, given that major personality traits predict performance modestly but consistently in meta-analyses (e.g., Salgado, Anderson & Moscoso, Chapter 31; Salgado & Tauriz, 2014). On an applied level, such studies support the use of personality assessment as an element of personnel selection (Sackett, Lievens, Van Iddekinge & Kuncel, 2017). There is also a growing, theoretically informed literature on situational moderators of personality traits (Judge & Zapata, 2015). The role of personality factors has been of particular interest in contexts in which performance competency is critical such as vehicle operation (Hennessy, 2011) and military aviation (Barron, Carretta & Bonto-Kane, 2016).

However, there are also significant barriers to identifying mediating cognitive processes in this area. First, work performance is notoriously difficult to assess (Campbell & Wiernik, 2015) and some personality studies rely on questionable proxies such as self-reports and supervisor ratings. Second, work performance is multifaceted; personnel selection may be geared not just toward "in-role" overt performance requirements but additional aspects of behavior including organizational citizenship and integrity. All of the Big Five Traits predict these contextual aspects of performance, depending on situational

moderators, but social processes as well as individual differences in information-processing may mediate these effects (Judge & Zapata, 2015; Roberts, Martin & Olaru, 2015). Third, in many jobs there is restriction of range in the cognitive processes required for in-role performance. We would likely not find many software engineers with low working memory capacity, for example, limiting the impact of personality factors whose effects are mediated by working memory. Finally, there is also a suspicion that personality traits, while relevant, typically play second fiddle to cognitive factors including both general ability and the knowledge, skills and abilities relevant to the job concerned (Matthews, 1999). Thus, paradoxically, understanding the role of personality in job performance represents something of a missed opportunity thus far. The big picture of personality at work is reasonably clear, but the role of cognitive processes is not. Future research might capitalize on the increasing availability of immersive work simulations to investigate how individual differences in cognitive processing associated with personality influence job performance. For example, Szalma and Taylor (2011) investigated how Big Five traits influence use of automation using a simulation of unmanned vehicle operation.

Types of Traits

The personality researcher can access a bewildering array of different instruments. Performance researchers have utilized a variety of different types of trait measure, partly reflecting the different purposes for research.

Superfactors

The Eysenck (1967) personality theory spawned significant performance research on each of the “Gigantic Three,” though with mixed success (Matthews & Gilliland, 1999). Progress is being made in comparable efforts to specify the neural systems underpinning the Five Factor Model (FFM: McCrae, Chapter 9), capitalizing on the greater sophistication of contemporary neuroscience (DeYoung & Blain, Chapter 20). Performance tasks are commonly used in the psychophysiological and functional brain-imaging paradigms that seek to elicit individual differences in response. However, the majority of such studies fail to test for mediation of personality – performance associations by neurological mechanisms, so that the functional significance of personality differences in brain function remains unclear. A welcome development is increasing interest in studies that aim to triangulate personality, brain-imaging and performance measures (e.g., Fuentes-Claramonte et al., 2016).

Single Traits

Research validating single-trait constructs (and facets of single traits) quite commonly includes performance studies, though more often with the aim of trait-mapping than of detailed theory development. Traits such as impulsivity

(Arce & Santisteban, 2006) and sensation-seeking (Zuckerman, 2005) have clear implications for performance. Studies of sensation-seeking are prominent in applied domains within which risk-taking may have adverse consequences such as vehicle crashes (Hennessy, 2011). Other traits are explicitly based on cognitive constructs such as vulnerability to cognitive failures (Carrigan & Barkus, 2016) and motivations to engage in cognitive activity (Haran, Ritov & Mellers, 2013), and so should correlate with relevant cognitive performance measures. Neglect of information-processing models is common in applied work. For example, some aspects of perfectionism are associated with elevated academic performance, and motivational factors such as setting task-approach goals may mediate the trait effect (Stoeber, Haskew & Scott, 2015). However, much of the work in this area relies on self-reports of motivational mediators, and few studies have utilized experimental methods to address information-processing mechanisms. One exception is a study that confirmed the hypothesis that perfectionism is associated with higher effort, indexed by the length of time spent working on a stimulus detection task (Stoeber, Chesterman & Tarn, 2010).

Abnormal Traits

The line between the extremes of normal personality dimensions and abnormal traits is increasingly blurred, and an influential school of thought has proposed using the FFM as the structural basis for both normal and abnormal personality research (Gore & Widiger, 2013; Widiger & McCabe, Chapter 33). Some abnormal trait dimensions have attracted substantial performance based literatures. Lubow and Kaplan (2010) reviewed studies of schizotypy and latent inhibition. During learning tasks, schizophrenic patients and nonclinical individuals high in schizotypy appear to have difficulty ignoring irrelevant stimuli to which they have been preexposed. Schizotypy may be associated with failure of a latent inhibition mechanism that normally protects the person from distraction. In clinical disorder, this filtering failure may contribute to “active” symptoms such as hallucination and delusions. Lubow and Kaplan (2010) point out that simply demonstrating an association between schizotypy and latent inhibition does not by itself do much to explain sources of pathology, which requires a deeper theoretical understanding. Indeed, their competing theories of latent inhibition, differing in the extent to which failure of inhibition is attributed to processes for associating stimuli or to processes for retrieving learnt associations. Resolution of such issues will help to clarify the symptomatology of schizophrenia. More generally, Lubow and Kaplan’s (2010) work illustrates how trait mapping (schizotypy correlates with latent inhibition) is necessary but not sufficient for understanding. Real progress requires theory testing (identifying mechanisms for latent inhibition that generate symptoms).

Blended Personality/Ability Traits

The interface between personality and intelligence has been of persistent interest to differential psychologists (Ackerman, 2003). Traits at this interface, i.e., personality factors that refer directly to cognitive processing constructs, should be associated with performance. One such construct is emotional intelligence (EI: Matthews, Zeidner & Roberts, 2002). Among sometimes grandiose claims made for EI was that it was essential for performance in a wide-range of real-world contexts, including the workplace. From a trait-mapping perspective, meta-analysis has confirmed that EI does predict job performance, albeit modestly (Joseph, Jin, Newman & O'Boyle, 2015). Theoretical progress has been hindered by the fractionation of EI into two distinct sets of constructs associated with ability and personality respectively. The predictive validity of "trait-EI" in particular in part reflects its overlap with standard personality traits (Joseph et al., 2015). In experimental studies, both types of construct appear to be only modestly associated with objective cognitive performance if at all (e.g., Matthews et al., 2015).

Contextualized Traits

Predictive validity is often enhanced by assessing traits expressed only in a specific context. Test anxiety is the exemplar here (Ben-Eliyahu & Zeidner, Chapter 32; Zeidner, 1998; Zeidner & Matthews, 2005). Descriptions of the construct are similar to those of general trait anxiety, bar the emphasis on evaluative threat as the trigger for state anxiety. There are two reasons why test anxiety may be a better predictor than general trait anxiety of context-relevant outcomes such as academic grades. First, test anxiety may better predict the level of state anxiety experienced by the student taking an exam. Second, test anxiety may also better reflect individual differences in knowledge and strategy that are specific to the academic context; for example, test-anxious students may be deficient in study skills (Naveh-Benjamin, Lavi, McKeachie & Lin, 1997).

Traits can be matched to other contexts also. Driver stress vulnerability traits predict emotional states during vehicle operation better than the Big Five (Matthews, 2002). Specific traits also pick up attitudes and coping styles specific to driving, such as hostile attributions of other drivers' behaviors and preferences for confrontive coping, which feed into dangerous actions such as risky passing (Matthews, 2002). In the organizational context, trait and state aspects of constructs such as work engagement (Bakker, 2014) are differentiated, supporting prediction of job performance.

Types of Process

A critical issue for theory is the nature of the processes mediating between traits and objective performance measures (Matthews, Deary & Whiteman, 2009). This framing of the issue assumes a short temporal span, i.e., the minutes or hours of an experimental study. Under this

circumstance, the trait can be treated as a fixed characteristic of the person, associated with individual differences in cognitive processing that are expressed in performance. Over long timespans, which are relevant in the applied context, the picture is less straightforward, as there may be feedback loops between traits and performance outcomes. For example, while neuroticism may be a predisposing factor for clinical emotional disorder, the disorder itself may sustain high levels of the trait, or leave a "scar" in the form of elevated neuroticism following recovery (Ormel et al., 2013). Presumably, contextualized traits are most sensitive to such feedback effects than basic traits. Examination failure is likely to elevate test anxiety, and surviving a car crash to increase driver stress vulnerability. In this subsection, I briefly sketch out the different types of mediating process to which trait theory can refer, with the primary emphasis on short-term mediation. Because this chapter has a theoretical focus, I will elaborate on mediation processes in the sections that follow, from a cognitive science perspective.

Biopsychological Processes

The Eysenck (1967) arousal theory and RST (Corr & Krupić, Chapter 19; Corr & McNaughton, 2008) are paradigms for the biopsychological approach. These theories identify a conceptual nervous system, i.e., a simplified account of key brain systems. Traits are identified with parameters of those systems such as arousability and sensitivities to reward and to punishment. Such theories are, of course, well-suited to explaining psychophysiological correlates of traits. They can also explain individual differences in performance linked to specific learning mechanisms whose neural bases are well understood, such as associative learning and procedural learning (e.g., Ettinger et al., 2013). However, biopsychological theories have been criticized for neglect of cognitive factors such as demands for attentional resources and strategy choice that are difficult to conceptualize in neurological terms (Matthews & Gilliland, 1999). There is also a lack of evidence for direct causal effects on consequential real-world outcomes of individual differences in the neural constructs specified by theory (Matthews, 2016).

Information-Processing

The rise of cognitive psychology from the 1960s onward provided a shot in the arm for trait researchers, allowing them to test associations between traits and information-processing constructs derived from theories of attention, memory, language, decision-making and other cognitive functions (Eysenck, 1981; Matthews, 2008a). Such data in turn inspired theories incorporating cognitive constructs such as processing resources (Humphreys & Revelle, 1984), neural net parameters (Matthews & Harley, 1993, 1996) and executive control processes (Eysenck & Derakshan, 2011). Recent work addresses the integration of information-processing models with neuroscience (e.g., Wacker & Smillie, 2015). The limitations of information-

processing models have proved to be similar to those of biopsychological models; individual differences in processing demonstrated in carefully controlled experimental studies do not necessarily influence real-world adaptation (Matthews, 1999).

Self-Regulation

Cognitive psychologists have addressed the role of the self in personality by hypothesizing a self-schema, a structured set of core beliefs about the one's place in the world held in long-term memory (Beck & Haigh, 2014). While the self-schema may influence components of information-processing, as an explanatory construct it differs from the latter in two important ways. First, content is as important as process; the person acquires specific beliefs and attitudes shaped by culture and circumstance. Second, the key processes are internal; people use cognitive strategies such as reappraisal to modulate thoughts, images and feelings. Metacognitive dispositions play a key role in shaping such self-regulative processes (Wells, 2013). These qualities of the self-schema tend to limit research using objective performance measures. Self-reports are necessary to probe the subject and salience of a person's ruminations.

Similarly, there has been considerable research on traits and stress processes, for example, identifying trait correlates of types of coping such as task- and emotion-focused (Carver & Connor-Smith, 2010). Again, reliance on self-report is a limitation, though more recently studies have begun to investigate associations between coping scales and individual differences in performance (e.g., Matthews et al., 2014).

Motivational and Emotional Processes

Motivational and emotional qualities are central to major traits. Extraversion and neuroticism are sometimes cast as positive and negative affectivity (Watson, 2000), whereas conscientiousness, agreeableness and openness can be linked to work motivation, prosocial motivation, and intellectual and artistic interests respectively. Trait-mapping and theory development purposes lead to differing perspectives on motivation and emotion. From the former perspective, it suffices to show that the trait predicts relevant motivational or emotional criteria. However, several leading theories propose that trait effects on performance are mediated by motivational or emotional states; for example, classic trait-state theory (Spielberger, 1972) attributes detrimental effects of trait anxiety to elevated state anxiety in threatening situations. Conversely, one of the weaknesses of the Eysenck (1967) theory is lack of evidence that extravert-introvert differences in performance are actually mediated by state arousal (Matthews & Amelang, 1993; Matthews & Gilliland, 1999). While states play a significant role in personality effects, state-mediation is far from universal, and in the performance context states and traits are organized around qualitatively different factor structures (Matthews & Zeidner, 2004).

Social Processes

Major traits also have social expressions, sometimes aligned with the assertiveness and compassion axes of the interpersonal circumplex (Gurtman, 2009). Especially in practical settings, social processes may mediate trait effects on performance. For example, social skills are important in the work setting, and remediating maladaptive interpersonal interactions is an important therapeutic task for educational and clinical psychologists. Accounts of emotional intelligence typically refer to superior competencies in understanding and influencing other people as central to the trait (Matthews et al., 2002).

COGNITIVE PATTERNING OF PERFORMANCE EFFECTS

The preceding section illustrates the diversity of performance studies. In this section, I examine more closely the contribution of cognitive psychology to understanding personality-performance correlations. Since the "cognitive revolution" of the 1960s, researchers have linked personality traits to individual differences in processes supporting attention, working memory and other information-processing functions. The scope of this research is quite broad and supports a variety of purposes. Some studies are performed with theory-testing aims in mind, with predictions derived from both neuroscience models (e.g., Wacker & Smillie, 2015), and from cognitive-psychological perspectives (e.g., Eysenck & Derakshan, 2011; Humphreys & Revelle, 1984). Other work is more exploratory in nature but contributes to trait-mapping aims. Studies also have applied motivations such as investigating abnormal processing associated with vulnerability to emotional disorder (Eysenck & Holmes, Chapter 26; Wells & Matthews, 2015) and determining the role of personality in human-computer interaction (e.g., Szalma & Taylor, 2011; Ziemkiewicz et al., 2013).

All the various types of trait discriminated above have inspired performance-based studies, but the largest bodies of research refer to superfactors: extraversion and neuroticism/trait anxiety. This section focuses on these two traits to illustrate current research. Bringing some structure to a complex literature is challenging. Personality research may usefully learn from stress research. Reviews of stressor effects (e.g., Hockey, 1984; Matthews et al., 2000) have concluded that stressors such as noise and heat typically influence multiple processes. Hockey (1984) advocates exploring the cognitive patterning of each individual stressor, i.e., evaluating in detail which processing functions are facilitated, impaired or unaffected by the stressful agent. Typically, cognitive patternings are complex, reflecting multiple mechanisms of different types. Effects may be structural, in affecting basic parameters of component processes, or strategic, referring to the person's choice of goals and subgoals in dealing with the task (Hockey, 1984). Similarly, personality traits too are

Table 21.1 Examples of cognitive functions investigated in personality and performance research

Cognitive function	Tasks	Key theoretical constructs
Attention: Focus and concentration	Demanding single tasks Dual/multi-tasking Sustained attention Working memory	Attentional resources Executive control Storage/processing integration
Selective attention	Performance with task or environmental distractors Performance with emotional target or distractor stimuli	Attentional filtering Preattentive threat processing Attentional disengagement from threat Higher-level cognitive bias
Speeded response	Choice reaction-time	Stage models of stimulus and response processes
Memory	Short- and long-term recall Eyewitness testimony	Memory processes: encoding, storage, retrieval
Language	Speech production	Voice stress and fluency Syntactic and semantic properties
Decision-making	Iowa Gambling Task Balloon Analogue Risk Task Choosing options according to gain and loss probabilities	Risk acceptance Confidence Heuristics and biases

associated with cognitive patternings composed of multiple, independent effects (Matthews, 2008a).

Table 21.1 summarizes some categories that can be used to define the cognitive patterning of a trait. Each class of function is associated with a set of tasks requiring that function, as well as key constructs from cognitive-psychological theory. In principle, observed correlations

between traits and task performance can then be used to infer individual differences in information-processing. In practice, task categories are heterogeneous, and mapping between tasks and processes complex. Any given theoretical construct may contribute to multiple tasks and even cognitive functions. Thus, the scheme illustrated in the table is pragmatic and ad hoc. It serves to bring some structure to a descriptive account of the byzantine personality-performance literature but it is not intended to define cognitive bases for traits on a rigorous basis. For each cognitive function, I will highlight some of the main task paradigms, and illustrate some principal theoretical inferences and controversies derived from the data. The review is not comprehensive; the aim is to illustrate how personality may be linked to a variety of different aspects of cognition and information-processing through experimental studies of performance tasks.

Attention: Concentration and Focus

The limited capacity of attention constrains people's ability to concentrate on one or more tasks. Personality may influence attentional capacity or resources (Humphreys & Revelle, 1984); for example, anxious people often seem distractible and unfocused. There are several types of experimental paradigm that link personality traits to attentional capacity. First, the difficulty or cognitive workload of tasks can be manipulated; effects of traits associated with capacity should be more evident with more difficult tasks. Second, the number of tasks performed may be varied in studies of dual-task performance or multi-tasking. Traits may predict the amount of dual-task interference seen when attention is overloaded. Third, sustaining attention on simple but demanding signal detection tasks taxes attention, so that we may investigate whether traits are associated with loss of vigilance over time (Finomore, Matthews & Warm, 2009). Fourth, working memory depends not only on short-term storage of information but also on a capacity-limited supervisory executive system that directs both short-term storage and voluntary attention. It is localized in the prefrontal cortex, the anterior part of the frontal lobes of the brain (Ilkowska & Engle, 2010).

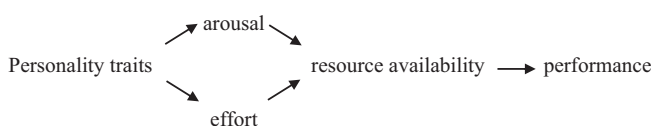
From a theoretical standpoint, the role of attentional capacity is elaborated by resource theories (see Matthews et al., 2000, for a review). A resource is a metaphorical reservoir of energy for processing whose availability may limit speed and accuracy of performance, especially on demanding tasks. There may be multiple resources supporting different processing functions, such as verbal and visuospatial processing. The theory has proved contentious, in that resources are hard to define and differentiate from more specific attentional processes. However, resource theories have been quite successful in predicting how performance varies with overall task demands or workload (Matthews & Reinerman-Jones, 2017).

Extraversion

The majority of studies of extraversion–introversion and focused attention have used vigilance tasks. There is a tendency for extraverts to be more vulnerable than introverts to loss of vigilance (Beauducel, Brocke & Leue, 2006), although data are somewhat inconsistent and effect sizes tend to be small (Finomore et al., 2009; Koelega, 1992). Data from other attentional paradigms have failed to suggest strong associations between extraversion and attentional capacity. In some dual-task performance studies, extraverts outperform introverts (Matthews, 2008a), but studies also show that finding the effect is dependent on careful control of task stimuli (e.g., Szymura & Necka, 1998). There is a marked discrepancy between extraversion tending to impair performance on traditional vigilance tasks, but facilitating dual-task performance in especially demanding conditions. This contrast is difficult to explain on the basis of resource theory.

Extraverts tend to show superior recall on traditional, verbal short-term memory tasks (e.g., Eysenck, 1981; Matthews, 1992), but such tasks are not especially capacity-demanding. Studies using working memory paradigms, requiring processing as well as storage of material, also found extravert superiority in some instances (Lieberman, 2000). Gray et al. (2005) used functional magnetic resonance imaging (fMRI) to confirm that, during task performance, extraversion correlated with activity in frontal areas implicated in working memory and executive control. In addition, extraversion modulated the impact of a dopamine antagonist on a working memory task, consistent with other evidence implicating sensitivity of a dopaminergic reward system in the trait (Wacker, Chavanon & Stemmler, 2006; Wacker & Smillie, 2015). However, a recent systematic review (Waris et al., 2018) failed to substantiate any consistent extraversion–working memory relationship. These authors also reported an online study that found a small but significant negative association between extraversion and one of three working memory tasks. The findings may not be reliable though, given use of a very short extraversion scale and online administration of tasks, which fails to provide the experimental control necessary for valid performance assessments.

Another approach integrates Eysenck's (1967) arousal theory with perspectives from cognitive psychology. Humphreys and Revelle (1984) proposed that trait effects on performance are mediated by states of arousal and effort that influence two distinct processing resources, for sustained information transfer (SIT; similar to attention) and for short-term memory (STM). Arousal, in their model, leads to increased availability of SIT resources, but loss of STM resources. Directing effort to the task is distinct from arousal, and influences SIT resources only.



High impulsives (similar to extraverts) were hypothesized to be lower in arousal in the early part of the day (the theory aimed to accommodate time of day effects). It follows that extraversion should be negatively correlated with attentionally demanding tasks, such as vigilance. The theory successfully explained interactive effects of extraversion and arousing agents such as caffeine, expected to counter depletion of SIT resources in extraverts. However, it also faced significant problems (Matthews, 2016). First, tests for mediation have failed to confirm that extraversion differences are a consequence of variation in arousal, whether measured subjectively (Matthews, 1992) or using the EEG (Matthews & Amelang, 1993). Extraversion and arousal typically had separable effects in these studies. Second, introvert superiority on vigilance should be greatest on the most demanding vigilance tasks that, presumably, require the maximal allocation of resources (Warm et al., 2008). However, this prediction is not confirmed; studies using high-workload tasks failed to find any general advantage for introverts (Matthews, Davies & Lees, 1990). Third, interactive effects of extraversion and arousal on attentional task performance should likewise be stronger for more demanding tasks requiring greater attentional capacity. In fact, interactive effects of extraversion and arousal on performance are most reliable with rather simple, routine encoding tasks, as opposed to demanding, resource-limited tasks (Matthews, 1997; Matthews & Harley, 1993). Alternative mechanisms such as automatic activation processes may provide a better explanation, as explored in a study that modeled the effect using neural nets (Matthews & Harley, 1993).

A focus on specific attentional tasks and processes may be more productive than general capacity models. Matthews and Zeidner (2012) investigated individual differences in performance on the Attention Network Test (ANT: Fan et al., 2002), which provides response-time based measures of efficiency of neural networks for alerting, orienting and executive control. Extraversion was associated with better executive control, a function that might contribute more to multitasking than to vigilance.

Anxiety

Resource theory was applied to personality research initially to explain detrimental effects of trait anxiety, and its worry component. Irwin Sarason's (e.g., Sarason, Sarason & Pierce, 1995) influential theory of test anxiety suggested that the effects of worry are mediated by diversion of resources onto offtask processing of personal concerns. The anxious student is essentially in a dual-task situation, in combining task performance with attending to thoughts about personal failure and other worries, a process termed "cognitive interference." Early work in the field confirmed the basic resource theory prediction that attentionally demanding tasks appear to be especially sensitive to detrimental effects of worry (Zeidner, 1998).

Recent work suggests a more nuanced view of anxiety effects, which do not always vary with task demands as resource theory would predict. The basic prediction that the impact of anxiety should increase with task demands can be tested against data from studies of working memory tasks, which are considered to require attentional resources (Ilkowska & Engle, 2010). Moran (2016) reported a meta-analysis of studies of anxiety and working memory, which confirmed an overall detrimental effect of trait anxiety, with an effect size of $-.292$ (26 studies; total N of 10,967), computed as Hedges' g . The meta-analysis distinguished studies of simple span, which primarily require short-term storage, and complex span, which impose an additional processing requirement. The effect size for complex span ($-.342$) was only a little higher than that for simple span ($-.318$), and, contrary to expectation, the two effect sizes did not differ significantly.

Similarly, anxiety should be more strongly associated with dual- than with single-task performance impairment, and some studies have confirmed this prediction. For example, Berggren, Koster and Derakshan (2012) investigated anxiety effects on a visual search task that required participants to search for a target emotion in a crowd of faces. Anxiety had no effect on performance of this task. However, when cognitive load was increased by having participants count backwards in threes, anxious participants were slower to perform the search. Similarly, Moran (2016) suggested that anxiety effects on dual-task performance are most reliable when two attentionally demanding tasks are paired, consistent with anxiety reducing availability of a general attentional resource. Studies of mathematics anxiety also suggest a general deficit in working memory (Moore, McAuley, Allred & Ashcraft, 2015). However, Berggren and Derakshan (2013) identified some inconsistencies in findings, which may reflect a tendency for anxious individuals to compensate for impaired processing efficiency by increasing effort to maintain processing effectiveness. These authors also point out studies differ in whether anxious individuals show more or less activity in relevant brain areas in prefrontal cortex, indicating a need for better understanding of when compensatory effort is engaged.

Another issue for the resource theory account is that anxiety does not seem to be reliably associated with vigilance decrement on attentionally demanding signal detection tasks (Finomore et al., 2009). Berggren, Blonievsky and Derakshan (2015) utilized a dual-task visual detection paradigm to show that anxiety was unrelated to the primary letter-detection task, but anxious participants were actually better at detecting an additional stimulus present on 50 percent of trials. The authors suggested that anxiety may enhance early visual processing but impair later processing stages requiring cognitive control, implying a need to adopt a fine-grained cognitive patterning approach to differentiate effects of anxiety on different component processes.

The resource metaphor may apply best to the specific neural and cognitive operations of the frontal supervisory executive system. Like other attentional systems, executive operations may be fractionated into more specific processes, including inhibition of strong but inappropriate responses, shifting between different processing operations, and updating the contents of working memory. Attentional Control Theory (Eysenck & Derakshan, 2011; Eysenck & Holmes, Chapter 26) seeks to relate anxiety not to the potentially nebulous resource construct but to these specific operations. Anxiety relates to weaker executive inhibition, evidenced in part by vulnerability to distraction, and also to difficulties in shifting between alternate task sets (although few studies have addressed this issue). The third function, updating, contributes to a number of prototypical working memory tasks, but tends to rely more on short-term storage processes than on direct attentional control. It is said to be less sensitive to anxiety than the other two executive processes. Differentiating executive processes supports a more detailed account of anxiety effects on attention than afforded by traditional resource theories. The theory has been valuable in generating studies of anxiety and theoretically meaningful performance indices. To give just one example, Gustavson and Miyake (2016) challenged the assumption that anxiety is unrelated to working memory updating in neutral conditions. They pointed out that the evidence for the claim relied mainly on span tasks primarily requiring storage rather than updating. Using an active updating task, they showed that trait worry was related to an updating impairment.

Two other features of the theory are significant (Eysenck & Derakshan, 2011). In addition to effects of anxiety on executive control of attention, the theory also proposes that anxiety increases the influence of stimulus-driven processes, such as involuntary attention to threat. Thus, effects of anxiety on selective attention to threat reflect the interaction of stimulus-driven and goal-directed attentional processes. Also, anxiety effects on performance may be moderated by strategy use. For example, anxious individuals may attempt to compensate for attentional deficits by increasing task-directed effort, maintaining processing effectiveness at the cost of lower processing efficiency.

Selective Attention

Selective attention refers to focusing attention on one of several stimulus sources, reflecting both stimulus salience and voluntary strategy for directing attention. Personality may influence the efficiency of selective attention. Some people may be faster to direct attention toward a designated stimulus source, or they may be better at resisting distraction from irrelevant stimuli. Also of interest is bias in selective attention; people may differ, for example, in their tendencies to direct attention toward potentially threatening stimuli.

Distractibility

Resistance to distraction can be assessed either by investigating environmental factors such as conversation, music and other forms of noise, or by introducing distracting stimuli into the task performed. Furnham and Strbac (2002) found that extraverts were more resistant to background noise than introverts across a range of tasks; extraverts may indeed prefer to study with music or other noise in the background. Similarly, extraverts are less vulnerable to distraction by music (Dobbs, Furnham & McClelland, 2011). Neuroticism and trait anxiety also tend to be associated with greater performance impairments in noisy environments (Wright et al., 2016) and with greater distraction from task-irrelevant stimuli (Berggren & Derakshan, 2014). Individual differences in distractibility might be attributed to working memory, although the evidence for such a mechanism is stronger for trait anxiety (Moran, 2016) than for extraversion (Waris et al., 2018), as previously described. Within Attentional Control Theory (Eysenck & Derakshan, 2011), vulnerability to distraction in anxiety follows directly from weaker inhibition, although other attentional processes may also be involved (Wright et al., 2016).

Anxiety, Threat and Bias in Selective Attention

Turning from general attentional deficits to cognitive bias, research on selective attention bias in anxiety was inspired by cognitive theories of emotional disorders (Wells & Matthews, 2015). Studies have compared clinical patients to controls, as well as investigating various relevant traits in nonclinical samples, including general anxiety, social anxiety, and fears of spiders and other specific threats. The general idea is that anxious individuals prioritize processing of negative-valent stimuli, especially if they are relevant to their particular concerns.

A variety of paradigms demonstrate that anxiety relates to preferential selection of threat stimuli (see Bar-Haim et al., 2007; Cisler & Koster, 2010; McNally, 2019). The emotional Stroop test requires the subject to name the ink color of a series of printed words. Anxious individuals are slow in color-naming threat words such as TORTURE or FAILURE, relative to neutral control words. Bias to some degree matches the individual's concerns; individuals who fear spiders may be especially slow in their response to words such as COBWEB or TARANTULA. A second common paradigm is the "dot-probe" technique. Stimuli are presented at two locations on a screen; one of which is a threat and the other is neutral. After the subject has identified the stimulus at one of the locations, a simple probe stimulus, such as a dot, is presented at either the attended or the unattended locations. Analysis of response time to the probe indicates how attentive the person is to each screen position. Typically, anxious individuals attend preferentially to locations in which the threat word is presented, as evidenced by relatively faster response when the probe is presented in the location of the threat.

Additional processing biases have also been linked to anxiety. Expectancy bias refers to overestimation of the likelihood of unpleasant consequences of an event, such as the probability that a spider will bite (Aue & Okon-Singer, 2015). Anxious individuals are also prone to interpret ambiguous sentences and facial expression negatively (interpretation bias: Chen, Milne, Dayman & Kemps, 2019). Further biases cited by Aue and Okon-Singer (2015) include memory bias and confirmation bias in decision-making. As these authors point out, the relationships between different biases have been underresearched. There are also unresolved psychometric issues such as poor reliability of some indices and failures to establish that alternate measures of bias actually converge with one another (e.g., Chapman, Devue & Grimshaw, 2017; McNally, 2019; Onie & Most, 2017). There are also concerns about the sensitivity of outcomes to various procedural factors such as stimulus presentation times, and whether a detection or discriminative response is required (Van Rooijen, Ploeger & Kret, 2017).

As with general attentional deficits, such observations raise a variety of theoretical questions. One issue is whether bias is unconscious, perhaps driven by early pre-attentive processes, or whether it reflects a voluntary strategy of active search for potential threats (Wells & Matthews, 2015). Unconscious bias is demonstrated by studies using subliminal stimuli that are not consciously perceived. Most reviews of tasks such as the emotional Stroop and dot-probe have concluded that unconscious bias is reliable (Bar-Heim et al., 2007; Cisler & Koster, 2010), although one meta-analysis of emotional Stroop effects failed to find any significant effect size in studies using subliminal stimuli (Phaf & Kan, 2007). Evidence for strategic influences on bias includes various contextual effects (Wells & Matthews, 2015), demonstrations of bias at relatively long stimulus durations (Cisler & Koster, 2010), delayed cross-trial bias (McKenna & Sharma, 2004) and modulatory effects of attentional control and emotion regulation strategies (Cisler & Koster, 2010).

Accounts of the information-processing bias for biases also differ. One approach is to identify multiple, fine-grained accounts of biases that may contribute to observed performance effects on specific tasks. For example, anxiety typically relates more reliably to slow disengagement of the focus of attention from threat stimuli, rather than to more rapid initial detection of threat (Leleu, Douilliez & Rusinek, 2014). In certain paradigms, an effect on initial engagement can also be demonstrated – but indices of engagement and disengagement biases are uncorrelated (Grafton & MacLeod, 2014). Such perspectives support a multiprocess view of bias; for example, Cisler and Koster's (2010) model includes automatic facilitation of threat detection, difficulty in disengagement linked to a deficit in attentional control, and additional, later-operating attentional avoidance process. However, as McNally (2019) discusses, recent work tends to deemphasize such granular accounts in favor of a more global

account based on weakness of top-down control of attention in regulating stimulus-driven capture of attention (e.g., Eysenck & Derakshan, 2011). Yet another perspective (Wells & Matthews, 2015) is that the dysfunctional metacognitions typical of anxiety and allied conditions promote top-down attention to threats.

Additional Tasks and Processes

Speeded Response

Speed of response selection and execution seems like a basic behavioral attribute that should be sensitive to personality. However, like other cognitive functions, variation in reaction time depends on a variety of factors. Stage models of RT discriminate a variety of separate processes ranging from encoding to motor response; moreover, RT is strategically regulated, as evidenced by the well-known speed-accuracy tradeoff function (see Matthews et al., 2000).

Although it is often assumed that traits including extraversion should be associated with a general pattern of fast, inaccurate performance, no such relationship is supported by the literature. Instead, a careful focus on different component processes is needed to demonstrate personality effects, and extraversion may have distinct effects on stimulus encoding and response execution stages. Ramm-sayer, Indermühle and Troche (2014) found that extraversion was associated with faster stimulus analysis, but was unrelated to the psychological refractory period, a slowing of response associated with response selection. Doucet and Stelmack (2000) used reaction time paradigms that provided separate measures of decision time (analyzing the stimulus and selecting the response), and movement time (executing the motor response of pressing the correct response key). Extraversion was found to relate only to faster movement time, linking this trait to a peripheral motor function. A review by DePascalis (2004) concluded that extraversion effects on motor response may relate to motoneuronal sensitivity, so that a purely neurological account of the finding may be advanced. DePascalis (2004) also discusses evidence on shorter-latency lateralized readiness EPs that index speed of response organization (i.e., a central rather than a peripheral process): Multiple component processes may contribute to observed personality effects.

Memory

Work done from an arousal theory perspective suggested that extraverts tend to have better short-term recall but also poorer long-term memory (Eysenck, 1967). A period of more cognitively-oriented research attempted to link the trait to component processes such as encoding (see Eysenck, 1981; Sanford & Fisk, 2009) and use of imagery (Rasmussen & Berntsen, 2010), but this approach has not been sustained in recent years. Applied cognitive research has been more productive, especially in relation to eyewitness testimony. For example, Areh and Umek (2007) had

participants view a short film depicting a robbery and tested their recall one week later. Contrary to previous findings on personality and long-term memory (Eysenck, 1967), extraverts recalled more material, and more true details. Earlier studies cited by Areh and Umek (2007) reported a similar extraversion advantage. Studies of false memories also show divergence of results from different paradigms. Sanford and Fisk (2009) had participants recall lists of words intended to prime a semantically related word not actually present in the list. Extraverts were more likely than introverts to falsely recall these "lures." However, in a study of recall of a mock crime film, extraverts were more resistant to false memories derived from postevent misinformation supplied by a cowitness (Doughty, Paterson, MacCann & Monds, 2017). Both stimulus materials (e.g., words versus video) and social context may moderate extraversion effects, but more systematic research is needed.

Neuroticism and trait anxiety tend to be modestly negatively associated with performance on a range of memory tasks (e.g., Munoz et al., 2013), in addition to the working memory effects already reviewed (Moran, 2016). As with the attentional deficits associated with these traits, these relationships can be broadly attributed to the impact of intrusive thoughts and worry (Munoz et al., 2013; Wells & Matthews, 2015). These findings are also compatible with the extensive neurobiological research literature on detrimental effects of stress on learning and retrieval of neutral material (Vogel & Schwabe, 2016). Much of the work in this area has used measures of traits for evaluative anxiety. For example, there is an extensive literature on test anxiety and cognitive processes supporting memory such as encoding, retrieval and organization (Zeidner, 1998). Interestingly, while test anxiety effects on working memory are well-established (Coy et al., 2011), the limited evidence available suggests it may not have much impact on long-term retention following learning (Fournier, Couret, Ramsay & Caulkins, 2017; Naveh-Benjamin et al., 1997).

Language and Speech

The psycholinguistics of personality has been somewhat neglected. Studies of trait anxiety and neuroticism have typically focused on vocal expressions of stress (e.g., Dietrich & Abbott, 2012), and the link between neuroticism and anxiety about learning a foreign language (Dewaele, 2013). Extraversion studies have made greater use of verbal performance data. Talkativeness is a central feature of extraversion, and, indeed, extraverts tend to have higher speech rates than introverts in social situations (Mehl, Gosling & Pennebaker, 2006). Dewaele and Furnham (1999) suggested several possible explanations for personality differences in speech production. In terms of information-processing, introverts may be hindered by limits on verbal working memory, and slower retrieval processes. Extraverts may also be more motivated to engage in conversation, they may have acquired greater

proceduralization of speech, and they may be less vulnerable to social anxiety that disrupts fluent speech. Extraverts may also be more willing to risk making errors during conversation in order to maintain fluency (i.e., speed–accuracy tradeoff). Subsequent research has tended to confirm these insights. For example, Beukeboom, Tanis and Vermeulen (2013) characterized introverts' speech as careful, precise and focused, whereas extraverts exhibit a more imprecise, loose and abstract style. Introverts also show greater physiological signs of voice stress than extraverts, specifically greater laryngeal muscle activity (Dietrich & Abbott, 2012).

Decision-Making

There are at least two research traditions in studies of personality and decision-making. The first is broadly concerned with risk-taking and impulsivity, and connects with neuropsychological studies of executive impairment. One commonly used task is the Iowa Gambling Task. Participants draw cards from four decks with different payoffs; participants must track the frequency and magnitudes of outcomes over time to determine which decks are advantageous in the long-term. Research has most commonly investigated single traits implicated in risk-taking such as impulsivity and sensation-seeking, but some research has addressed broad traits of interest here. For example, Hooper et al. (2008) found in a study of adolescents that neuroticism was associated with poorer performance, perhaps as a consequence of impaired executive control, but extraversion was not predictive.

In the Balloon Analogue Risk Task, participants inflate a (virtual) balloon with pumps of air until they choose to stop or the balloon bursts. Risk is indexed by number of pumps: Wang et al. (2017) reported that extraversion but not neuroticism was associated with this measure. From a theoretical standpoint, a key process in behavioral risk-taking tasks is temporal discounting, the tendency for participants to prefer a smaller immediate reward over a larger delayed rewards. Participants can be given a direct choice between the two types of reward. Extraverts tend to prefer the smaller immediate reward, and to show greater functional connectivity in a reward evaluation network centered on ventromedial prefrontal cortex (Civai, Hawes, DeYoung & Rustichini, 2016). From an applied perspective, such processes may contribute to extraverts' greater participation in risky activities (Graham et al., 2017). Indeed, both extraversion and neuroticism appear to be associated with poorer everyday decision-making, though perhaps for different reasons (Dewberry, Juanchich & Narendran, 2013). Extraverts also tend to be more confident than introverts in their judgments and decisions, which may lead to performance impairments when making decisions in unfamiliar contexts, such as cross-cultural settings (Matthews et al., 2018).

A second research tradition is the heuristics and biases approach introduced by Tversky and Kahneman (1974). It

defines an array of specific biases that can be demonstrated using simple behavioral tests. Research on biases can be somewhat atheoretical, except that bias is broadly attributed to failure of a deliberative System 2 system to override a more automatic System 1. There is a rather scattered literature that links traits to specific biases; for example, introverts may be somewhat more prone to anchoring bias than extraverts (Furnham, Boo & McClelland, 2012), and anxiety is associated with framing decisions in relation to loss (Lauriola & Levin, 2001). Indeed, similar to attentional bias, anxiety may generally encourage increased weighting of negative evidence in decisions, although such effects appear to be too context-sensitive to simply reflect an automatic bias (Matthews, Panganiban & Hudlicka, 2011).

Cognitive Patterning: Implications for Theory

As in the case of external stressors (Hockey, 1984), traits relate to a set of typically small biases in multiple, independent processes. Empirical findings such as those reviewed above support a description of how a particular trait relates to key cognitive functions such as those listed in Table 21.1, provided that task performance can be mapped to a construct such as attentional resources, selective attention bias, etc. Traditional psychobiological theories of personality (e.g., Eysenck, 1967) aimed to reduce the multifarious performance correlates of basic traits to individual differences in a small number of brain processes, such as cortical arousal. However, the cognitive patterning account of the data calls this approach into question. Specific personality effects appear to relate to qualitatively different mechanisms: some strategic (e.g., impulsive problem exit), some relating to basic component parameters of the cognitive architecture (e.g., short-term memory capacity), and some to nonsymbolic neural processes (e.g., motoneuronal excitability). A given theory might account for a subset of the observations, but neither arousal theory (Eysenck, 1967) nor RST (Corr & Krupić, Chapter 19) appears to provide a comprehensive explanation for the cognitive patternings associated with extraversion and neuroticism (Matthews, 2016; Matthews & Gilliland, 1999). Expressions of traits in performance are *distributed* across multiple mechanisms, which is a key observation for theory to explain. Next, I will discuss how different mechanisms for trait effects can be explained in three qualitatively different ways specified by cognitive science.

PERSONALITY AND PERFORMANCE: THREE LEVELS OF EXPLANATION

Cognitive patternings of the type illustrated in the previous section are intriguing but problematic. The research provides a tangle of multiple findings and interpretations. Some findings are reliable and support quite well-substantiated theoretical explanations, whereas others

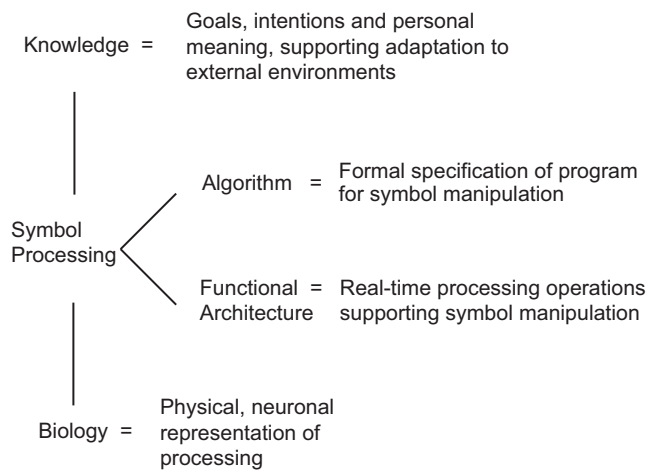


Figure 21.2 Trilevel explanatory framework for cognitive science

are more questionable empirically and theoretically. The dominant, psychobiological approach to explaining performance correlates of traits has been to seek a small number of master-processes that are expressed across a wide range of outcome variables. Reticulo-cortical arousal (Eysenck, 1967) and sensitivity of brain motivation systems (Corr & McNaughton, 2008) are the paradigmatic examples. The diversity of performance correlates of traits suggests a radically different perspective. That is, traits are associated with multiple processes, at different levels of abstraction from the brain, and no single process can explain all the various correlates of the trait. Thus, no single theory is hegemonic. Instead, we need to embrace “explanatory pluralism” (Dale, Dietrich & Chemero, 2009) such that different types of theory are utilized for explaining different performance outcomes. Of course, it is hoped that a limited number of key mechanisms will explain outcomes for any given trait, but mechanisms may include both basic neural processes and high-level cognitive processes (Matthews, 2000).

This section introduces the trilevel framework from cognitive science (Pylyshyn, 1999) that clarifies different types of explanation for the behavior of intelligent systems (see Figure 21.2). Some effects may be directly attributed to neural processes (biological level), some to basic parameters of the virtual cognitive architecture (symbol-processing or syntactic or level) and some to higher-level self-regulation guided by personal meaning (knowledge or semantic level). These three levels in part correspond to the different types of process of Figure 21.1, but provide a more explicit account of what kinds of explanatory construct are permitted at each level. Next, I will briefly review the strengths and limitations of these different perspectives.

Neurobiological explanations

The traditional paradigm for biological explanations of personality effects on performance is Eysenck’s (1967) arousal theory. The explanatory constructs are activity

levels in two brain circuits, a cortico-reticular circuit controlling alertness (linked to extraversion) and a cortico-limbic circuit for emotion (neuroticism). By invoking additional principles such as the Yerkes-Dodson Law and arousal effects on conditioning, Eysenck (1967) was able to explain associations between traits and a wide range of performance outcomes. Unfortunately, the theory is unsatisfactory due to lack of evidence from psychophysiology for a mediating role for cortical arousal (Matthews & Amelang, 1993), the discrediting of the Yerkes-Dodson Law in stress research (Matthews et al., 2000), and sundry other empirical and theoretical issues (Matthews, 2016; Matthews & Gilliland, 1999).

Other biologically based theories may do a better job of explanation, especially as they are compatible with mechanisms that are more precisely-specified than the vague and psychometrically elusive arousal construct. In RST (Corr & Krupić, Chapter 19) extraversion attaches to the Behavioral Approach System (BAS), and neuroticism to both the Behavioral Inhibition System (BIS) and Fight-Flight-Freeze System (FFFS), subject to some nuances beyond the present scope. Each system controls response to relevant reinforcement signals, based on the integrated functioning of multiple brain structures.

Hence, traits should interact with motivational factors to influence outcomes including learning and performance. There is indeed some supportive evidence, within various task paradigms (Corr & McNaughton, 2008), but it is questionable whether the theory’s predictions for performance are supported in detail (see Matthews, 2008b for a critique). However, RST has more room to grow than traditional arousal theory. Studies using fMRI have shown meaningful personality effects on regional brain activations in several of the task paradigms previously discussed in this chapter, including extraversion and working memory (Gray et al., 2005; Wacker & Smillie, 2015). Brain-imaging studies of anxiety and attentional bias using tasks such as dot-probe implicate structures for emotional response (e.g., amygdala), prefrontal areas supporting attentional control, and fronto-amygdalar connectivity (e.g., White et al., 2016). Candidate explanatory processes for neuroticism/anxiety effects identified in research of this kind include reduced functional connectivity limiting cognitive control over negative stimuli (Ormel et al., 2013), higher reactivity of the amygdala to punishment signals (Kennis et al., 2013), and increased fear learning and anticipation of aversive stimuli (Servaas et al., 2013). In some accounts, neurochemicals such as stress hormones also serve as explanatory constructs (Zuckerman, 2005).

Despite grounds for optimism, biological theories are vulnerable to two types of difficulty. First, although they identify important moderator factors including arousal and motivation, specific predictions of the theories have often been disconfirmed (Matthews, 2016; Matthews & Gilliland, 1999). Second, it is questionable whether, in principle, biological theories are even capable of

explaining the variation of personality effects with information-processing demands. (The issue, of course, is the extent to which the cognitive can be reduced to the physical.) Strategic and contextual effects that depend on the meaning the person attributes to the task are especially difficult for psychobiological theory to accommodate, such as the self-handicapping strategies used by some to test anxious students (Zeidner, 1998).

Personality effects that are not mediated by symbolic processes including language may be most readily described in terms of neurological functioning. Examples are individual differences in conditioning and in the startle reflex (Corr & McNaughton, 2008). Connectionist models may also contribute to integration of biological and cognitive explanations (Matthews & Harley, 1993; Matthews et al., 2000). Future progress requires a clear demarcation of which personality effects are open to direct biological explanation, and which effects are cognitively (symbolically) mediated.

Symbolic Information-Processing

The cognitive patternings of traits – i.e., biases in multiple, independent, processing components – support theories that link traits to individual differences in information-processing. The trilevel framework (Pylyshyn, 1999) requires that explanatory constructs correspond to symbolic data representations and a fixed set of computational operations similar to a programming language (the “algorithm”). Constructs may also define a “functional architecture” that allows symbol processing to operate in real-time, such as working memory. Traits may vary especially in relation to constructs of this kind.

Developing adequate explanations requires more than broad references to memory or attention, which may be little more than redescriptions of the data. The more productive research areas show a progression in three steps. The first step is simply to show that a broadly defined effect exists for a given task or category of task, such as an impairment in working memory, or a selective attention bias. The second step is to outline a broad theory that makes some general predictions. For example, the theory that bias in anxiety operates preattentively leads to the prediction that it should be evident even when stimuli are subliminally presented. The third step is to develop a detailed computational model, such as building a connectionist network that simulates the phenomenon in detail (Matthews & Harley, 1993, 1996; Matthews & Mackintosh, 1998). This step entails a transition from broad constructs such as resource availability or working memory to a precise specification of the processes sensitive to trait variation.

Most research areas have yet to progress much beyond the second step, but the desired research progression is clear. Application of the normal methods of cognitive psychology should yield detailed computational models for numerous specific effects of traits on parameters of

individual processing components. Parameters might include the speed with which a process is activated, or its likelihood of generating an error (see Matthews & Harley, 1993). At least a subset of models might be integrated with neuroscience via connectionism.

Supposing we have such a detailed specification of trait effects, what then? The enterprise has both advantages and limitations (Matthews, 2008a). On the positive side, accurate description of phenomena is necessary for personality science, and cognitive psychology provides a conceptual language that supports precision of description. We can also predict how personality effects are moderated by tasks and task parameters, e.g., how we should configure a selective attention task so as to observe bias related to anxiety.

On the negative side, information-processing accounts are incomplete. Sometimes, personality effects are strategic in nature. That is, there may be no personality effect on the parameters of information-processing, but different individuals use the functionality provided by the cognitive architecture to pursue different task goals, e.g., in terms of valuing speed over accuracy. To understand how personality impacts voluntary choice of strategy, we must look at high-level self-regulation and the self-knowledge that supports it. More generally, the information-processing approach risks losing sight of the forest for the trees. Describing a multitude of small biases in attention, memory and speeded response does not in itself tell us why extraverts are sociable and introverts are reserved. A different perspective is needed to understand the unity and coherence of traits (Matthews, 2018), as discussed in the final section of this chapter.

The Knowledge Level and Self-Regulation

A part of the cognitive patternings for the major traits reflects individual differences in strategy choice. For example, studies of problem-solving show that extraverts are prone to choose a solution impulsively, without due reflection (Weinman, 1987). Often, it is difficult to tell whether a given effect derives from basic parameters of processing or from strategy use. Effects of anxiety on attentional bias are a case in point. As previously discussed, both automatic biases and voluntary search for threat may contribute to bias. Careful experimentation is required to test which type of mechanism is operative in any given instance. We can build processing models for strategic bias. For example, Matthews and Harley (1996) advanced a connectionist model of the emotional Stroop effect in which strategic threat monitoring was modeled as activation of a “task demand” unit which modulates the sensitivity of the network to threat stimuli.

Information-processing models of strategy use are useful descriptively, but they cannot explain why personality influences top-down regulation of processing. To do so, we need a “knowledge-level” analysis (Newell, 1982). That is, we need to understand how personality

affects the personal meanings that people attribute to tasks contexts, the goals they set for themselves, and what values and social norms moderate behavior. Such constructs are acceptable for explanation at the knowledge level. For example, test anxiety might be attributed to the student perceiving tests as a setting for being humiliated, setting a goal of doing well enough to preserve self-respect, and valuing blending in with the other students.

Such issues are commonly addressed by self-regulative theories of personality (e.g., Carver & Scheier, 2005; Carver & Scheier, Chapter 22; Robinson & Sedikides, Chapter 24; Wells & Matthews, 2015). Behavior is driven by self-representations that activate goals such as reducing a perceived discrepancy between actual and ideal status. In the performance context, the person is typically motivated to maintain some personally acceptable level of performance, to maintain self-esteem and a sense of control and to appear competent to others. Traits may influence the meanings that shape these motivations. For example, neurotic individuals tend to read threat into innocuous events, to perceive themselves as ineffective in coping and to attribute importance to their own negative thoughts, images and metacognitions (Wells & Matthews, 2015). Processing biases are likely to shape self-knowledge but self-beliefs cannot be directly reduced to parameters of the cognitive architecture. Thus, information-processing biases should be understood within the context of the different meanings that individuals “read into” performance environments. Self-regulative explanations may also be necessary for understanding contextual moderators. For example, to understand extraverts’ susceptibility to misinformation in eyewitness testimony (Doughty et al., 2017), we might need to address the social motivations supporting attention to false statements made by others. In fact, given the social nature of the self (Robinson & Sedikides, Chapter 24), the knowledge level may also be suitable in many cases for explaining associations between traits and social behaviors. Limitations of knowledge-level explanations include their neglect of detailed mechanisms for performance effect, which may be better captured at lower levels of explanation, and difficulties in assessing attribution of meaning and personal goals other than through fallible self-report.

Implications for Trait Theory

Thus far, I have claimed that personality–performance associations are distributed in two ways. First, they are distributed *between* levels of explanation. Major traits are associated with individual differences in distinct neurological, computational and self-regulative processes; different performance phenomena will require different types of explanation. Second, they are distributed *within* levels of explanation. The major traits appear to be correlated with multiple processes at each level, though multiple processes may sometimes be grouped under broad labels

such as reward sensitivity or executive control. Accepting the basic complexity of trait expressions improves the psychological science of personality through matching performance phenomena to appropriate explanations. Within the basic stance of explanatory pluralism, there is also some scope for integrating explanations across levels. For example, information-processing models of attentional bias in anxiety can be complemented downwards with accounts of underlying neural systems (Eysenck & Derakshan, 2011) and upwards with reference to strategic control and metacognitive factors (Wells & Matthews, 2015).

However, describing and explaining cognitive patternings for traits leaves open three important issues. First, it raises awkward questions about trait coherence (Matthews, 2018). If traits correspond to multiple, distinct biases in processing at multiple levels, is there really any unitary trait to investigate? Instead of trait anxiety, perhaps we should be investigating threat-searchers (fast engagement), threat-fixaters (slow disengagement), threat-attributors (interpretation bias), etc., that is to say, treating personality on a much more granular basis. Second, the cognitive patterning approach says little about the adaptive significance of trait (in the sense of costs and benefits in everyday life, not the evolutionary sense). Effects seen under laboratory conditions do not necessarily translate into consequential outcomes; for example, social anxiety reliably biases processing of threatening facial stimuli only when stimulus durations are short, because the brain rapidly registers the lack of real threat posed by a photograph (Staugaard, 2010). More important in real-life are acquired skills for capitalizing on opportunities and nullifying threats in specific contexts (Wells & Matthews, 2015). Thus, basic cognitive functions such as focusing attention may influence real-life outcomes indirectly, though influencing skill acquisition, as much as via their direct impact (Matthews, Wohleber & Lin, 2020). Third, performance may fall short of actual competence because of motivational and emotional factors, such as lack of effort and distraction due to worry. Laboratory studies in part address such issues through investigating motivational-affective moderators, e.g., in studies showing that anxiety impairs performance when a stressor is imposed (Spielberger, 1966). However, such research provides only limited insight into the much wider range of real-life contextual factors that may variously inspire peak performance or prompt performance shortfalls.

The cognitive-adaptive theory of traits (CATT: Matthews, 1997, 1999, 2008, 2016, 2018) attempts to address these issues and specify what performance correlates of traits might tell us about the adaptive benefits and costs of traits. Its basis is the cognitive-adaptive triangle illustrated in Figure 21.3. Individual differences in skill are the immediate influence on adaptive outcomes, but their effectiveness also depends on motivations, emotions, and allied cognitive factors such as self-efficacy. The three points of the triangle interact via feedback loops; for

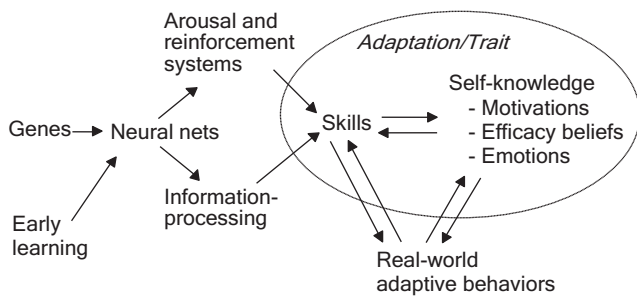


Figure 21.3 Cognitive-adaptive processes supporting personality traits

example, high skill leads to better outcomes, building self-efficacy which motivates further skill enhancement. The psychobiological and cognitive correlates of traits typically studied in the laboratory exert more distal influences on adaptation. Basic information-processing components may speed or slow skill learning; for example, working memory is critical for early stages of skill acquisition (Anderson, 2009). Neurological attributes have similar modulatory effects on learning depending on the reinforcers and level of stimulation present in the environment. However, both cognitive and neurological influences work so as to introduce often modest biases rather than directly determining level of accomplishment.

CATT identifies the coherence of traits with adaptation rather than any specific master-process such as arousability. The multiplicity of processes associated with any given trait supports a common adaptive goal, typically realized in a specific set of environments. Thus, extraversion is associated with adaptation to demanding social environments which require social skills such as keeping track of multiple conversations and influencing others. Objective skills are accompanied by greater confidence and self-efficacy (Guerin et al., 2011) as well as greater exposure to social environments (e.g., larger social networks: Pollet & Roberts, 2011). Basic neural and information-processing attributes of extraversion such as advantages in divided attention, language fluency and stress tolerance support acquisition of the skill, and thus tend to influence adaptation indirectly rather than directly. A downside of the trait is excessive impulsivity and risk-taking in social settings (Graham et al., 2017). Similarly, neuroticism represents adaptation to social threat through avoidance and anticipation, as opposed to direct management of threat (Matthews, 2004). The various neurological and cognitive characteristics of the trait linked to threat sensitivity provide a kind of early-warning radar that when adaptive supports preparedness but can be expressed maladaptively through exaggeration of threat and avoidance of feared environments that blocks skill acquisition (Wells & Matthews, 2015).

CONCLUSION

This review illustrates the diversity and scope of research on personality traits and human performance. A wide

range of traits correlate with objective performance measures in basic and applied contexts. Theoretical accounts range from molecular accounts of individual differences in neural functioning and information-processing to molar perspectives on variation in real-world social functioning. The accomplishments of performance research can be summarized with respect to the different aims introduced previously.

- *Trait-mapping.* Evidence that traits predict objective performance supports the key assumption that traits are real personal attributes and not arbitrary social constructions. Associations between anxiety and cognitive bias and between extraversion and risk-acceptance support the validity of key elements of trait descriptions. For the more researched traits, we can also begin to construct more detailed cognitive patternings. As Hans Eysenck recognized, it is also important to control for situational modifiers of trait effects.
- *Theory-testing.* Psychobiological theory provides a template for how performance measures can be used for hypothesis testing. Outcomes of testing have been mixed thus far, but it is reasonable to anticipate progressive theory development through normal scientific procedures. Anxiety research illustrates how cognitive constructs such as working memory, executive control and selective attention can provide the basis for information-processing theory. Indeed, the trilevel explanatory theory of cognitive science provides the means to organize different levels of theorizing and selecting the type of theory appropriate for a given scientific question.
- *Construct-indexing.* The use of performance measures to define latent, implicit personality traits is a new and promising frontier for research. Psychometric issues such as convergence of alternate measures remain to be tackled. It also remains to be seen how the typical context-sensitivity of performance measures can be accommodated within measurement models.
- *Applications: Clinical and educational psychology.* Performance research is informative about biases and deficits in information-processing that may contribute to clinical disorder and to poor adjustment at school. In addition to supporting clinical diagnosis and treatment decisions, recent work has explored performance tasks as means for remediating dysfunctional processing through training, notably in studies of attentional bias modification.
- *Applications: Organizational psychology.* Personality assessment continues to provide a useful if limited role in personnel selection, and performance studies help to support validity of this approach. Personality research also has considerable potential to contribute to enhancing selection and training in new work domains based on information technology such as unmanned vehicle operation, cybersecurity and utilizing artificial intelligence.

Accomplishments of performance research must be set against continuing challenges and issues, many of which relate to the complexity and lack of cohesion of the field, uncertainty over the right “grain size” for data and theory, and difficulties in generalizing from laboratory findings to real-world contexts. Specifically, the following challenges remain to be addressed.

- *Granularity of theory.* It is often unclear whether information-processing models should be expressed in terms of broad constructs such as resources or working memory, or specific processes such as disengagement of attention from a stimulus. As discussed above, anxiety research has wavered between micro- and macro-level concepts. There is a similar dilemma for cognitive neuroscience, i.e., whether to work with broad “conceptual nervous system” constructs such as arousability or reinforcement sensitivity, or whether to ground traits in properties of specific brain pathways or anatomical regions. The advantages of a molecular approach are greater precision of hypotheses and scope for developing computational models. By contrast, the molar approach affords greater parsimony and flexibility of application, including prediction of performance in real-world settings where fine-grained delineation of processes is difficult to accomplish. A possible solution is validating multilayered models that interrelate constructs at different levels of generality.
- *Mapping tasks to processes.* The design of performance tasks is central to cognitive psychology. Typically, variants of the task are designed to isolate some key process; for example, comparing response times on color-congruent and incongruent versions of the Stroop test to demonstrate a response inhibition process. The approach is promising to personality theorists because traits can be linked to individual differences in specific processes. However, the approach can break down where there are uncertainties over task-process mapping, which may arise for several reasons. Performance outcomes are shaped by multiple peripheral and central processes, and teasing them apart often rests on assumptions that may be questionable, such as additive-factors logic in reaction time studies. Task design is often ad hoc as individual researchers introduce their own modifications. Even small changes in procedure may change process-outcome mappings, and generate inconsistency across studies. Contextual factors such as stress, workload and even social influence can have similar effects. Stronger, better-validated cognitive models of task performance would mitigate such issues, as would greater awareness of psychometric issues among cognitive psychologists. Greater use of computational modeling to make explicit the assumptions of cognitive modeling is highly desirable, and, indeed, necessary for an adequate symbol-processing level explanation.
- *Generalization to the real-world.* There is no guarantee that laboratory findings on trait correlates of performance

generalize to the real world. Factors threatening generalization include neglect of social context, neglect of the importance of learnt skills for adaptation, and neglect of self-regulative factors that may introduce gaps between competence and performance. As expressed in CATT, it is important to examine links between traits and skill acquisition and execution in specific contexts. Existing research suggests a range of relevant contexts including risk-taking in everyday life (extraversion), social skills for influencing others (extraversion), avoidance of feared encounters (neuroticism) and decision-making under stress (neuroticism). A focus on modeling individual differences in skilled performance in such settings may be the best research strategy for understanding the performance correlates of personality traits.

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22

Self-Regulation and Control in Personality Functioning

CHARLES S. CARVER* AND MICHAEL F. SCHEIER

INTRODUCTION

Personality has been viewed from many different angles (Carver & Scheier, 2017a). This chapter outlines a view in which personality is considered through the lens of feedback control processes. We address two layers of control processes, managing two distinguishable aspects of behavior. One function of the layers is to permit people to handle multiple tasks across time. More specifically, they help transform simultaneous motives into a stream of actions that shifts repeatedly from one goal to another.

The viewpoint described here has long been identified with the term *self-regulation* (Carver & Scheier, 1981, 1998). That term has different connotations in different contexts. When we use it, we intend to convey the sense of purposive processes, involving self-corrective adjustments as needed, and the sense that the adjustments originate within the person.

This view is not an approach to defining personality but a way of talking about how personality becomes expressed in behavior. It focuses on general principles concerning how people negotiate life. Although it certainly is possible to examine individual differences within this framework, we focus here on broad functions we believe are part of everyone's personality.

BEHAVIOR AS GOAL DIRECTED AND FEEDBACK CONTROLLED

A basic concept here is the feedback loop. An easy way to approach it is to start with the more intuitive concept of a goal. Everyone knows generally what a goal is: a person's mental representation of a condition the person is trying to attain. People have many goals, at varying levels of abstraction and importance. Most can be reached in many ways, and a given action can create movement toward very different goals.

Feedback Processes

Approaching a goal illustrates the principle of feedback control. A feedback loop involves four subfunctions (Miller, Galanter & Pribram, 1960; MacKay, 1966; Powers, 1973; Wiener, 1948): an input, a reference value, a comparison, and an output (Figure 22.1). Think of the input as perception; input is information about present circumstances. A reference value is a goal. The input is compared to the reference value. Any discrepancy detected by the comparison is called an "error signal." We treat the output here as behavior, but sometimes the behavior is internal.

If the comparison detects no discrepancy, the output remains as it was. How detection of a discrepancy affects output depends on what kind of loop it is. In a discrepancy reducing loop, the output acts to reduce the discrepancy. Such an effect is seen in attempts to reach a valued goal, maintain a desired condition or conform to a standard. There also are discrepancy enlarging loops, which avoid the reference value rather than approach it. The value in this case is a threat or an "anti-goal," for example, a feared or disliked possible self (Ballard, Yeo, Vancouver & Neal, 2017; Carver, Lawrence & Scheier, 1999; Ogilvie, 1987). A discrepancy enlarging loop senses existing conditions, compares them to the anti-goal, and enlarges the discrepancy.

The effects of avoidance processes in living systems are typically constrained by discrepancy reducing processes. Put differently, acts of avoidance often lead into acts of approach. Imagine a person escaping a threat. There may be a salient goal to approach that keeps the person distant from the threat. Thus, the tendency to avoid the threat is joined by the tendency to approach that goal. This pattern of dual influence defines active avoidance: An organism facing a feared stimulus picks a safer location to escape to, and approaches that location.

Feedback loops are ubiquitous in living systems. The feedback concept is most often applied to physiological systems, such as the homeostatic systems that maintain blood pressure and body temperature. We have argued, however, that the same structural elements underlie the behaviors that are of interest to personality psychologists.

* Charles S. Carver died while this chapter was in production. During the course of his career, he contributed substantially to the fields of social, health, and personality psychology, and more recently to the field of psychopathology. He will be deeply missed by his family, friends, and colleagues.

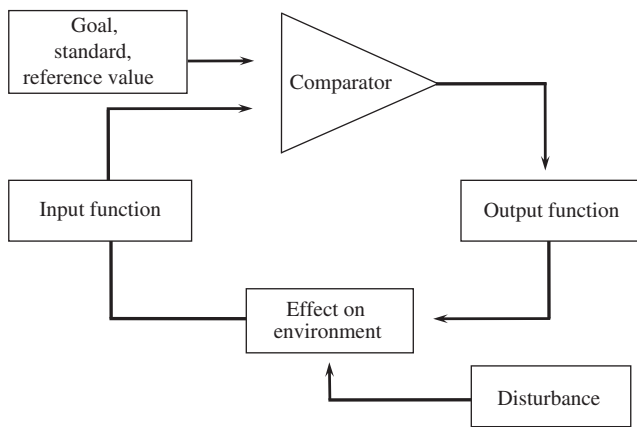


Figure 22.1 Schematic depiction of a feedback loop, the basic unit of cybernetic control. In a discrepancy reducing loop, a sensed value is compared to a reference value or standard, and adjustments occur in an output function (if necessary) that shift the sensed value in the direction of the standard. In a discrepancy enlarging loop, the output function moves the sensed value away from the standard.

Remember that personality emerges from a physical body that stays alive through feedback processes. Nature is a miser. If the same structure that ensures continued life can also yield more complex phenomena, there is no need for a new kind of structure – the existing one will be used.

A few more points: It is easy to portray the elements of a feedback loop conceptually. In some cases (e.g., in electronic systems), it is also easy to point to each element. In other cases, this is harder. In particular, some feedback processes have no explicit representation of a reference value. The system regulates around a value, but no value is represented as a goal (Berridge, 2004; Carver & Scheier, 2002).

Another point concerns using homeostasis as an illustration of feedback processes. Some people infer from this that feedback loops act only to create and maintain steady states, but this is incorrect. Some goals *are* static end states. But others are dynamic and evolving (e.g., the goal of taking a week's vacation, the goal of raising a child to become a good citizen). In such cases, the "goal" is the process of traversing the changing trajectory of the activity, not just to be at the end point. Feedback processes apply perfectly well to moving targets (Beer, 1995).

Finally, goals vary in abstractness. You may have the goal of being a good citizen, but you can also have the goal of recycling refuse, a narrower goal that contributes to being a good citizen. To recycle entails concrete goals, such as placing newspapers into containers and moving them to a pickup location. Thus, building on the work of Powers (1973), it is often said that goals form a hierarchy (Carver & Scheier, 1998; Toates, 2006; Vallacher & Wegner, 1987). Abstract goals are attained by the attaining of the concrete goals that help define them.

FEEDBACK AND AFFECT

Personality is manifest partly in behavior – how people spend their time and energy. Personality is also manifest

in affects, feelings, emotions. What is affect? Where does it come from? Affect pertains to one's desires and whether they are being met (Clore, 1994; Frijda, 1988; Ortony, Clore & Collins, 1988). But what is the internal mechanism by which feelings arise?

Answers range from neurobiological (e.g., Davidson 1992) to cognitive (Ortony et al., 1988). We posed an answer that focuses on what appear to be some of the functional properties of affect (Carver & Scheier, 1990, 1998). We used feedback control once more as an organizing principle, but now focusing on a different quality than before.

We suggest that feelings arise as a consequence of another feedback process that operates simultaneously with the behavior-guiding process and in parallel to it. It operates automatically and without supervision. The easiest characterization of what this second process is doing is that it is checking on how well the first process is doing. The input for this second loop thus is the *rate of progress in the action system over time*.

Consider this physical analogy. Action implies change between states. Thus, behavior is analogous to distance. If the action loop controls distance, and if the affect loop assesses the action loop's progress, then the affect loop is controlling the psychological analog of velocity, the first derivative of distance over time. If this analogy is meaningful, the perceptual input to the affect loop would be the first derivative over time of the input used by the action loop.

Input alone does not create affect; a given rate of progress has different affective effects in different contexts. We think this input is compared to a reference value (Frijda, 1988), as in other feedback systems. In this case, the reference is an acceptable or expected rate of behavioral discrepancy reduction. As in other feedback loops, the comparison checks for deviation from the standard. If there is a discrepancy, the output function changes.

We believe the error signal in this loop is manifested as affect, a positive or negative valence. A rate of progress below the criterion creates negative affect. A rate exceeding the criterion creates positive affect. In essence, feelings with a positive valence mean you are doing better at something than you need to, and feelings with a negative valence mean you are doing worse than you need to (for detail, see Carver & Scheier, 1998).

What determines the criterion value for the velocity loop? There surely are many influences. Framing the action to oneself in different ways may change the criterion (Higgins & Brendl, 1995). If the activity is unfamiliar, what is used as a criterion probably is quite flexible. If the activity is familiar, however, the criterion is likely to reflect accumulated experience, an expected rate. Whether "expected" or "desired" or "needed" rate is more accurate as a depiction may depend greatly on the context.

The criterion can also change. We think that change in rate criterion in a relatively familiar behavior domain occurs relatively slowly. Repeated overshoots result automatically in an upward drift, repeated undershoots result

in a downward drift (see Carver & Scheier, 2000, for greater detail). A somewhat ironic consequence of such a recalibration would be to keep the balance of a person's emotional experience (positive to negative, aggregated across a span of time) relatively similar, even when the rate criterion changes considerably.

Two Kinds of Behavioral Loops, Two Dimensions of Affect

So far we have focused on approach loops, but the same logic applies to avoidance loops. We just said that positive feeling exists when a behavioral system is making rapid progress *doing what it is organized to do*. Some systems are organized to approach. Others are organized to avoid. If such a system is making rapid progress attaining its ends, there should be positive affect. If it is doing poorly, there should be negative affect. Thus, we believe that both approach and avoidance have the potential to induce positive feelings (by doing well), and that both have the potential to induce negative feelings (by doing poorly).

But doing well at approaching an incentive is not quite the same as doing well at moving away from a threat, and there may be differences between the two positives, and between the two negatives. As have Higgins (e.g., 1987, 1996) and his collaborators, we argue for two dimensions of affect, one arising during approach, the other arising during avoidance (Carver, 2001; Carver & Scheier, 1998). Approach yields such positive affects as elation, eagerness and excitement, and such negative affects as frustration, anger and sadness (Carver, 2004). Avoidance yields such positive affects as relief, serenity and contentment and such negative affects as fear, guilt and anxiety.

Merging Affect and Action

This description implies a natural connection between affect and action. That is, if the input of the affect loop is a rate of progress in action, the output function of the affect loop must be a change in rate of that action. Thus, the affect loop has a direct influence on what occurs in the action loop.

Some changes in rate are straightforward. If you are lagging behind, you try harder. Some changes are less straightforward. The rates of many "behaviors" reflect not the pace of physical action but choices among potential actions. For example, increasing your rate of progress on a project may mean choosing to spend a weekend working on it rather than playing with family and friends. Increasing your rate of being kind means choosing to do an act that reflects kindness, when an opportunity arises. Thus, change in rate must often be translated into other terms, such as concentration, or allocation of time and effort.

The idea of two layers of feedback systems functioning together turns out to be quite common in control engineering (e.g., Clark, 1996). Engineers have long recognized that having two systems – one controlling position, one

controlling velocity – permits the device they control to respond in a way that is both quick and stable, without overshoots and oscillations.

The combination of quickness and stability in responding is desirable in the kinds of devices engineers deal with, but it is also desirable in living beings. A person who has very reactive emotions overreacts and oscillates behaviorally. A person who is emotionally unreactive is slow to respond even to urgent events. A person whose reactions are between those extremes responds quickly but without overreaction and oscillation.

For biological entities, being able to respond quickly yet accurately confers a clear adaptive advantage. We believe this combination of quick and stable responding is a consequence of having both behavior-managing and affect-managing control systems. Affect makes people's responses quicker (because this system is time sensitive); as long as the affective system is not overresponsive, the responses are also stable.

UNEXPECTED IMPLICATIONS

This model differs in several ways from other views of the meaning and consequences of affect. The argument that affect reflects the error signal from a comparison in a feedback loop has a very counterintuitive implication concerning positive affect (Carver, 2003).

As noted, if affect reflects the error signal in a feedback loop, affect is a signal to adjust rate of progress. This would be true whether the rate is above the mark or below it – that is, whether affect is positive or negative. For negative feelings, this notion is not at all controversial: Indeed, it is quite intuitive. The first response to negative feelings is usually to try harder. (For now we disregard the possibility of quitting; we return to it later.) If the person tries harder – and assuming more effort (or better effort) increases the rate of intended movement – the negative affect diminishes or ceases.

What about positive feelings? Here prediction is less intuitive. In this model, positive feelings arise when things are going better than they need to. But the feelings still reflect a discrepancy, and discrepancy reducing loops minimize discrepancies. Thus, such a system "wants" to see neither negative nor positive affect. Either quality (deviation from the standard in either direction) would lead to changes in output that would eventually reduce it.

This view argues that people who exceed the criterion rate of progress (and thus have positive feelings) will automatically tend to reduce subsequent effort in this domain. They will "coast" a little (Frijda, 1994, p. 113) – not necessarily stop, but ease back, such that rate of progress subsequently returns to the criterion. The impact on subjective affect would be that the positive feeling itself is not sustained for very long. It begins to fade.

Expending greater effort to catch up when behind, and coasting when ahead, are both presumed to be specific to the goal domain to which the affect is attached. Usually

this is the goal from which the affect arises in the first place (for exceptions, see Schwarz & Clore, 1983). We are not arguing that positive affect creates a tendency to coast *in general*, but rather that it creates a tendency to coast with respect to the specific activity producing the positive feelings.

This is a kind of “cruise control” model of affect. That is, a system of this sort would operate in the same way as a car’s cruise control. Coming to a hill slows you down; the cruise control responds by giving the engine more fuel, speeding back up. If you come across the crest of a hill and roll downward too fast, the system cuts back the fuel and the speed drags back down.

Both in a car and in behavior, doing something about going too slow requires adding resources. Doing something about going too fast requires only reducing resources. Your car’s cruise control does not engage the brakes, it just reduces fuel. The car coasts back to the velocity set point. Thus, the effect of the cruise control on a high rate of speed depends in part on external circumstances. If the road down is steep, the car may exceed the cruise control’s set point all the way to the valley below.

In the same way, people usually do not react to positive affect by actively trying to make themselves feel less good (though there are exceptions). They just ease back a little on resources devoted to the domain in which the affect has arisen. The positive feelings may be sustained for a long time (depending on circumstances), as the person coasts down the subjective analog of the hill. Eventually, though, the reduced resources cause the positive affect to diminish. Generally, then, the system acts to prevent great amounts of pleasure as well as great amounts of pain (Carver, 2003; Carver & Scheier, 1998).

To test the idea that positive affect leads to coasting, a study must assess coasting with respect to the same goal as underlies the affect. Many studies have created positive affect in one context and assessed its influence on another task. However, that does not test this question. We are aware of three sources of evidence bearing on this idea. One study found that professional basketball teams were more likely to lose after a playoff victory than after a defeat (Mizuruchi, 1991). Although consistent with coasting after winning, this finding is also ambiguous. It is impossible to tell whether the pattern reflects coasting after success or renewed effort after failure or both. Less ambiguously, a series of three studies by Louro, Pieters and Zeelenberg (2007) found consistent evidence that positive affect induces coasting, but only when goal attainment was imminent.

Finally, an experience-sampling study had participants make a set of ratings pertaining to each of three goals, three times a day, for twenty-one days (Fulford, Johnson, Llabre & Carver, 2010). The ratings included reports of effort toward the goal during the previous time block, perceived progress toward it during the previous time block and expected progress in the forthcoming time

block. Multilevel modeling revealed that instances of progress exceeding expectation were followed by reduction in effort toward that goal in the next time period.

Coasting and Multiple Goals

This last study raises another point. Why would a process be built in that limits positive feelings – indeed, dampens them? After all, people do seek pleasure and avoid pain. We believe the adaptive value of a tendency to coast comes from the fact that people have multiple goals at any given time (Carver, 2003; Carver & Scheier, 1998; Frijda, 1994). Given multiple goals, people generally do not optimize on any one of them, but rather “satisfice” (Simon, 1953) – do a good enough job on each to deal with it satisfactorily.

A tendency to coast would virtually define satisficing regarding that particular goal. That is, reduction of effort prevents you from attaining the best possible outcome on that goal. A tendency to coast would also make it easier to satisfice on a broader set of goals. That is, if progress in one domain yields a tendency to coast in that domain, it would be easy to shift to another domain, at little or no cost. This would help ensure satisfactory goal attainment in the other domain and ultimately across multiple domains.

Continued pursuit of one goal without letup, in contrast, can have adverse effects. Continuing a rapid pace in one arena may sustain positive affect in that arena, but by diverting resources from other goals it also increases the potential for problems elsewhere. Indeed, a single-minded pursuit of yet-more-positive feelings in one domain can even be lethal, if it causes the person to disregard threats looming elsewhere.

PRIORITY MANAGEMENT AS A CORE ISSUE IN SELF-REGULATION

This line of argument begins to implicate positive feelings in a broad function within the organism that deserves further consideration: shifting from one goal to another as focal in behavior (Dreisbach & Goschke, 2004; Shallice, 1978). This critical phenomenon is often overlooked. Many goals are under pursuit simultaneously, but only one can have top priority at a given moment. People need to shift flexibly among goals.

The problem of priority management was addressed many years ago by Simon (1967), who pointed out that any entity with many goals needs a way to rank them for pursuit and a mechanism to change rankings as necessary. He argued as follows: Most of people’s goals are largely out of awareness at any given moment. Only the one with the highest priority has full access to consciousness. Sometimes events occur during the pursuit of that top-priority goal that create problems for another goal that currently has a lower priority. Indeed, the mere passing of time sometimes creates a problem for the second goal, by

making its attainment less likely. If the second goal is also important, an emerging problem for its attainment needs to be registered and taken into account. If the situation evolves enough to seriously threaten the second goal, some mechanism is needed for changing priorities, so that the second goal replaces the first one as focal.

Negative Feelings and Shifting Prioritization

Simon (1967) proposed that emotions are calls for reprioritization. He suggested that emotion arising with respect to a goal that is out of awareness eventually causes people to interrupt their behavior and give that goal a higher priority than it had. The stronger the emotion, the stronger is the claim being made that the unattended goal should have higher priority than it now has. The affect is what pulls the out-of-awareness into awareness.

Simon's analysis applies readily to negative feelings such as anxiety and frustration. If you promised your spouse you would go to the post office this afternoon and you have been too busy to go, the creeping of the clock toward closing time can cause an increase in frustration or anxiety (or both). Neither affect would pertain to the work you are doing, however. They would pertain to a potentially unmet obligation and a potentially angry spouse. The stronger the affect, the more likely it is that the goal it relates to will rise in priority until it comes fully to awareness and becomes the focal reference point for behavior.

Positive Feelings and Reprioritization

Simon's discussion focused on cases in which a nonfocal goal demands a higher priority than it now has and *intrudes* on awareness. By strong implication, his discussion dealt only with negative affect. However, there is another way in which priority ordering can shift: The currently focal goal can *relinquish its place*. Simon addressed this possibility obliquely, by noting that goal completion terminates pursuit of that goal. However, he did not address the possibility that an as-yet-unattained goal might yield its place in line.

Positive feelings may also represent a reprioritization cue, but a cue to *reduce* the priority of the goal to which the feeling pertains. That is, the function Simon asserted for affect may pertain to affects of both valences. Positive affect regarding an act of avoidance (relief or tranquility) indicates that a threat has dissipated, no longer requires as much attention as it did and can now assume a lower priority. Positive feelings regarding an act of approach (happiness, joy) indicate that an incentive is being attained. If it is fully attained, effort can cease, as Simon noted; if it is not yet attained, the affect is a signal that you could temporarily put this goal aside, because you are doing so well (Carver, 2003).

If a focal goal diminishes in priority, what follows? It depends partly on what else is waiting in line. It also depends partly on whether the context has changed in

any important way while you were busy with the focal goal. That is, opportunities to attain incentives sometimes appear unexpectedly, and people put aside their plans to take advantage of them (Hayes-Roth & Hayes-Roth, 1979; Payton, 1990). It seems reasonable that people with positive affect should be more prone to shift goals at this point if something else needs fixing or doing (regarding a next-in-line goal or a newly emergent goal) or if an unanticipated opportunity for gain has appeared.

Sometimes the next item in line has fairly high priority in its own right. Sometimes the situation has changed and a new goal has emerged for consideration. On the other hand, sometimes neither of these conditions exists. In that case, no change would occur, because the downgrade in priority of the focal goal does not make it lower than the priorities of the alternatives. Positive affect does not *require* a change in direction. It simply sets the stage for such a change to be more likely. Indirect support for this general line of reasoning is reviewed elsewhere (Carver, 2003).

We should be clear that we are not claiming that affect is the only source of shifts in goal prioritization. Changes in context can also produce shifts, because different contexts have been linked in the past to different goals. The resulting associations in memory mean that a change in context can prompt the emergence of a different goal via those associations. Our position is simply that affect is part of the prioritization process.

Effortfully Evading Automatic Functions of Affect

We have been describing what we see as a set of automatic effects of emotions in priority management. However, it should also be noted that people learn to intervene in these effects, by actively regulating their emotions (Gross, 2007). For example, suppose you are an athlete trying to perform in a timed event. Suppose you get ahead quickly. By our reasoning, if you therefore feel happy, you may relax a little. But relaxing – and becoming vulnerable to distraction – is undesirable in this situation. How can you prevent that from happening?

A common strategy for athletes is to try to prevent feelings of pleasure from arising. One strategy is to maintain an extremely high level of aspiration, so it could hardly ever be exceeded (thus no positive affect). Another strategy is to artificially generate anger, taking the place of any pleasure that exists in being ahead. Yet another strategy is to remind yourself that your lead is small and you are still vulnerable, or even to pretend that you are not really ahead at all.

The point more generally is that there often are ways to trick the automatic system of affective response by reframing the situation in various ways. If the affective reaction itself can be changed, the resulting impact on priority management should also change.

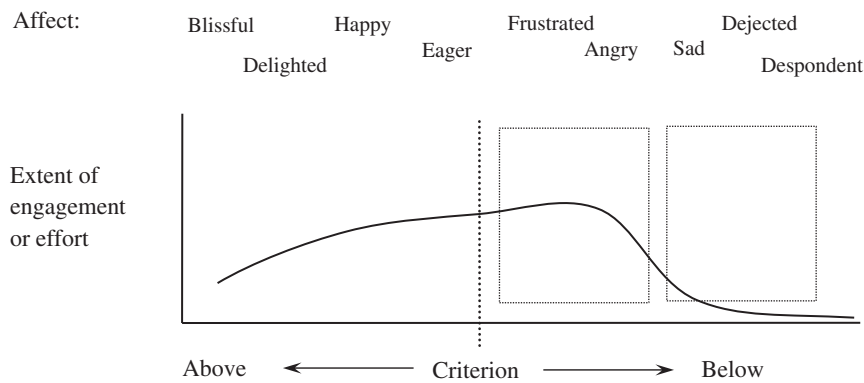


Figure 22.2 Hypothesized approach-related affects as a function of doing well versus doing poorly compared to a criterion velocity. Adapted from C. S. Carver, Negative affects deriving from the behavioral approach system. *Emotion*, 2004, 4, 3–22.

Priority Management and Depressed Affect

One more aspect of priority management concerns the idea that goals sometimes are not attainable and are better abandoned. We argue that sufficient doubt about goal attainment results in disengagement from efforts to reach the goal, and even from the goal itself (Carver & Scheier, 1981, 1998). This is a kind of priority adjustment, in that the abandoned goal is now receiving an even lower priority than it had before. That is, no behavior is being directed to its attainment at all.

How does this sort of reprioritization fit into the picture sketched up to here? At first glance, the idea that doubt about goal attainment (and the negative feelings associated with that doubt) cause reduction in effort seems to contradict Simon's (1967) position that negative affect is a call for higher priority. However, two very different negative affects relate to approach (Carver, 2003, 2004; a parallel line of reasoning applies to avoidance, but we limit ourselves here to approach). Some approach-related negative affects coalesce around frustration and anger. Others coalesce around sadness, depression and dejection. The former relate to an increase in priority, the latter to a decrease.

We believe that approach-related affects fall on a dimension, but not a simple straight line (Figure 22.2). We think that falling behind creates negative affect as the incentive slips away: frustration, irritation and anger. These feelings (or the mechanism that underlies them) engage more effort, to overcome obstacles and reverse the inadequacy of current progress. If more effort (or better effort) can improve progress, it allows the person to move toward the incentive at an adequate rate, and attaining the incentive seems likely. This case fits the priority management model of Simon (1967).

Sometimes, however, continued efforts do not produce adequate movement forward. Indeed, if the situation involves loss, movement forward is precluded, because the incentive is gone. In a situation where failure seems (or is) assured, the feelings are sadness, depression, despondency, dejection, grief and hopelessness (Finlay-Jones & Brown, 1981). Accompanying behaviors reflect

disengagement from – giving up on – effort toward the incentive (Klinger, 1975; Wortman & Brehm, 1975).

Patterns of emotions consistent with this portrayal have been obtained in at least two studies (Mikulincer, 1994; Pittman & Pittman, 1980). In each, participants received varying amounts of failure, and their emotional responses were assessed. In both cases, anger was most intense after small amounts of failure and lower after larger amounts of failure. Depression was low after small amounts of failure and intense after larger amounts of failure.

Both kinds of reactions have adaptive properties. In the first situation – falling behind, but the goal not lost – frustration and anger accompany an increase in effort, a struggle to gain the incentive despite setbacks. As Frijda (1986, p. 429) argued, anger implies having the hope that things can be set right. This struggle is adaptive because it fosters goal attainment. In the second situation – when effort appears futile – feelings of sadness and depression accompany reduction of effort. In this case, things can not be set right; further effort is pointless. Reduction of effort here is adaptive (Carver & Scheier, 2003; Wrosch, Scheier, Carver & Schulz, 2003; Wrosch, Scheier, Miller, Schulz & Carver, 2003). It conserves energy rather than waste it in futile pursuit of the unattainable (Brehm & Self, 1989; Gendolla & Richter, 2010; Nesse, 2000), and it eventually readies the person to take up pursuit of alternative incentives (Klinger, 1975).

The variations in effort described in the preceding paragraphs are portrayed in Figure 22.2. The left side portrays the hypothesized reduction in effort when velocity exceeds the criterion, discussed earlier. The right side portrays both the strong engagement that is implied by frustration and anger (on one box) and the disengagement of sadness and dejection (on another). This part of the figure has much in common with other depictions of variations in effort when difficulty in moving toward a goal gives way to loss of the goal (for detail, see Carver & Scheier, 1998). Best known is Wortman and Brehm's (1975) integration of reactance and helplessness, which portrays a region of threat to control (where there is enhanced effort to regain

control) and a region of loss of control (where efforts diminish).

IMPULSE AND CONSTRAINT

The view described in the early parts of this chapter has had adjustments and elaborations over the years. We turn now to a topic that led to some of the more recent of those adjustments. A theme that has been prominent in many areas of psychology in recent years is the tension that exists between impulse and constraint. This issue is by no means new. Over an extensive period it has been framed in terms of delay of gratification, planfulness and even id versus ego (Freud, 1962). The concept of impulsiveness is itself quite broad (e.g., Parker, Bagby & Webster, 1993; Smith, Fischer, Cyders, Annus, Spillane & McCarthy, 2007; Whiteside & Lynam, 2001), and the word is used in diverse ways in different contexts. But its conceptual core seems to be that people sometimes face situations in which they can immediately, reflexively express an impulse or desire (or whim) or they can instead take a broader view that might result in different behavior.

Both impulse and constraint are valuable in the appropriate contexts (Block & Block, 1980; Bocanegra & Hommel, 2014; Otto, Gershman, Markman & Daw, 2013). When it is manifested as spontaneity, impulsiveness introduces a sense of vigor and freedom to life (e.g., Dickman, 1990; Hansen & Breivik, 2001). Impulsive action is also highly adaptive in environments that are unpredictable (e.g., Tops, Boksem, Luu & Tucker, 2010), and especially where the future availability of resources is unknown (e.g., Del Giudice, 2014).

Impulses can also create problems, though. They can interfere with attainment of longer-term goals (e.g., by spending today rather than saving for the future). They can lead to violation of social norms (Cooper, Wood, Orcutt & Albino, 2003; Lynam, 1996) and thus help generate interpersonal conflict. The ability to control impulsive reactivity when it is desirable to do so is typically seen as crucial to successful self-management (Daly, Delaney, Egan & Baumeister, 2015; Vohs & Baumeister, 2016).

If impulse and constraint represent a sometimes delicate balance, what determines which property emerges? At least two conceptual mechanisms have been applied to this question. One account rests entirely on the basic processes of approach and avoidance (e.g., Gray, 1982, 1994). The stronger the tendency to approach incentive cues, the greater the likelihood of impulsive approach. If there are also threat cues, though, the threat system becomes active, stifling ongoing approach. One might think of this stifling of approach as defining constraint. In this view, only acts of approach can display impulsiveness. Either they are executed or they are restrained.

The competition between approach and avoidance is a starting point in thinking about impulse and constraint. But there are reasons to suspect that it is not the whole story. For example, in trait models of personality, the trait

that is generally seen as reflecting approach – extraversion – and the trait that is generally seen as reflecting avoidance – neuroticism – are both separate from the trait that reflects constraint. Impulse versus constraint is reflected instead in disinhibition versus constraint in Clark and Watson's (1999) three-factor model, and in conscientiousness in the Five-Factor Model (Depue & Collins, 1999; Zelenski & Larsen, 1999).

Dual-Process Models

Another way of thinking about constraint follows from what are often termed dual process models of functioning. These models start with the idea that people process information in two somewhat distinct ways simultaneously. The two processing modes appear to focus on different aspects of the available information (Rudman, Phelan & Heppen, 2007). There is evidence that they learn in different ways, and that the two patterns of learning create parallel influences on action that potentially compete with one another (Daw, Niv & Dayan, 2005; Otto, Gershman, Markman & Daw, 2013).

The mode that is often characterized as the more primitive (which we will call reflexive) is often (but not always) said to operate largely out of consciousness and to be reactive to cues of the moment and to emotions. The other mode (which we will call deliberative) is what people typically think of as the rational mind. As noted earlier, some theorists hold that the reflexive mode is well-suited to contexts that are relatively unpredictable (e.g., Tops, Boksem, Luu & Tucker, 2010), because what it learns is patterns of associations which accumulate slowly but thoroughly (by what is often called model-free learning, e.g., Daw et al., 2005). The deliberative system is optimal in contexts that are predictable, because what it learns is rules (by what is often called model-based learning), which can be formed abruptly and then be applied freely (for discussion of how two modes of processing can be instantiated within a single architecture, see Dayan, 2008).

We should note that the idea of dual systems is by no means without controversy (e.g., Keren & Schul, 2009; Evans & Stanovich, 2013). Furthermore, there are many variations on the idea which sometimes differ substantially from each other. There are also uses of the dual-systems label that differ in important ways from the one we are referring to (e.g., Braver's, 2012, model of proactive and reactive control). This can make the literature a bit difficult to assimilate.

Nonetheless, by now variations on the dual process idea have been used in many areas of psychology (Kahneman, 2011; MacDonald, 2008; Rothbart, Ahadi, Hershey & Fisher, 2001; Rothbart, Ellis, Rueda & Posner, 2003; Evans & Stanovich, 2013). A version of this idea that seems particularly useful is from developmental psychology (Eisenberg, Hofer, Sulik & Spinrad, 2014; Kochanska & Knaack, 2003; Nigg, 2000, 2003; Rothbart et al., 2001, 2003). This theory posits basic approach and avoidance

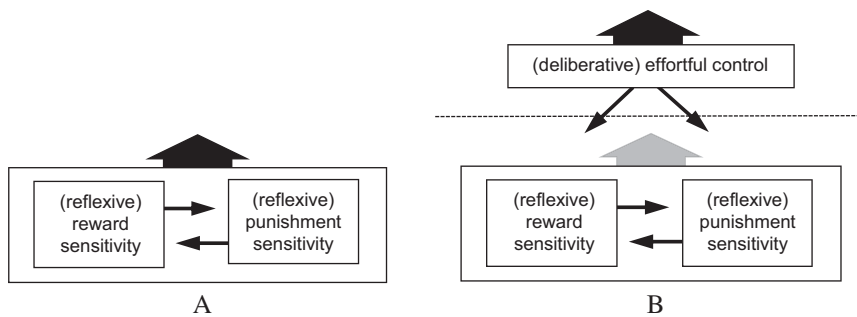


Figure 22.3 Three temperamental influences on behavior. A. A reactive system for approaching rewards and a reactive system for avoiding threats or punishment compete for ascendancy; in the absence of effortful control, the resultant of that competition is expressed in behavior. B. The engagement of an effortful control system permits another influence to compete with that resultant, thus dampening the role of the reactive systems in determining behavior. Adapted from statements by Rothbart, Eisenberg and others.

temperaments that act reflexively in the presence of incentive and threat cues, respectively. In acting reflexively, they are said to exert reactive control.

A third temperament develops more gradually, often termed effortful control. The label “effortful” is intended to convey the sense that this is an executive, planful activity, entailing the use of cognitive resources to deter the tendency to react impulsively. It relies on development of prefrontal brain areas (e.g., Durston, Thomas, Worden, Yang & Casey, 2002; Durston, Thomas, Yang, Ulug, Zimmerman & Casey, 2002; Kochanska & Knaack, 2003; Nigg, 2003; Rothbart & Bates, 1998). It is seen as superordinate to approach and avoidance temperaments (e.g., Ahadi & Rothbart, 1994; Clark, 2005) and thus in some sense can countermand or outweigh them (Evans & Stanovich, 2013). In that way, it permits control over reactive behavior (Figure 22.3).

This does not mean that effortful control is used only to restrain approach impulses. Effortful control can also override what might be thought of as a reflexive tendency toward avoidance if the avoidance temperament is more active than the approach temperament. Thus, for example, effortful control resources allow a person to remain in a tension-inducing social situation rather than flee from it. If a person’s approach temperament is weak or inactive, effortful control can override a reflexive tendency toward inaction. For example, it can get you to go exercise when you do not really want to (Sansone, Wiebe & Morgan, 1999). Thus, exerting effortful control can move a person toward either restraint or action, depending on what reactive response is being overcome (Kieras, Tobin, Graziano & Rothbart, 2005; Rick, Cryder & Lowenstein, 2008).

This view casts a somewhat different light on the concept of impulsiveness than the view described earlier. In this view, what is impulsive is what is *reactive*, whether the resulting overt manifestation is of action or inaction. Impulsiveness as a concept has always been hard to pin down (Block, 2002; Dickman, 1990; Eisenberg, 2002; Nigg, 2000; Solanto et al., 2001; Stanford & Barratt, 1992; White et al., 1994; Whiteside & Lynam,

2001, 2003) partly because it can take many forms. The aspect of impulsiveness emphasized in the viewpoint now under discussion is that impulses are reactive: reflexive responses to some stimulus in disregard of other considerations.

A potentially important question, though tangential to our main concerns here, is how to think about the interaction between these two systems. Supervisory control is sometimes portrayed as a struggle for the deliberative system to overcome or suppress a basic impulse. However, it is also possible to view the competition between systems in terms of biasing of mental calculations surrounding behavior in favor of one set of contingencies versus the other (Buckholz, 2015). Though these two characterizations of the competition feel quite different from each other, the consequences may not be.

Another pair of labels sometimes appearing in this discussion is habits and plans. The reactive system is said to use habits to influence behavior, whereas the deliberative system uses plans and rules (Dayan, 2008). Habits reflect the gradual accumulation of associations between contextual cues and behaviors, whereas plans and rules (and, in some discussions, goals) reflect the deliberative formation of intentions. In many circumstances habits dictate people’s behavior rather than intentions (Ouellette & Wood, 1998; Wood & Neal, 2007; Wood & Rünger, 2016). In this view, impulsivity would be defined by whatever is habitual and reflexively cued, whether it be approach or avoidance based.

Dual-Process Models and Hierarchical Organization of Behavior

This section of the chapter has addressed impulsive reactivity versus deliberative control. How does this relate to anything that came earlier? For one, this discussion suggests a different way to think about the hierarchy of control mentioned in passing earlier (Powers, 1973). Let us add labels to some levels in that hierarchy. What Powers called Programs of action are action paths where there are decisions that have to be made, based on the

circumstances encountered. Programs are managed top-down, using planful, effortful control to make decisions about what to do at choice points. As it happens, planfulness is also a common characterization of behavior guided by the deliberative system. It seems reasonable to suggest that what Powers (1973) called Program-level control (along with higher levels) reflects the deliberative, reflective mode of functioning.

In contrast to this deliberative quality, what Powers (1973) termed Sequences are well-learned action combinations that occur in a relatively automatic stream once they are triggered. Sequences (and lower levels) are necessarily called up during the execution of programs (since programs are made up partly of sequences). However, it seems likely that sequences can also be triggered more autonomously, rather than always being a subroutine of effort toward a program. For example, think about seeing a hundred-dollar bill on the ground and reaching reflexively to pick it up, or seeing someone you dislike and reflexively turning away. The action intrudes on whatever else is taking place. Sequences can be triggered by activation of strong associations in memory (the appearance of money as positive, the appearance of the other person as negative). In such cases, what happens seems to reflect the reactive mode of functioning.

We have often noted that the level of control that is functionally superordinate can vary across situations and persons (e.g., Carver & Scheier, 1998). It is easy to imagine cases in which a person is acting according to a general principle (e.g., a moral or ethical value), and it is easy to imagine cases in which the person is acting according to a plan. But it is also easy to imagine cases in which the person is acting impulsively and spontaneously, without regard to either principle or plan.

In making this case in the past, our main emphasis generally was on how sequences and programs differ. In some instances, however (e.g., Carver & Scheier, 1998), we also considered this difference in light of literatures in which self-control over behavior was disrupted by such influences as alcohol (Hull, 1981; Steele & Josephs, 1990) and deindividuation (Diener, 1979). In those cases, behavior seems to reflect reactive responses to impulses and cues of the moment rather than principles or programs. In effect, we suggested, sequences were being rendered functionally superordinate in these contexts.

The dual process literature raises a question about whether this differentiation between levels of control is more important than we had realized. We may have underappreciated the extent to which lower self-regulatory structures can be triggered autonomously and their outputs enter the stream of ongoing action, without oversight from higher levels, and potentially even in conflict with values at higher levels. Perhaps this is what is happening any time a habit intrudes in behavior in the absence of intention (Norman, 1981; Wood & Neal, 2007; Wood & Rünger, 2016). Perhaps a continuous competition pits habits against plans and principles as determinants of

action. To put it in terms used earlier in this section, there may be a continuing competition between model-based and model-free management of behavior (Daw, Niv & Dayan, 2005).

The idea that model-based and model-free systems are in competition for control over action is an interesting one, which has a number of implications, both for normal self-regulation and for understanding maladaptive behavioral tendencies. We have a few things to say about the latter, but before we do so we briefly introduce one more side point, concerning certain of the biological underpinnings of the properties now under discussion.

Serotonergic Function and Impulsive Reactivity

It has often been suggested that different neurotransmitter systems may play different roles in the management of behavior. Carver, Johnson and Joormann (2008), following the lead of Spont (1992), recently suggested that the serotonergic system is particularly important to the balance between impulsive reactivity and constraint. As one example, substantial evidence links low serotonergic function to a history of fighting and assault (Coccaro, Kavoussi, Cooper & Hauger, 1997), domestic violence (George et al., 2001) and impulsive aggression more generally (Coccaro, Kavoussi, Hauger, Cooper & Ferris, 1998; Cleare & Bond, 1997; Manuck et al., 2006). Aggression is, of course, only one area in which serotonergic function has been examined (for review, see Carver et al., 2008).

Many discussions relate serotonergic function to negative affect *per se*. However, Carver et al. (2008) concluded that the existing evidence overall was more consistent with a view in which serotonergic function influences which mode of processing dominates behavior. The idea that serotonergic function is particularly relevant to variation in impulsiveness is a potentially important one, but further exploration of it is beyond the scope of this chapter (see, e.g., Carver et al., 2008; Carver & Scheier, 2017b).

IMPULSE, CONSTRAINT AND PROBLEMS IN BEHAVIOR

In this section of the chapter we consider an extension of the dual process view to the nature of problems in behavior. As was implied by the preceding section, there is a great deal of evidence linking impulsiveness and disinhibition to externalizing problems such as impulsive violence; indeed, impulsiveness is considered to be almost a hallmark of externalizing problems (Kreuger & Markon, 2006). Evidence linking impulsive reactivity to internalizing problems has been more sparse, until recently. Whether or not a link appears to internalizing problems seems to depend at least partly on what aspect of impulsivity is being assessed.

As noted earlier, impulsivity has long been recognized as having multiple facets or manifestations. Interest in this

diversity has grown in recent years, in part because it appears particularly important when considering problems in behavior. There now are many measures of impulse versus constraint, several of which focus subparts on differing aspects of impulsiveness (including both diverse triggers and diverse manifestations; e.g., Barratt, 1965; Whiteside & Lynam, 2001).

Of particular interest, moving forward in this discussion, are measures that focus on reactivity to emotions. Dual process models tend to posit that the reflexive mode is hyperresponsive to emotions, whereas the deliberative mode is more distanced from emotions. Although that is not the only feature of dual process models, it is a feature that has come to the fore in this context.

Several measures exist that specifically target reactivity to emotions. The first developed was a scale titled Urgency (later labeled Negative Urgency), from an inventory called the UPPS (Whiteside & Lynam, 2001; Whiteside, Lynam, Miller & Reynolds, 2005). Negative Urgency is the tendency to act impulsively in response to negative feelings. A parallel measure of Positive Urgency was later created (Cyders et al., 2007), which assesses the tendency to act impulsively in response to positive feelings. There is evidence that Negative and Positive Urgency share a common core (Sperry, Lynam & Kwapił, 2018). Another index was later created that includes both Positive and Negative Urgency, plus another measure labeled Reflexive Reaction to Feelings (Carver, Johnson, Joormann, Kim & Nam, 2011). The items of the latter reference behavioral reactivity to emotions, but do not specify either positive or negative valence.

Given the availability of these various measures, evidence is now accumulating that emotion-triggered impulsivity is more robustly relevant to a wide range of behavioral problems than other aspects of impulsivity (see Berg, Latzman, Bliwise & Lilienfeld, 2015; Kaiser, Bonsu, Charnigo, Milich & Lynam, 2016; Pearson, Combs, Zapolski & Smith, 2012; Riley, Combs, Jordan & Smith, 2015). This is true both for externalizing problems and internalizing problems. As examples, Johnson, Carver and Joormann (2013) found that Carver et al.'s (2011) index of responsivity to emotion was related to measures of aggression, borderline personality features and alcohol use. The same index is related to manic temperament, measured by the Hypomanic Personality Scale, after controlling for comorbid syndromes (Johnson, Carver, Mulé & Joormann, 2013). The same index has been related to interview-based lifetime diagnosis of major depressive disorder (Carver, Johnson & Joormann, 2013). Longitudinal evidence also links emotion-related impulsivity to depression. Smith, Guller and Zapolski (2013) followed a group of fifth graders for a year, assessing diverse markers of psychopathology over time. They found that a measure of overall urgency (reflecting impulsive reactions to both negative and positive emotions) predicted increase in relative depression over that year, after controlling for a wide range of externalizing symptoms.

The available evidence does appear to suggest that both externalizing problems and internalizing problems are linked to a tendency to be impulsive in response to emotions. To the extent that hyperresponsivity to emotion can be seen as reflecting greater influence of the reflexive system, this evidence suggests that these vulnerabilities may involve a greater-than-desirable reliance on habitual responses, a dependence on model-free processing. The evidence that this reliance also characterizes both behavioral problems such as impulsive violence and internalizing problems such as depression raises further questions about how broad this vulnerability is.

Transdiagnostic Vulnerability

The possibility that the broad spectrum of psychopathologies may be characterized by a more limited number of features that are actually transdiagnostic has been raised in a number of places in recent years (e.g., Harvey, Watkins, Mansell & Shafran, 2004; Johnson-Laird et al., 2006). It seems worth asking whether an impulsive overreactivity to emotions may be one such transdiagnostic feature (see also an argument made by Johnson-Laird et al., 2006, about the role of emotional overresponsiveness in psychopathology). As noted earlier, findings have been emerging that are consistent with the notion that an impulsive overreactivity to emotions represents a feature common to a great many behavioral problems (Berg et al., 2015; Kaiser et al., 2016; Pearson et al., 2012; Riley et al., 2015).

The notion of transdiagnostic vulnerability (in general) has been given an additional boost from a series of studies that have isolated a general factor of psychopathology (Caspi et al., 2014; Castellanos-Ryan et al., 2016; Laceulle et al., 2015; Lahey et al., 2012; Lahey et al., 2015; Snyder et al., 2017; Tackett et al., 2013; Waldman et al., 2016). The studies that make this case measured diverse aspects of psychopathology and extracted factors from the resulting data matrices. A common factor emerged, which related to a wide range of disorders, both externalizing and internalizing.

What is that factor? One way to interpret it in functional terms is that it may represent individual differences in impulsive responses to emotion (Carver, Johnson & Timpano, 2017), or perhaps even individual differences in the balance of influence of the two modes of processing more generally. When combined with one sort of temperamental substrate, this impulsiveness yields externalizing; when combined with another substrate, the result is internalizing. If this analysis were supported in future research, it would perhaps represent an important step in conceptualizing a range of problems in behavior. This is a topic we expect to continue to receive further attention in the coming years.

CONCLUSION

This chapter began by describing basic principles of a control-process view of behavioral self-regulation. We

have necessarily left aside a number of issues that pertain to self-regulation. We have also omitted many more issues that pertain to personality. For example, we have not discussed in any detail how self-regulatory functions map onto dimensions of individual differences that have been identified by other approaches to personality. Nor have we considered the relations of this viewpoint to others that it complements (though see Carver & Scheier, 2017a, Chapter 14 for discussion of that issue). Nonetheless, we hope the picture we have sketched will be seen as a useful complement to principles discussed in other chapters in this volume.

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23

Basic Needs, Goals and Motivation

JAMES L. SZALMA

INTRODUCTION

A psychological need is a condition of an organism that must be attained or maintained in order to preserve well-being and adaptive psychological functioning. Psychological needs are proactive, in that they promote engagement with the environment to satisfy the needs (Reeve, 2015). Recently, Dweck (2017) proposed two criteria for a “basic” need: (1) The goals that serve to satisfy the needs are high in value and universal in scope; and (2) successful attainment of goals related to a need is important for both immediate and long-term wellbeing. In addition, she identified needs as “basic” only if they are irreducible to other needs, and if they are present at or very soon after birth. Derivative needs develop over the span of early childhood. One problem with this conception is that it is very difficult to clearly establish that a need is “irreducible,” or that it is present at the beginning of life, i.e., that it is not a product of development via person–environment transaction (Lazarus, 1991; Matthews, 2001).

Discussion of basic needs and how they influence motivation is further complicated by the multitude of needs that have been proposed and differences in criteria for defining basic needs. There are competing theories of motivation and of personality that propose different, but perhaps in some cases overlapping, structures and processes. This has resulted in disagreements regarding which needs are “basic” and which are composites or combinations of basic needs. For instance, in Self Determination Theory (SD-Theory) there are three basic needs, with autonomy being a crucial determinant of the form of motivation and self-regulation associated with a given activity. Recently, however, Dweck (2017) proposed a model in which autonomy is a combination of two basic needs: predictability and competence. Further complicating the situation, conceptions of needs, motives and personality traits are taxonomically fractured. Our understanding of needs, traits and how they relate to psychological function is constrained by lack of consensus regarding how many needs/traits there are and what they are.

Needs conceptualized in early theories reflect both the directional and the energetic component of motivation. In contrast, Dweck (2017) argued that “If motivation is defined as the forces that drive and direct behavior, then needs serve the energizing (drive) function, whereas goals and goal processes then serve the directive function, guiding the individual step by step toward need fulfillment” (p. 697). Similarly, in a two-process view of SD-Theory, needs serve to energize goal-directed behavior, and satisfaction of the needs is a desired outcome of the activity (Sheldon, 2011). Hence, these perspectives place the directive component in the goals (which almost all the major theories of motivation do) but view needs as serving an energizing function, while in earlier conceptions needs reflect both directive and energetic functions (e.g., Hull, 1943; Maslow, 1943; Murray, 1938).

A BRIEF HISTORY OF NEED THEORIES

Needs tend to be organized around a particular set of desired outcomes the individual seeks to attain, but they are more general than specific goals and they energize behavior to attain the goals. Multiple need theories have been developed, based on somewhat different definitions of psychological need. Here, we briefly consider three early but influential views; those of Murray (1938), Lewin (1935, 1936) and Maslow (1943).

In an early discussion of needs, Murray (1938) defined a need as “an organic potentiality or readiness to respond in a certain way when certain conditions occur. In this sense a need is a latent attribute of an organism” (p. 34). In this conceptualization a need has a directional component that distinguishes it from other needs, as well as an energetic component that “drives” the behavior. From Murray’s perspective, a need is a directional force within an organism that determines behaviors, which in turn satisfy the need. Murray considered a need as a hypothetical concept that linked stimulus and response. Note that Murray originally proposed over twenty psychological needs, but subsequent research narrowed these to three

motives: Need for Achievement, Need for Power and Need for Affiliation. The Need for Achievement refers to a need to accomplish a goal relative to a high standard of excellence (Atkinson, 1964; Murray, 1938). The Need for Power refers to a need for control or to influence another person, which may manifest as a desire to help others or a desire to dominate others (Veroff, 1957; Atkinson & Birch, 1978). The Need for Affiliation is defined as a need for positive interpersonal relationships (Atkinson & Birch, 1978).

An early but more general approach to the need concept was proposed by Lewin (1935, 1936) who defined a need as a system in a state of tension, which is created by the positive and negative valences of different regions of the life space. The life space was defined as the person and his/her surrounding psychological environment (for a thorough discussion of Lewin's theory, see Atkinson, 1964). In more modern terms, this is similar to the notion of the discrepancy between current state and goal state, with the "tension" caused by the discrepancy motivating activities to eliminate it (Carver & Scheier, 1998). According to Lewin's conception, the tension is eliminated ("released") when the need is satisfied, i.e., when the goal with the strongest net motivational force is attained.

Among the best-known early models of needs was proposed by Maslow (1943). The specific needs can be delineated as deficiency needs, which are needs that motivate behavior to reduce a discrepancy between current and goal state, and growth needs, which correspond to needs that are not energizing discrepancy reduction, but are oriented toward attaining and maintaining optimal wellbeing. The deficiency needs are defined as physiological, safety and security, love and belongingness, and esteem. The growth need is self-actualization, which is a need to fulfill one's potential: to improve and grow. The five needs are organized in a hierarchical structure in which satisfaction of the lower needs is necessary for higher-level needs to be satisfied. In other words, if the physiological or safety needs are not met, then satisfying belonging, esteem and self-actualization needs is impossible.

SD-THEORY

SD-Theory is a broad framework that describes human motivation in terms of basic psychological needs, cognitive evaluation and internalization of goals (Deci & Ryan, 2000; Ryan & Deci, 2000). SD-Theory is unique among motivation theories in that it defines motivation as something that varies qualitatively as well as quantitatively. Other theories, such as control theory (Carver & Scheier, 1998) or goal-setting theory (Locke & Latham, 1990) posit central mechanisms that underlie a single motivational dimension. The specific goal that is pursued is based on the value of the goal, but given equivalent values, the motivations for pursuing them will be of the same kind. In contrast, SD-Theory argues that there is a difference

between intrinsic motivation and extrinsic motivation. The former is defined as motivation that originates from engaging in an activity in order to experience the activity itself. In other words, the goal is to experience doing the activity itself rather than to attain a goal external to the activity. Intrinsic motivation often occurs when a person finds an activity to be interesting and enjoyable. Extrinsic motivation occurs when an activity is motivated by an external goal rather than intrinsic to the activity; it is a means to an end.

Subtheories within S-D Theory

SD-Theory may be delineated into six subtheories, five of which will be discussed here: Basic Psychological Needs Theory, Cognitive Evaluation Theory, Organismic Integration Theory, Causality Orientation Theory and Goal Contents Theory (Ryan & Deci, 2008). Together, these subtheories provide a comprehensive theory of human motivation.

Basic Psychological Needs Theory

One of the mini-theories in the broader SD-Theory framework is the *Basic Psychological Needs Theory*. The theory asserts that there are three psychological needs that are basic and universal. These are the needs for autonomy, competence and relatedness. The three basic needs are conceptualized as requirements for maintaining psychological wellbeing and effective psychological functioning. They are thus not deficiency needs that follow a homeostatic or cybernetic mechanism (e.g., Hull, 1943; Carver & Scheier, 1998, 2012). Note that this view differs from early conceptions of psychological need. For instance, Maslow's lower four needs, and needs as defined by Lewin, are deficits created by the absence of something. Needs are activated and when satisfied, no longer drive behavior. For Basic Psychological Needs Theory, needs do not follow homeostatic regulation. Instead, they are ongoing states or experiences the environment must provide and maintain in order for the organism's wellbeing to be preserved. Deci and Ryan (2000) described the three basic needs in SD-Theory as the "nutriments" required for a person to function psychologically.

It is the satisfaction or thwarting of these needs that determines the type of motivation experienced (intrinsic or extrinsic). Further, the specific content of goals can influence how the corresponding activities are experienced. Goals or aspirations that satisfy these needs result in improved psychological functioning and wellbeing; these are referred to as *intrinsic aspirations*. Goals or aspirations that do not facilitate or may thwart need satisfaction are *extrinsic aspirations* (Kasser & Ryan, 1993, 1996). Studies examining the effects of these aspirations indicate that intrinsic aspirations are associated with greater wellbeing, while extrinsic aspirations are associated with lower wellbeing (Deci & Ryan, 2009; Martela & Ryan, 2016; Ryan & Deci, 2008; Sheldon, Ryan, Deci & Kasser, 2004).

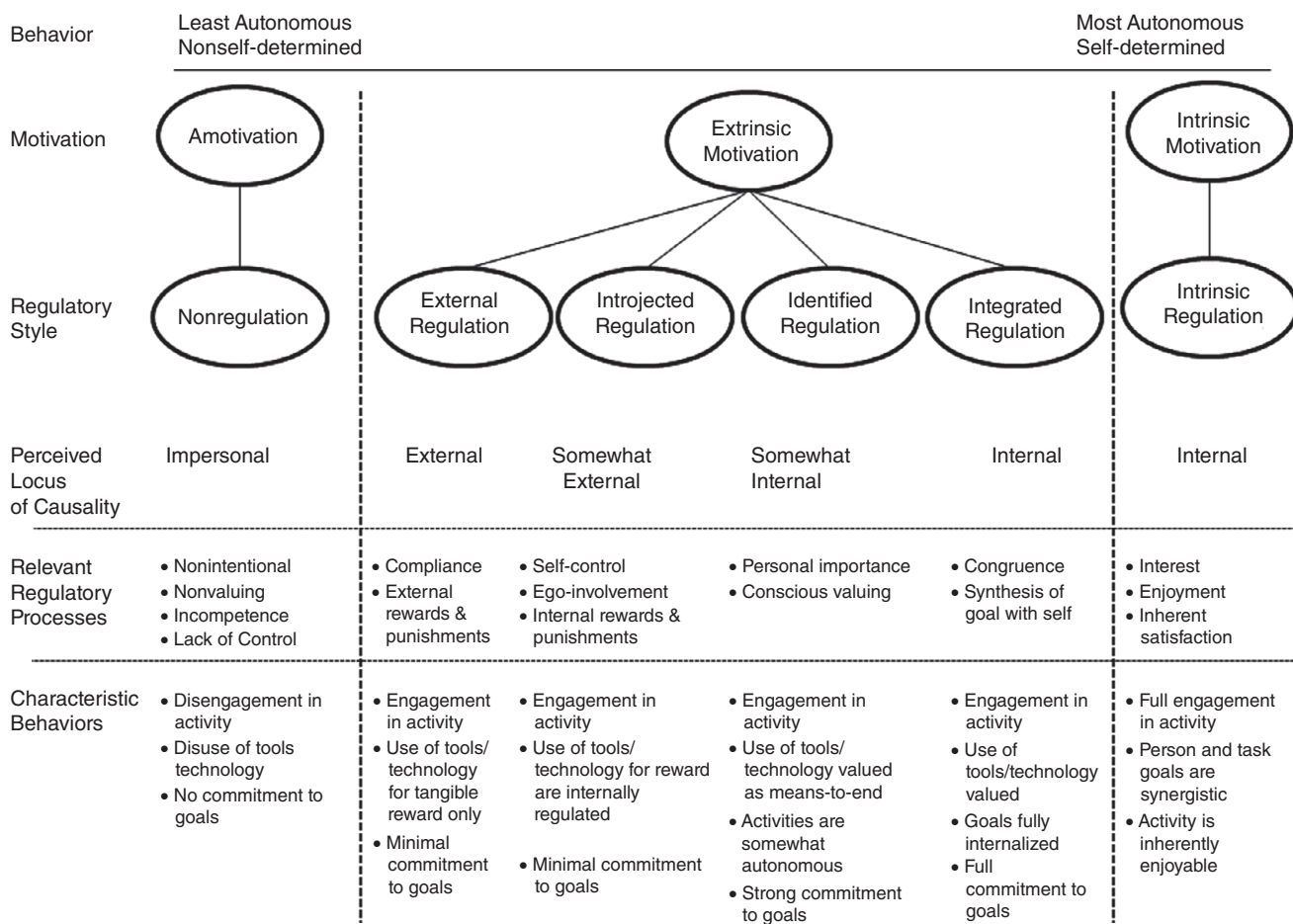


Figure 23.1 The different forms of motivation as a function of the degree of autonomy experienced. Adapted from Ryan and Deci (2000) and Szalma (2014).

Cognitive Evaluation Theory

Cognitive Evaluation Theory argues that individuals evaluate their activities or events that occur in terms of the functional significance of the event or activity for experiencing need satisfaction. Specifically, events are evaluated as informational or controlling. An event perceived as more informational than controlling facilitates an experience of autonomy and competence, while events perceived as controlling weaken or thwart the experience of autonomy and competence. It is this part of the broader SD-Theory that accounts for the undermining of intrinsic motivation with controlling extrinsic rewards (Deci, Koestner & Ryan, 1999).

Organismic Integration Theory

Extrinsic motivation does not ubiquitously undermine autonomous motivation. Indeed, there are four distinct forms of extrinsic motivation, which are differentiated according to the degree to which the activity is experienced as self-determined. *Organismic Integration Theory*, the third subtheory, was proposed to account for how these different forms of motivation develop and how they influence the self-regulation of behavior. The mechanism

by which this occurs is *internalization*, in which a goal determined by an external agency is integrated with a person's sense of self. The degree to which a goal is internalized determines the form of extrinsic motivation experienced. These are illustrated in Figure 23.1.

External regulation is the least autonomous of the four; in this case the goal is not internalized at all, and the behavior is motivated by the reward and punishment contingencies associated with the activity. *Introjected regulation* occurs when a goal is internalized but not endorsed by the person or integrated to any degree with one's sense of self. It is as if the goal is "swallowed whole" by the person (Deci et al., 1994), but is still experienced by the person as externally determined. Introjected regulation motivates behavior by linking it to maintaining self-esteem, to gaining or maintaining esteem and approval from others, or to avoid feeling guilty.

The two more autonomous forms of extrinsic motivation are identified and integrated regulation. In *identified regulation* the goal is internalized sufficiently for the person to believe that pursuing an externally determined goal has value (Deci & Ryab, 2000). The person "identifies" with the activity as one that has value for other

goals that are internalized and therefore important to the person's sense of self. However, in identified motivation the goal is not important to the self, except as a means to attain more self-relevant goals. That is, it is not fully integrated with the person's sense of self. This occurs in *integrated regulation*, the most autonomous form of extrinsic motivation. Fully integrated goals are fully endorsed by the person and are organized with other goals important to the self (Ryan & Deci, 2000). Integrated motivation is associated with a level of autonomy that is close to that of intrinsic motivation. The crucial difference between the two is that for the latter the experience of doing the activity itself is motivating the behavior, while for integrated regulation the activity is a means to an end; i.e., the motivation originates from a goal that is external to the activity.

Goal Contents Theory

One implication of the distinction between types of motivation is that goal content matters (e.g., Sheldon, Ryan, Deci & Kasser, 2004). This is the foundation for the fifth subtheory, Goal Contents Theory. In contrast to other theories in which attaining any high value goal leads to positive outcomes (e.g., goal setting theory; Locke & Latham, 1990; control theory; Carver & Scheier, 1998), SD-Theory argues that psychological wellbeing is facilitated by adopting and attaining goals that are intrinsic or extrinsic and highly internalized. Extrinsic goals that are not internalized, or minimally internalized, are associated with lower wellbeing (Ryan & Deci, 2000).

Causality Orientation Theory

The fourth subtheory within SD-Theory is *Causality Orientation Theory* (COT; Ryan & Deci, 2017). Cognitive Evaluation Theory and Organismic Integration Theory emphasize state processes; COT is concerned with stable individual differences. In essence, the theory asserts that the experience of autonomy is not entirely determined by the context or task structure. It is also a stable characteristic of the individual. Individuals vary in the degree to which they experience activities autonomously, and this influences whether they are extrinsically or intrinsically motivated. The theory identifies three "orientations" toward autonomous experience: autonomy orientation, controlled orientation and impersonal orientation (Ryan & Connell, 1989).

Individuals high in *autonomy orientation* tend to interpret activities and the context in which they occur as autonomy supporting. They are more likely than those low in this orientation to experience identified, integrated or intrinsic motivation. *Controlled orientation* is associated with the tendency to experience activities as controlled by external agents, i.e., a tendency to experience external or introjected motivation. The *impersonal orientation* is the tendency to experience activities as outside of their control or influence; experiencing events

passively or "helplessly." It is associated with a general absence of motivation for activities, i.e., a tendency to experience amotivation (for a more detailed description, see Ryan & Deci, 2017).

CRUCIAL PROBLEMS FOR MOTIVATION

A Fractured Theoretical Landscape

There are competing theories regarding the structures and processes underlying motivation as well as personality. To further complicate matters, the conceptualization of needs, motivational traits and personality traits are taxonomically fractured. Our understanding of needs, traits and how they relate to psychological functioning is constrained by a lack of consensus regarding how many needs and traits there are, and what they are. Hierarchical views (e.g., Carver & Scheier, 1998; Vallerand, 1997) are helpful, but they are incomplete in that they do not adequately address the mechanisms by which needs influence behavior and how behavior influences need satisfaction. For instance, cybernetic control theory of self-regulation proposed by Carver and Scheier (1998, 2012) can account for the regulation of goal-directed behavior, but it is not clear how the negative feedback mechanisms are influenced by personality traits, or whether the traits themselves are an emergent property of hierarchical feedback loops. On the other hand, SD-Theory provides an excellent broad framework, identifies distinctions among different forms of self-regulation, but provides very little in terms of specific micro-level cognitive mechanisms. Carver and Scheier (1998) did propose a hierarchical structure to show how broad level goals shape lower level regulatory functions, but their theory fails to distinguish between intrinsic and extrinsic motivation, as well as the different forms of extrinsic motivation.

Baumeister (2016) called for a general theory of motivation, arguing that it was a fundamental concept; cognition and even emotion result from motivation. Such a broad theory has yet to materialize, and Reeve (2016) noted that a problem for establishing such a theory is "that the various theorists would be unable to agree on the basic assumptions about the nature and dynamics of motivation" (p. 34). Motivation theories do not agree on which needs are fundamental or "basic," and in some theories needs are not represented at all (e.g., Carver & Scheier, 1998). Most theories include a role for goals, although the emphasis varies (e.g., goal setting, Locke & Latham, 1990; goal regulation, Carver & Scheier, 1998), while some theories link goals directly to the satisfaction of psychological needs (Dweck, 2017; Ryan & Deci, 2000). If we are to understand the structure and function of motivation and personality, integration of the various perspectives is needed. In addition, motivation, like personality, should be considered a complex system (Dunning, 2016; Mayer, 2005). A potentially fruitful avenue may be the cognitive science approach (Matthews, 1997, 2008, 2009).

A POTENTIAL SOLUTION: COGNITIVE SCIENCE APPROACH

Since the cognitive revolution (Dember, 1974), there has been a shift in personality research to not only describe the *structure* of personality but also the *processes* associated with them. Matthews (1997) applied a cognitive sciences framework (see Figure 23.2), in which personality is conceptualized as a set of integrated systems that can be described at different levels of analysis: a knowledge level, a symbolic level and a biological neural level (see Figure 23.3). Mayer (2005) conceptualizes this as a molecular–molar continuum, in which the molecular level is concerned with biological and biochemical mechanisms, and the molar level is concerned with groups or entire societies. This perspective, the Cognitive–Adaptive Theory (Matthews, 2008), considers personality as emerging from multiple cognitive and affective systems. In the context of personality, a system is a set of interrelated psychological structures that function together and influence one another as well as behavioral outcomes. From this perspective, questions such as, “Which is fundamental, motivation or cognition?” as Baumeister (2016) framed it, are not very

useful, because these are both systems that interact and are thus causally related in a complex way. Part of describing personality is identifying the “cognitive patterning” of traits (Matthews, 2008, 2009). According to Matthews (2009) traits have functional coherence rather than structural coherence, and it is adaptation that gives a trait its coherence. From this perspective, traits are modes of adaptation to environmental demands. Note that these demands include not only the social environment, but also the technological environment (for the application of personality to research on and design for human technology interaction, see Szalma, 2009). The different forms of motivation represent one component of this adaptation, and need satisfaction is an adaptive requirement for this system.

Cognitive Science, Systems and SD-Theory

One of the strengths of SD-Theory is that it is a broad framework compatible with other major theories. A limitation, however, is the relative lack of mechanisms or specifications of the role of cognitive and affective systems in determining motivation. In personality theory this issue has been addressed using the cognitive science approach, in which personality is considered to be organized at multiple levels of analysis, and traits are conceptualized as the integration of cognitive, affective and motivational systems (Matthews, 1997, 2008). SD-Theory specifies the motivational and, to some extent, affective components, but these have been evaluated primarily at the knowledge level, and cognitive structures and processes have yet to be fully specified. For instance, SD-Theory proposes that people cognitively evaluate the events around them, and they evaluate the personal relevance of those events to their own goals, whether the experience is autonomous, and whether it results in an evaluation of competence and belonging. Cognitive evaluation seems very similar to cognitive appraisals (Lazarus, 1991, 1999) and attributions (Weiner, 2012). If so, there may be core relational themes associated with these cognitive evaluations, i.e., themes related to the three basic needs. Further, it is possible that the evaluation of need satisfaction operates via a negative feedback loop, as

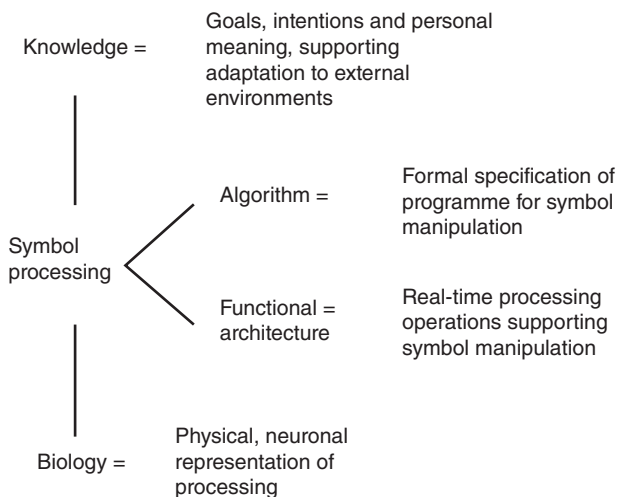


Figure 23.2 Levels of explanation in the cognitive science approach. From Matthews (2009)

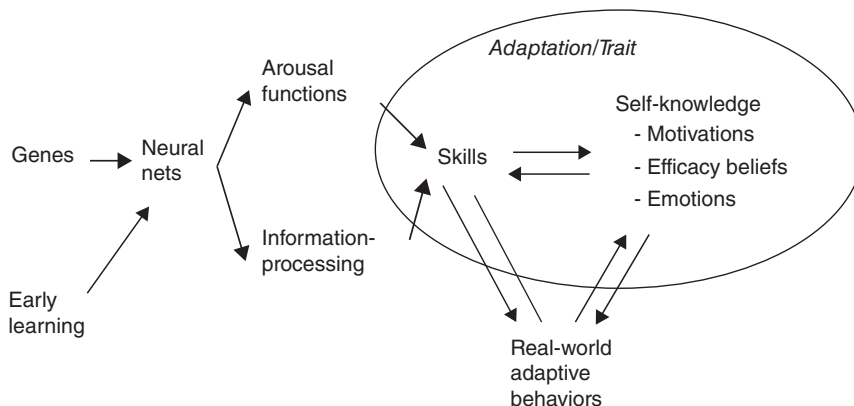


Figure 23.3 The Cognitive–Adaptive Framework for Personality. From Matthews (2009)

Table 23.1 Positive (+), negative (–), or no (0) correlation between personality traits and measures of needs and goals

Traits	Intrinsic Aspirations		Extrinsic Aspirations		Need Satisfaction			Orientation		
	I-Attain	I-Imp	E-Attain	E-Imp	A-Sat	C-Sat	R-Sat	A-Orient	C-Orient	I-Orient
E	+	+	+	+	+	0	+	+	0	–
N	–	0	–	+	–	0	–	–	+	+
C	+	+	+	0	+	+	0	+	0	–
A	+	–	–	–	+	0	+	+	–	0
O	0	+	–	–	0	0	0	0	0	0

Note. I-Attain = Intrinsic goal attainment; E-Attain = Extrinsic goal attainment; I-Imp = intrinsic goal importance; E-Imp = Extrinsic goal importance; A-Sat = Autonomy need satisfaction; C-Sat = Competence Need satisfaction; R-Satg = Relatedness Need satisfaction; A-Orient = Autonomy orientation; C-Orient = Control Orientation; I-Orient = Impersonal Orientation.

described in control theory (Carver & Scheier, 1998, 2012). However, even if this is the case, the cognitive mechanisms by which the needs lead to setting specific goals and determining the paths to attain them have yet to be specified.

Relationship between Personality and Motivation from a Self-Determination Theory Perspective

There is work supporting the notion that personality plays a role in determining the form of motivation and self-regulation a person experiences for a given activity. There have been a few studies investigating how the “basic” personality traits relate to the three autonomy orientations described in Causality Orientation theory. These are summarized in Table 23.1. Although these relationships are based on a limited number of studies, there does seem to be a form of “motivational patterning” of personality traits analogous to the cognitive patterning discussed by Matthews (2008; see also Szalma, 2008). The cognitive patterning associated with the different forms of motivation needs to be further investigated.

An autonomy orientation correlates positively with Extraversion (Hml & Pincus, 2002; Olesen et al., 2015), Conscientiousness and Agreeableness (Hml & Pincus, 2002). Romero et al. (2012) reported that attaining intrinsic goals correlates positively with Extraversion, Agreeableness and Conscientiousness, and negatively with Neuroticism (Openness was not correlated with intrinsic goal attainment). Attaining extrinsic goals correlated positively with Extraversion and Conscientiousness and negatively with Neuroticism, Openness and Agreeableness. However, the perceived importance of extrinsic goals was correlated positively with Neuroticism and Extraversion, and negatively with Openness and Agreeableness. The perceived importance of intrinsic goals correlated positively with Extraversion, Openness and Conscientiousness, and negatively with Agreeableness (Neuroticism was not correlated with the importance of intrinsic goals).

Sulea et al. (2015) reported that autonomy satisfaction correlated positively with Extraversion, Conscientiousness and Agreeableness, and negatively with Neuroticism. Competence satisfaction correlated (positively) with Conscientiousness. Relatedness satisfaction correlated positively with Extraversion and Agreeableness, and negatively with Neuroticism.

Phillips et al. (2003) reported that the controlled extrinsic motivation did not correlate with traits, but that controlled-introjected regulation correlated positively with Neuroticism. Identified regulation correlated positively with Extraversion and Conscientiousness, and autonomy-intrinsic motivation correlated (positively) only with Conscientiousness.

The general pattern seems to be that personality exerts some influence on the types of goals pursued as well as the importance of and attainment of intrinsic and extrinsic goals. Although the patterns across studies are not entirely consistent, in general Extraversion and Conscientiousness are associated with more autonomous characteristics, e.g., autonomy orientation, identified regulation, importance and attainment of intrinsic goals, and satisfaction of autonomy needs. By contrast, Neuroticism is associated with the importance and attainment of extrinsic goals, and negatively with attainment (but not importance) of intrinsic goals. Consistent with this finding, Neuroticism is also positively related to controlled-introjected forms of regulation, and it is negatively related to satisfaction of the needs for autonomy and relatedness. Thus, Neuroticism seems to be a “risk factor” for adopting extrinsic, relatively controlled forms of motivation and self-regulation. It seems that Neuroticism is associated more strongly with extrinsic than intrinsic goals, while Conscientiousness, and to some extent Extraversion, are more strongly associated with intrinsic goals and forms of regulation. The patterning of Agreeableness shows that this trait is associated with autonomy and relatedness satisfaction but not competence satisfaction (a pattern one would expect given the interpersonal

nature of the trait), and correlated positively with an autonomy orientation and negatively with a controlled orientation. However, there seems to be one inconsistency. Agreeableness correlates positively with *attainment* of intrinsic aspirations but negatively with the *importance* of such aspirations. It seems that individuals high in Agreeableness are more likely to attain intrinsic goals, but that goals (both intrinsic and extrinsic) are less important to them.

Personality therefore helps to shape not only which goals are adopted, but also the form of motivation experienced in the goal-directed activity as well as the satisfaction of the basic needs. However, the table does point toward a “motivational patterning” for the traits, such that measures indicating autonomy or intrinsic-motivation correlate positively with Extraversion, Conscientiousness and Agreeableness, and negatively with Neuroticism; And measures indicating controlled or extrinsic motivation are associated with higher Neuroticism.

Summary: Challenges for SD-Theory

Although there is evidence that personality traits correlate with different forms of motivation (Lewis & Sutton, 2011; Phillips et al., 2003), the mechanisms by which personality influences which form of motivation is experienced have not been described. Presumably personality traits would influence the cognitive evaluation of events to determine the functional significance of the event and whether it is experienced autonomously, but it remains unknown how the traits do this.

With respect to internalization, it is not clear how personality traits influence the process of internalization, e.g., the degree to which a goal is internalized, or whether it influences only the kinds of goals that are internalized. It may be that personality also influences the cognitive evaluation process by which individuals determine the degree to which the environment and their current activity facilitates satisfaction of the needs for autonomy, competence and relatedness, e.g. the degree to which the activity is experienced autonomously.

In addition, the structure and mechanisms of cognitive evaluation and internalization need to be identified at multiple levels of analysis beyond the knowledge level. The symbol processing level would lead to identifying the cognitive mechanisms associated with SD-Theory concepts. There have been recent efforts to examine motivational concepts at a neural level (see Di Domenico & Ryan, 2017; Reeve & Woogul, 2012), and Reinforcement Sensitivity Theory (Corr, DeYoung & McNaughton, 2013) offers an additional framework that integrates personality and motivation as deriving from three conceptual nervous systems. How these systems map to the different forms of regulation is not clear. For instance, it seems likely that activation of the Behavioral Activation System is associated with intrinsic motivation and more autonomous extrinsic motivations (identified and integrated), and that

the other two systems (Flight-Fight-Freeze System and Behavioral Inhibition System) would be dominant in extrinsic and introjected motivation. Amotivation would likely be linked to the Behavioral Inhibition System. However, in the absence of empirical evidence integrating these two theories, these linkages must remain speculative.

Theory and research on motivation and personality should also consider how the design of technology influences an individual's motivation, and how a person's motives and personality traits shape how (or even whether) the person uses the technology. Basic frameworks have been established for applying personality theory (specifically, the cognitive-adaptive theory) and SD-Theory to the study of human-technology interaction as well as to the development of principles and guidelines for technology design (Szalma, 2009, 2014). These provide a foundation for research on how technology shapes motivation and how personality influences its use, and they also provide a basis for incorporating our current understanding of needs, motivations, and goal selection and attainment to improve the design of technology to better support human wellbeing.

CONCLUSION

SD-Theory is a broad theoretical framework that can integrate motivation and personality processes and structures. It is suggested here that perhaps asking how personality affects motivation is not the right question, and that we should instead view these as components of a larger system of traits that consist of cognitive, motivational and affective components. The cognitive science perspective offers a potentially useful approach for this effort, although more research focused on the information processing (“symbolic processing”) level is needed. In addition, a brief review of the extant literature revealed that there is a “motivational patterning” of personality traits, indicating stable tendencies to experience particular kinds of motivation and to adopt particular types of goals (i.e., intrinsic versus one of the types of extrinsic goals). To achieve a better understanding of motivation and personality, and how they operate to influence behavior, SD-Theory conceptualizations of motivation should be integrated into the broader systems and cognitive science approaches. The resulting model may be large and perhaps complex, but it would represent a step toward a more comprehensive theory of motivation and personality.

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24 Personality and the Self

MICHAEL D. ROBINSON AND CONSTANTINE SEDIKIDES

INTRODUCTION

In his influential text, William James (1890) devoted separate chapters to the self and to its habits. His chapter on the self focused on the malleability of self-views and the manner in which they are diverse, encompassing disparate aspects such as the material, social and spiritual selves. By contrast, his chapter on habits highlighted the ways in which an individual becomes more and more like a particular type of person, with a particular type of disposition, over time. Whether functional or dysfunctional, habits coalesce into personality traits, and these personality traits become relatively fixed by the age of thirty.

James's (1890) separate treatments of the self and its habits may have contributed to divergent research streams in empirical psychology. Self researchers (primarily social psychologists) often operate under the assumption that the self is multifaceted, malleable and low in cross-situational consistency (McGuire & McGuire, 1988). By contrast, trait researchers (primarily personality psychologists) have converged on the idea of basic personality dimensions that are fairly stable and consistent across situations (Benet-Martinez & John, 1998). This tension between malleable and stable views was brought to a sharp focus with Mischel's (1968) critique of the trait construct. Although much of the dust from the person-situation debate has settled (Kenrick & Funder, 1988), the self and personality traditions continue to remain largely separate.

This independence of the two traditions may be unfortunate. When people report on their traits, they access features of the self-concept, give that the self-concept organizes information about the self and self-reports of personality concern information about the self (McCrae & Costa, 1982). A researcher could therefore garner insights into personality by considering the sources of self-knowledge upon which people draw when characterizing their personality. People retrieve abstract self-knowledge when thinking about their personality, and the broader implications of this point have yet to be appreciated.

Additionally, whereas personality psychology can be praised for its well-established taxonomies (Funder, 2009), there are concerns that the resultant traits are largely descriptive rather than explanatory concerning the relevant individual differences (Pervin, 1994). Drawing from the self literature could provide clues about the manner in which traits operate. The self-enhancement motive is a key contributor to what people report about themselves (Sedikides & Gregg, 2008), and thus the personality scores that they receive, whereas research from other traditions (e.g., *raison oblige* theory; Gregg, 2009) can explain why people act in ways that are trait-consistent (McCrae & Costa, 1994).

At the same time, the personality traits literature can inform the self literature. Psychologists of the self sometimes emphasize how malleable the self can be from one situation to the next (Markus & Wurf, 1987). However, when researchers consider the self-concept in terms of dispositional knowledge, this degree of malleability is not evident. Rather, people have remarkably stable views of the self (Köber & Habermas, 2017), even across fifty years (Trzesniewski, Donnellan & Robins, 2003). Similarly, although self-theorists historically emphasized the role of socialization experiences (Cooley, 1902), researchers today recognize the substantial genetic contribution to the self-concept (Luo, Liu, Cai, Wildschut & Sedikides, 2016) just as to traits (Plomin & Caspi, 1999).

Thus, an integration of the personality trait and self literatures could benefit both. We forge integration while highlighting promising research paths. We start with foundational questions concerning links between traits and the self-concept.

ARE THERE LINKS BETWEEN PERSONALITY TRAITS AND THE SELF-CONCEPT?

Personality traits capture the ways in which people differ from each other with respect to their thoughts, feelings and behaviors. For example, neuroticism captures tendencies toward negative emotional experiences (McCrae &

John, 1992). Although traits could be assessed using clinician or informant reports, or perhaps by repeatedly observing behavior (Allport, 1937), the self-report method is the dominant one (John & Srivastava, 1999). People are asked to characterize themselves with respect to adjectives (e.g., “nervous”) or phrases (e.g., “worry a lot”) pertinent to having a trait (here, neuroticism). Assessing personality this way is not only practical and expedient, but also theoretically justified: People have more knowledge about themselves than others do (Funder, 1995).

Nonetheless, when researchers assess traits this way, they are asking people about their *self-concepts*. That is, they are asking participants how they view themselves in general terms. As such, it should not be surprising that personality traits overlap substantially with measures focused on the self. This is true for self-certainty (Campbell et al., 1996), self-deception (Paulhus & John, 1998), self-discrepancies (Hafidahl, Panter, Gramzow, Sedikides & Insko, 2000), and self-control (Tangney, Baumeister & Boone, 2004). It is also true for self-esteem (Rosenberg, 1979). From one perspective, low self-esteem is introverted neuroticism (Watson, Suls & Haig, 2002). From another perspective, self-esteem is a glue that links all Big Five traits together (Anusic, Schimmack, Pinkus & Lockwood, 2009) given that self-esteem correlates with all of them (Erdle, Gosling & Potter, 2009).

Personality traits are not entirely isomorphic with the self-concept. A percentage of Big Five items reference behavior (Werner & Pervin, 1986), for example, and behavioral references may be less common for many self-concept measures. Nonetheless, there is a great deal of overlap between personality and self-concept measures, particularly when people rate their own traits (Anusic et al., 2009). Such forms of overlap encourage efforts to understand traits in terms of self-related processes. We describe next models of the self that distinguish generalized and context-specific forms of self-knowledge.

WHAT KNOWLEDGE CONTRIBUTES TO TRAIT VIEWS OF THE SELF?

When people respond to how they are feeling, they consider the current state of the body (e.g., hungry or tired), where they are, what they are doing and what the events of the day will be like. When they are asked what they feel *in general*, they are presented with a nearly impossible task. Feelings, like thoughts, are constantly changing (Klinger, 1999). It could be difficult to generalize from a life in constant flux. Furthermore, the phrase “in general” is vague. Should it be equated with the current year, some phase of life (e.g., since leaving home and going to college), or one’s life as a whole? Lastly, if one could translate “in general” to some temporal frame (e.g., the last ten years), how could one tally up all the individual moments to make a judgment?

Such considerations suggest that people ought to find assessing their feelings in general difficult. Yet, they seem

to be doing fine. Robinson and Clore (2002a) instructed participants to rate their positive (e.g., joy, pride) and negative (e.g., anger, sadness) emotions over seven temporal frames that varied on width and proximity to the present: “at this moment,” “last few hours,” “last few days,” “last few weeks,” “last few months,” “last few years,” “in general.” These authors also assessed the time it took participants to make the judgments. If people base their emotion reports on event-specific or *episodic* emotion knowledge, it should take them longer to make judgments as the temporal frame becomes increasingly wide, from right now to the last few weeks to in general. Longer time frames mean more specific experiences to recall and aggregate (Brown, 1995). If people give up retrieving specific emotional episodes, there will be a curvilinear effect of time frame on judgment latencies, with a flat slope for especially long temporal frames.

Figure 24.1 displays a prototypical results pattern (Robinson & Clore, 2002a). There is a linear increase in judgment latency from the momentary time frame to the last couple of hours through the last couple of weeks. This indicates an episodic retrieval strategy as longer temporal frames would necessitate retrieving more instances. By contrast, the figure suggests that people stop using this retrieve-and-aggregate strategy for time frames longer than the last couple of weeks. For these longer temporal frames, increased frame width does not result in slower judgment times; rather, the latencies flatten out and then decrease, consistent with a different, nonepisodic strategy for making these judgments.

What sources of information do people retrieve when judging their emotions over long time frames? Robinson and Clore (2002a) termed this emotion knowledge *semantic* and suggested that people have beliefs about their emotions, even stereotypes, that they use when it is difficult to recall specific emotional episodes. The authors obtained relevant evidence by priming gender stereotypes as most people believe that women are more emotional than men. Men reported less intense emotion, and women reported more intense emotion, but only for the long temporal frames (“last few months,” “last few years,” “in general”). However, participants discounted these activated stereotypes when judging their emotions over the short temporal frames (“at this moment,” “last few hours,” “last few days”). People draw on beliefs about emotion, rather than specific instances of felt emotion, when judging their emotions over long time frames or “in general.”

Klein and Loftus (1993) came to similar conclusions about trait judgments. They asked whether people retrieve specific episodic information when deciding if they have a personality trait (e.g., “agreeable,” “dominant”). For example, when rating the self’s agreeableness, a person might have to recall specific instances in which they acted agreeably (e.g., helped Suzie move) or disagreeably (e.g., yelled at Todd). The researchers used three tasks. In the “describe” task, participants were asked whether the trait describes them, that is, to make a trait judgment. In the

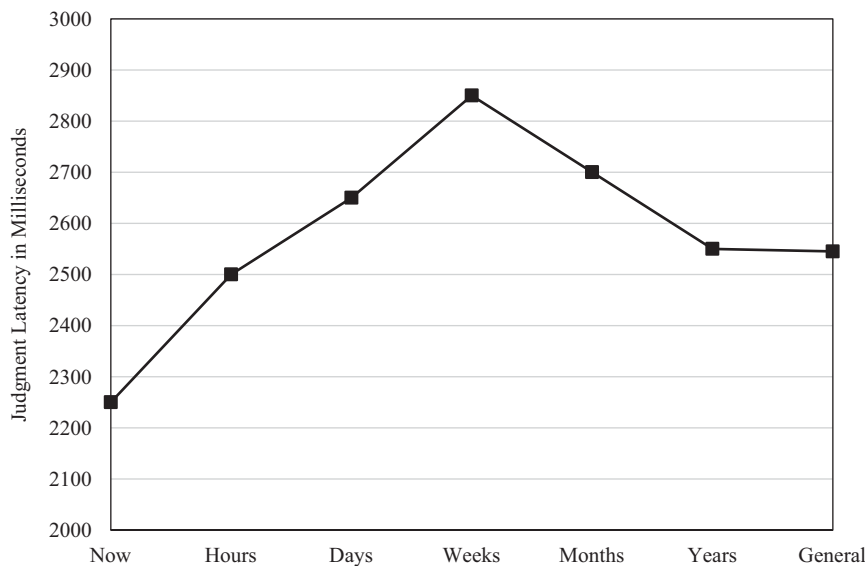


Figure 24.1 The effect of temporal frame on judgment latencies, based on Robinson and Clore (2002a).

“recall” task, participants were asked to recall a specific event or behavior relevant to their standing on the trait dimension. The final “define” task was a control condition. Participants were asked to define the trait (e.g., agreeable behavior is nice and caring) without thinking about the self.

By pairing the tasks together, Klein and colleagues could determine whether the person needed to retrieve specific instances to make a trait judgment. If the recall/describe order is faster than the define/describe order, then the recalled information was useful in making a trait judgment. Participants, however, do not show such priming, suggesting that they do not judge their traits “in general” by considering specific trait-relevant information (e.g., having engaged in a concrete behavior that was either extraverted or introverted; Klein & Loftus, 1993). Also, judging one’s personality traits does not speed one’s ability to recall trait-relevant exemplars (Klein, Sherman & Loftus, 1996a), converging on the idea that people do not need to consider specific behaviors when deciding which personality traits they possess. Instead, they have abstract ideas about the self’s traits that are divorced from the particulars of their lives.

The case is different for more contextual forms of the self-concept. Schell, Klein and Babey (1996) asked participants to judge their personality traits in general and also in the specific context of college. The authors reasoned that people have well-formed self-schemas for their personality traits in general, but they prefer to base contextual views of the self on more specific informational sources. Following this logic, recalling behaviors or events relevant to a trait should facilitate trait judgments for the self in college, but not in general. Schell et al. obtained this exact pattern: A priming effect (606ms) for the recall task when judging the self’s traits in college, but not in general (58ms).

These results are consistent with a hierarchical view of self-knowledge. In their day-to-day lives, people encounter events, receive feedback and engage in specific behaviors. These features of day-to-day life influence momentary self-views as well as a corresponding contextual self-concept, such as the self in college. However, specific events and behaviors do not impact more generalized views of the self – the sort that are the focus of trait scales. Contextual self-views will thus be more tied to events of one’s life than generalized views of the self. Figure 24.2 depicts such a hierarchical organization, with events and behaviors at the bottom of the hierarchy, contextual self-views in the middle and ideas about the self in general at the top.

In a neurocognitive case-study approach, Klein, Loftus and Kihlstrom (1996b) worked with a woman (W. J.) who had suffered temporary retrograde amnesia as a result of a concussive blow to the head. She could not recall specific events or experiences that occurred since high school, but could make reliable judgments about her personality. These ratings agreed with what her boyfriend thought about her, suggesting trait-related self-insight. Even more dramatic findings have been reported for patients who had lost their ability to retrieve episodic facts, whether due to severe head injury (K. C.), Alzheimer’s disease (K. R.), or stroke (D. B.). These patients, too, were able to characterize their traits despite inability to remember the details of their lives. In all, people retrieve generalized and abstract (i.e., semantic) forms of self-knowledge when characterizing their traits. We explore implications next.

IS THERE SUCH A THING AS A CONTEXTUAL PERSONALITY?

Conner and Barrett (2012) contrast an experiencing self with a semantic or believed self. The experienced self lives in the moment rather than in the abstract and its

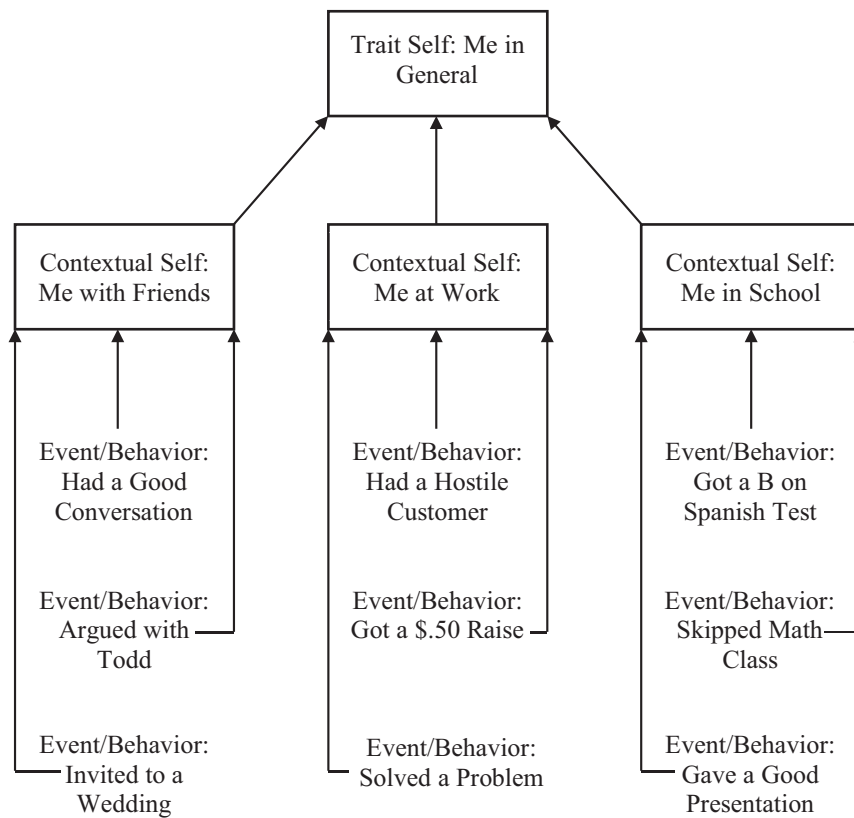


Figure 24.2 A hierarchical view of self-knowledge.

perceptions are determined by the motivational-embodied context at the time. This self is probed using experience-sampling procedures (Bolger, Davis & Rafaeli, 2003), and its thoughts, feelings or behaviors are malleable (Klinger, 1999). Indeed, Fleenon (2001) argued that the typical person exhibits nearly every level of a particular trait – such as extraversion – across the situations of his/her daily life. Fleenon and Gallagher (2009) used experience-sampling procedures to determine that between 50 and 75 percent of the variance in Big Five levels was due to occasions or time points rather than individuals. Nonetheless, this variability organizes itself into larger entities such as the person-in-situation (Shoda & Mischel, 2000) or the social role one is currently inhabiting (Markus & Wurf, 1987).

McAdams (1995) made a distinction between decontextualized and contextualized personality aspects, the latter of which are more role-bound. People not only modify the self to fit the social role, but they also recognize that they do so (Roberts, 2007). In a typical study, participants are instructed to characterize their personality in different social roles such as with friends, at work or at school (Figure 24.2). People describe their personalities differently in different roles. They may be more agreeable with friends, more extraverted at work and more conscientious at school than is true of the self in general (Donahue & Harary, 1998). Moreover, specific experiences in a role

(e.g., succeeding at school) affect how people view themselves within that role more than they affect how people view themselves in general (Wood & Roberts, 2006), confirming predictions that would follow from the hierarchical scheme of Figure 24.2.

There is also support for the opposite direction of influence, as shown in the frame-of-reference literature. Organizational psychologists have sometimes thought that generalized traits are relatively inconsequential in predicting work outcomes, such as job satisfaction or job performance (Morgeson et al., 2007). Personality inventories can be contextualized, though, by adding the phrase “at work” to the end of the items (Hunthausen, Truxillo, Bauer & Hammer, 2003). People rate themselves as more conscientious when the pertinent self is at work than in other contexts (Schmit, Ryan, Stierwalt & Powell, 1995). More interestingly, contextualized personality inventories exhibit higher levels of predictive validity for experiences and behaviors in a particular domain, such as work (Hunthausen et al., 2003).

In a relevant study, extraversion “at work” (rather than in general) was a better predictor of job satisfaction and turnover intentions, agreeableness “at work” was a better predictor of work-related absenteeism, and neuroticism “at work” was a better predictor of one’s tendency to be frustrated on the job (Bowling & Burns, 2010). Similar forms of contextualization are evident in occupational

and scholastic outcomes (Schmit et al., 1995). Thus, it would be informative to extend these findings by determining whether an inventory modified to include the phrase “with friends” predicts better interpersonal experiences and behaviors (Donahue & Harary, 1998). Regardless, people have forms of personality that are contextual. These forms are closely tied to relevant behaviors and experiences, and exhibit greater malleability across time (Wood & Roberts, 2006) and context (Markus & Wurf, 1987).

HOW CAN ONE ACCOUNT FOR THE STABILITY OF TRAIT JUDGMENTS?

Humanistic psychologists view the life course as one in which people might grow and self-actualize over time (Maslow, 1943; Rogers, 1961). However, people's responses to personality inventories exhibit remarkable stability over time, even among those who think their personalities have changed. McCrae and Costa (1994) noted that mean levels of the Big Five traits change to a small degree from age twenty to thirty (e.g., neuroticism decreases), but test-retest coefficients are more impressive. Over periods of five to ten years, McCrae and Costa reported test-retest coefficients of .60–.80. When such coefficients are compared to scale reliabilities (.70–.90), there appears to be almost no change in personality: What people say about their personality traits is the same over periods of five to ten years.

Yet, people's lives do change – they get married, advance in their jobs or encounter illness. Although many of these changes influence wellbeing and life satisfaction (Diener, Lucas & Scollon, 2006), they do not affect personality much. In a meta-analysis, Anusic and Schimmack (2016) found markedly higher stability coefficients for personality than for emotional wellbeing/life satisfaction. Part of this stability may be due to personality remaining stable over time. Evidence shows that peer-based judgments of personality, like self-based judgments, display test-retest coefficients in the .60–.80 range (Costa & McCrae, 1988). Part of this stability, however, is also due to people forming beliefs about themselves that become fixed and insulated from the everyday circumstances of their lives (Robinson & Clore, 2002b).

Consider Klein et al. (1996b), who found that one woman (W. J.) made the same personality judgments about herself when she suffered from retrograde amnesia and when she did not: She was accessing the same generalized self-knowledge in both cases. Moreover, such beliefs about the generalized self can be mistaken. Klein, Cosmides and Costabile (2003) worked with a woman (K. R.) with severe dementia. This woman could make reliable judgments about her personality. Yet, K. R.'s views of herself were outdated, better reflecting her personality in the past than in the present (Klein et al., 2003). Hence, we can account for the stability of personality self-judgments by positing that people form stable beliefs

about the self (e.g., “I am an introvert”) that they repeatedly access when asked to make trait judgments. Whether such beliefs are accurate or not, they are divorced from the particulars of one's life, thus lending them a considerable degree of stability over time (Klein & Lax, 2010).

CAN PERSONALITY BELIEFS BIAS MORE MOMENTARY JUDGMENTS?

People have generalized beliefs about themselves and they have daily lives (Conner & Barrett, 2012). Although participants can often keep these sources of information separate, they may not always do so. For example, when people retrospect on their emotions, some of the particulars of their emotional experiences will fade over time. To fill in these gaps, people will consult more generalized beliefs about the self or their emotions. In retrospect, people overestimate the extent to which pleasant events cause pleasure (Mitchell, Thompson, Peterson & Cronk, 1997) and unpleasant events cause distress (Gilbert, Pinel, Wilson, Blumberg & Wheatley, 1998). They also overestimate their emotions (Robinson & Clore, 2002a), especially if they think of themselves as emotional (Robinson & Clore, 2002b).

Barrett, Robin, Pietromonaco and Eyssell (1998) instructed participants to report on their momentary emotional reactions to daily social interactions for one week. The same participants completed trait-related scales of positive affect, negative affect and affect intensity. The researchers found little evidence that women are more “emotional” in their momentary reactions. The trait emotion scales revealed robust differences, however, with women believing that they are more emotionally reactive than men. Thus, there is a dissociation between generalized beliefs about emotion, which are associated with pronounced sex differences, and online experiences of emotion, which are inconsistent with generalized beliefs. Robinson, Johnson and Shields (1998) asked women and men to report their emotional experiences immediately after playing a competitive game. These reports of emotion did not vary by sex. By contrast, sex differences were observed when participants reconstructed their emotional reactions a week later or when they merely imagined their reactions to the game. Apparently, people draw on generalized beliefs about their emotions, including sex stereotypes, when specific experiential information is missing, either due to the passage of time (retrospective condition) or the absence of relevant experience (hypothetical condition).

Similar dissociations have been reported for culture. Asians are more modest in their self-presentation and report lower levels of subjective wellbeing than Westerners (Diener, Oishi & Lucas, 2003). However, these beliefs about happiness may be in error. In several experience-sampling and laboratory studies, Oishi (2002) found no differences in wellbeing between Asian and Caucasian

samples. Nonetheless, Asians retrospectively reported lower wellbeing than Caucasians. Diener et al. (2000) found a similar belief-infusion effect for the difference between one's satisfaction with specific life domains (e.g., textbooks, lectures) and the more global life domains that these would constitute (e.g., education). Cultural groups differed in the extent to which they reported greater satisfaction with global than specific domains, and such differences in "global positivity" systematically varied by culture (e.g., the difference was higher for "happy" cultures like Puerto Rico, but lower for "modest" cultures like Japan). Thus, cultural beliefs about happiness bias retrospective and global judgments about wellbeing relative to the actual experiences that cultural members have.

Personality-related beliefs, too, could bias retrospective estimates of online experience. Larsen (1992) collected online reports of somatic symptoms (e.g., aches and pains) for two months and then had the same participants retrospectively report on their somatic symptoms during this total time period. Neuroticism predicted online reports of symptoms, but there was a stronger relationship with retrospective reports of symptoms: Neurotic individuals thought that they had more somatic symptoms than they did. Similarly, Houtveen and Oei (2007) found that people prone to think of themselves as ill and symptomatic (in their trait reports) retrospectively overestimated their tendencies toward somatic distress during a one-week time period. Hence, personality traits can be viewed in terms of beliefs about the self that can bias retrospective estimates of experience relative to online reports of experience. Research focusing on other personality dimensions (e.g., conscientiousness) and other classes of outcomes (e.g., behavior) is needed. Nonetheless, it stands to reason that people would consult their personality-related beliefs when asked what the self would do, think, or feel in the absence of easily retrieved evidence.

Consider the results of Van Boven and Robinson (2012). These researchers induced emotions, using film clips or vignette-based inductions. Participants reported their emotional reactions a mere twenty minutes later. To disrupt episodic memory retrieval, some participants rehearsed complex letter strings while attempting to recall their earlier emotional reactions. Under such circumstances, people might have difficulties recalling specific details and should consult generalized beliefs concerning their emotions. Indeed, women reported more intense reactions to sadness inductions, and men to anger inductions, when under high than low cognitive load. Cognitive load led women and men to report emotional reactions that were consistent with gender stereotypes, even though the relevant emotional episodes occurred recently. People might use generalized beliefs about the self as "fill in" information under conditions in which event-specific meaning is difficult to come by.

Further support for these ideas derives from research on individual differences in reaction time. Robinson, Solberg, Vargas and Tamir (2003) examined the relationship between extraversion and subjective wellbeing. Extraversion predicts wellbeing (DeNeve & Cooper, 1998), but might do so in a "fill in" fashion. That is, under mundane circumstances, extraverts might be inclined to make more positive evaluations of their environment than introverts, which would facilitate higher levels of wellbeing (Lucas & Diener, 2001). Such top-down effects, though, should be lesser to the extent that the person is good at distinguishing neutral and positive events in more episodic, event-specific terms (e.g., at encoding).

To test this formulation, Robinson et al. (2003) designed a reaction time task that required participants to distinguish neutral and positive events (words) as quickly as possible. People who make these distinctions quickly are more skilled in online evaluation and may consult their dispositional beliefs less often in evaluating their circumstances. Extraversion interacted with evaluation speed to predict subjective wellbeing. Extraversion did not predict wellbeing among participants who were fast to distinguish neutral and positive events, but did predict wellbeing judgments among slow evaluators. Thus, extraversion, as a source of dispositional beliefs, is important among people who have difficulty making distinctions at encoding.

In the previously described research, Robinson et al. (2003) assumed that the distinction between neutral and positive events was relevant, because most of the events people encounter in life fall somewhere between neutrality and positivity (Cacioppo, Gardner & Berntson, 1997). Subsequent studies, though, supported a broader consideration of such phenomena. In Robinson and Oishi (2006), participants distinguished pleasant and unpleasant words, but also made nonevaluative distinctions such as between fruits and vegetables or animate and inanimate objects. Participants who were faster at one categorization task were faster at others, indicating a general speed or episodic encoding factor.

Robinson and Oishi (2006) found results similar to Robinson et al. (2003), with a representative pattern reported in Figure 24.3. Extraversion predicted life satisfaction, a component of subjective wellbeing, particularly among participants slow to categorize events (words) as they occur. Among those proficient in assigning meaning to events, the dispositional beliefs captured by extraversion did not predict life satisfaction levels. In the latter case, these people may live their lives in a more episodic manner, rendering their dispositional beliefs less relevant. Personality-related beliefs may matter more when event-specific meaning is harder to come by, here due to poorer categorization skills.

Such evidence is not limited to the extraversion/wellbeing relationship. Recall that neuroticism biases symptom reporting (Watson & Pennebaker, 1989), particularly in

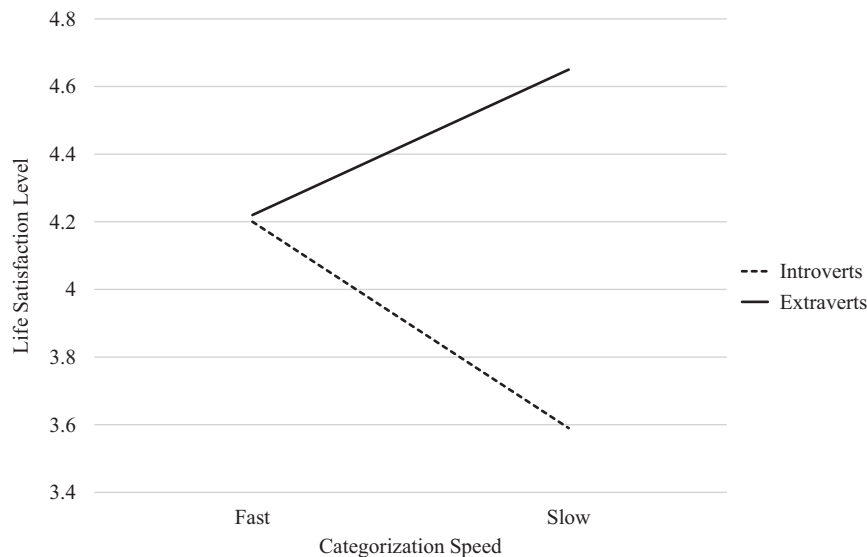


Figure 24.3 Extraversion as a predictor of life satisfaction among fast and slow categorizers, based on Robinson and Oishi (2006).

retrospective designs (Larsen, 1992). Following the logic of Robinson and Oishi (2006), the neuroticism/symptom relationship, too, might be stronger among people who have difficulties attaching meaning to events as they occur. Robinson and Clore (2007) tested this hypothesis by assessing neuroticism, individual differences in categorization speed and the extent to which the person felt they had been suffering from somatic symptoms (e.g., headaches, nausea) over the past weeks or months. Categorization speed and neuroticism interacted, such that neuroticism was a stronger predictor of somatic symptom reports among participants who exhibited difficulties assigning meaning to events in the choice reaction time tasks.

These results are informative. Personality traits, at least when assessed via noncontextual self-report scales, tap generalized beliefs about the self. Such beliefs alter construal and reporting in a top-down manner (Robinson & Clore, 2002b). To the extent that the person is attuned to the current environment, dispositional beliefs about the self matter less.

There are other lines of relevant research. One aligns people along a perseveration dimension, with some oriented toward the past (high perseveration) and others toward the present (low perseveration). Robinson, Wilkowski, Kirkeby and Meier (2006) theorized that participants high in perseveration, who are inclined toward cognitive-behavioral inertia, should exhibit greater “trait-edness” as well – that is, their personality traits should matter more. The researchers supported this idea with respect to the neuroticism/distress relationship. We conclude that personality beliefs can exert a top-down influence on momentary judgments and behavior, particularly when episodic meaning is lacking (Robinson & Oishi, 2006) or the person leans toward habitual responding (Robinson, Goetz, Wilkowski & Hoffman, 2006).

PUTTING THE SELF INTO PERSONALITY

Personality psychology has been criticized for emphasizing structure over process (Pervin, 1994). Researchers know a lot about how traits relate to each other, and about taxonomic issues, but they know less about why personality traits predict certain outcomes. Viewing self-reported traits as features of the self-concept can provide process-based scaffolding, because the self literature emphasizes process over structure (Sedikides & Gregg, 2003). Thus, the taxonomic strengths of the personality literature can be joined with the process-related strengths of the self literature in a mutually beneficial manner.

The self literature is partially organized in terms of hyphenated concepts such as self-enhancement, self-protection, self-affirmation, self-regulation, self-certainty and self-deception (Baumeister, 1998). Many, if not most, of these concepts implicate motivation (Sedikides & Gregg, 2008), which has traditionally been thought of as distinct from traits (Winter, John, Stewart, Kohnen & Duncan, 1998). Motivational perspectives on personality traits, however, are in the ascendance (Denissen & Penke, 2008). We endorse such perspectives by highlighting mechanisms that can account for either the origin or operation of traits.

Self-Enhancement and Self-Certainty

Self-enhancement is a potent and cross-culturally prevalent motive that refers to the pursuit and endorsement of overly positive self-views (Sedikides, Gaertner & Cai, 2015). Self-enhancement is observed in judgments such as the better-than-average effect, whereby participants think they are better than their average peer on desirable qualities and attributes (Alicke & Govorun, 2005), or the

overclaiming effect, whereby people exaggerate their knowledge within important domains (Paulhus, Harms, Bruce & Lysy, 2003). More dynamically, self-enhancement leads people to seek positive information about the self (Hepper, Hart, Gregg & Sedikides, 2011) while rejecting negative feedback (Ditto & Boardman, 1995). Self-enhancement, which is related to social desirability (Sedikides & Gebauer, 2010), influences trait judgments. Edwards (1966) examined the correlation between trait desirability and trait self-endorsement. It was .892. What people report about their traits is strongly related to how desirable the trait is.

There are individual differences in the strength of the self-enhancement motive (Hepper, Gramzow & Sedikides, 2010) that are predictive of personality scores (Asendorpf & Ostendorf, 1998). People who self-enhance have higher self-esteem levels (Hepper et al., 2010), and self-esteem correlates with the Big Five (Robins, Tracy, Trzesniewski, Potter & Gosling, 2001). Thus, one would expect high self-enhancers to report greater extraversion, agreeableness, conscientiousness, stability and openness to experience in a manner that exaggerates these traits. Indeed, the evaluative nature of all Big Five traits gives rise to inter-correlations. Digman (1997) first noticed two clusters of higher-order traits, termed alpha (A+C+N-) and beta (E+O+). Paulhus and John (1998) pointed out that these two clusters are highly related to two self-enhancement biases – a moralistic bias that leads people to exaggerate their communal qualities (A+C+) and an egoistic bias that leads them to exaggerate their agentic qualities (E+O+).

These distinct forms of self-enhancement, moralistic and egoistic (Paulhus & John, 1998), are also interrelated. Muek (2007) reported evidence for a “Big 1” of personality that combines the desirable poles of all Big Five traits. This General Factor of Personality is apparent when people self-report their personalities (Anusic et al., 2009) and is strongly associated with self-esteem (Erdle et al., 2009). Moreover, it correlates with improbable forms of self-enhancement such as claiming to be attractive, intelligent and athletic despite the orthogonality of these desirable qualities (Anusic et al., 2009). Hence, what people report about their traits reflects, in part, operations of the self-enhancement motive (Paulhus & John, 1998).

The implications of this analysis have been debated. Some regard it unfortunate that self-reports of personality confound descriptive content – whether one is more talkative or quiet – with tendencies to make positive evaluations about the self (Saucier, 1994). Others think that whether a person views themselves favorably or not is a meaningful personality component (Muek, 2007). Regardless, traits that are more evaluative, and therefore more likely to trigger the self-enhancement motive, result in lower levels of self-peer and peer-peer agreement (John & Robins, 1993). Also, traits that are more evaluative often result in lower levels of test-retest stability (Wood & Wortman, 2012), because the self-enhancement motive also

waxes and wanes with time (Alicke & Sedikides, 2009). Hence, it can be useful to control for evaluation and/or focus on neutral or less evaluative traits.

Although some people do not habitually self-enhance, this does not mean that they dislike themselves. Rather, they may present themselves in a modest, self-protective manner as one is less likely to look foolish by claiming skills or potentials that are lacking (Sedikides, Hoorens & Dufner, 2015). People low in self-esteem are motivated by such concerns (Baumeister, Tice & Hutton, 1989) and hesitate when opportunities for self-promotion arise (Heimpel, Wood, Marshall & Brown, 2002). Given links between self-esteem and the Big Five (Robins et al., 2001), some of the modesty characteristic of low self-esteem individuals may also be found among those lower in extraversion or higher in neuroticism (Watson et al., 2002), especially because introversion and neuroticism are linked to self-protective concerns (Cheek & Buss, 1981).

The relation between self-esteem and self-certainty is relevant. People with lower self-esteem are less certain and more conflicted in their self-views (Baumeister, Campbell, Krueger & Vohs, 2003). They report less clarity concerning the self, give less extreme self-ratings, make these ratings with lesser confidence and exhibit longer latencies when judging the self (Campbell, 1990). This degree of uncertainty matters with respect to personality because individual differences in self-certainty are systematically related to multiple Big Five traits, including neuroticism (Campbell et al., 1996). Moreover, a self-certainty perspective can explain individual differences in reactivity: When people are uncertain about the self, negative events or feedback will have more impact on momentary self-views, affecting emotional wellbeing (Kernis, 2003). Given that neurotic individuals are less certain about the self (Campbell et al., 1996), they are more prone to emotional reactivity (Bolger & Schilling, 1991).

There are further reasons to explore self-certainty as a personality component. Certainty is a classic measure of attitude strength, such that attitudes held with greater certainty are more predictive of behavior (Petty & Krosnick, 1995). In a meta-analysis, the average attitude-behavior correlation was $r = .45$ at high levels of certainty, but $r = .08$ at low levels of certainty (Kraus, 1995). Similarly, higher certainty about one's traits predicts behavior better (Dalal et al., 2015): Extraversion is more predictive of observer judgments among people who are more certain of their extraversion (Swann & Ely, 1984).

The self-enhancement motive is potent, prevalent and dynamic (Sedikides et al., 2015). A great deal is known about how this motive influences processes such as attention, feedback-seeking and memory (Sedikides, Green, Saunders, Skowronski & Zengel, 2016). Given that the motive has been linked to major personality traits (Paulhus & John, 1998), researchers will learn more about how these traits operate by adopting experimental paradigms pioneered by social psychologists for the study of

self-enhancement (Alicke & Sedikides, 2011). For example, extraverted people may recall memories of successful social interactions as a way of bolstering their social confidence when it is threatened (Denissen & Penke, 2008).

Raison Oblige as a Basis for Personality Congruence

Once people have formed ideas about what they are like, they seem to act in ways that will confirm those beliefs. For example, people with negative self-views may dwell on negative feedback and even seek it out (Swann, Rentfrow & Guinn, 2003). In one such paradigm, people with positive and negative self-views are offered the choice to interact with someone who has given them either positive or negative feedback. Although people with positive self-views choose to interact with favorable others, those with negative self-views choose to interact with unfavorable others (Swann, 1992). Negative feedback seems to “fit” better for people with negative self-views and anticipated interactions appear smoother.

Such findings can be accounted for by self-verification theory (Swann et al., 2003), but they can also be accounted for by a simpler alternative, *raison oblige* theory (Gregg, 2009). According to it, individuals with negative self-views do not want their self-views to be true. Rather, they consider favorable feedback as implausible and, constrained by reality, accept unfavorable feedback because they view it as more plausible than favorable feedback. So, individuals with negative self-views find themselves rationally obliged to pursue feedback that they would prefer not to be part of their identity. These individuals do not differ from those with positive self-views in their desire for favorable or unfavorable feedback or in their wish for favorable or unfavorable feedback to be true; they only differ in the plausibility that they ascribe to favorable feedback. In a typical experiment of this type, participants with negative self-views who choose to read an unfavorable (over favorable) personality profile report that they prefer the rejected (favorable) profile, but consider the chosen (unfavorable) profile as more plausible.

People with low self-esteem seem to inhabit worlds that are less joyful and eschew positive affective outcomes (Wood, Heimpel, Manwell & Whittington, 2009). By contrast, the untroubled extravert is someone who regularly seeks pleasure, including in their social interactions (Lucas & Diener, 2001). People also expect (but not necessarily want) mood states that match their dispositional tendencies. Tamir, Robinson and Clore (2002) found that extraverts were faster to identify desired and undesired outcomes when they were in positive rather than neutral mood states, but happy introverts exhibited difficulties with the same tasks. Hence, people’s ideas about dispositional affect can influence the emotional experiences that make sense for them, affecting performance.

The downstream consequences of *raison oblige* theory processes can be significant. People who are depressed

often act in ways that magnify their depression (Joiner & Metalsky, 1995) and people who are anxious often act in ways that reinforce this state (Suls & Martin, 2005). There are physiological consequences to such dynamics. Brown and McGill (1989) reported that positive events undermined health for people with low self-esteem, but promoted health among people with high self-esteem. Similarly, Ayduk, Gyurak, Akinola and Mendes (2013) found that blood pressure levels increased when people with negative self-views received positive feedback, but decreased when they received negative feedback. In all, people create and inhabit psychological worlds that match their dispositional self-beliefs.

We underline two implications. First, *raison oblige* theory can explain why personality traits predict certain outcomes. Disagreeable people, for example, may act in a less moral manner because doing so is consistent with features of the self-concept (Mulder & Aquino, 2013). Second, *raison oblige* theory can explain why personality traits are stable over time. When people continue to act in ways consistent with the self-concept, that self-concept will become more entrenched (McCrae & Costa, 1994).

CONCLUSION

Personality psychologists study traits and social psychologists study the self-concept. An integration of these traditions is possible because both ask people to characterize themselves and there are systematic relationships between measures of traits and the self-concept (Robins et al., 2001). The two literatures can inform one another.

When people self-report on their traits, they access semantic self-knowledge, which is independent of time and place (Klein & Lax, 2010). Its decontextualized nature may contribute to the temporal stability of traits (Klein et al., 1996b), but it may also result in self-views that no longer map onto the particulars of one’s life (Klein et al., 2003). People also have contextualized self-views that are updated more frequently, though they may capture a limited scope of operation (Schell et al., 1996). Such considerations give rise to a hierarchical view of self-knowledge, one in which decontextualized ideas about the self organize multiple contextual self-views, which in turn respond (though conservatively) to particular experiences and behavior (Wood & Roberts, 2006; see Figure 24.2).

Viewing personality in terms of generalized beliefs about the self invites questions. Generalized beliefs are usually accurate, but they can sometimes be inaccurate (Clore & Robinson, 2012). In the context of personality, similarly, some people may have beliefs about the self (and/or their traits) that are systematically inaccurate in characterizing their everyday lives (Conner & Barrett, 2012). Even so, beliefs about the self provide a sense of continuity (McAdams, 2013) and can serve as a default when information relevant to the judgment is not readily accessible (Robinson & Clore, 2002b). In the chapter, we

used these ideas to address the nature of retrospective biases and then extended these ideas to a consideration of trait–outcome relationships. Personality traits could be particularly consequential under cases of ambiguity or when people encounter difficulties assigning meaning to events as they occur (Robinson & Clore, 2007; Robinson & Sedikides, 2009). This framework is not sufficient for understanding all trait–outcome relationships, but it does offer insights concerning some of them.

In the final portion of the chapter, we attempted to integrate the personality and self literatures by considering whether motives such as self-enhancement can contribute to an understanding of personality functioning. People differ in the strength of the self-enhancement motive (Hepper et al., 2010), and such differences can explain why some are more likely than others to endorse personality items on the basis of their favorability (Leising, Scherbaum, Locke & Zimmermann, 2015). People who do not gravitate toward self-enhancement may be less certain about the self and more modest. Additional work on certainty merits attention. For example, because people who are less certain about the self should exhibit greater reactivity in daily life (Kernis, 2003) and weaker personality–outcome relationships (Dalal et al., 2015). Finally, we outlined ways in which *raison oblige* theory (Gregg, 2009) can explain some cases of personality trait congruence. Altogether, the chapter illustrates multiple benefits that can follow from an integration of the personality and self literatures.

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Traits and Dynamic Processes

ERANDA JAYAWICKREME AND CORINNE E. ZACHRY

INTRODUCTION

The study of human behavior in psychology has been shaped by the two competing perspectives that make up the Lewinian equation – the person and situation perspectives (Fleeson & Jayawickreme, 2018). Whereas Lewin emphasized the importance of *both* the person and the situation as determinants of individual behavior, these two perspectives on behavior have historically been examined separately in the fields of personality and social psychology. As a field, personality science has a long and distinguished history, and has accrued a deep and robust evidence base for describing individual differences, assessing their stability over time, and showing their predictive functionality for a range of positive life outcomes (Jayawickreme et al., 2014). More recently, this focus on description has given way to sustained interest in the question of why, how, when and where individual differences (e.g., in traits, goals, values) originate, manifest in daily lives, and entail important personal, social, occupational and societal consequences.

In this chapter, we outline the strengths of the descriptive approach, how dynamic theories have built on this approach to focus on explaining personality – with a focus on Whole Trait Theory – and outline new directions for further understanding the processes underlying personality.

PERSONALITY SCIENCE TODAY

Broadly, the history of personality itself has been broadly defined by three perspectives. The dominant perspective has focused on structure, with researchers focusing on describing people in terms of phenotypic traits (e.g., outgoing, anxious) and classifying those trait-descriptions into taxonomic structures (e.g., the Big Five, HEXACO, the Big Seven, the interpersonal circumplex). While the early years of personality science were characterized by a number of such structures (e.g., Borgatta, 1964; Costa & McCrae, 1985; Digman & Takemoto-Chock, 1981; Fiske, 1949; Goldberg, 1982; John, 1989; Norman, 1963; Tupes &

Christal, 1961), it is noteworthy that these structures produced a high level of consensus around a replicable five dimensions of extraversion, agreeableness, conscientiousness, emotional stability (or neuroticism) and openness. In part due to the success of this approach, many people continue to view this approach as representative of the field more generally.

More recently, with the advent of large-scale longitudinal studies, psychologists have also examined changes in individuals' trait levels across time. In the wake of Block's (1993) call that studies of personality should be lengthy enough for such changes to be observed, these substantive longitudinal studies of personality have allowed researchers to examine stability and change in trait levels. New insights into normative change, rank-order stability, and interindividual differences in conformity to normative patterns of change have been examined (e.g., Lucas & Donnellan, 2011; Ludtke, Roberts, Trautwein & Nagy, 2011; Roberts & DelVecchio, 2000; Soto, John, Gosling & Potter, 2011), as well as the genetic and environmental explanations for personality development across the lifespan (Bleidorn et al., 2010, 2012). Additionally, the link between personality and positive human outcomes has been specified and replicated through both preexisting data and intentionally designed studies (Diener et al., 1992; Friedman et al., 1993; Kern & Friedman, 2008).

More recently, a process-focused perspective has gained traction (Baumert et al., 2017). While early personality scientists noted the importance of identifying the processes underlying personality traits (e.g., Allport, 1937), the reasonable goal of specifying the structure of personality took precedence over this for much of the field's history. This perspective focuses on the question of why, how, when and where individual differences (e.g., in traits, goals, values) originate, manifest in daily lives, and entail important personal, social, occupational and societal consequences. Specifically, this perspective emphasizes personality traits as collections of contextualized dynamic processes that play out across time and occur within or across individuals, and within or across different contexts

(Fleeson & Jayawickreme, 2015; Wright & Hopwood, 2016).

In this chapter, we present some basic information on the achievement of structure-oriented perspective (which facilitated the subsequent focus on process perspectives) and delve into a selection of recent instantiations of the process-oriented perspective. We frame this discussion around Whole Trait Theory, which we believe integrates both descriptive and dynamic personality perspectives and facilitates a better understanding of the manifestations, explanations and outcomes of traits. While our discussion focuses on Whole Trait Theory, we will also note connections, similarities and differences between our approach and other dynamic approaches that have as their common goal the explanations of the dynamic manifestation of personality across contexts (e.g., DeYoung, 2015; Roberts, 2017) and outline future directions for dynamic personality research, including examining the possibilities for consensus across models and the promise of interventions to promote positive personality change (Jayawickreme & Blackie, 2014; Roberts, Hill & Davis, 2017; Widiger, 2017).

PERSONALITY STRUCTURE AND THE ACHIEVEMENT OF THE BIG FIVE

Most trait psychologists agree that differences between people can be organized into a hierarchical structure, with the five traits of extraversion, agreeableness, conscientiousness, emotional stability, and intellect/open-mindedness (the “Big Five”) at an intermediate level (Costa & McCrae, 1985; Goldberg, 1982; John et al., 2008; Soto & John, 2016). On this view, describing a person involves identifying his or her level of these five broad traits. In other words, the Big Five identifies the main ways to describe what a person is like and how he or she is different from other people. Each of the Big Five traits is broad and carries with it a fairly rich description of what a person is like. For example, describing a person as extraverted implies that he or she is talkative, energetic and verbal, that he or she is assertive, bold and commanding, and that he or she is adventurous and daring. Describing a person as agreeable implies that he or she is warm, kind and friendly, and that he or she is generous, giving, and respectful. In addition, multiple research assessments have shown that facet-level traits (that is, facets underlying each of the Big Five traits) capture meaningful information, that these facets show distinctive developmental trends and that these individual facets relate uniquely with important life outcomes. For example, following Soto and John’s account (2016), the broad Big Five trait of agreeableness contains within the trait the facets of compassion, respectfulness and trust. This approach had as its main goal organizing the pattern of relationships among individual differences in traits, so that this pattern reveals the systematic organization of the Big Five, as well as confirming the central nature of these traits in describing individuals (Fleeson & Jayawickreme, 2018).

An alternative perspective of personality, however, focuses on the behavior patterns that result from traits. The act-frequency approach (Buss & Craik, 1983) and the density distribution approach (Fleeson, 2001) both focus on describing individuals in terms of the frequency with which they perform trait-relevant behavior. Such a conceptualization of personality captures the dynamic nature of personality manifestation in daily life, and provides an ideal framework for understanding of the processes that explain variability and consistency in trait manifestations within and across people, as we discuss later in this chapter.

PERSPECTIVES ON PERSONALITY PROCESSES

While focus on describing behavior (at the global but also at the momentary level) has been a rich and fruitful talk for personality psychologists, researchers have begun systematically examining the processes that undergird behavior (Baument et al., 2017). Understanding the psychological processes as well as the situational and social constraints that explain the occurrence of these broad dimensions of human variability in behavioral patterns has remained a question largely unanswered by the descriptive trait perspective (Hampson, 2012).

Some accounts have incorporated biological explanations for traits. Biological theories of personality, such as Reinforcement Sensitivity Theory (Corr, 2008), propose that neurophysiological and endocrinal processes generally shape behavior but vary systematically among and within individuals. This variability between and within persons accounts for interindividual as well as intraindividual differences in behavior. McCrae and Costa (2008) have also provided a genetic account for traits in their Five-Factor Model. Other work has focused on the neurobiological foundation of traits (Allen & DeYoung, 2017; DeYoung, 2015), with a focus on the likely explanatory role of neurotransmitters such as serotonin and dopamine on different sets of the Big Five. Relatedly, areas within the dorsolateral prefrontal cortex appear to be involved in approach and avoidance motivations, via their networks with other motivation-relevant areas of the brain (Spielberg et al., 2011; Wright, 2017).

In terms of understanding psychological processes, the social cognitive perspective has made important theoretical advances in clarifying the possible mechanisms underlying these traits, by proposing explanatory mechanisms underlying individual differences in behavior. Of note, Allport (1937) originally described traits as being made up of cognitive, motivational and affective processes that produce trait-manifesting behavior, which predicted the current interest in process accounts of traits (Fleeson & Jayawickreme, 2015). Rotter’s (1954) social learning theory emphasized the role of generalized expectancies in the prediction of behavior, and claimed that personality could be described as a relatively stable set of potentials (the likelihood of engaging in a specific behavior in a given

situation) for responding to situations in a particular way. Similarly, Bandura's social cognitive theory (Bandura, 1986, 1999) emphasized cognitive elements in learning or the acquisition of behavior, as well as the importance of self-efficacy beliefs and motivation, described in terms of standards or goals.

Perhaps the most influential social-cognitive theory of personality is Mischel and Shoda's (1995, 2008) cognitive affective processing system (CAPS) account. On the view of CAPS, cognitive, affective, and motivational units form the foundation of situation-based tendencies in individuals' behavior. For example, a student may engage in aggressive behavior when responding to taunting by peers but compliant when teachers engage her because of various expectations she has about the behavior of peers and teachers (see Baumert et al., 2017, p. 511). Mischel and Shoda made a persuasive argument in favor of identifying the processes, provided an outline of what the processes would be like, pointed to social-cognitive mechanisms as likely locations of these processes, and provided a set of components likely to be involved in these processes. Included in these components were encodings, expectancies, affects, competencies and self-regulatory plans (Mischel, 1973). For example, the social-cognitive approach has pointed to goals and beliefs as causes of personality-relevant behavior, so that when psychologists wish to explain personality-relevant behavior, they should look to goals and beliefs.

It should be noted, however, that while these theories can explain why people differ, they do not explicitly identify how people differ or which individual differences the theories should be used to explain. In other words, social-cognitive theories were not tied to the structural project of personality, but instead developed in opposition to it (Fleeson & Jayawickreme, 2018). These theories claim that whatever ways people turn out to differ, the causes of those differences will be social cognitive mechanisms such as encodings, expectancies and self-regulatory plans, without direct reference to the Big Five. Moreover, these views predicted that these differences would be highly localized and specialized, or perhaps "fragmented," rather than grouped into meaningful broad traits. Indeed, some psychologists operating within the social cognitive perspective have remained skeptical of trait perspectives (e.g., Bandura, 1997), claiming that while traits can be observed, they are relatively uninteresting or overtly simplistic, and do not correspond to psychological processes (Mischel, 2009).

The relationship between traits and motivation has also received increased attention. Being motivated to change one's personality in the long-term is effective (Hudson & Fraley, 2015; Wood & Wortman, 2012) and being motivated by investment in work predicts change in personality, especially conscientiousness (Hudson et al., 2012). Traits and goals exhibit bidirectional causal connection, with traits causing goals (Lüdtke et al., 1989) and goals causing traits and trait manifestations (Bleidorn et al., 2010;

McCabe & Fleeson, 2016). Supporting the view that traits may be malleable through self-regulated behavior, Roccas and others (2014) provided evidence that traits are more mutable than values, and are driven by values but not vice versa, further suggesting the more dynamic nature of traits compared to values (Kandler, Zimmermann & McAdams, 2014).

DYNAMIC APPROACHES TO PERSONALITY

More recently, however, a number of novel integrative explanatory accounts of traits have been developed and evaluated (e.g., DeYoung, 2015; DeYoung & Krueger, 2018; Fleeson & Jayawickreme, 2015; Jayawickreme, Zachry & Fleeson, 2018; Roberts, 2017). These approaches have in common a recognition of the dynamic nature of personality function and the need to explain this nature. For example, in Whole Trait Theory (Fleeson & Jayawickreme, 2015; Jayawickreme & Fleeson, 2017), a link is stipulated between traits defined as the density distributions of Big Five-relevant personality states (Fleeson, 2001) and relevant social-cognitive mechanisms. On this view, the manifestation of traits in everyday life takes a form predicted by social-cognitive explanations which is nevertheless consistent with structural accounts of traits (Fleeson, 2001; Fleeson & Gallagher, 2009). Thus, the view of traits as density distribution is consistent with social-cognitive mechanisms, in that states are highly variable across moments. Second, when one manipulates social-cognitive mechanisms, this predicts changes in the actual manifestation of traits, showing that they are indeed at least part of the explanation of trait manifestations (Fleeson, 2007; McCabe & Fleeson, 2012; McNiel, Lowman & Fleeson, 2010).

In a different yet complementary approach, Roberts' sociogenomic approach (2017) distinguishes between two different levels of the trait – an enduring trait concept that is embedded within neurological structures (Jackson, Hill & Roberts, 2012), and state-level manifestations of that personality trait. This account thus both highlights the mechanisms underlying stability in the trait as well as trait manifestations that both reflect the trait but vary in response to contextual factors (Jackson & Roberts, 2017).

What these two approaches share is a view that, in so far as traits are descriptions of how people act, then mechanisms capable of explaining the dynamic nature of personality manifestations across time and individuals are required. As noted earlier, this is a characteristic common to many integrative theories of personality dynamics. In the following section, we describe the rationale for Whole Trait Theory in greater detail. In doing so, we highlight similarities of our approach with other theories.

Explaining Traits

Are traits descriptions or causal dispositions? One long-running conceptual debate in personality has been over

whether traits are causal dispositions (McCrae & Costa, 2008) or descriptions of individuals (de Raad & Mlacic, 2017). Whole Trait Theory attempts to reconcile these approaches by integrating them into a distinctive understanding of trait. On this view, traits consist of two components or “sides” (Fleeson & Jayawickreme, 2015; Jayawickreme & Fleeson, 2017). The explanatory component (denoted by the term *TraitEXP*) consisting of dynamic social-cognitive processes causing trait manifestations, and the descriptive component of traits (denoted by the term *TraitDES*), which are manifestations of personality (or personality states; Fleeson, 2001) that both vary across context and form stable distributions over time as a function of the dynamic processes characterized by *TraitEXP*.

The central claim of Whole Trait Theory is that it provides an explanatory account for the manifestations of the Big Five (and potentially traits outside the Big Five; Jayawickreme & Fleeson, 2017) in daily life. Specifically, if *TraitDES* represents the Big Five and *TraitEXP* represents social cognitive mechanisms, then social-cognitive mechanisms imply the Big Five and the Big Five imply social cognitive mechanisms. This can be tested by showing that manifestations of the Big Five have characteristics of something producible by social-cognitive mechanisms and compatible with consistency, and that social-cognitive mechanisms produce Big Five manifestations. In the following sections, we specify the distinction between these two traits components, explain how they combine to explain the dynamic nature of personality, and highlight similarities and differences between this approach and other accounts.

TraitDES

Assessing manifestations of traits of each individual on multiple occasions enables us to examine how traits manifest in behavior. Traditional self-report trait assessments of personality are in this regard limited in facilitating our understanding of the dynamic nature of personality functioning in daily life. Specifically, while the explanatory side brings dynamic processes to traits, the descriptive side using standard assessments does have room for dynamic processes. Explanatory processes are dynamic, situation-based and activation based, producing changes in behavior, whereas the descriptive side refers to stability, the way the person is in general; for example, the person might change his or her behavior in response to extreme situations such as funerals or weddings, but the person is presumed to act and be more or less the way he or she is most of the time. In other words, the changes inherent to the social-cognitive perspective are not consistent with the stability inherent to traits understood as stable, unchanging characteristics (Costa & McCrae, 2017). However, as we have noted above, models such as the act-frequency approach (Buss & Craik, 1983) and the density distribution approach (Fleeson, 2001) describes individuals in terms of the frequency with which they

perform trait-relevant behavior. In particular, the density distribution approach has described individuals in terms of their manifestations of *personality states* across context.

Personality States

An important question concerns the degree to which a person manifests a given trait at any moment, as well as the degree of stability and variability in these manifestations. This question can be answered by assessing personality states (Cattell, Cattell & Rhymer, 1947; Fleeson, 2001; Fleeson et al., 2002; Fridhandler, 1986). These are defined as having the same affective, behavioral and cognitive content as a corresponding trait (Pytlik Zillig, Hemenover & Dienstbier, 2002) applied for a shorter duration (Wilt & Revelle, 2019). For example, an extraverted state has the same content as extraversion (talkativeness, energy, boldness, assertiveness, etc.), but applies as an accurate description for only a few minutes to a few hours rather than for the months or years that a trait description applies. They are also assessed in a similar manner to traits (e.g., self-reports of – for example – how talkative, bold and assertive an individual is at the moment, from 1 to 7). This definition transfers the content of the trait as a whole to the state. Thus, personality states are directly commensurate with personality traits. This focus on states also distinguishes the density distribution approach from other models that sample thoughts, feelings and behavior in the daily lives of individuals (e.g., the act frequency approach; Buss & Craik, 1983).

Traits As Density Distributions

Over time, each individual's various states will form a distribution, in which the frequency the individual is at each level of the state is indicated. It is possible to calculate a standard deviation of this distribution for each person, separately, describing the amount that his or her states differed across occasions. A large standard deviation means that the individual's state levels varied widely, such that on some occasions he or she behaved at a high level of the state, and on other occasions he or she behaved at a low level of the state. A low standard deviation, in contrast, indicates that the individual behaved the same or similar way on most occasions. The average of the standard deviations across all people is the typical individual's amount of variability. Crucially, the amount that one typical individual varies in his or her behavior across two weeks has been shown to be almost as much as the total amount that behavior varied in the entire sample. This variability is similar to the amount of within-person variation in affect, and more than the amount of variability between individuals, meaning that individuals differ from themselves more than they differ from others (e.g., Fleeson, 2001; Nettle & Fleeson, 2010). Critically, the variability within these distributions is *meaningful*. When

generally introverted individuals act extraverted, they are being extraverted in the moment in a manner that has affective consequences (McNiel & Fleeson, 2011), is responsive to situations (Fleeson, 2007), is designed to accomplish goals (McCabe & Fleeson, 2015), and that feels true to themselves (Fleeson & Wilt, 2010).

However, the fact that people vary in their manifestations of personality states does not imply that individuals do not differ in the traits they manifested (Fleeson, 2001; Fleeson & Nofle, 2008; Jackson & Roberts, 2017). People's distributions are rather centered around personal averages, and persons differed from each other in these averages. Furthermore, these averages are highly stable from week to week, with correlations around .8 (Baird, Le & Lucas, 2006; Fleeson, 2001). In other words, these distributions constitute individual differences in trait manifestation in everyday behavior. This high variability in personality states created the descriptive space into which the dynamics of the explanatory account might be placed. Because the typical person's traits, as manifest, are shifting rapidly from occasion to occasion, this shifting may be explained by dynamic process. Because this shifting of states is part and parcel of the distribution, and because the distribution makes up the individual differences in the descriptive side of traits, this shifting represents the potential location of the consequences of the explanatory side of traits within the descriptive side of traits.

To provide one example (Baird, Le & Lucas, 2006; Fleeson, 2001), most people shift from being extraverted to introverted and all points in between during the course of just a few days; this allows for the dynamics of the explanatory account to apply to extraversion. These shifts in extraversion from moment to moment are the result of social-cognitive mechanisms such as encodings, expectancies and self-regulatory plans.

People Manifest Different Levels of the Trait from Moment to Moment

Therefore, people clearly differ in their amount of variability across situations. Moreover, within-person variability is large, such that most variation in personality occurs within people, and not between people. Thus, trait manifestations are only somewhat consistent from moment to moment. However, the Big Five research tradition weakens the plausibility of this claim. An alternative to this is to define *individual differences in trait descriptions in terms of density distributions*. Large intraindividual variability means that no single trait level represents a person's trait and that an individual's mean captures only a small part of his or her personality. However, individual differences in parameters of distributions (location, size and shape) are stable, meaning that all parameters are part of personality. Thus, it may be the combined frequencies of each manifestation level that best characterizes the individual.

TraitEXP

Density distributions describe the manifestations of traits, but the variability represented by these distributions allow explanations by social-cognitive mechanisms. Specifically, *TraitEXP* needed to explain consistency (causal mechanism), variability (a mechanism sensitive to situations), the content of the Big Five (how the Big Five are the result of the mechanisms) and breadth (how the mechanism links similar Big Five-related content together).

Whole Trait Theory's account of *TraitEXP* builds on the prior work of CAPS and consists of links between nodes. Therefore, trait manifestations are adaptive tools for accomplishing goals – variability is useful, responsive and controllable. In other words, trait manifestations are not just style, habit or temperament – they have consequences and are related to motives. Understanding the purpose of traits from this perspective required examining specific goals and specific subcomponents of traits. For example, the extraversion facet of talkativeness may be theorized to facilitate conveying information to someone, entertaining someone and enjoying someone's company. McCabe & Fleeson (2013) found that goals explained 50 percent or more of Big 5 trait manifestations. Thus, the Big 5 traits are for achieving goals, and these findings support motivational processes as part of the explanatory machinery constituting *TraitEXP*.

Explaining how traits work requires predicting states, that is, predicting the traits the person exhibit in his or her behavior. The predictors reveal the processes underlying trait manifestations in behavior, affect and cognition. Because states vary so rapidly over time and within person, candidate predictors must be variables that similarly vary rapidly over time and within a person; such candidate predictors include situations, cognitions, affects and drives. This generalizes to the trait level: If a given predictor demonstrably predicts a given state in the moment, then standing levels of the predictor may predict standing levels of the trait. For example, if pursuing the goal of connecting with others demonstrably predicts state extraversion in the moment, then standing levels of pursuit of connecting with others may predict standing levels of trait extraversion (McCabe & Fleeson, 2015). Or, if interpreting another's behavior as hostile predicts low levels of state agreeableness in the moment, then chronic accessibility of hostility attributions may predict low levels of trait agreeableness in general.

Whole Trait Theory proposes that several processes, including social-cognitive ones, are the determinants of states (Fleeson & Jolley, 2006). These processes are not identical to those described in CAPS. They include interpretative processes, motivational processes, stability-inducing processes, temporal processes and random error processes. These processes collectively make up *TraitEXP*. The Interpretative Process represents the cognitive aspects of the mind, specifically, the manner in which information is processed and which results in implications for behavior. To provide one example of such

a process, extraverts tend to exhibit more positive beliefs relative to negative beliefs, leading to having more favorable thoughts towards social situations (Fleeson et al., 2002; Zelenski et al., 2013). The Motivational Process brings the representation of end states into the model. Desired and feared end-states create the directional impetus in the individual; agreeable individuals are more motivated to seek out social accommodation (Graziano & Tobin, 2009).

The Stability-Inducing Process is present in order to account for any factors that guide the individual towards his or her typical trait manifestation, such as genetic, homeostatic or habit forces. For example, while people may vary in their manifestation of conscientiousness, this variation is in relation to their dispositional level of that trait (Jackson & Roberts, 2017). The Temporal Process is necessary to account for influences of past events on the present, such as inertia or cycles. Finally, the Random Error Process is needed to account for unpredictable trait manifestations.

Processes in *TraitEXP*

The processes are similar to each other but differ in content and in some of their flows. All processes have structural elements and dynamic elements. The structural elements consist of inputs, intermediates, outputs and links, while the dynamic elements are flows. The outputs are always increases or decreases in at least one of the Big-Five states. For example, the output of an interpretative process might be to increase an individual's state extraversion and to decrease his or her state conscientiousness. The input is some environmental or internal event and the intermediates are other environmental or internal events influenced by those inputs. Links are connections between inputs, intermediates and/or outputs; they are structural elements that allow other structural elements to influence each other. Finally, flows are the dynamic elements, and they describe the paths of influence among the structural elements.

Most importantly, individuals differ in these processes. Individual differ in these processes because they differ in the links between the inputs, intermediates and outputs. As a result, the same input to different individuals may lead to different outputs (trait manifestations), depending on the individuals' strengths of the links between those inputs and those outputs. For example, individuals who have a strong link between other people's disagreement behavior and attributions to hostile intentions are likely to manifest low levels of agreeableness in their states (Jensen-Campbell et al., 2002); individuals with strong links between goals of connecting with others and extraverted behavior are likely to manifest high levels of extraversion in their behavior (McCabe & Fleeson, 2015). The outputs of these processes are changes in current levels of states. Because states include affective, behavioral and cognitive elements, states may influence each other. For

example, the cognitive change in a state may then lead to a behavioral change in the same state.

The Interpretative Process

In an interpretative process, psychologically active elements of situations trigger cognitive-affective units that ultimately lead to behavior (Fleeson, 2007; Shoda & Lee-Tiernan, 2002). That is, trait manifestation partially represents flexible and discriminative changes in behavior due to interpretations of changing situations. For example, an individual in a relatively structured situation may expect it to be easy to concentrate and so may increase his or her level of conscientiousness (Fleeson, 2007). The inputted environmental or internal events flow via encoding of the events into interpretations, which flow via activation to other beliefs. These beliefs flow to implications for behavior, and the output of that flow is behavioral changes in manifestation of states. This step is the final step only in the schematic of the process. All outputs (interpretations, beliefs and behaviors) count as internal or environmental events that feed back into the process, continuously adjusting the interpretative process (Mischel, 1973), and impacts of the outputs on the situation also change the environmental events, creating new situations (Snyder, 2006; Snyder & Stukas, 1999). Thus, the interpretative process is a continuous process, which includes changes in states on an ongoing basis – those changes in states influence other beliefs, which continue to influence other beliefs, other emotions and other behaviors. For example, encoding of a partner's grimace as a threat already is a cognitive manifestation of neuroticism; activation of fear of future threats is a further, affective manifestation of neuroticism; and biting one's nails is a final, behavioral manifestation of neuroticism, which may in turn activate further thoughts about threat, continuing the process.

Whole Trait Theory sees trait-manifestations as reasonable responses to situations. Variability is caused by the situation, when people interpret situations and act accordingly. A key test of Whole Trait Theory, then, is whether even manifestations of the Big Five are dependent on situations? Situations consciously observed as well as situations observed by others affect Big Five manifestations. If *TraitEXP* includes links from situations to manifestations, then situations will predict manifestations. Recent research found that both target and observer perceptions of situations independently predicted Big Five trait manifestations. Additionally, individual differences in Big Five contingencies and situation features have been observed (Fleeson, 2017; Fleeson & Jayawickreme, 2015).

Because individuals differ in the links in the processes, they will differ in the outputs of the processes and ultimately will differ in the distribution of states they manifest in their behavior. In fact, the entire distribution of states – its whole range, its location and its width – is produced by *TraitEXP*. Variability in states is produced because the

inputs to the processes change from moment to moment, and when the inputs to the processes change, the outputs change. A stable mean and shape of the distribution are produced because the processes are stable; over time, the same processes will tend to produce similar output. Thus, the descriptive, manifesting side of traits is intimately linked to the explanatory, causal side of traits, and, individual differences in the descriptive, manifesting side of traits are intimately linked to individual differences in the explanatory, causal side of traits. Putting the two sides together results in “whole traits.”

Given that both sides of traits are parts of whole traits, individual differences in traits refer to individual differences in both parts of traits. An individual's level of a *TraitDES* is the mean of his or her enacted states. For example, to say that someone is extraverted is to say that he or she acts more extraverted than others do on average. An individual's level on *TraitEXP* is the level of *TraitDES* that his or her processes would produce with typical or average input (e.g., how extraverted his or her processes would lead him or her to act in an average situation). For example, to say that someone is extraverted is also to say that in a given situation, he or she is more likely to interpret things in such a way or to pursue such goals that produce more extraverted behavior. Note that these levels will not always match up. Because the outputs of the processes are determined not only by the links in the processes, but also by the inputs to the processes (such as situations, moods, etc.), individuals with the same level of *TraitEXP* may have different levels of *TraitDES*.

When individuals complete personality questionnaires, they are probably referring to some combination of these two individual difference factors to report their level of the whole traits (Fleeson & Gallagher, 2009). In this sense, one clear distinction between Whole Trait Theory as a dynamic explanatory model of traits and other perspectives such as the act frequency approach (Buss & Craik, 1983), Five-Factor Theory (McCrae & Costa, 2009), and the sociogenomic model (Roberts, 2017) and the TES-SERA model (Wrzus & Roberts, 2017), is that the latter models views trait levels of personality as synonymous with the explanatory mechanisms underlying traits.

Accretion

TraitEXP are latent, social-cognitive type links that take many forms (e.g., situations to manifestations, and goals to manifestations), that enable traits to be responsive and purposive, and explain the Big Five. Critically, the form of *TraitDES* (density distributions of personality states) allows for this. One open question is understanding how these narrow processes accrete into the Big Five. Various thinkers have argued that accretion may occur through generalization, learning abstract principles, the links and outputs influencing each other, and logical, biological and cultural processes. To provide one example, Read and

colleagues (2009) provided an insightful computer simulation depicting how the Big Five traits may arise.

The complexity and multitude of links constituting the processes in *TraitEXP* raises the question whether there are thousands of mini-traits or a small number of broad and general traits. If each link in the processes were independent of the other links, such that an individual could be bold in one kind of situation and timid in another, the resulting traits would have to be specific and narrow in applicability (consistent with CAPS; Mischel & Shoda, 2009). In other words, traits would consist of thousands of unrelated, very narrow conditionals, not unlike a kind of Thorndikian behaviorism (Allport, 1937; Funder, 2001). In contrast, the Big Five are broad and general: If an individual is extraverted, he or she is expected to be bold in most situations, and also to be daring and assertive in most situations as well. If the social-cognitive processes are to explain the Big Five, and if the explanatory part of traits is to be fused to the descriptive side of traits into wholes, it is necessary for the links to be organized in such a way that they produce broad and general traits rather than mini-traits.

Whole Trait Theory proposes three main accretion mechanisms to align links to each other to produce the Big Five. The first mechanism is generalization (Allport, 1937). As individuals develop, they begin to recognize similarities in situations, similarities in behaviors and similarities in effects of behaviors, and this recognition leads to accreting generalized processes together. As they develop, individuals recognize, for instance, that bold behaviors and assertive behaviors tend to have similar effects on other people, and consequentially join those behaviors together. A second mechanism of trait accretion is that individuals learn abstract principles about situations and behavior, and apply these general principles broadly. These principles follow the same logical, cultural and biological principles that produce the Big Five, and so themselves lead to systems of linkages that produce the Big Five. Individuals may learn, for example, that boldness has conceptual ties to assertiveness. The final accretion mechanism is that the links and outputs cause each other and interact with each other. That is, the positive correlations between subcomponents of a given trait are proposed to result from a network of bidirectionally related behavioral processes facilitating and benefitting each other during development (Cramer, Waldorp, van der Maas & Borsboom, 2010; van der Maas et al., 2006). Energy and adventure, for instance, have bidirectional causal influences on each other.

In summary, Whole Trait Theory creates a model of what is described in behavior, and how that description comes to be, merges trait and social-cognitive perspectives, merges the descriptive with the explanatory side of traits, incorporates both the person and the situation into the definition of traits, builds on and integrates a wide range of literature, creates a communicative framework for future research on traits, generates new research

directions and provides a theory of traits that both acknowledges the fact that personality reveals itself in daily life (Epstein, 1983) and provides an explanation for its manifestation (Allport, 1937).

NEW DIRECTIONS

Whole Trait Theory facilitates integration between descriptive and explanatory accounts of personality because it is a theory that is sensitive to the concerns related to both stability and variability. Whole Trait Theory integrates the person and the environment into a common framework, integrates process with structure, integrates explanation with description, integrates experiments with correlations, and focuses on interpretation. As already noted, this theory is emblematic of a number of dynamic personality theories that seek to answer core questions at the heart of personality dynamics: How do we distinguish between personality traits and states? How do we explain intraindividual and interindividual regularities, and how do these regularities take the structures they appear to? What is the origin of these variations and how do they stabilize and change (Back, 2018)?

These new developments show personality psychologists putting increased effort into discovering the processes and mechanisms underlying personality variables. Such a move would reduce the gap in underlying theoretical approaches (e.g., on explanation versus description) and reduce the gap in preferred methodological tools (experiments versus correlations). In providing an explanatory basis for distributions of trait manifestations of behavior, Whole Trait Theory provides a comprehensive explanation for the dynamic nature of personality. However, we note that Wrzus and Roberts (2017) have proposed a theoretical framework of the short- and long-term processes that underlie personality development throughout adulthood, which provides an explanatory account of state manifestations. This framework specifies the key components that lead to patterns of continuity and change in personality. These parts are recursive sequences of Triggering situations, Expectancies, State/State expressions and ReActions (TESSERA). On this view, while normative personality change has been shown to occur gradually over time, the specific short-term processes of how life events translate into repeated daily experiences and situations, captured by TESSERA sequences, lead to changes in behavioral patterns and personality representations through both *reflective* and *associative* processes. This view in many ways represents a particular specification of Whole Trait Theory, although a key difference is the distinction made in the TESSERA between the processes that shift daily thoughts, feelings and behaviors on the one hand, and the reflective and associative processes that lead to trait change on the other. Whole Trait Theory views the TESSERA processes that shift daily behavior as the key mechanisms behind trait manifestation and trait change (Jayawickreme, Zachry & Fleeson, 2018).

We note that these theories differ in additional key respects. DeYoung (2015) couches his theory within a cybernetic framework, which posits functional values for each of the Big 5 traits. Additionally, the sociogenomic model (Roberts, 2017), the TESSERA framework (Wrzus & Roberts, 2017) and DeYoung's (2015) approach do not conceptualize descriptive traits in terms of density distributions of states. In our view, the key advantage of viewing traits in this manner is that it is then possible to understand and explain the dynamic nature of personality.

Nevertheless, as Wright (2017) has pointed out, just as multiple independent research programs into the structure of personality led to the common answer of the Big 5, the relative similarity of personality approaches that seek to provide dynamic explanations for the manifestation of traits in daily life point both to a recognition of the potential explanatory power of such theories and the possibilities of meaningful comparison and integration of different perspectives (Baumert et al., 2017). In short, these theories represent a welcome maturation of the field. In the following section, we review some additional directions for expanding and capitalizing on the dynamic nature of personality.

Understanding Situations in the Context of Personality

The value of understanding the psychological meaning of situations and their relationship to trait manifestations has led to new developments in categorizing situations. Incorporating situations into our understanding of how traits manifest in daily life involves incorporating situations into the process models of how traits affect behavior. A dynamic model that incorporates both traits and situations could characterize personality units in terms of their role in social processes, and their development might begin to be characterized as a consequence of social processes (Fleeson & Jayawickreme, 2018). Such a model would also facilitate new directions in describing, explaining, and predicting person–situation transactions.

A number of situation taxonomies have been developed, including the lexically derived CAPTION model (Parrigon, Woo, Tay & Wang, 2016), the Situational Affordances as Adaptive Problems (SAAP: Brown et al., 2015), the Situation 5 (Horstmann & Ziegler, 2019; Ziegler, 2014), and Situational Interdependence Scales (SIS: Gerpott et al., 2017). Of note, Rauthmann and colleagues (2014) have identified what they termed the “Situational Eight” DIAMONDS: Duty (Does something need to be done?), Intellect (Is deep information processing required?), Adversity (Is someone being overtly threatened?), Mating (Is the situation sexually and/or romantically charged?), pOsitivity (Is the situation pleasant?), Negativity (Do negative things taint the situation?), Deception (Is someone deceptive?) and Sociality (Is social interaction and relationship formation possible, desired or necessary?). This taxonomy was found to predict behavior independent of personality

(Sherman et al., 2015). The DIAMONDS integrate the most often identified dimensions and thus provide a common language (Rauthmann et al., 2014,) by reducing the 89-item Riverside Situational Q-Sort to a key set of dimensions that have analogous content to major dimensions of personality. Notably, the different taxonomies overlap substantially in content (Rauthmann & Sherman, 2018).

Interventions to Change Personality

A particularly exciting direction for research involves capitalizing on the dynamic manifestation of personality in daily life to leverage interventions. Given the association between the Big 5 and a significant range of positive outcomes, some researchers have argued that interventions focused on increasing the positive instantiations of the Big 5 would represent a significant public good (Widiger, 2017). Blackie and colleagues (2014) noted that interventions such as behavioral activation therapy that focused on shifting individuals' personality states could have the long-term outcome of shifting individuals' distributions in a more positive direction. This would be because, following Fleeson and Jayawickreme (2015), the enactment of personality states would lead to positive consequences, leading to further enactments. Over time, this enactment could lead to a shift in the explanatory mechanisms (*TraitEXP*) underlying individuals' distributions.

This view is echoed by both the TESSERA and socio-genomic approaches, which emphasize the value of shifting personality states in order to ultimately move the explanatory mechanisms underlying the trait. Roberts, Hill and Davis (2017) recently proposed a sociogenomic trait intervention model in which well-planned behavioral activation therapy programming coupled with motivation to change one's trait standing can leave to increases in state conscientiousness and subsequently trait conscientiousness.

CONCLUSION

Personality psychology has historically been concerned with describing the fundamental characteristics of persons. The Big Five model that has resulted stands as a model of systematic and replicable science. However, there is now sustained interest in the question of why, how, when and where individual differences (e.g., in traits, goals, values) originate, manifest in daily lives, and entail important personal, social, occupational and societal consequences. In this chapter, we have centered Whole Trait Theory as an example of current dynamic theories focused on explaining personality and outlined future directions for further understanding the processes underlying personality. We trust that the next few years of personality science research will be exciting and important ones, as we move from descriptions to explanations of traits.

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INTRODUCTION

One of the few incontrovertible assumptions concerning human personality is that it is influenced and determined by a wide range of factors. Of major importance are individual differences in genetic factors. This was shown very clearly by Vukasović and Bratko (2015) in their meta-analytic review of twin, family and adoption studies designed to assess the percentage of individual differences attributable to genetic factors for major personality factors or dimensions. With respect to H. J. Eysenck's three orthogonal dimensions of extraversion, neuroticism and psychoticism (see H. J. Eysenck & M. Eysenck, 1985), the percentage figure ranged between 30 percent for psychoticism and 42 percent for neuroticism (which closely resembles trait anxiety).

In spite of the existence of compelling evidence that genetic factors strongly influence individual differences in personality (including trait anxiety and depression), it is clear that environmental factors are at least as important and probably more important. In addition, of course, there are probably complex interactions between genetic and environmental influences.

This chapter is concerned with the personality dimensions of trait anxiety and trait depression and with the bidirectional effects between these personality dimensions and cognitive functioning. There is a burgeoning literature on the relationship between anxiety and cognitive functioning and another burgeoning literature on the relationship between depression and cognitive functioning. Surprisingly, however, there is still relatively little research in which the profiles of cognitive functioning in anxiety and depression are compared directly with each other.

LACUNA IN ANXIETY AND DEPRESSION RESEARCH

One of the main reasons for the lacuna in the research evidence is that personality measures of anxiety and depression (e.g., Spielberger's Trait State Anxiety Inventory; Beck Depression Inventory) typically correlate

moderately highly with each other (Watson & Clark, 1984). Such findings make it hard to achieve discriminant validity between anxiety and depression and led Watson and Clark (1984) to propose a personality dimension of negative affectivity based on commonalities between anxiety and depression. They argued that scales assessing personality dimensions such as trait anxiety, neuroticism, and so on are all essentially measuring the same global and stable trait of negative affectivity. The global nature of negative affectivity (incorporating major aspects of trait anxiety and trait depression) was expressed as follows by Watson and Clark: "High-NA [negative affectivity] Ss [subjects] are more likely to experience discomfort at all times and across situations, even in the absence of overt stress. They are relatively more introspective and tend differentially to dwell on the negative side of themselves and the world" (p. 465). As discussed shortly, Clark and Watson (1991) developed and extended their conceptualization of anxiety and depression to focus on differences between them as well as similarities.

While the emphasis of this chapter is on individual differences in anxiety and depression within healthy populations, there is also considerable research based on clinical groups considering the relationships between anxiety and depression on the one hand and cognitive functioning on the other. Reference is made to this literature as and when it is of relevance. For example, the problem of discriminant validity with measures of trait anxiety and trait depression is mirrored within clinical populations where concurrent comorbidity involving depressive and anxiety disorders is approximately 30 percent (Huppert, 2008).

As is discussed in detail later, there are important commonalities between anxiety and depression. For example, they are both associated with various cognitive biases that produce distortions in attentional, comprehension and memory processes. In addition, anxiety and depression are both often associated with impaired cognitive performance, especially on relatively demanding tasks. However, it is likely that at least some of these reported commonalities merely reflect issues with discriminant validity.

There has been greater theoretical and empirical progress in understanding trait anxiety than trait depression. As a consequence, this chapter provides more detailed coverage of the former.

In spite of evidence indicating probable commonalities between anxiety and depression, it is also important (especially theoretically) to focus on the differences between them (including differences in the nature and extent of cognitive biases). In order to achieve any measure of success in understanding such differences, it is almost essential to have an overarching theoretical framework. Three theoretical frameworks are discussed here followed by a consideration of research on cognitive biases.

THREE THEORETICAL FRAMEWORKS

Three main theoretical frameworks are discussed in this section (for more detailed discussion of these and other frameworks, see Eysenck & Fajkowska, 2018).

Functional Framework: Overview

What is perhaps the closest we currently have to an overarching theoretical framework is based on a thorough consideration of the functions and adaptive value of anxiety and depression. A key initial assumption of this approach is that negative states (of which anxiety and depression are prominent examples) may involve short-term costs. However, they often prove beneficial and adaptive in the long-term (Del Giudice & Ellis, 2015).

What are the main functions associated with depression? Sadness or depression is typically caused by goal loss (Oatley & Johnson-Laird, 1987). This leads to sustained analytical thinking focusing on the lost goal and the generation of a strategy to produce a new goal (Andrews & Thomson, 2009). Such thinking is associated with anhedonia (inability to experience positive or pleasurable emotions) reducing the motivation to engage in other activities. Being in a depressed state has the following sequelae (Durisko, Mulsant & Andrews, 2015, p. 315): "Biasing cognition to avoid losses, conserving energy, disengaging from unobtainable goals, signaling submission, soliciting resources, and promoting analytical thinking."

What are the main functions associated with anxiety? Anxiety or fear typically occurs when the individual faces a threat to self-preservation (Oatley & Johnson-Laird, 1987). As a consequence, major functions of anxiety or fear involve selective attention to potential environmental threat and rapid detection of danger (e.g., Eysenck, 1992, 1997). More generally, anxiety is associated with a focus on potential future threats. For example, Eysenck and van Berkum (1992) found trait anxiety correlated +.65 with frequency of worrying about diverse possible future negative events. Patients with various anxiety disorders (especially generalized anxiety disorder) report greater severity

and frequency of worry than those with other mental disorders (Olatunji, Wolitzky-Taylor, Sawchuk & Cie-sielski, 2010).

It is consistent with the functional perspective that anxiety generally has a future orientation whereas depression generally has a past orientation. These predictions were tested by Eysenck, Payne and Santos (2006). In one study, participants identified personal events strongly associated with anxiety or with depression. Anxious events were much more associated with future than with past events, whereas depressive events were much more associated with past events.

In a second study, Eysenck et al. (2006) asked participants to indicate what their emotional reactions would be to hypothetical negative events lying in the past or in the future. Negative past events were associated with more depression-related than anxiety-related reactions, whereas the opposite was the case for the same negative events relating to the future. Pomerantz and Rose (2014) used the same experimental approach as Eysenck et al. (2006) and essentially replicated their findings.

Rinaldi, Locati, Parolin and Girelli (2017) provided support for the assumption that anxiety and depression differ with respect to temporal orientation. They focused on psychological distance of an actual event occurring one month earlier and an imagined event occurring in the future in one month's time. Their key finding was that anxious individuals differed from depressed ones in perceiving future events as psychologically closer.

The research discussed so far provides only a snapshot of reactions to emotional events. It would be instructive to extend this type of research to consider the temporal dynamics of anxiety and depression. If anxiety precedes the onset of negative events, whereas depression is the main emotional reaction subsequently, it follows that anxiety should generally precede (rather than follow) depression.

Evidence supporting the predictions mentioned in the previous paragraph was reported by Wittchen, Kessler, Pfister and Lieb (2000) in a long-term longitudinal study. Anxiety disorders were much more likely to precede depressive disorders than the opposite. Starr and Davila (2012) considered the temporal pattern of anxious and depressed mood over considerably shorter time periods. Patients with generalized anxiety disorder and a history of depressive symptoms completed a daily mood diary. Anxiety on any given day strongly predicted depression one, two, three and four days later. In contrast, depression did not predict anxiety on subsequent days.

Various different kinds of empirical evidence support the notions that there is an association between anxiety and future orientation, and an association between depression and past orientation. However, these notions represent substantial oversimplifications for various reasons. First, as we have seen, most healthy individuals who are highly anxious also tend to experience high levels of depression, and vice versa.

Second, while the perceived cause of depression typically lies in the past, depressed mood has important future implications. One reason is because the mechanisms involved in constructing hypothetical future events closely resemble those involved in accessing past autobiographical memories (Schacter, Addis, Hassabis, Martin, Spreng & Szpunar, 2012) and such memories are predominantly negative for depressed individuals. Szpunar, Spreng and Schacter (2014) developed this idea, arguing that representations of future events are constructed by using a mixture of information from episodic memory (recollections of past personal episodes and events) and semantic memory (schematic knowledge about the world). The relevant literature is reviewed by MacLeod (2016).

Functional Framework: Cognitive Biases

The functional perspective is of relevance in terms of predicting the existence of various cognitive biases. More specifically, at least three major cognitive biases have typically been identified in the literature (see Eysenck & Keane, 2015): (1) attentional bias (selective attention to threat-related stimuli); (2) interpretive bias (tendency to interpret ambiguous stimuli and situations in a threatening fashion); and (3) memory bias (disproportionate tendency to retrieve negative or threatening information compared to positive or neutral information).

What predictions follow from the functional perspective with respect to the above cognitive biases? If anxious individuals have a future orientation, we would expect them to exhibit an attentional bias. This selective attention to threat-related stimuli could produce consequences downstream (e.g., interpretive bias; memory bias). In contrast, if depression is associated with a past orientation, this implies depressed individuals should exhibit memory bias. Finally, the generally negative and pessimistic outlooks of anxious and depressed individuals mean that it would be expected they would have a negative interpretative bias.

Williams, Watts, MacLeod and Mathews (1997) proposed an extremely influential theoretical approach that is consistent with the functional framework. It represents a development and extension of that framework, leading to more specific predictions with respect to the effects of anxiety and depression on cognitive biases. Before discussing their theory (and its associated predictions), we need to draw a distinction between explicit memory (memory involving conscious recollection of information from long-term memory) and implicit memory (memory not involving conscious recollection from long-term memory) (Schacter, 1987).

The approach of Williams et al. (1997) differed from the functional framework presented here in that they distinguished between fast, “automatic” perceptual processes and slower, controlled conceptual processes. According to their theory, anxiety facilitates the perceptual processing of threatening stimuli whereas depression enhances

the conceptual processing of information in autobiographical memory related to failure.

The theoretical approach of Williams et al. (1997) makes various testable predictions. Anxious individuals should have an attentional bias for threatening stimuli when perceptual processes are involved (e.g., enhancing engagement with such stimuli). In contrast, depressed individuals should have an attention bias when conceptual processing is involved (e.g., impairing disengagement with threatening stimuli). Since explicit memory bias depends mostly on conceptual processes whereas implicit memory bias depends on perceptual processing, anxiety should be associated more with implicit than explicit memory bias whereas the opposite should be the case with depression.

Tripartite Model

The tripartite model was originally proposed by Clark and Watson (1991) and then subsequently developed by Watson (2009). In essence, it is assumed within the model that anxiety and depression are both characterized by negative affectivity (i.e., distress and related negative emotional states). In addition, Clark and Watson identified two other factors. First, there was positive affectivity (involving pleasurable engagement and energy), which is orthogonal to negative affectivity. Second, there was physiological hyperarousal. Depression is associated with an absence (or low level) of positive affectivity (i.e., anhedonia) and of physiological hyperarousal. In contrast, anxiety is associated with an average level of positive affectivity plus high levels of physiological hyperarousal.

Khazanov and Ruscio (2016) reported findings of relevance to the tripartite model in a meta-analytic review of studies concerned with the relationship between the trait of positive emotionality or extraversion and anxiety and depression. In a cross-sectional meta-analysis, positive emotionality was negatively associated with both anxiety and depression. However, the strength of this negative correlation was greater for depression. In a longitudinal meta-analysis, the negative correlation between positive emotionality and subsequent depression was slightly greater than that between positive emotionality and subsequent anxiety. Overall, the findings provided modest support for the predictions of the tripartite model.

Content Specificity Approach

The assessment of the cognitive biases discussed in the last section requires the presentation of actual or potentially negative stimuli. According to Beck (1976), anxious and depressed individuals differ with respect to their central or focal concerns. More specifically, high-anxious individuals emphasize the theme of danger: they exaggerate psychological threats and the probability and cost of anticipated harm. In contrast, depressed individuals emphasize the theme of self-depreciation. As a consequence, they have negative beliefs about themselves, the world and the future. The differing themes and beliefs of anxious and depressed individuals are represented in long-

term memory in the form of cognitive schemas. A cognitive schema is “a well-organized cognitive structure of stored information and memories that forms the basis of core beliefs about self and others” (p. 598).

There is much support for Beck’s content-specificity hypothesis (see Eysenck & Fajkowska, 2018, for a review). For example, Beck, Brown, Steer, Eidelson and Riskid (1987) developed the Cognition Checklist to assess themes such as those of danger and self-depreciation. Anxious and depressed individuals differed as predicted with respect to the themes they reported.

Cognitive Biases: Attention

Research on attentional bias in high- and low-anxious groups was examined in a meta-analytic review by Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg and van IJzendoorn (2007). There was convincing evidence for attentional bias in high-anxious healthy individuals and also patients with anxiety disorders. A limitation with most of the studies included in Bar-Haim et al.’s meta-analytic review is that they provided only a snapshot of the allocation of attention at a given moment in time rather than more comprehensive information about the time course of attentional bias. For example, many studies used the dot-probe task: A threat-related stimulus is presented concurrently with a neutral stimulus and then one stimulus is replaced by a dot. The task is to respond to the dot as rapidly as possible with the assumption being that reaction times will be faster if the visual area within which the dot is presented is currently in focal attention than when it is not.

The limitation with most studies reviewed by Bar-Haim et al. (2007) can largely be obviated by using online eye tracking. Armstrong and Olatunji (2012) provided a meta-analytic review of research involving online eye tracking with anxious and nonanxious individuals. Anxious individuals exhibited an attentional bias for threat-related stimuli over neutral stimuli. Analysis of the time course of this bias revealed evidence for initial orienting toward threat in free viewing and visual search conditions and some evidence for subsequent delayed disengagement in visual search conditions. However, no such bias was associated with depression although there was evidence of difficulty disengaging from dysphoric content.

Armstrong and Olatunji (2012) obtained a different pattern of findings when reviewing studies involving emotionally positive and neutral stimuli. There was no attentional bias for anxious individuals but depressed individuals took longer than controls to fixate positive stimuli. Similar findings were reported by Winer and Salem (2016) in a meta-analysis of findings using the dot-probe task: there was significant avoidance of emotionally positive stimuli among depressed individuals.

In sum, anxious individuals have heightened sensitivity to threat-related but not emotionally positive stimuli. In contrast, depressed individuals have decreased sensitivity

to emotionally positive stimuli but often exhibit no attentional bias with threat-related stimuli. This last conclusion is supported by studies using subliminal stimuli to assess “automatic” attentional bias in depression, since they typically found no evidence of bias (Foland-Ross & Gotlib, 2012). For example, using the emotional Stroop task, depressed individuals were found not to differ from non-depressed under subliminal presentation conditions, but showed slower reaction times for naming the colors of negative words with supraliminal presentation (Donaldson, Lam & Mathews, 2007; Mogg, Bradley, Williams & Mathews, 1993).

These findings are largely consistent with predictions based on the functional framework, the approach of Williams et al. (1997) and the tripartite model. However, the functional framework has difficulty in explaining findings not discussed so far in which it was found that depression was associated with attentional biases that took longer to emerge than was the case with anxiety (e.g., Gotlib & Cane, 1987; Gotlib & McCann, 1984; Mogg, Bradley & Williams, 1995). This pattern of findings is consistent with the Williams et al. model.

Cognitive Biases: Interpretation

Anxious individuals typically exhibit an interpretive bias when interpreting ambiguous stimuli and situations. In an early study, Eysenck, MacLeod and Mathews (1987) devised a homophone task in which participants wrote down the spellings of auditorily presented words including homophones having separate threat-related and neutral interpretations (e.g., *die*, *dye*). Trait anxiety correlated +.60 with the number of threat-related homophone interpretations. Eysenck, Mogg, May, Richards and Mathews (1991) found patients with generalized anxiety disorder were more likely than healthy controls to interpret ambiguous sentences in a threatening fashion.

The association between anxiety and interpretation bias has been demonstrated across a range of different experimental tasks and stimuli. Interpretive biases have also been shown in individuals during real-life anxiety-provoking situations, such as awaiting a potentially painful dental procedure (e.g., Richards, Blanchette & Munjiza, 2007). Other findings reveal that high-anxious individuals show an increased sensitivity to situational context (e.g. Blanchette & Richards, 2010; Richards, Holmes, Pell & Bethell, 2013).

Recent research indicates high-anxious individuals lack an interpretive bias for some threat-related situations. Walsh, McNally, Skariah, Butt and Eysenck (2015) asked participants to indicate their likelihood of making threatening or nonthreatening interpretations of ambiguous scenarios in four domains. High anxiety was associated with interpretive bias for scenarios potentially involving social or intellectual threat but not those potentially involving physical or health threat. Thus, interpretive bias in high-anxious individuals is restricted to interpersonal threats.

What are the effects of depression on interpretive bias? Early research designed to address that question produced variable and apparently inconsistent findings. However, it became apparent that the existence or absence of an interpretive bias often depended on whether or not the presented material was interpreted with respect to the person themselves (i.e., self-reference). For example, Hertel and El-Messidi (2006) presented homographs with negative and neutral meanings. Participants showed an interpretive bias when primed to think about themselves but not when thinking about a friend. Similarly, Wisco and Nolen-Hoeksma (2010) found stronger evidence of an interpretive bias associated with depression when interpretations were made about the self rather than a friend.

Everaert, Podina and Koster (2017b) reported a comprehensive meta-analysis of research on interpretive bias in depression. Overall, clinical depression and high depression in healthy controls both had a moderately strong association with the magnitude of interpretive bias. Consistent with the findings of Hertel and El-Messidi (2006) and Wisco and Nolen-Hoeksma (2010), interpretive bias in depression was generally much stronger when the interpretation task involved self-reference than when it did not.

In sum, there is convincing evidence that individuals high in anxiety and those high in depression have moderately strong interpretive biases for negative emotional material. In the case of depression, however, strong interpretive bias is typically found only when the material is interpreted so that it has personal relevance.

Cognitive Biases: Memory

Blaney (1986) carried out a meta-analytic review of research on explicit memory bias (involving conscious recollection of information) associated with depression and obtained strong support for a positive association. There is also related evidence from autobiographical memory research that depressed individuals have an explicit memory bias (Holland & Kensinger, 2010). Of relevance to the tripartite model approach, Folland-Ross and Gotlib (2012) found in a review of research on positive memory (i.e., enhanced memory for positive versus neutral material) that this bias was sometimes absent in depressed individuals.

The research on explicit memory biases has also revealed that depressed individuals report fewer specific memories in favor of more overly general negative memories (Raes et al., 2006). This tendency to overgeneralize has been identified as a predictor for more severe depressive symptoms and longer depressive episodes (Sumner, Griffith & Mineka, 2010).

Mitte (2008) carried out a meta-analytic review focusing on explicit memory bias in clinically anxious individuals and healthy individuals high in trait anxiety. Anxiety was associated with a negative explicit memory bias on recall tests but not recognition tests. Recall depends more on recollection (including contextual information) whereas

recognition depends more on familiarity (Eysenck & Keane, 2015). This implies that anxiety affects the top-down processes associated with recollection to a greater extent than the less effortful processes associated with familiarity.

Herrera, Monterio, Cabrera and Botella (2017) conducted an updated meta-analytic review of research on memory biases in anxious individuals. Their findings mostly replicated and extended those of Mitte (2008). High anxiety was associated with an explicit memory bias on free recall tests but not with cued recall or recognition memory tests.

We turn now to implicit memory bias (involving long-term memory not involving conscious recollection). Phillips, Hine and Thorsteinsson (2010) conducted a meta-analysis on depression and implicit memory bias. Overall, there was a small positive relationship. Gaddy and Ingram (2014) carried out a meta-analytic review of implicit memory in depressed individuals. They discovered that a small negative implicit memory bias for negative stimuli was associated with depression. For clinically depressed individuals, this implicit memory bias was stronger when the encoding and recall tasks were matched with respect to the involvement of perceptual or conceptual processes.

In a meta-analytic review, Mitte (2008) found no evidence of an implicit memory bias in high anxiety. In their meta-analytic review, Herrera et al. (2017) also obtained no significant evidence for an implicit memory bias in high anxiety.

In sum, depression is generally associated with a stronger and more consistent explicit memory bias than is the case with anxiety. In addition, depression is associated with a relatively small implicit memory bias whereas anxiety is typically not associated with any implicit memory bias. We can conclude that most (but not all) of the findings are consistent with the functional approach discussed earlier in which depression is far more associated than anxiety with a past orientation. However, the presence of an implicit memory bias in depression and the absence of one in anxiety suggest that Williams et al.'s (1997) approach of associating anxiety with perceptual processing and depression with conceptual processing is oversimplified.

General Cognitive Processes

What are the processes or mechanisms underlying the cognitive biases (attentional, interpretive and memory) exhibited by individuals high in anxiety or depression? It has typically been assumed (e.g., Williams et al., 1997) that these underlying processes are relatively specific in that they are directly related to individual differences in sensitivity to negative emotion information.

However, it is also possible that more general processes are involved. For example, one reason why some individuals have an attentional bias may be because their top-down control processes are deficient and so they find it

hard to avoid attending to threat-related stimuli. In similar fashion, some individuals may have an interpretive bias because their deficient top-down processes prevent them from inhibiting threatening interpretations of ambiguous stimuli and situations.

More specifically, our focus will be on executive processes related to cognitive or attentional control. Relevant theories and research will be discussed, starting with anxiety and then moving on to depression.

Anxiety

Several cognitive psychologists have put forward theories focusing on executive processes. However, there are substantial differences among these theories with respect to both the number and nature of human cognitive control processes (see Eysenck & Keane, 2015). One of the most influential of such theories was proposed by Miyake and his colleagues (Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000; Miyake & Friedman, 2012). They identified three major executive or control processes. First, there is the inhibition function which is used to override dominant responses and, more generally, to resist distraction. Second, there is the shifting function, which is used to switch attention and control in a flexible fashion both within and between tasks. Third, there is the updating function, which is used to monitor and decide on the current contents of consciousness.

Eysenck, Derakshan, Santos and Calvo (2007) used Miyake et al.'s (2000) theory as a major basis for their attentional control theory. They argued that high-anxious individuals have impaired efficiency of shifting and inhibition.

Derryberry and Reed (2002) found a positive relationship of moderate strength between trait anxiety and attentional control and attentional bias in high-anxious participants was significantly reduced among those with high attentional control. Bardeen and Orcutt (2011) found individuals with many posttraumatic stress symptoms showed evidence of attentional bias only if they had low attentional control. Taylor, Cross and Amir (2016) found individuals high in social anxiety showed slow disengagement from social threat stimuli only if low in the shifting form of attentional control.

Judah, Grant, Lechner and Mills (2013) reported a study focusing on attentional control generally rather than on specific executive functions. They reduced the availability of attentional control processes by using a high working memory load involving neutral stimuli. As predicted by attentional control theory (Eysenck et al., 2007), this increased the difficulty high-anxious individuals (but not low-anxious ones) had on an attentional bias task in disengaging attention from threat-related stimuli.

In sum, attentional control modifies the effects of anxiety on attentional bias. More research is needed to establish definitively that anxiety also has the more direct effect of impairing the efficiency of attentional control.

Depression

Disner et al. (2011) proposed an integrated cognitive-biological model comprising two key systems. First, the augmentation of bottom-up mechanisms involved in the automatic processing of emotional stimuli is associated with amygdala hyperactivity in the amygdala, thalamus, nucleus accumbens, hippocampus, caudate, putamen and anterior cingulate cortex. These mechanisms are instrumental in initiating maladaptive cognitive biases.

Second, dysfunctional top-down processes involved in diminished cognitive control are associated with patterns of hypoactivity in ventral, dorsal and medial areas of the prefrontal cortex. Attenuated cognitive control among individuals with depression may be central to the maintenance of mood-congruent cognitive biases and, consequently, negative mood states.

Joormann, Yoon and Zetsche (2007) argued that executive control processes are important when searching for mechanisms of relevance to the cognitive biases associated with depression. Their specific focus was on inhibitory control. They argued (with supporting evidence) that depressed individuals have impaired inhibitory control and so experience difficulty in disengaging from attention to negative stimuli and information. Depressed individuals are likely to elaborate on this information during the time they attend to it (i.e., interpretive bias). This in turn can lead to greater long-term memory for such information (i.e., memory bias).

Joormann and Tanovic (2015) developed some of the earlier ideas of Joormann et al. (2007). They argued with supported evidence that depressed individuals have impaired cognitive control with respect to the three executive functions identified by Miyake et al. (2000): inhibition, shifting and updating.

Depressed individuals resemble anxious individuals in that they have deficient attentional/cognitive control with respect to inhibition, shifting and updating. However, there is an important difference. Most of the research on high-anxious individuals indicates that they have deficient cognitive control processes regardless of whether the material being attended to, processed, or remembered has negative valence or is neutral. In contrast, deficient cognitive control processes in depressed individuals are typically found with material having negative valence and are less often found with emotionally neutral material.

However, unlike anxiety, depression may be characterized primarily by top-down impairments arising specifically in the context of mood-congruent processing (Murphy, Michael & Sahakian, 2012; Saunders & Jentsch, 2014). This specificity may arise due to the propensity for negative material to prompt a refocusing of attention toward the self (Lemogne, Delaveau, Freton, Guionnet & Fossati, 2012). Self-directed attention may, in turn, result in less efficient cognitive control and task-related performance and additional cognitive resources may be recruited to overcome these

impairments. In line with this view, Kaiser et al. (2015) found that when participants were presented with negative distractors in a Stroop task, depressive symptoms were associated with greater activation in the anterior cingulate cortex and the posterior cingulate cortex. As the former region is involved in cognitive control and the latter in internally directed attention, their findings suggested depressed participants were recruiting additional cognitive control to overcome the internalization of attention and to remain task-focused and ignore distracting negative content.

Evolutionary Processes

We still lack an adequate theoretical account of cognitive biases characterizing anxiety and depression. However, as we have seen, cognitive biases in anxiety and depression depend on general, top-down control processes as well as on processes specific to processing emotionally loaded information. As a consequence, we need a broader theoretical approach than has typically been adopted. Of relevance, recent work with nonhuman primates may provide some important insights into the role of top-down control and emotion-specific processes in *human* cognitive biases (e.g., Bethell, Holmes, MacLarnon & Semple, 2012a). For example, whereas rapid attentional engagement with threat-related material is common to humans and rhesus macaques (*Macaca mulatta*), delayed disengagement from emotional stimuli, under conditions of stress, is more characteristic of the human response to threat (Bethell et al., 2012a). These data push back the link between emotion and attentional engagement with threat to an early evolutionary point and suggest the later emergence, with human variation, of top-down cognitive processes mediating sustained attention toward threat. These preliminary results call for further investigation of emotion-cognition interactions across nonhuman animals to further our understanding of mechanisms underlying cognitive biases in anxiety and depression (see, e.g., Bethell, Holmes, MacLarnon & Semple, 2012b, 2016; Harding, Paul & Mendl, 2004).

PERSONALITY AND COGNITIVE BIASES: CAUSALITY

The research evidence indicates clearly that trait anxiety and trait depression are both associated with various cognitive biases. From the theoretical perspective, the direction of causality is of critical importance. It would be of interest to discover that a consequence of having an anxious or depressive personality is the possession of various cognitive biases. However, it would be of much greater theoretical importance to discover that these cognitive biases serve to maintain (or enhance) anxiety and depression.

Much research in recent years of relevance to this causality issue has used cognitive bias modification, which

consists of “methods designed to modify cognitive factors that maintain psychiatric conditions such as anxiety and depression” (Lau, 2015, p. 735). More specifically, cognitive bias modification typically focuses on reducing attentional bias and/or interpretive bias and is intended to reduce experienced anxiety or depression.

Several meta-analyses assessing the effectiveness of cognitive bias modification in reducing anxiety and depression have been published. For example, Hallion and Ruscio (2011) found that cognitive bias modification reduced attentional and interpretive biases, especially the latter. In addition, cognitive bias modification significantly reduced the anxiety experienced in response to a stressor, but the effects on depression were non-significant.

Cristea, Kok and Cuijpers (2015) conducted a meta-analytic review of studies using cognitive bias modification techniques to reduce attentional and/or interpretive bias. They concluded that these techniques were relatively ineffective: “CBM [cognitive bias modification] may have small effects on mental health problems, but it is also very well possible that there are no significant clinically relevant effects. Research in this field is hampered by small and low-quality trials, and by risk of publication bias. Many positive outcomes are driven by extreme outliers” (p. 7).

The conclusions drawn by Cristea et al. (2015) are excessively pessimistic. The central problem with their meta-analytic review was identified by Grafton et al. (2017). They pointed out that Cristea et al. had failed to distinguish between procedures and processes. They included in their meta-analysis all studies making use of cognitive bias modification procedures. However, no one would expect these procedures to be effective in reducing anxiety and depression unless they produced changes in cognitive processes leading to significant reductions in cognitive biases.

Accordingly, Grafton et al. (2017) reanalyzed the data used by Cristea et al. (2015) dividing the studies into those in which cognitive biases had been reduced and those in which they had not. This produced very clear-cut findings: In every study where the intended CBM procedure has successfully elicited the process of cognitive bias change, this process has been accompanied by a significant change in emotional vulnerability. Conversely, in every study where the intended CBM [cognitive bias modification] procedure has not successfully elicited the process of cognitive bias change, there has been no significant change in emotional vulnerability (p. 269).

Less positive findings were reported by Mogg, Waters and Bradley (2017) in their review of the effects of attentional bias modification. In contrast to the findings emerging from Grafton et al.’s (2017) review, they found anxiety reduction frequently occurred in the absence of a significant reduction in attentional bias. It is currently unclear why these two reviews produced such conflicting findings.

General Cognitive Processes

Evidence indicating that the presence of attentional and interpretive biases in anxious and depressed individuals depends in part on general processes (e.g., cognitive control) was discussed earlier in the chapter. Such findings suggest that the success of cognitive bias modification may depend on improved attentional or cognitive control. Some recent findings support this suggestion. For example, Booth, Mackintosh, Mobini, Oztot and Nunn (2014) investigated attentional bias modification in individuals high in trait anxiety. Their key finding was that attentional bias modification was ineffective when the conditions were set up to reduce the ability of the high-anxious participants to exercise attentional control.

Similar findings were obtained by Sari, Koster, Pourtois and Derakshan (2016) in a study in which they provided training that was designed to increase attentional control. Those individuals whose attentional control benefited the most from the training generally showed the greatest reduction in trait anxiety level.

Koster, Hoorelbeke, Onraedt, Owens and Derakshan (2017) conducted a meta-analysis of research in which depression was treated by interventions designed to enhance cognitive control. Their conclusion was as follows: "Most CCT [cognitive control training] studies have yielded promising effects. . . in terms of reducing cognitive vulnerability for depression" (p. 86).

Some progress has been made in understanding the ways in which attentional or cognitive control and cognitive interact to determine any given individual's level of anxiety or depression. However, much remains to be discovered. Everaert, Grabek and Koster (2017a) have contributed to this issue with respect to depression by obtaining measures of cognitive control (e.g., inhibition; shifting), attentional and interpretive biases, and symptoms of depression. Deficient cognitive control did not directly influence depressive symptoms but did so indirectly through its effects on attentional bias. There was also evidence that deficient inhibitory control influenced interpretive bias which was in turn associated with symptoms of depression.

CONCLUSION

In this chapter, we have shown that a cognitive approach can contribute much to an understanding of individual differences in trait anxiety and in trait depression. While previous theories have indicated the importance of genetic and physiological factors, such theories are inherently limited if they deemphasize the role played by the cognitive system (Eysenck, 2016).

Many important differences between anxiety and depression are explicable from the perspective of a functional perspective assuming that depression is associated with goal loss and the search for new goals and thus has a past orientation. In contrast, anxiety is associated with

threats to self-preservation leading to a future orientation revolving around potential future threats. This functional approach provides a partial understanding of the differential effects of anxiety and of depression on major cognitive biases (especially attentional bias and memory bias). However, other theoretical approaches such as the tripartite model and Beck content-specificity approach are required to provide a more comprehensive account of the complex findings.

It has sometimes been argued that cognitive approaches to understanding anxiety and depression are limited because there is little evidence indicating that cognitive processes (e.g., cognitive biases) have causal influences on anxiety and depression. However, we have shown in this chapter that there is, in fact, substantial evidence for such causal influences. Most of this evidence comes from meta-analytic reviews of research using cognitive bias modification techniques.

Finally, while the emphasis has been on ways in which relatively specific cognitive processes (e.g., attentional bias, interpretive bias, memory bias) impact on anxiety and depression, there are strong grounds for considering an approach focusing on more general and overarching cognitive processes. An evolutionary approach is one potentially important way of implementing such an approach. In addition, there is increasing evidence that individuals high in anxiety and in depression have deficient or inefficient top-down processes involving executive functions such as inhibition, shifting and updating. These general deficits probably play an important role in explaining the more specific cognitive biases exhibited by anxious and depressed individuals.

So far as the future is concerned, there are encouraging signs that techniques designed to reduce (or eliminate) general attentional and/or control deficits may causally reduce individuals' levels of anxiety and depression. However, the precise causal mechanisms involved remain unclear. It will be of importance for the future to ascertain more precisely the interrelationships among components of cognitive control, cognitive bias and individual differences in trait anxiety and trait depression.

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PART VI

**SOCIAL AND
CULTURAL
PROCESSES:
PERSONALITY AT THE
INTERSECTION OF
SOCIETY**

INTRODUCTION

Narrative as a component of personality has a long history in the field, but it is only within the last two decades that it has been fully accepted into contemporary approaches to personality (e.g., McAdams & Pals, 2006). One part of the flourishing of the field of narrative psychology has been the attention paid to the social and cultural contexts of narrative production. Yet this work has been somewhat outside the reach of personality psychology, occurring more often within the fields of developmental, cognitive and social psychology (e.g., Fivush, Haden & Reese, 2006). One of the reasons for this separation is the attention to how social and cultural contexts *change* narration, and a focus on malleability in psychological phenomena has not traditionally been under the purview of personality psychology. We aim to merge these areas of study – personality and social and cultural contexts of narration – by focusing on the role that those contexts play in the *stability* of narrative as a component of personality.

We accomplish this aim by unpacking the theoretical and empirical work on the social nature of narrative from its origins in the focus on dyadic and conversational processes of sharing stories with others, to more recent work that seeks to capture the social nature of narrative in its cultural context with an examination of master narratives. We couple our review of the empirical work with a discussion of methodological approaches, concluding with new questions for the future. But, to begin, we review the theoretical framework we employ: McAdams and Pals' (2006) approach to personality, in which personality is represented by five principles – evolution, traits, characteristic adaptations, narrative and culture.

A COMPREHENSIVE FRAMEWORK FOR CONCEPTUALIZING PERSONALITY

The study of narrative within the realm of personality has been articulated within “The New Big Five,” a framework developed by McAdams and Pals (2006). The framework includes five principles for conceptualizing personality.

There are two principles that are relevant to how personality is expressed in individual lives, which bookend what have been termed “levels” of personality. At one end is the first principle that captures individual variability expressed as part of our *evolutionary* design. The fifth principle concerns the ways in which *cultural contexts* impact how personality is expressed. Between these two principles of evolution and culture lie three levels of personality that can be conceptualized as a continuum moving from personality as more rooted in biology and similarities across people, toward personality conceptualized as greater contextual variability between people.

The first level is personality *traits*, most often defined as The Big Five (Costa & McCrae, 1994), or more recently as the hierarchical big five, in which the big five domains comprise lower order aspects and facets and are situated within two higher-order meta-traits (DeYoung, 2015). At this level we see variation between people rooted along the five continua of these dispositions (openness, conscientiousness, extraversion, agreeableness, neuroticism), which are viewed as relatively rooted in early temperament, biology and genetics (McCrae & Costa, 2008). Indeed, contextual variation at the level of traits is “smoothed over,” with an emphasis on generalized, or aggregated, patterns across situations.

The second level is termed *characteristic adaptations*, and focuses on variability that is more contextualized within particular developmental contexts. Here, the focus is on personal goals, generalized schemas (e.g., attachment), and motives (e.g., power and intimacy). McAdams and Pals (2006) suggested that this is the level through which traits are enacted in daily life as individuals pursue a particular agenda (see also McAdams, 2015). Thus, variation at this level becomes more contextual, as one moves through life stages, or develops new goals or agendas, or different schemas for understanding the world.

The third level concerns *narrative* as represented by the life story, an internalized and evolving story that serves to integrate and give purpose to the individual. As people recall and reconstruct the past events of their lives, they construct the most unique part of their personality – the

level that defines their identity. Life stories contain high points, low points, themes, values and goals, with the aim of capturing the past, present and future self. Across the many narrative episodes collected in the life story, researchers aggregate the patterns across episodes to capture the general patterns of narration (e.g., McAdams, Anyidoho, Brown, Huang, Kaplan & Machado, 2004), or assess specific narrative episodes as a component of narrative processing (e.g., McLean & Breen, 2009; Syed & Azmitia, 2008).¹ It is the variation in these narrative patterns that captures personality at this level.

Level three is the most contextualized, or “protean,” aspect of personality, and is thus, more socially and culturally informed than traits, which are viewed as an amalgam of behavior averaged across situations. In reviewing the field, we build on this framework, but focus on how the malleability or contextual variability that has been central to thinking on narration has obscured how these contexts can also promote stability in narration. This is particularly important, as stability is part of what defines a psychological phenomenon a part of personality – patterns of individual variability that show some consistency across time and context.

THEORETICAL FOUNDATIONS

The field of narrative identity derives from a long history within personality psychology that focuses on the role of narration as an individual difference that targets both implicit aspects of personality (e.g., TAT, Murray, 1938), as well as explicit reports of one’s life (McAdams, 1985). But with the rise of trait psychology, such conceptions of personality were falling through the cracks. As described previously, narrative identity was instantiated as an empirical area of study through the work of Dan McAdams (e.g., 1985, 1993), who argued for narrative as a “level” of personality, paying particular attention to the need for a broader conceptualization of personality beyond traits. One of the components of McAdams’ original argument was the importance of attending to cultural contexts in understanding personality, something that was often lost in the original surge of attention to personality traits. Indeed, McAdams and Pals (2006) argued, “The complex interplay between culture and human individuality may be most evident at the level of narrative identity” (p. 211). However, much of the work in this area has emphasized how contexts can move narrative around, a point we question here.

Does Contextualized Always Mean Change?

In short, viewing narrative as the most “protean” level of personality, may have overprivileged attention to change.

For example, much of the research on audience effects on narration and cultural differences in narrative production highlights how these contexts can *change* the story one is telling. Such an emphasis may have muted the powerful forces that cultural and social contexts can play in *maintaining stability* in one’s stories. There are several ways in which this muting may have occurred.

The first is the notion that individuals’ motives, goals and decisions in particular moments of social life drive the kind of story they tell, and the way they tell it (e.g., Pasupathi, 2001). Attention to these components of storytelling is certainly critical for understanding what is happening in a storytelling situation, but they also privilege the individual’s *agency* in shaping that context (McLean, 2015; McLean & Syed, 2015). The notion that we are the authors of our own stories often leads to an emphasis on the autonomy individuals have in how they decide to narrate their lives (see Waterman, 2015). There is choice, and thus, there is room for change as we can simply *decide* to tell the story in one way or another – we can change the story. McAdams and Pals (2006) emphasized the agency individuals have in this choosing, noting that “... individuals select and appropriate in the making of narrative identity” (p. 212), likening this process to making a “choice” on the menu of cultural options for storytelling.

Yet social and cultural contexts provide a strong constraint for how to story ourselves (McLean, 2015; McLean & Syed, 2015) – the menu is fixed after all, at least to some extent. And this constraint may privilege stability in the kinds of stories that are told, regardless of our goals and motives. Second, even as we *may* choose to tell stories in a certain way, when those stories are validated by others, they begin to stick (see Pasupathi, 2001). That is, the social force of storytelling can work to instantiate particular stories, especially those that fit the cultural mold and are thus agreeable to the listener (Syed, Pasupathi & McLean, in press). In this way, listeners are not only agents of change, but also forces for stability.²

Theoretical Beginnings: Personal Memory Telling

The seeds of these ideas about social narration as a force for stability come from Thorne’s (2000) work connecting personal memory telling to processes of personality. The premise of Thorne’s work – that the social context of narration was important – was distinct from the great majority of theorizing and empirical work in personality at the time, which was reticent to (or even antagonistic toward) taking on social contexts, as a part of personality. Personality was internalized, individual, biological and stable (Block, 1981; Costa & McCrae, 1980, 1994). Part of

¹ See Syed (2017) for a discussion of narrating the life story versus specific episodes within a personality framework.

² We note that we do not expect that McAdams and Pals (2006), or other theorists, would disagree with this notion of constraint; it is more an issue of emphasis. The emphasis has been on agency and change (see also McLean & Syed, 2015), to the neglect of the role of social and cultural context as forces for stability.

this tension was the history between the worlds of personality and social psychology in which the social context was used as a threat to the validity of personality (Block, 1981; Mischel & Peake, 1982). And part of this was a history of measurement and theoretical tradition that put the lens on the person (e.g., self-reports, interviews, q-sorts), as opposed to the social context of personality (Thorne, 1987).

The crux of Thorne's argument was not simply that stories are used in social settings – such as for entertainment, which they are – but rather that narratives “drive personality development in concrete moments of social life” (p. 45). Thorne argued that sharing personal stories with others is not only an example of both “reciprocal interactionism” (Endler, 1981) – how persons and situations influence each other – it is also an example of cultural dynamism. That is, through the proximal context of sharing stories we have access to the larger cultural constraints and affordances that feed into a story and a self.

Monisha Pasupathi provided further evidence for the importance of social contexts in narration but her argument was forged more from cognitive and social psychology traditions. Like Thorne, Pasupathi argued that development occurs in social contexts, and that many of those contexts are rife with the disclosure of personal narratives. Pasupathi's basic premise was that when we tell stories to other people, their responses shape how we later remember and recall those stories (see also McLean, Pasupathi & Pals, 2007). Her work emphasized the particularities of these “telling” contexts, such as the goals or motives a person brings to the sharing of a story, as well as specific variations in the responses of listeners (e.g., disagreeable or attentive). Pasupathi's work was not grounded in personality, and she emphasized more heavily the mutability of narrative in social contexts – how these moments of social narration can change the story told (and remembered). However, the theoretical framework can be used to understand stability in narration as well.

Theoretical Development: Master Narratives

The original work done by Thorne and Pasupathi to forge a theoretical framework for thinking about the sharing of stories, fed into a more recent framework for understanding the cultural dynamics of narrative identity development that centers on *master narratives*. The idea that the responses of audiences can impact the stories we tell and remember, suggests that there is a “correct” way to tell a story, or a story that pleases or displeases a listener. These audience desires are shaped by master narratives – culturally shared templates for stories that guide thoughts, feelings and actions (Hammack, 2008; McAdams, 2006; McLean & Syed, 2015; Thorne & McLean, 2003). These stories are not about individual personal experiences, but rather serve as broad cultural templates for how to tell

particular types of stories. And these templates can enforce a certain kind of story, with sanctions for those whose stories do not align with the template.

In describing their master narrative framework, McLean and Syed (2015) outlined five core principles that explain the strength of master narratives, which may also help to explain how they facilitate stability in stories. In brief, master narratives provide useful information for how one ought to be and how one's stories ought to unfold (*utility*). They permeate many aspects of society, in family life, institutions and the media (*ubiquity*). They are cast as natural, so they are rarely even noticed or named by those who align with them (*invisibility*). It is expected that most members of a society will adhere to them, and there are often real risks to deviating and endorsing an alternative narrative (*compulsory*). And, perhaps most important for the current argument, they gain their power from being resistant to change in order to maintain cultural dynamics (*rigidity*).

These five principles work together to give master narratives their social power in individual lives. And they may also work together to push for stability in narrative, providing a sociocultural explanation for why our stories are stable. The constraints of master narratives can provide great stability in the ways that identities are defined, both in the possibilities for self-definition that exist in a given context (i.e., the cultural menu) and in the ways that sanctions are imposed for those who do not align.

In sum, the simple and ubiquitous act of sharing a personal story with another person is a moment in which personality processes are enacted in the decision to tell a story, the ways in which stories are shared and the responses from an audience. What is shareable, how it is shared and responses to the story are shaped not only by aspects of the immediate situation, such as the listener, but also by cultural norms and values. Further, if these cultural expectations for storytelling are violated, consequences may follow. Those processes can create change in personality, such as the subtle, or not so subtle, prompts from others to revise one's story, to reinterpret it. But these processes can *also* create stability in personality: shaping a story to meet others' expectations, coupled with validation from those others, works to calcify one's story. Thorne and Pasupathi led the charge to elaborate and contextualize this level of personality with their attention to the social nature of narrative, laying the theoretical ground work for the study of the “personal” story as a joint production. And the empirical work soon followed.

EMPIRICAL FOUNDATIONS OF THE SOCIAL NATURE OF NARRATIVE

In reviewing the empirical work, we draw from Thorne and Pasupathi's original studies, and discuss the distinct methods that each used to target the social processes of narration. We distinguish those studies that have taken a more subjective approach – assessing the recollection of

shared stories, versus a more objective approach – the observation of storytelling, to highlight methodological variation. We follow with a review of the recent work on master narratives.

The Subjective Assessment of Tales Told: Methods and Findings

Building directly from her theoretical proposals, Thorne and colleagues (Thorne, McLean & Lawrence, 2004), began to investigate the landscape of memory telling. These initial studies were self-report assessments of having told memories to other people, a common measurement technique in personality psychology (Adler, Dunlop, Fivush, Lilgendahl, Lodi-Smith, McAdams, McLean, Pasupathi & Syed, 2017). Participants are asked to write down an important memory in narrative form, and are then asked if they have told it. If so, they are asked to describe that “telling narrative” (McLean, 2005; Thorne et al., 2004). These layers of narratives can be used to understand the person’s own take on their experiences, as well as some of the social ecologies in which those experiences are shared. These subjective accounts are objectively coded for various attributes (Syed & Nelson, 2015), such as the degree of personal meaning included in the narrative, how positive or negative the story is, and how positive or negative the response of the listener was.

Initial descriptive work revealed that people tell their stories – a lot. Almost 90 percent of self-defining memory narratives, elicited from emerging adult college students, had been told at least once to someone else in the past. This high percentage of shared memories has held remarkably constant across various types of narrative prompts and samples (e.g., McLean, 2005; Pasupathi, McLean & Weeks, 2008; Rimé, Mesquita, Philippot & Boca, 1991). Even those stories that we do not remember over the long term, such as the most interesting thing that happened to you today, are more likely to be told soon after their occurrence than not (Pasupathi et al., 2008). This baseline descriptive evidence tells us, at minimum, that not studying that social context (e.g., what happens when these stories are shared) means that we lose a large part of our understanding of the phenomenon of personal narrative as a part of personality.

Building on the description of the phenomena, McLean (2005) investigated the *reasons* for telling memories (see also Bluck & Alea, 2009). As Pasupathi (2001) argued, the reasons one has for telling a story can impact the way the story is told as well as the response of a listener. If I tell a traumatic experience because I need comfort, the story will look different than if I tell it as a testament to my personal strength. Descriptively, McLean (2005) found that telling self-defining memories for self-related reasons (e.g., self-explanation, meaning-seeking, personal validation) was quite common, and was more closely related to narratives that had more elaborated meaning-making. In other words, when people tell stories with reasons

related to communicating who they are, those stories have more elaborated explanations of who they are. If I tell that trauma with the interpretation of my personal strength and resilience – the story tells you a lot about who I am via my explicit statements about who I am. If I tell it to entertain you, the meaning it has to my identity will be less explicit (McLean & Thorne, 2006).

The savvy (or disagreeable) reader might be muttering that there are certainly remembered stories that are unshared; perhaps you can even think of a few of your own. And, indeed, there are. In particular, the telling of transgressions – at least in American contexts – is less common (Pasupathi et al., 2008). In a cultural context in which positive self-evaluations are king, why would one tell stories about one’s misdeeds? Yet this does not mean that transgressions are not shaping and shaped by the social world. One major reason people are less likely to tell such stories is fear of social shaming. Put differently, these stories are not culturally acceptable; these selves are not culturally acceptable. So they are hidden away, and shape a cultural world with limited access to discussion of transgressions.

But not so in all groups. For example, in observational studies of conversations between parents and children, we see that Chinese American parents talk about their children’s wrong-doings as a mechanism of value and behavioral socialization more so than White American parents (e.g., Wang & Leichtman, 2000). Similarly, in samples of White Americans, working class families discuss transgressions more than middle class families (Miller, Sandel, Liang & Fung, 2001). In these families where transgressions are more available for discussion, they appear to be a useful tool for socializing behavior and protecting children from potential threats. What we can take from this – and it is an important lesson – is that the social and cultural context influences both the affordances for *and* the barriers to sharing stories, and when those stories are shared (or not shared) they maintain the cultural context that includes those affordances and barriers.

These initial studies were biased by the subjective nature of the recollection. That subjectivity is still important, perhaps particularly to the study of personality, because such recollections still tell us a good deal about the person. But what happens in vivo?

The Objective Assessment of Tales Told: Methods and Findings

While Thorne and colleagues were examining recollections of experiences with telling personally important stories, Pasupathi was driven by her training in experimental methods to focus on the actual conversations in which narratives were shared. Across multiple studies, evidence accumulated showing that the manner in which audiences respond to a shared story predicts whether and how that story is retained, as well as its self-relevance over time (Pasupathi & Hoyt, 2009; Pasupathi & Rich, 2005). For

example, you come to the lab and share something (relatively trivial) to an audience who is distracted or attentive (via experimental manipulation). With an attentive, supportive audience you later remember the story better, and think it is more self-relevant. You forget details, or dismiss the importance of stories told to an audience who is distracted. This kind of work shows the real power of close others to shape our stories – not only how they are told, but *if we remember them at all!*

This research is consistent with that conducted in a parallel field also focused on examining conversations about past events. But these researchers were driven to understand childhood amnesia, and were focused on the importance of parent-child conversations about past events as drivers of developing an autobiographical self, or a self that extends through time (see Fivush et al., 2006 for a review). These researchers took a socio-cultural approach to their studies, viewing these conversations as moments of scaffolding, in which parents supported their children's growing ability to narrate the personal past. The manners in which parents engaged in this support, somewhat analogous to variations in distraction and attentiveness in Pasupathi's studies, predicted the behavior of the children in the conversation at the moment, in subsequent conversations over time, as well as the child's recollection of the personal past in nonconversational contexts (see Reese, Yan, Jack & Hayne, 2010, for an example). Though not necessarily focused on stable individual differences, this work provided methodological opportunities.

Indeed, in conversational studies, the methods shift. First, the personal story must be captured, which can be done in ways similar to those self-report methods, e.g., is the shared story positive or negative, meaning-laden or sparse? Second, the manner of the response must also be captured. For example, researchers can code each utterance of the audience responses for whether they validate or support the speaker, or whether they disagree or reframe what the speaker has shared (e.g., Bird & Reese, 2006; Haden, Haine & Fivush, 1997; McLean & Mansfield, 2011). Further, it is not always the case that participants are sharing their most important, or identity-defining stories. Indeed, some studies have used laboratory-induced events to share our more everyday experiences (Pasupathi & Rich, 2005). Others have used emotional events (e.g., sad, happy; McLean & Mansfield, 2011), but little research has focused on self-defining, turning point, or other "life story" type memories. This makes good sense because participants may not always be willing to share such memories; these are the types of memories that may be reserved for more intimate conversations, or very particular audiences.

These techniques for capturing conversations, as currently used, give us insight into conversation processes related to narration, but how much of those processes translate to the life story, writ large, is still unclear. McLean and Pasupathi (2012) suggested that, over time, these micro contexts of storytelling accumulate into the

larger stories embedded within the life story. It is as if everyday storytelling serves as practice for the kinds of stories that define us in the life story. Once our life story becomes more solidified, perhaps the everyday storytelling is a way to maintain that solidity of who we are. But this kind of claim demands methods to capture these micro processes over time, and as they connect to the larger story that is developing (see Kunnen & Metz, 2015 for related methods on another topic).

Based on these initial findings, it is clear that narrative construction is inherently social. We follow the storyline of empirical work to scale up from these dyadic conversations to an examination of the broader social context by discussing the findings related to how the cultural nature of master narratives can push for stability in narrative.

Master Narratives and the Stability of Narrative

As we have discussed, the notion of stability of psychological phenomena is a cornerstone of any approach to the study of personality. In fact, some of the first empirical endeavors in the field of narrative identity were conducted to show that there was some stability in narrative patterns over time (McAdams et al., 2006; Thorne, Cutting & Skaw, 1998). These initial studies were critical to making the argument that narrative was actually a part of personality, but they were quite distinct from the theoretical traditions of Thorne and Pasupathi because the social context was not considered in these examinations of narrative stability. However, merging these social constructivist theories and personality theories, we can see that such contexts may help to explain some of the stability of narrative.

At the most basic level, several theorists have made the argument that sharing personal stories helps us to develop a story that is socially acceptable, and once we get that acceptable story down, that is the story that we will stick with (McLean, Pasupathi & Pals, 2007; Pasupathi, 2001). Aspects of self, such as personality, influence when and how stories are constructed and shared, but the sharing feeds back into those selves to solidify them, akin to active and evocative forces (McLean et al., 2007). From this perspective, the microprocesses involved in storytelling conversations can serve to stabilize narrative.

Beyond the immediacy of a listener response, there is a strong bidirectional relation between individual and culture in this kind of model, and the dynamics are strongly tuned to maintaining master narratives (McLean & Syed, 2015), increasing solidity in cultural and personal stories. Thus, if we see stability in the ways that some people tell the ending of their stories – for example, with resolution – this may be because positive resolution is a culturally desirable story characteristic (at the distal level). So people are more likely to end their stories positively because of the social feedback they receive that this is the correct way to construct a narrative (at the proximal level). As they continue to tell stories this way, it reinforces the interpersonal and cultural value placed on resolution.

This premise concerning the bidirectional nature of personal and master narratives is well-exemplified in Phil Hammack's (2011) culturally sensitive analysis of identity development in Israeli and Palestinian adolescents. In extensive life story interviews, he found that the historical story of these two groups, the master narrative for each, was embedded within their personal narratives (e.g., the holocaust and subsequent return to Israel; the disruption and division of one's homeland). This is a theme of master narrative work: one can *see* master narratives in personal narratives, if reading for them (Galliher, McLean & Syed, 2017).

Further, the fact that these historical, master narratives appeared in personal narratives is one way that master narratives maintain their power – they are retold each time an individual tells his or her own story. Even more, Hammack found that the ways in which these adolescents negotiated their own identity stories with these larger cultural stories shaped the cultural and historical context by maintaining divisions between groups. It turned out that, for these kids, defining oneself as Israeli necessitated an anti-Palestinian identity, and vice-versa. This act of personal storytelling upholds the current structures of a cultural context, and the stories that infuse it.

This is one of the more powerful studies to reveal the ways in which culture impacts the individual, *and* how the individual impacts culture. In this way culture is not the independent variable, which is static and separated from the individual. Instead culture and the person are engaged in a bidirectional interaction. And when stories are told in ways consistent with that cultural framework, the framework, or master narrative is maintained – one explanation for the stability of stories.

At a more metalevel, some cultures may also press for stability and predictability themselves. In American culture, there is an emphasis on continuity across contexts – we want to be able to predict how ourselves and others will act. So the emphasis on stability may come from aligning with cultural expectations, which are relatively static, and also with the expectation for predictability and stability itself.

We have argued that these master narratives press for stability in stories, and this may be one reason that we see stability in narrative patterns over time. But we have yet to fully link individual differences to these social and cultural processes. We close the chapter with a discussion of the linkage between individual differences in personality and master narratives – raising ideas that are largely untested, as of yet.

MASTER NARRATIVE NEGOTIATION AND PERSONALITY: IDEAS FOR THE FUTURE

Master narratives have yet to be clearly incorporated into a model of personality. They have been used to study identity and culture, but not necessarily individual differences. We have argued that the concept of master

narrative helps us to understand stability in narrative. But we want to push the master narrative model a bit more into the territory of personality by playing with some ideas about the process of negotiation with master narratives.

In thinking about variation in engagement with master narratives, there is a critical piece of the framework to which we have only alluded so far, which are the societal power dynamics that must lie at the center of the analysis of master narratives (McLean & Syed, 2015; Syed, 2016). Master narratives are not value-neutral. In governing what is good, just and acceptable in society, master narratives reinforce the norms established by those who hold power. Indeed, those who are in more marginalized positions by virtue of ethnicity, gender or sexuality, report being more likely to deviate from the master narrative (McLean et al., 2017). Such individuals are also more likely to elaborate *alternative narratives*, those that are counter to the master narrative, providing a different framework with which to define the self (McLean et al., 2017; see also Gyberg, Frisén, Syed, Wängqvist & Svensson, 2018; Juan, Syed & Azmitia, 2016; McLean, Shucard & Syed, 2017; Way & Rogers, 2015). Alternative narratives are stories that are in resistance to, or divergent from, the normative expectations. They provide a different cultural framework for those who are marginalized from the mainstream or dominant powers.

Whether one deviates from the master narrative is not necessarily a question of personality, but *how* one manages or responds to the deviation may be a place ripe for investigation of individual differences. For example, one may deviate from the master narrative through no choice of one's own (e.g., being a sexual minority). But aligning oneself with an alternative narrative is an agentic process (Toolis & Hammack, 2015), which takes more intensive, thoughtful identity work or reflection. For example, we have found that those who not only deviate, but also elaborate an alternative narrative, score higher on identity exploration processes (McLean, Lilgendahl et al., 2017; see also McLean et al., 2017). Though the press to align with an alternative narrative may be high – at minimum to find a place to belong – it does take personal effort, and some people may be more inclined toward this reflective task.

In thinking about how components of personality might illuminate these processes, at level two, constructs like ego development may relate to engaging in the work of understanding the intricacies of the master and alternative narrative negotiation process. Those higher on ego development have greater complexity of thought (Loevinger, 1976) – they have greater perspective, experience greater nuance in emotions and are less rigid in their thinking – the kinds of skills that might allow one to find a home in an alternative narrative. At level 1, agreeableness may facilitate obtaining others' understanding of personal experiences of deviation, and extraversion may facilitate finding the group with which one resonates (we

do know that extraverts tell their stories more, and take more pleasure in sharing their stories with others; McLean & Pasupathi, 2006). In terms of those who align with the master narrative, of course demographics play a role, but perhaps also low openness to experience. Those with more inflexible outlooks on life may be less likely to engage with alternate possibilities for defining the self.

It is also the case that finding and connecting to an alternative narrative may take some risk. For example, when put in conversational contexts, these alternative narratives become less visible as people are reticent to “out” themselves as deviating from the norm, instead using master narratives to discuss personal experience, even when personal experience does not match those master narratives (McLean et al., 2017). It appears that individuals would rather find common ground, and not feel marginalized, than disclose a story that runs counter to expectations. Perhaps other components of personality may be important in facilitating risky exploration, such as attachment security, or generalized self-esteem, which may allow a comfort with risking the self.

Beyond thinking about who is likely to engage in processes of negotiating with alternative and master narratives, we can also think about the *degree to which one internalizes* master and alternative narratives. That is, it may not be a binary – you belong to one or the other – but a matter of gradation. Some people go the whole hog with the master or alternative narrative, living a life or telling a story in complete alignment with expectations of either narrative. Yet others may adopt a softer version, or bits and pieces. This softer version may be represented by not adopting all components of the master or alternative narrative, or by adopting these narratives in less centrally defining ways (for other similar process see Yoo, Burrola & Steger, 2010 on internalization of the model minority myth; David & Okazaki, 2006 on colonial mentality; Benet-Martínez & Haritatos, 2005 on bicultural identity). For example, there is a biographical master narrative in the US that includes events such as finishing school, finding a job, getting married and having a child. A person may adopt some of these – an education, job, marriage, but no child. Or a child but not a marriage. This would be a piecemeal version. One may also be married, but not find that to be centrally defining, which would be another way to soften conformity, perhaps especially for a woman.

At the beginning of this section we raised a central component of the master narrative framework, which is the importance of power dynamics. Indeed, this distinction in how much a narrative is centrally defining may be particularly important for those who do not align with the master narrative. For those who align with the master narrative, but do not view it as central, this is not problematic because one is still fitting in with cultural expectations, and in a position of greater power. In contrast, for those who do not adopt the alternative narrative, they might be left more isolated, more at risk, less empowered. In a recent paper (McLean et al., 2017), we included a

narrative from a young gay man who reported not aligning with the alternative narrative for gay individuals in the US – as he discussed it:

I’ve also diverged from what’s considered normal and expected of a young gay male. I’m not at all feminine like many of the caricatures on TV series, etc., and don’t fulfill the “gay best friend” role that a number of straight women have asked me to fulfill.

The outcome of not adopting the alternative narrative, for this reporter, is isolation: “...makes me feel as if I’m floating in a void, fulfilling nobody’s expectations but my own.” Thus, personality may help us to understand these dynamics of negotiation, but maintaining a lens on the power differentials inherent to these negotiation processes is critical. Researchers must synthesize a personality and sociocultural lens in understanding these phenomena.

CONCLUSION

We have used McAdams and Pals (2006) framework for understanding personality, in which cultural contexts play a role in understanding personality processes at three levels – traits, characteristic adaptations and the life story. In focusing on level three, we have made the argument that focusing on social and cultural contexts is not necessarily limited to thinking about how those contexts change, or make fluid, narrative. But, instead, we can also see how those contexts can be a force for stability in stories and storytelling. Finally, we have argued that engaging with cultural contexts by employing a master narrative framework may be a place ripe for examining individual differences. We hope these ideas serve as food for thought for those working to marry a personality and cultural approach to narration.

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INTRODUCTION

The traditional study of personality focuses on the structure of personality and its origins (Allport, 1937; Murphy, 1932). However, an important reason to examine personality is to understand how it influences people's daily lives in meaningful and predictable ways (Shiner & Masten, 2012). For example, personality is associated with individual outcomes such as physical health, happiness and identity; interpersonal outcomes including romantic relations (e.g., to whom individuals are attracted; Ozer & Benet-Martinez, 2006), marital satisfaction, marital success and parenting; and social outcomes such as occupational choice, community involvement and political affiliation (Ozer & Benet-Martinez, 2006). Personality also impacts the perception of received social support and actively seeking social support (Lahey et al., 2010). Although social behavior is often shaped by the dispositions and perceptions of the individuals involved in the interactions (Elster, 2015), social relationships also profoundly affect personality (Back et al., 2011).

In this chapter we examine personality's influence on social relations and social support. First, we examine the direct effect of personality on social relations and social support across a range of interpersonal relationships that occur during the lifespan. Second, we consider the bidirectional relationships between personality, social relations and social support. Third, we discuss how personality, social relations and perceived social support may be influenced by the cultural context within which these relations occur. Finally, we discuss two methodologies that allow researchers to study personality and social relationship effects simultaneously.

The personality dimensions presented in this chapter are not meant to be exhaustive but instead are offered as examples when considering the association between personality, social relations and social support across the lifetime. These constructs will primarily be examined through the lens of the Five-Factor Model of Personality (e.g., neuroticism, extraversion, openness, agreeableness, conscientiousness; McCrae & Costa, 1987). We will use

the terms "temperament" and "personality" somewhat interchangeably. Temperament is often defined as constitutionally based individual differences in both reactivity and self-control that are early-appearing and is believed to be the biological core of personality (e.g., Rothbart & Bates, 2006). Personality, in contrast, has been defined as "an individual's characteristic pattern of thought, emotion, and behavior" (Funder, 1997). Given that both definitions focus on characteristic patterns of responding, there is considerable overlap in these constructs when attempting to understand how these differences influence social relations across the lifespan.

PERSONALITY'S INFLUENCE ACROSS THE LIFESPAN

Given the social nature of humans, establishing and maintaining meaningful social relationships are among the most important tasks individuals face (Baumeister & Leary, 1995). Although the interpersonal dynamics of a relationship are important in understanding how it is formed and maintained (e.g., Gottman, 2014), the characteristics an individual brings to that relationship may be equally as important for satisfying, high-quality relationships (Robins et al., 2002; Elster, 2015). For example, personality characteristics associated with socioemotional competence (e.g., extraversion, effortful control, emotional intelligence, empathic accuracy) predict the duration and quality of relationships across the lifespan (e.g., Asendorpf & van Aken, 2003; Bridgett et al., 2009; Gleason, Jensen-Campbell & Ickes, 2009). Childhood extraversion and agreeableness are associated with social competence in emerging adulthood as well as romantic and social competence in adulthood (Shiner & Masten, 2012). In a meta-analytic review, Malouff and colleagues (2010) found agreeableness, conscientiousness and extraversion predicted relationship satisfaction of people's romantic partner. Individuals high in agreeableness and conscientiousness have longer marriages and are less likely to get divorced compared to individuals high in neuroticism (Roberts et al., 2007).

Personality and Socialization

The role of personality on social relations is seen as early as infancy in the relationship between an infant and caregiver. For example, a warm, receptive parenting style is crucial for developing a secure attachment with an infant (De Wolff & Van IJzendoorn, 1997). However, the parent's personality plays a critical role in their ability to provide warm, supportive, nurturing caregiving. For example, high maternal neuroticism is associated with less positive affective ambience and parental nurturance as well as increased negative discipline, negative emotion and power assertion (Kochanska et al., 2004; Smith et al., 2007). High maternal agreeableness and conscientiousness are related to consistent care giving, positive affect, positive emotional expressions (e.g., love, compassion, joy), cognitive stimulation and maternal sensitivity; maternal empathy is positively associated with responsive parenting (Kochanska et al., 2004; Shiota, Keltner & John, 2006; Smith et al., 2007). However, parents' personalities are only a portion of the relationship; the child's temperament also shapes the interaction. Children higher on joy and lower on anger have higher shared positive ambience with both their mothers and fathers (Kochanska et al., 2004). According to Condon et al. (2013) paternal positive affect and infants' fussy-difficult temperament discriminated strong infant-father attachments from weak attachments.

Additionally, parenting involves socializing children to internalize societal and parental norms (e.g., Maccoby, 2015). Both the child and parent's personality influence the socialization process interactively and bidirectionally (Kiff, Lengua & Zalewski, 2011; Maccoby, 2015; Pomerantz & Thompson, 2008) thereby allowing for multiple pathways to successful socialization (Kochanska, Aksan & Carlson, 2005; Kochanska, Aksan & Joy, 2007). For example, both the child's and parent's personalities can influence the child's responsiveness to parental authority. Having a responsive mother is particularly important for anger-prone infants; when a mother is highly responsive, an anger-prone infant is likely to become more cooperative over time. This increase in cooperation is not seen for anger-prone infants who have nonresponsive mothers (Kochanska, Aksan & Carlson, 2005). This interactive pattern is known as the differential susceptibility hypothesis, which suggests highly reactive children may significantly benefit from positive environments but may be stifled and at risk for poor outcomes in negative environments (Belsky & Pluess, 2009; Ellis et al., 2011). For instance, Stright, Gallagher and Kelley (2008) found infants with mothers who engaged in high-quality parenting were more likely to have better interpersonal relationships, higher academic success and better social skills this relationship was stronger for infants with difficult temperaments compared to infants who did not have difficult temperaments.

In addition, the child's fearfulness moderates successful internalization of parental beliefs. Fearful children who

are harshly disciplined often experience an arousal level that exceeds the optimal level and inhibits the child's ability to effectively process the parents' message (Kochanska, 1993, 1995). In contrast, it is rare for fearless children to be adequately aroused by gentle discipline (Kochanska, 1993). Increasing pressure to conform, however, often leads to anger in the fearless child, which undermines effective internalization of the parental message (Hoffman, 1983). Fearful children respond best to gentle discipline whereas fearless children respond best to parenting methods that capitalize on a positive parent-child relationship (Kochanska, Aksan & Joy, 2007).

Beyond discipline, certain parental behaviors and characteristics may engender or attenuate fearfulness in the child. Likewise, a child's behaviors and characteristics may elicit changes in parenting that provoke or reduce fear in the child. An infant's tendency to be fearful may contribute to the shared positive affective ambience the child has with their parent (Kochanska et al., 2004). Parental rejection and inconsistent discipline are associated with children's increased fearfulness (Lengua & Kovacs, 2005). Moreover, a child's fearfulness predicts increases in maternal emotional regulation and acceptance (Lengua & Kovacs, 2005; Martini, Root & Jenkins, 2004). However, the effects of a child's fearfulness are complex and often depend on the age of the child and personality of the parent (Kiff et al., 2011).

Social Support

Another important aspect within social relations is social support which is defined as any process in which social relationships promote health and wellbeing. Social support is multifaceted and has an array of benefits for both recipients and providers (Brown et al., 2003; Gottlieb & Bergen, 2010). In attempting to define social support, two camps emerged within the literature: researchers who argued solely for an objective definition (e.g., Henderson et al., 1980) and researchers who emphasized an individual's cognitive appraisals (i.e., perception) of the quality of social support received (e.g., Barrera, Sandler & Ramsay, 1981). This dichotomy highlights a criticism concerning social support research: a lack of consistency. Social scientists have argued that definitions of social support are broad and conceptually vague. Given this issue, measures of social support and the ensuing results are abundant and disparate (Barrera, 1986; Sarason et al., 1983; Wills & Shinar, 2000). Consequently, most researchers find it more meaningful to examine domains within social support including social embeddedness, perceived social support and tangible support (Barrera, 1986; Barrera, Sandler & Ramsay, 1981).

Sarason and colleagues (1983) suggested social support has two important dimensions: (1) a support system of available (or perceived to be available) individuals to offer assistance and (2) satisfaction with the available and

received support. However, other researchers separate social support into either functional support (e.g., received support from others, perceptions of support) or structural support (e.g., embeddedness, size of one's network; Cohen & Willis, 1985). Disagreements concerning definitions and measurements persists among contemporary researchers (Gottlieb & Bergen, 2010) and may hinder attempts to investigate underlying mechanisms through which social support exerts its effects (Thoits, 2011).

Understanding Structural versus Functional Support

As previously stated, social support can be classified as structural or functional support (Cohen & Wills, 1985). Structural support refers to components of the social environment including number of friends, number of visits between friends, marital status, and participation and group membership in organizations. Structural support reflects social embeddedness, the degree to which an individual is connected to and has contact with significant others (Barrera, 1986). However, this connectedness is not a reflection of the quality of interactions and social support but rather an indication of the access to and availability of resources within the social environment. Indeed, it is not the size of the social network but the strength of relationships, contact with and characteristics of those involved, and kinship (e.g., functional support) that facilitate feeling supported (Wellman & Wortley, 1990).

Functional support refers to the degree to which relationships provide specific supportive functions and perceptions of social support (Cohen & Wills, 1985). Functional support is also referred to as received or enacted support (e.g., Barrera, 1986). For example, emotional support includes meaningful interactions that provide an individual with feelings of empathy, acceptance, trust and love, as well as reassurances of worth and self-esteem. Other supportive functions include tangible support, providing an individual with money, goods, and/or assistance, as well as informational support, giving helpful advice, guidance and problem-solving suggestions (Cohen & Wills, 1985; Wills & Shinar, 2000). Another aspect of informational support is appraisal support which includes information relevant to self-evaluation. People receive information about themselves and their standing within the social environment by engaging in social comparisons to evaluate whether the response to a stressor is appropriate. This cognitive appraisal is a form of social support because it assists the individual in redefining his/her situation as less stressful through direct comparisons (Cohen & McKay, 1984).

Role of Personality in Social Support

When examining functional support, perceptions of social support is important. Perceived social support involves the cognitive appraisal of an individual's satisfaction with received support and available support (regardless of whether support is actually available; Knack, Waldrip & Jensen-Campbell, 2007). Rather than examining social

support objectively (i.e., number of emotional, instrumental, informational exchanges), perceived social support evaluates an individual's subjective perceptions regarding the amount, quality of, and satisfaction with social support he/she received (Cohen & Wills, 1985; Sarason et al., 1983).

Functional support, compared to structural support, is a stronger predictor of associated outcomes, although both types of support tend to benefit the recipient (Cohen & Wills, 1985; Barrera, 1986; Pierce et al., 1997; Wethington & Kessler, 1986). Further, received support and perceived support are thought to have differing effects within models of social support; specifically, perceived support is more reliably related to advantageous health outcomes (Uchino, 2009; Krause, 2007; Wills & Shinar, 2000). Due to differential effects associated with perceived social support, some researchers have argued it is an individual difference variable and subsequently a reflection of the recipient's personality rather than an environmental variable (e.g., Pierce et al., 1997).

There is evidence that perceptions of social support depend on the characteristics and personality of everyone within the social environment. Lakey and Cassady (1990) argued perceived social support is a cognitive personality variable (e.g., self-esteem, dysfunctional attitudes); they found stronger correlations between perceived support and cognitive personality variables compared to functional support measurements. Regardless of the frequency of functional support exchanged, members of the same social network reported vastly different perceptions of social support (Lakey et al., 2010; Wethington & Kessler, 1986). Additionally, responses to similar forms of enacted support differ depending on the recipient. Perceptions of low support depend on cognitive biases that lead an individual to perceive support as unhelpful and prevent the recipient from being able to recall as many previous supportive events than those who lack these biases (Lakey & Cassady, 1990). Further, the nature of the support matters. More covert, invisible forms of social support are perceived as more helpful than overt, deliberate forms of support which may exacerbate the recipient's stress and cause them to feel controlled, indebted and incompetent (Bolger & Amarel, 2007; Maisel & Gable, 2009).

The effects of social support largely depend on the recipient's perception rather than the provider's intentions and actions (Thoits, 2011). For example, individuals high in neuroticism report lower levels of social support and are more likely to be insecure and face difficulties in relationships, which undermines the social support received (e.g., Caspi, Roberts & Shiner, 2005). Additionally, neuroticism is associated with fewer support seeking behaviors, lower levels of perceived social support and less satisfaction with one's social network (Asendorpf & van Aken, 2003; Swickert, Hittner & Foster, 2010). Conversely, extraversion is associated with positive affect, sociability and assertiveness. Thus, individuals high in extraversion tend to report larger and stronger social support networks,

more enjoyment and satisfaction with their social environment and higher levels of perceived social support (Pierce et al., 1997; Swickert et al., 2002). Extraversion, agreeableness and conscientiousness are also associated with giving, receiving and perception of social support (Bowling, Beehr & Swader, 2005; Pow, Lee-Baggle & DeLongis, 2017; Williamson & O'Hara, 2017).

Social Support and Attachment

Social support also influences parent and child interactions. Social support is one of the best predictors of secure infant attachment. Indeed, parental perceptions of social support affect the parents' ability to provide a warm, positive environment. Specifically, mothers with low social support are more likely to have highly resistant and avoidant babies; this relationship is stronger for mothers with highly irritable infants, which leads to an anxious attachment (Crockenberg, 1981). Some researchers have suggested parental bonding and care are a key antecedent to social support and its perceived long-term stability (Sarason, Sarason & Shearin, 1986). Further, infant attachment patterns are thought to extend into adulthood; perceptions of these early relationships and experiences help shape perceptions of social support throughout adulthood (Shaw et al., 2004).

Marital support and satisfaction also affect parenting behaviors and contribute to parental self-efficacy in terms of confidence in one's ability to provide protection, discipline, emotional support and nurturance to his/her child (e.g., Seigny & Loutzenhiser, 2010). Parents who reported high partner support were more likely to engage in high-quality parenting behaviors. Parents who received social support (e.g., friendship, community support) reported less overall stress (Guralnick et al., 2008; Van Bakel & Riksen-Walraven, 2002). Conversely, mothers with low social support displayed less maternal reactivity and sensitivity to their infants' needs (Mertesacker et al., 2004). Further, parental relationship stress was associated with increased negative emotion in the child (Bridgett et al., 2009). Infants also benefit directly through contact with significant others (e.g., grandparents, aunts/uncles, friends) within the parents' social network and indirectly through the supportive environment that fosters the development of higher-quality parenting skills (Crockenberg, 1981; Kanaiaupuni et al., 2005).

PERSONALITY AND PEER RELATIONS IN CHILDHOOD AND ADOLESCENCE

Personality continues to be important in social relations during childhood and adolescence. As children grow older, peers and friends become increasingly important. Peers provide contexts for learning social skills, are resources of emotional, cognitive and social support, and can be used as practice for later relationships (Brown & Larson, 2009). Peers also influence people's personality

through social norms shaped by interaction patterns (e.g., role expectations, reputations) and dyadic relationship characteristics (e.g., communal sharing; Reitz et al., 2014). Personality can influence youth's ability and success in forming and maintaining peer relationships. For example, being extraverted in late adolescence predicted selecting more friends than being introverted, whereas agreeable adolescents were more likely to be selected as friends than disagreeable adolescents (Selfhout et al., 2010). Both agreeableness and extraversion are associated with children's social competence (Asendorff & van Aken, 2003). Agreeable children are more likely to employ constructive resolution tactics (e.g., negotiation) in peer conflicts than less agreeable children are (e.g., Jensen-Campbell & Graziano, 2001; Jensen-Campbell, Gleason, Adams & Malcolm, 2003). In contrast, low agreeable children are more likely to use power assertion tactics (e.g., threats) which can harm or end a relationship and be involved in more serious bullying behaviors (Bollmer, Harris & Milich, 2006; Gleason, Jensen-Campbell & Richardson, 2004). Indeed, low agreeableness is associated with peer rejection, victimization, conduct problems and social support problems (e.g., being avoided, disliked by others, inability to make friends; Ehrler, Evans & McGhee, 1999; Jensen-Campbell et al., 2002; Newcomb et al., 1993).

This association between agreeableness and successful peer relations continues beyond childhood. During adolescence, agreeableness is associated with providing social support to peers through prosocial behaviors (e.g., being helpful, trustworthy, engaging) and being "other-oriented," altruistic and empathic; agreeableness is an important antecedent of prosocial behavior (Graziano, 1994; Penner, Dovidio & Piliavin, 2005). Agreeableness is also correlated with emotional intelligence and regulation, which contribute to building and maintaining successful relationships (Russo et al., 2012).

A friend's personality can also influence the child's social relations. For example, having an agreeable friend buffers against the negative influence of being low on agreeableness oneself (Knack et al., 2007). That is, there is no association between agreeableness and peer acceptance when the child has a best friend who is high on agreeableness. However, the lower the child is on agreeableness, the more likely they will be rejected by the peer group. It may be that a highly agreeable best friend is able to smooth over the "ruffled feathers" of peers, which gives the disagreeable child a buffer against being rejected by them.

Other personality traits are equally important to interpersonal relations during childhood. Extraverted individuals are more likely to experience positive affect, be adaptable and have emotional intelligence, which may lead to smoother, higher-quality interpersonal relationships (Fleeson, Malanos & Achille, 2002; Russo et al., 2012). Indeed, extraversion has been associated with general peer acceptance and fewer social support problems

(Ehrler et al., 1999; Jensen-Campbell et al., 2002; Lubbers et al., 2006). Furthermore, extraversion may buffer against the negative effects of being victimized. Calvete and Gamez-Guadix (2016) found a weaker association between bullying and social anxiety and depressive symptoms when adolescents were high in extraversion.

Conscientiousness is also important for childhood peer relationships (Jensen-Campbell & Malcolm, 2007). Conscientious versus low conscientious children are less likely to be victimized and rejected. Moreover, conscientiousness is positively related to friendship quality, prosocial behavior, decreased aggression, and lower rates of delinquency (Pursell et al., 2008). Conscientiousness is also associated with characteristics which help individuals interact with peers appropriately including emotional intelligence, emotional regulation and low impulsivity (Russo et al., 2012), whereas low conscientiousness is associated with social support problems and conduct problems (Ehrler et al., 1999). Finally, the link between anger and aggression is strongest for individuals lower on conscientiousness (Jensen-Campbell et al., 2007). This finding is not surprising given conscientiousness reflects a person's self-control processes and enables them to maintain appropriate social behavior that allows for higher-quality peer relationships (Jensen-Campbell & Malcolm, 2007).

Neuroticism is associated with many social difficulties in childhood (Asendorpf & van Aken, 2003; Eisenberg et al., 2000). Neurotic individuals tend to have a negative view of others, which may be translated as feelings of dislike by others (Erez & Judge, 2001; Watson & Clark, 1984). Indeed, neuroticism is related to negative affective disposition, impulsivity, poor emotional regulation, lower emotional intelligence, increased social support problems and atypical behavior (Ehrler et al., 1999; Russo et al., 2012). Neurotic individuals also tend to be hypersensitive to negative events, which may lead to poorer peer relations, increased victimization and low perceived social support (e.g., Suls, Martin & David, 1998). For example, because neurotic children are more likely to experience negative emotions, they are angrier during peer conflict, less forgiving of others and more likely to blame others, which increases the likelihood of being victimized by peers (Bollmer, Harris & Milich, 2006). Neurotic children who have an emotionally stable best friend do not differ from a low neurotic child on skills such as initiating relationships, resolving conflict and self-disclosing. However, a neurotic child with a neurotic best friend has the lowest levels of interpersonal functioning (Knack et al., 2007).

Further, an individual's own personality characteristics may interact to effect change in perceptions of social support. Swickert, Hittner and Foster (2010) found that although extraversion and neuroticism were associated with perceptions of social support, they did not interact to change the relationship between personality and perception. However, when openness to experience was accounted for, individuals with low extraversion,

neuroticism and openness perceived high levels of support. People with low neuroticism and openness to experience but high extraversion perceived the most support. Interestingly, individuals with high levels of all three characteristics perceived more support than those low in openness. Swickert and colleagues (2010) suggested individuals high in extraversion, neuroticism and openness to experience may be protected from poor outcomes because they fit the "artsy" (i.e., sociable, nonconforming, emotionally unstable) social role.

Personality and Adult Relationships

There is also an established link between personality and social relationships in adulthood. Extraversion, neuroticism, conscientiousness and agreeableness influence adult relationship outcomes (Berry, Willingham & Thayer, 2000; Lehnart & Neyer, 2006; White, Hendrick & Hendrick, 2004). For example, among adults, conscientiousness has been associated with mate desirability, relationship quality and marriage stability (e.g., Gattis et al., 2004; Robins, Caspi & Moffitt, 2000). Extraversion has been linked to social status (Anderson et al., 2001). In addition, both agreeableness and conscientiousness are negatively related to a friend's annoyance with the individual; conscientiousness and extraversion are negatively associated with number of conflicts in adult friendships (Berry et al., 2000).

Marital satisfaction has also been positively correlated with agreeableness, conscientiousness and extraversion (Heller, Watson & Lies, 2004; Malouff et al., 2010). Conversely, neuroticism is associated with characteristics that could exacerbate marital problems including marital dissatisfaction, trait anger, low self-esteem, aggression and chronic stress (Donnellan, Conger & Bryan, 2004; Lavner & Bradbury, 2010). Adults higher on social absorption or who have a partner high on social absorption have higher marital satisfaction (Charania & Ickes, 2007). This result should not be surprising since social absorption involves being amenable to highly interdependent relationships such as marriage (Ickes, Hutchison & Mashek, 2004). In addition, Charania and Ickes (2007) found marriage partners tend to have similar levels of openness to experience, neuroticism, sensation seeking, psychological femininity, social absorption, social individuation, anxious attachment and sociosexuality (see also Decuyper, De Bolle & De Fruyt, 2012). However, there is conflicting evidence regarding whether similarity in personality leads to marital satisfaction (Gattis et al., 2004; Luo & Klohnen, 2005). Using the Actor-Partner Interdependence Model (APIM), Solomon and Jackson (2014) found that low agreeableness and conscientiousness and high neuroticism and openness within the actor and partner in the relationship put the relationship at higher risk for dissolving.

Personality and other individual characteristics also influence giving and receiving social support. For example, females, younger adults and individuals high in

extraversion, conscientiousness and openness to experience are more likely to receive and provide social support. Perceived social support is also influenced by the gender of and relationship to the provider (i.e., romantic partner; Williamson & O'Hara, 2017). Further, the relationships between extraversion, conscientiousness, openness to experience and subjective wellbeing are mediated by perceived social support (Zhu et al., 2013). In the workplace, extraversion and agreeableness were positively related to providing and receiving non-job- and positive job-related social support, but neuroticism was not associated with giving nor receiving social support. Further, reciprocity was also observed in the workplace; an individual receiving a specific type of support (i.e., non-job-, positive job-, or negative job-related support) was more likely to provide that same type of support (Bowling, Beehr & Swader, 2005).

One limitation with many of these studies is that they are concurrent designs. An exception is a longitudinal study by Robins, Caspi and Moffitt (2002) who found that a personality profile of low negative emotionality, high positive emotionality and high constraint predisposes a person to become involved in relatively happy, nonabusive relationships. More specifically, negative emotionality at eighteen years of age predicted more conflict and abuse, and lower quality in romantic relationships three and eight years later. They also found the influence of negative emotionality on romantic relationships was quite stable. Further, using latent change models, Allemand, Schaffhuser and Martin (2015) found that the relationship between agreeableness, extraversion and increased perceived social support, and the relationship between neuroticism and decreased perceived support, persisted over an eight-year period in middle-aged adults. Individuals who became more agreeable and extraverted over time perceived more support over time, whereas people who became more neurotic perceived less social support.

TRANSACTIONAL MODELS OF PERSONALITY DEVELOPMENT

To date, researchers have focused on how personality influences relationship experiences. An equally important issue involves whether relationship experiences change personality. Personality development is a complex process integrating the individual and social environment; we cannot ignore how social relations may influence an individual's personality. However, prior to 1990 most research focused on adult personality and ignored the link between infant/childhood development and later adult personality and its association to social relations (Allemand, Schaffhuser & Martin, 2015; Helson et al., 2002).

Dynamic interactionism. The notion that there is a co-development of personality and relationships was perpetuated by the dynamic interactionist paradigm (Back et al., 2011; Robins, Caspi & Moffitt, 2000; Reynolds et al., 2010).

Although personality and the environment are relatively stable over short periods of time, such as a few weeks, both personality and the environment are subject to change over longer periods (Asendorpf & Wilpers, 1998). It is likely these changes are influenced by both the individual's own personality and their social relations. For example, a dyadic relationship between spouses can be seen as a transactional or dynamic interactional relationship. The personality of the wife may influence and be influenced by the personality of the husband over time. In addition, the quality of the marital relationship can influence and be influenced by the personalities of both spouses.

Recent empirical consideration has been given to transactional models of personality and social relations (Asendorpf & van Aken, 2003; Neyer & Asendorpf, 2001; Neyer & Lehnart, 2007). For example, Robins, Caspi and Moffitt (2002) found that antecedent personality characteristics predicted later social relations and that social relations predicted changes in personality over time. When individuals were involved in maladaptive romantic relationships, their negative emotionality increased over time. Similarly, changes in an individual's personality, especially agreeableness, were associated with changes in his/her perceptions of support received from the family unit. Interestingly though, these changes are more strongly linked to other family members' changes in perceived support from the individual indicating an individual's social environment can exert strong effects (Branje, van Liesholt & van Aken, 2004).

Further evidence that the relationships and environment an individual operates within can shape an individual's personality is seen in Neyer and Lehnart's (2007) study in which they examined changes in young adults' personality and relationships over an eight-year period. Using latent growth models, they showed that personality change was related to change in family and peer relationships; specifically, less contact with peers was associated with increased neuroticism and insecurity. Further, introduction of a serious partner for the first time moderated personality maturation such that individuals decreased in neuroticism and increased in conscientiousness, agreeableness and self-esteem.

A more stringent test of the transactional model may be to examine how social relations can influence personality change in middle adulthood. As late as the 1990s, researchers believed personality was essentially fixed and unchanging by age thirty (e.g., plaster hypothesis; Costa & McCrae, 1994). However, more recent evidence suggests personality does reliably change in middle adulthood; moreover, midlife concerns associated with social relations (e.g., work stress, social support) influence personality change (van Aken et al., 2006). For example, marital tensions and divorce predicted changes in dominance and masculinity/femininity in women during early and middle adulthood (Roberts, Helson & Klohnen, 2002). Although there appears to be personality-relationship transactions,

Asendorpf and van Aken (2003) found surface characteristics (e.g., loneliness, self-concept) are more likely to be influenced by social relations than are core personality characteristics (e.g., extraversion, agreeableness, conscientiousness).

Another approach to understanding how social relations may influence personality change in adulthood is the Social Investment Theory. This theory attempts to identify *why* there are individual-level changes in personality (via interpersonal transactions) and consistent mean-level changes in personality during adulthood. For example, adults as a group (i.e., mean level changes) become more agreeable, emotionally stable and conscientious over time (Wood & Roberts, 2006). These changes in personality are associated with age and are reflective of important milestones such as college graduation, marriage and becoming a parent (Soto et al., 2011). These experiences are linked to social roles and are believed to influence mean-level changes in personality (Helson et al., 2002; Wood & Roberts, 2006). For example, although there are increases in conscientiousness and emotional stability in adulthood, only people experiencing satisfying relationships show these predicted increases (Roberts, Wood & Smith, 2005).

The corresponsive principal is another way to conceptualize the interaction between personality and life experiences. The corresponsive principal takes into consideration selection effects of personality. In other words, certain traits predispose individuals to self-select into certain environments, which further accentuates that trait. For example, adolescents who scored high on variables reflecting conscientiousness (i.e., traditionalism, control, harm avoidance) were more likely to have achieved their professional goals, be satisfied in their job and have reached financial stability eight years later; subsequently, these now young adults also reported higher levels of conscientiousness compared to when they were adolescents (Roberts, Caspi & Moffitt, 2003). Similarly, Zimmermann and Neyer (2013) observed that students who participated in a year-long study abroad program were higher on openness to experience prior to traveling compared to their peers who did not study abroad. Upon return, the study abroad students reported increases in openness and agreeableness over and beyond their predeparture rates.

Social support processes. Researchers have suggested it is helpful to use theoretical models of personality and environment interactions developed by Scarr and McCartney (1983) to explore underlying mechanisms and better understand the role of perception in social support (Pierce et al., 1997). Personality influences how people choose and actively construct their social network and environment (i.e., proactive interaction), respond to individuals and events occurring within the environment (i.e., reactive interaction) and evoke others to behave in a certain way (i.e., evocative interaction).

Carver and Connor-Smith (2010) found in a meta-analytic review that extraversion, optimism, conscientiousness and

openness were associated with engagement coping which includes support seeking (i.e., proactive interaction). Additionally, extraversion and agreeableness were associated with providing and seeking support in response to a threat (Pow et al., 2017). People who seek support and make a concentrated effort to change their surroundings are actively constructing their social environment. Responses to received social support reflect a reactive interaction within the social environment. For example, Williamson and O'Hara (2017) showed recipients of social support experienced a more positive mood when interacting with female providers. The type of support, manner it was provided, mood when it was received and personality of the recipient all influence how people react to social support (Bolger & Amarel, 2007; Lakey & Cassedy, 1990; Maisel & Gable, 2009). Lastly, an evocative interaction is best exemplified by examining behaviors that elicit or evoke others to provide support. People who gave more support were more likely to have supportive behavior returned to them (Bowling, Beehr & Swader, 2005; Gottlieb & Bergen, 2010).

THE INFLUENCE OF THE BROADER CULTURAL CONTEXT

Culture influences the way people see and interpret the world; different cultures may value different personality qualities in social relationships. As such, the function and significance of certain personality traits may differ by culture, which may have implications for how personality is associated with social relations (Chen, French & Schneider, 2006). For example, the personality characteristic of responsibility appears to be influenced by the cultural climate the person is part of; responsibility is lowest when individualism in the larger culture is high (Helson, Jones & Kwan, 2002).

Shyness-inhibition (e.g., being reserved) is more of a social liability in individualistic cultures that promote social initiative and independence. However, behaviors associated with shyness-inhibition are more valued in collectivistic cultures that emphasize interpersonal harmony and interdependence among individuals (Chen, Wang & DeSouza, 2006). In the United States, a more individualistic culture, shy children are more likely to be neglected by the peer group and shy men are less likely to initiate relationships (Caspi et al., 1988; Kerr, Lambert & Bem, 1996). In China, a more collectivistic culture, shyness is associated with being more socially mature and having a higher social status in children (Chen, Rubin & Li, 1995; Chen et al., 2002). In contrast, extraverted Chinese children are often seen as having more externalizing problems by teachers (e.g., being less respectful and more aggressive; Chen et al., 1995).

Future research must better examine culture's influence on the association between personality and social relationships. To achieve this goal, development of cross-cultural personality assessments is needed. Current personality

measurements popular in Western cultures fail to adequately capture personality in East Asian cultures (Cheung, van de Vijver & Leong, 2011). Current cross-cultural personality measures indicate that people living in countries such as China may not have openness to experience as a central personality characteristic. Relying on the Five-Factor Model or Big Five personality model may prevent researchers from capturing prominent personality characteristics present in nonWestern cultures (Heine & Buchtel, 2009). For example, the Chinese Personality Assessment Inventory (Cheung et al., 1996) reflects four personality factors including social potency/expansiveness, dependability, accommodation and interpersonal relatedness. In joint factor analysis, interpersonal relatedness failed to load on any of the five Westernized factors (Cheung et al., 2001).

Several researchers have examined the role of culture in social support processes. Individuals from collectivistic cultures such as South Korea, Japan and China are less likely than Americans to actively seek support from friends during stressful times and more likely to try to cope on their own (Oliver et al., 1999; Taylor et al., 2004). Furthermore, people in East Asian societies do not perceive as much need for social support compared to people in more individualistic cultures (Wellisch et al., 1999). Similarly, Kim and colleagues (2006) found Asian Americans seek social support less and find it less effective than European Americans.

USING INTERACTIONAL MODELS TO STUDY THE INTERPLAY BETWEEN PERSONALITY AND SOCIAL RELATIONS

In addition to people's personality influencing social relations, the array of interaction partners (e.g., romantic partners, friends, strangers, coworkers) a person comes in contact with influences the way a person thinks, feels and acts. This reciprocal or mutual influence is often termed "interdependence." Although interdependence is a central part of personality and social theories, it was only recently that statistical models have allowed researchers to account for instances of nonindependence (e.g., Kenny, 1988; Kenny, Mohr & Levesque, 2001). The ability to statistically account for interdependence of scores allows researchers to more adequately account for the variance in outcome measures by considering more than the effect of the individual being studied (i.e., the actor effect). Below, we discuss two statistical models that account for interdependence, namely the Social Relations Model (SRM) and the Actor-Partner Interdependence Model (APIM). Other statistical models and research methodologies (e.g., Hierarchical Linear Modeling (HLM), longitudinal designs and cross-lag designs) are equally important in studying the influence of personality to social relations (and vice versa) but are beyond the scope of this chapter.

Social relations model. The SRM is a two-way random effects statistical model which examines the interaction between personality characteristics and social relations (Kenny, Kashy & Cook, 2006; Lashley & Kenny, 1998). Although SRM is an appropriate statistical analysis for studies with dyadic interaction partners (Kenny, 1988), it is more commonly used in studies pairing a target individual with multiple individuals (Kenny, Kashy & Cook, 2006). SRM treats each individual in an interaction as both a subject and an object with each dyadic score a function of four components: constant, actor, partner, and the relationship (Kenny, 1988; Kenny, Kashy & Cook, 2006). The constant represents the group mean and accounts for the variation of an outcome measure as it differs between interactions.

To illustrate, imagine a study in which the outcome measure is agreeableness. The constant component accounts for differing levels of agreeableness across dyadic interactions. The actor and partner components account for the individual responses of the dyadic members. For example, individuals may consistently rate people on agreeableness. The actor component accounts for the target member's outcome scores (i.e., how agreeable the target member consistently views his/her partners). Note that the actor effect does not have predictive ability in the SRM but instead estimates the variability in how consistently the target member rates various interaction partners on a particular outcome (i.e., in this case, agreeableness).

In contrast, the partner component accounts for whether the interaction partner is consistently rated on the outcome behavior regardless of the dyadic partner (e.g., degree that all interaction members view the partner as agreeable). The relationship effect reflects the variance in the outcome score above and beyond the individual contributions of each dyadic member (i.e., accounting for the variability in agreeableness after parsing out the effects of the actor and the partner). The relationship component allows researchers to draw conclusions about social interactions above and beyond the typical responses, actions and personality of the two dyadic members. Variability is therefore accounted for at multiple levels including the group level (i.e., constant components), individual level (i.e., actor and partner components) and dyadic level (i.e., relationship component).

A strength of the SRM is that analysis is not limited to dyadic partners and can be used when examining groups (Kenny, Kashy & Cook, 2006). Another strength of the SRM is that the variance of the effects is estimated rather than estimating the actual effects (Kenny, Kashy & Cook, 2006). Estimating the variance allows interpretation at the population level rather than at the individual level and/or specific interaction level. For instance, the actor effect allows researchers to examine how much of the variability in data is accounted for by the consistency of the target member's responses and/or behaviors. This ability to partial out actor effects has the potential to enhance the field's

understanding of personality's role in social behavior and relationships.

However, there are also limitations of the SRM. First, the variance components are indirectly measured (Marcus & Kashy, 1995). It is also quite difficult to estimate effect size and power (Lashley & Kenny, 1998). This difficulty lends itself to questions regarding sample size and the ideal size of the groups. Lashley and Kenny ran Monte Carlo simulations and repeatedly found that large-sized groups, rather than a large number of groups, had the highest power. Researchers are encouraged to carefully consider these methodological components.

Marcus and Kashy (1995) pointed out that the SRM is not simply a new statistical method but is also a new methodological technique. As such, there are several considerations to note. First, due to the necessity of each participant rating each relationship partner, it is possible carryover effects may occur (Kenny, Mohr & Levesque, 2001). Second, to date there is no way to account for missing data points (Marcus & Kashy, 1995). Therefore, if one relationship partner is lacking a complete set of data points, the entire group may be thrown out.

Actorpartner interdependence model. The APIM is an interactional model which assumes a causal direction in that the actor and partner components cause the outcome measure (Kenny, Kashy & Cook, 2006; Cook & Kenny, 2005). APIM treats the individual predictor scores as being nested within the dyadic unit. As such, both individual scores and dyadic level scores are estimated. Similar to SRM, APIM makes use of actor, partner and interaction components. However, these effects have a very different meaning in an APIM than in the SRM. Again, consider the example with agreeableness (Kenny, Kashy & Cook, 2006). In APIM, the actor effect assesses the degree to which a target dyadic member's agreeableness influences his/her own outcome score. The partner effect assesses the degree to which the partner's agreeableness influences the target dyadic member's outcome score. The actor effect is computed while holding any partner influence constant; the partner effect is computed while controlling for any actor effects. As such, there is a predictive nature of the APIM (i.e., predictor variables cause or influence the outcome variable). A third component of APIM is the actor X partner interaction in which the joint influence of each dyadic partner on a particular measure affects the outcome measure (i.e., effect of the target member's agreeableness X partner's agreeableness on adjustment).

A strength of APIM is the ability to estimate the partner effect (Cook & Kenny, 2005) because researchers can truly examine interpersonal effects by accounting for the variance of the partner's influence. Most social and personality theories acknowledge the effects of interaction partners; APIM presents a statistical method to account for such interdependence. APIM can be used with both categorical and continuous data (Kenny, Kashy & Cook, 2006) and can examine both the individual effects of each dyadic partner and the joint influence of the dyadic partners. In

addition, APIM can be analyzed with one of three underlying statistical methods, namely pooled regression, multi-level modeling or structural equation modeling (see Kenny et al., 2006 for details).

In summary, the SRM and APIM are statistical methodologies that enable researchers to more fully and adequately account for the association between personality and social relations. Each model accounts for nonindependence of scores slightly differently. SRM accounts for the overall variance of effects whereas APIM accounts for the predictive effect of each of the dyadic members on an outcome measure. The increased use of these two models will likely advance the depth and richness of understanding of how personality influences social relations (and vice versa).

CONCLUSIONS

Several conclusions can be drawn from the findings reviewed in this chapter. First, personality influences interpersonal relationships and social support across the lifespan. Second, the influence of personality, social relations and social support is bidirectional. Third, cultural context can influence the association between personality and social relations. Because certain personality traits may be more valued in some cultures, culture may influence the display of certain personality traits and how these traits contribute to social relationships. Fourth, despite the strengths of the SRM and APIM, new methodologies are needed to better parse out the unique contributions of personality in social relations.

Future research should assess changes in personality, social relations and social support to better understand the relationships between the constructs and their stability versus mutability. In addition, research that better considers how culture and subcultural contexts influence these associations are necessary. Nonetheless, the findings reviewed in this chapter provide a strong case that personality and social relationships share a symbiotic, dynamic relationship.

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Personality in Cross-Cultural Perspective

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INTRODUCTION

All human beings are products of the lifelong concurrent processes of socialization and individuation both of which are grounded in a genetic foundation. Together, these three components mold each person's distinctive personality. In this chapter, our concern is with the contribution that culture makes to personality structure and functioning, its constancy and modification.

Culture is an inclusive and multifaceted concept that is notoriously difficult to define. Proceeding from the classical statements by the pioneers of cultural investigation, Colman (2001, p. 179) distilled culture's defining features as follows: "The sum total of ideas, beliefs, customs, values, knowledge, and material artifacts that are handed down from one generation to the next in a society." Herskovits (1949) described culture as the human-made part of the environment. According to Chirkov (2017, p. 97), it "constitutes a species-specific niche for human development and functioning." Matsumoto and Juang (2016) consider culture essential to human survival, need satisfaction, and goal attainment. To Poortinga and van Hemert (2001), personality and culture demarcate the continuum between the universal and the unique.

Research on the interplay of culture and personality has burgeoned in scope and complexity. The three volumes of *The Praeger handbook of personality across cultures* (Church, 2017) constitute a virtually encyclopedic resource on the topics that link these two constructs. Fischer (2018) proposed a gene-culture coevolution model of personality and values using multidisciplinary approaches. In the light of this monumental accumulation of recent evidence, what can we offer to the field? We shall focus on the contributions during the last decade, since the appearance of the corresponding chapter (Draguns, 2009) in the first edition of this handbook.

Two research topics (Heine & Buchtel, 2009) have been prominent in this area of investigation: traits or consistencies in a person's behavior and experience and the self as the central construct for the person's inner world. We also intend to explore personality development across cultures.

CULTURE AND PERSONALITY AS A MOVEMENT: PROMISE AND ACHIEVEMENT

Franz Boas (1910), a pioneering anthropologist, envisaged, and Ruth Benedict (1934) and Margaret Mead (1935) implemented, empirical observation of early parent-child interactions, especially in relation to weaning, bladder and sphincter control, and formation of gender identity as putative antecedents of adult personality traits in non-Western, traditional, small-scale cultures. Ralph Linton (1945) and Abram Kardiner (1939) attempted integrating psychoanalytic theory with anthropological fieldwork. Cora Dubois (1944) demonstrated a strong relationship between early socialization experiences and adult personality patterns in Alor, Indonesia. In Japan, Benedict (1946) succeeded in identifying characteristic social interaction patterns, using research approaches that transcended the classic culture-and-personality studies. A host of other studies cast within this mold yielded less solid findings, leading Hogan and Bond (2009, p. 577) to infer that "the literature linking culture and personality is fragmentary and inconclusive."

In a more sophisticated form, culture and personality research has been pursued by LeVine (2001), who maintained that, in their more modern version, such studies continue to extend knowledge on the universality and variability of human conduct. Two trends should be noted: Research is increasingly open to influence from a variety of sources such as behavioral, cognitive and gestalt, and contemporary investigation is no longer beholden to the expectation of one modal personality for each culture. Instead, a network is envisaged between a variety of psychological and ecological influences and resulting personality variables.

Gradually, the culture and personality enterprise has evolved into the subdiscipline of psychological anthropology. Psychological anthropologists continue to employ traditional naturalistic observation methods in investigating personalities in a variety of cultures (Piker, 1998). The study of infancy and early childhood has been pursued vigorously, on a larger scale, and in dealing with problems

and situations of increasing complexity. LeVine et al. (1994), and LeVine and LeVine (1988) investigated the impact of multiple care takers in East Africa. Parin, Morgenthaler and Parin-Mathey (1963, 1980) of Switzerland combined ethnographic fieldwork with psychoanalytic exploration including the use of free association among the Dogon of Mali and the Agni of Côte d'Ivoire in West Africa. Consistent with the results obtained by a variety of other methods (Okeke, Draguns, Sheku & Allen, 1999), sociocentric orientation was found to prevail throughout the lifespan of the persons who remained in their customary milieu, with security and harmony. Helplessness and disorientation were experienced by those who found themselves outside of it. Thus, psychological anthropologists have demonstrated the value of ethnographic studies of childhood using naturalistic observation, thereby contributing to contextual research on personality and socialization across cultures (LeVine & LeVine, 2007).

FROM A UNIQUE CULTURE TO A MULTIPLICITY OF CULTURES: CROSS-CULTURAL COMPARISONS OF HUMAN RELATIONS AREA FILES

Traditionally, culture was regarded as a qualitative concept, useful for descriptive purposes, but not amenable to quantitative comparisons of several cultures or to ascertaining empirical links between cultural characteristics and psychological variables. To overcome this limitation, Murdock (1967) embarked on a major project of gathering and coding a large sample of ethnographies or culture descriptions. This collection evolved into the Human Relations Area Files (HRAF). Founded in 1949 at Yale University, HRAF is a unique repository of ethnographic data from all regions of the world. Each of the ethnographies is rigorously and thoroughly coded for all cultural features included in the description. For purposes of worldwide comparisons each culture in the HRAF sample is considered a unit, and correlation coefficients between cultural attributes are computed for the total set of cultures or for specially designated subsets. HRAF make it possible to investigate relationships among selected variables on the basis of hologetic information that has been systematically collected over several decades.

SEARCHING FOR CULTURAL DIMENSIONS

Hofstede's Contribution

Going beyond the classical definitions of culture, Geert Hofstede in The Netherlands took a major step toward making cultures comparable by collecting an unprecedented amount of information on International Business Machines (IBM) employees' attitudes to work environment in seventy-one countries from all regions of the world (Hofstede, 1980). Hofstede applied complex multivariate techniques in order to identify reasonably

independent factors. Upon the completion of these analyses, four dimensions emerged, labeled respectively Power Distance, Individualism-Collectivism, Uncertainty Avoidance, and Masculinity-Femininity. Power Distance refers to acceptance of income and status inequality. Individualism pertains to the preference for independent functioning and pursuit of personal goals. Collectivism involves predilection for interdependence within families, communities, clans or other groups based on kinship or culture. Masculinity is characterized by a clear-cut separation of men's and women's traditional roles. Masculine cultures value competition and performance. Feminine cultures prize cooperation and relationships. High Uncertainty Avoidance taps the discomfort experienced in unclear, vague, ambiguous and unstructured situations, while at low levels it connotes seeking and enjoying complex, unfamiliar and multifaceted experiences.

Another team of investigators (Chinese Culture Connection, 1987) added a fifth dimension on the basis of traditional Chinese principles investigated by means of the Chinese Value Survey which was applied in twenty-three countries on several continents. The resulting dimension was first termed Confucian Work Dynamism and was subsequently renamed Long-Term versus Short-Term Orientation, the former expressed through persistence, thrift, self-restraint, and respect for tradition – traits frequently encountered in East Asia – the latter marked by pursuit of pleasure and striving for rewards together with spontaneous self-expression and self-promotion, often found in North America, Western Europe, Australia and New Zealand (Hofstede, 2001).

Data collection on Hofstede's dimensions expanded to seventy-six nations and regions, especially after the collapse of the Communist socioeconomic system in Russia and Central Europe (Hofstede, Hofstede & Minkov, 2010). Hofstede's (1980) factors came to be investigated in family and school contexts; physical and mental health facilities; correctional, military and recreational institutions; and voluntary associations. A prodigious amount of information has been collected on the antecedents and correlates of Hofstede's dimensions (Hofstede, 2001; Hofstede et al., 2010; Minkov, 2011).

Individualism-Collectivism remains one of the most intensively investigated dimensions in psychology. One of the emerging research questions concerns cross-temporal changes due to hypothesized modernization within national culture (Hamamura, 2012). The results of cross-temporal comparison of individualism-collectivism in the United States and Japan revealed mixed outcomes depending on indices of activity. In Japan, despite rising individualism, collectivistic values still remain prominent in areas of interpersonal relations and sense of obligations.

Michael Minkov, an international and interdisciplinary scholar born in Bulgaria, undertook the herculean task of extending Hofstede's research by using the four waves of the World Values Survey coordinated by Inglehart (1997).

Minkov (2007) identified several factors two of which overlapped with Hofstede's dimensions and one, labeled Indulgence-Restraint, that covered new ground. Hofstede et al. (2010) described indulgence as a tendency to allow for gratification of natural human desires related to everyday life and having fun, and restraint as a conviction that such gratification should be curbed by strict social norms.

Hofstede (2001) has cautioned against equating cultural dimensions with personality variables. Instead, culture factors are based on the descriptions of what its members consider desirable and important in their work situation. There may be no relationship between the two scores, even if they are identically labeled (see, for example, Terracciano et al., 2005). Researchers may hypothesize and investigate links between individual and cultural scores.

Tight and Loose Cultures

In addition to Hofstede's five dimensions, several other constructs have been introduced. They include culture tightness versus looseness. Proposed by Pelto (1968) and thoroughly described by Gelfand, Harrington and Fernandez (2017), tightness refers to strength of social norms that brook little deviation, and looseness denotes greater tolerance, of being guided by cultural rules without being compelled to follow them automatically. Gelfand and her international collaborators (Gelfand et al., 2011) carried out a major study of tightness-looseness with close to 7,000 participants from thirty-three countries. The authors developed a tightness-looseness scale composed of six statements regarding the clarity and number of social norms, the degree of tolerance for norm violations, and overall compliance with social norms in each nation. Respondents rated the degree of agreement or disagreement with each statement referring to their nation as a whole. They found that the tightness-looseness construct yielded one factor.

International comparisons yielded, at first glance, a rather baffling picture. As reported by Gelfand et al. (2017), loose or socially permissive nations included Venezuela, Australia, Estonia, Greece, Hungary, Israel, the Netherlands, Ukraine and the United States. Germany, India, Japan, Mexico, Pakistan, Norway, China, Portugal, South Korea and Turkey were at the tight end of the continuum. Of the Big Five Factors, to be described below, Conscientiousness and Openness to Experience were correlated with tightness-looseness (Gelfand et al., 2017). Gelfand et al. (2017) discerned a relationship between tightness and need for closure. Gelfand et al. (2011) demonstrated that tighter cultures foster greater self-control, and inhibit risk-taking and exploration. Tightness promotes internalizing responses to stress and looseness favors externalizing (Oltmanns & Emery, 2014). Triandis (1995) investigated combinations of loose and tight cultures in relation to individualism-collectivism. He found remarkable contrasts between loose individualistic cultures such as the Netherlands and tight collectivistic

cultures such as Singapore in personal pressure and levels of life-satisfaction.

Face and Dignity Cultures

Face as a prominent concept in Eastern Asia has a long history, and dignity has played a similar role in the Euro-American cultures. Kim, Kwon, Seo and Seo (2017) have identified the pivotal components of face as hierarchy, harmony and humility. Persons in face cultures are more responsive to the judgments of other people, especially those from their own family and community. Consequently, they shift more to the observer's perspective and more consistently strive to avoid experiencing negative emotional states. In dignity cultures the promotion of positive states is an overriding goal (Uskul, Sherman & Fitzgibbon, 2009). The prominence of shame as a social control mechanism is perhaps the best known attribute of Confucian-oriented face cultures (Kim et al., 2017).

According to Kim et al. (2017), the gist of dignity is the belief that each person possesses an intrinsic value equal to that of every other person. Equality is the cornerstone of dignity, and it stands in contrast to hierarchy. Other fundamental components of dignity are autonomy and self-esteem. Numerous realistic social experiments conducted in Hong Kong and elsewhere (Kim, Cohen & Au, 2010) support the conclusion that "people from face cultures absorbed how others' world view them when judging themselves, whereas those from the dignity cultures did not seem to care or at least did not incorporate how others would view them" (Kim et al., 2017, p. 249).

INDIVIDUAL DIFFERENCES

Value Orientation

Schwartz (2017, p. 121) defined values as "general beliefs about desirable goals." On the basis of culturally oriented research, Schwartz and Sagiv (1995) identified ten universal values: (a) power, (b) achievement, (c) hedonism, (d) stimulation, (e) self-direction, (f) universalism, (g) benevolence, (h) tradition, (i) conformity and (j) security.

Empirical research yielded substantial information on universal and culturally variable components of values (Schwartz, 1992). Schwartz and Bardi (1997, 2001) pointed to the prominence of security and tradition within the Mediterranean region and in the countries of East Central Europe, while Western and Northern Europeans favored self-direction, stimulation and hedonism. Within Estonia, a country that contains a majority of ethnic Estonians and a minority of Russian speakers, Tulviste, Konstabel and Tulviste (2014) investigated both differences and change during four rounds of European Social Survey. Value consensus was high across the two groups. Differences indicated higher benevolence, universalism, and stimulation among Estonians and higher power and

achievement among Russians. In the United States emphasis on self-promotion and self-actualization coexisted with the endorsement of traditionalism (Kitayama, Conway, Petromonaco, Park & Plaut, 2010), a situation that may generate intrapsychic conflict.

Major life changes through political instability, migration, loss of income and threat of violence stimulate quest for security and inhibit exploration, provided the transition is experienced as prominent or long-term. Bardi, Buchanan, Goodwin, Slabu and Robinson (2014) reported substantial changes in the values of Polish immigrants to the United Kingdom, while the values of Britons who had experienced noteworthy but not extreme transitions remained unmodified.

With samples in seventy countries, Schwartz and Rubel-Lifschitz (2009) established value priorities between genders. In virtually all comparisons, men assigned a higher value to power, stimulation and self-direction, while women consistently chose benevolence and universalism. Positive relationship between age and security, conformity, tradition, benevolence, and universalism were consistent; negative coefficients appeared with stimulation and hedonism. Roccas and Elster (2014) studied religiosity in twenty-eight countries, which yielded positive correlations with tradition and negative correlations with hedonism. These results held in samples of Catholic, Protestant and Orthodox Christians, Muslims, and Jews.

Social Axioms: Universal but Culturally Variable Beliefs

In their interaction with other persons, human beings are guided by widely shared but rarely articulated sets of convictions or social axioms, which Leung et al. (2002, p. 289) defined as “general beliefs about oneself, the social and physical environment, or the spiritual world, in the form of an assertion about the relationship between two entities or concepts.” Leung et al. (2002) designed the Social Axioms Survey to be applied across individuals, to assess the relative prominence of social axioms and to compare cultures. Leung and Bond (2009) regard social axioms as modulators between culturally characteristic traits and various significant outcomes of social behavior.

In a series of studies with ever larger number of both participants and cultures, Leung et al. (2002) succeeded in interrelating and factor-analyzing a large pool of items that would result in the identification of five independent dimensions of social axioms labeled as: (a) cynicism (e.g., “Powerful people tend to exploit others”), (b) social complexity (e.g., “One’s behaviors may be contrary to his or her true feelings”), (c) reward for application (e.g., “Adversity can be overcome by efforts”), (d) spirituality (e.g., “Belief in a religion makes people good citizens”) and (e) fate control (e.g., “Good luck follows if one survives a disaster”).

Cynicism is based on a negative view of human nature and of social institutions resulting in pervasive distrust in

social interactions and manipulation of others. Cynicism does not result in increasing satisfaction with life, in fact it lowers it (Bond et al., 2004; Leung & Bond, 2009). Social complexity implies recognizing that there is no one optimal way to solve most problems of living. Consequently, it promotes flexibility in dealing with the challenges of daily life, tolerance toward self and others, and readiness to seek compromise in conflict situations (Iliescu, Dincă & Bond, 2017). Reward for application describes a set of beliefs that challenges can be overcome and goals attained through advance planning and concerted effort. Chen et al. (2016) demonstrated that reward for application and social cynicism predicted psychological wellbeing based on self-esteem in children, adolescents and adults in Hong Kong.

Religiosity is the belief of the existence of a supreme being. It is associated with the support of traditional institutions such as the family and with an accommodating style of conflict resolution, together with an altruistic orientation (Bond, Leung, Au, Tong & Chemonges-Nielson, 2004; Boski, Bilas-Henne & Więckowska, 2009). Fate control is a near-synonym for fatalism, the belief in and acceptance of fate as the governing principle of life, linked with a desire to know one’s fate and rituals and techniques for that purpose. According to Chen, Bond and Cheung (2006), social axioms are deeply nested within an individual’s personality as modulators between personality traits and important outcomes in social behavior (Kurman, 2011; Leung et al., 2012). For example, Iliescu et al. (2017) in Romania found zero-order correlations between NEO-PI-R scores of the Big Five traits and the quality of dyadic relationships in the four ethnic groups included in the comparison, Romanians, Hungarians, Germans and Roma. When, however, social axioms were incorporated in the analysis, the relationships between traits and dyadic interactions became significant.

Traits across and within Cultures

Is distinctive human behavior and experience organized in the form of traits? Do human beings possess the same traits, or are each person’s traits unique? Are traits based on statistical abstractions or theoretical tenets? Do they exist in a concrete psychological and/or biological sense of the term? Are there alternative ways of investigating personality, without relying on traits? These questions have been central concerns to personality psychology (Church, 2009; Mischel, Shoda & Ayduk, 2007).

Goldberg (1992) attained a significant milestone when he identified the Big Five Factors (BFF) on the basis of the psycholexical analysis of the universe of trait-descriptive terms, first in English with American participants and then in other languages. The BFF research program was international and cross-cultural from its inception, animated by the aspiration of developing worldwide research tool on the basis of psycholexical, factorial and

cross-national research. Based on McCrae and Costa (1987, 1997), and Rolland (2002), BFF can be described as follows:

1. Openness to experience (O), with high scorers characterized by curiosity and quest for novelty and low scorers exhibiting caution and preference for accustomed and familiar activities;
2. Conscientiousness (C), with high scorers reticent and well-organized and their low-scoring counterparts easy-going and less dependable;
3. Extraversion (E), expressed through outgoing sociability and high energy with low scores by individuals who prefer solitary pursuits and are reserved in self-expression;
4. Agreeableness (A), characterized by compassion, cooperation and friendliness at the high-end of the continuum, and detachment and indifference at the low end;
5. Neuroticism (N), with high scores associated with frequent experience and expression of negative emotions and with responding readily and intensely to stressful and frustrating events, while the prominent features of the low scorers are their emotional stability and calm.

McCrae and Costa (1997) promoted the collection of NEO-PI-R data across language, national and cultural boundaries. In Germany, Portugal, Israel, Hong Kong, South Korea and Japan, the five-factor structure was virtually identical to that of the United States. Further research focused on translation issues into languages of very different structure and origins (McCrae, 2017). McCrae, Terracciano and 78 Members of the Personality Profiles of Cultures Project (PPCP) (2005) expanded the scope of their investigation by including substantial samples from each of the fifty participating cultures from all major regions of the world. Factor analyses conducted separately for each culture and for the entire worldwide store of data were concordant in supporting the five-factor model (FFM) and were highly congruent with American data. In this major study, however, the NEO-PI-R was scored in the third person, for a friend of the same gender, which might have introduced some distortion. Schmitt, Allik, McCrae and Benet-Martinez (2007), however, collected data on a test related to the NEO-PI-R, the Big Five Inventory. Their samples came from fifty-six countries carefully chosen to represent ten regions. Their results complement and confirm those of the PPCP in supporting congruence of the FFM across cultures, instruments and approaches to investigation. McCrae (2017, p. 50) concluded “that the FFM is a reasonable representation of personality trait structure for almost all groups” and that it is “an empirical generalization about the co-variation of traits” (McCrae, 2017, p. 48).

McCrae and Costa (1997) also proceeded to the exploration of the next lower level of characteristics within the Big Five hierarchy. Within the NEO-PI-R each of the Big Five traits was broken down into six facets. Thus,

N encompassed Anxiety, Angry Hostility, Depression, Self-consciousness, Impulsiveness and Vulnerability; O comprised Aesthetics, Feelings, Actions, Ideas and Values. McCrae and Costa (1997) hypothesized that the facet scores may be indicative of a person’s individual and a culture’s or community’s characteristics. Research reviewed has clearly established the existence of interculturally comparable, factorially independent personality traits, while the exploration of facets tended to provide a more differentiated picture of the culturally indigenous aspects of the FFM.

Combined Emic-Etic Approach

In Africa, there is a pressing need for more culturally sensitive tests that would complement the universalist FFM. Following the collapse of apartheid in South Africa, psychologists embarked upon constructing the South African Personality Inventory (SAPI) that was designed to assess personality from the indigenous point of view, while incorporating the FFM’s universalist features (Fetvadjev, Meiring, Nel, Hill & van de Vijver, 2017; Fetvadjev, Meiring, van de Vijver, Nel & Hill, 2015). SAPI’s nine-cluster model provided a good fit for the major components of South African population. Valchev et al. (2013), however, noted some stylistic trends, with Blacks describing specific patterns of behaviors in their context and Whites providing generic, abstract and decontextualized descriptions.

In several countries of East and South Asia, research has been focused on the development of indigenous personality measures that would supplement the local derivatives of the Big Five scales and improve their practical utility and cultural sensitivity (Cheung, Fan & Cheung, 2017). In Hong Kong, Cheung, Cheung and Fan (2013) validated two versions of the Chinese Personality Inventory (CPI) and identified the Interpersonal Relatedness (IR) factor, independent of the Big Five. IR involves endorsement of hierarchical Confucian relationships together with cultivation of self-discipline. In Japan, in addition to the typical lexical approach, psychologists developed a six-factor Gitaigo Personality Scale composed of a subtype of sixty mimetic Japanese words regarded as “words that imitate actions or states” (Komatsu, Sakai, Nishioka & Mukoyama, 2012). Benet-Martinez and John (2000) undertook to increase the cultural fitness of the Spanish version of the NEO-PI-R by simultaneously using systematically selected Spanish language descriptors thereby successfully combining imposed etic and quasi-indigenous procedures.

After reviewing the massive accumulation of findings, van de Vijver and He (2017) concluded that there is “impressive evidence” (p. 268) that the five-factor structure can be found in over 100 cultures in which it has been applied. O varied somewhat more across cultures than the other four factors. Comprehensive personality assessment is best accomplished by using the five factors, but adding emic or culturally indigenous components and/or turning

to locally constructed and validated tests such as the CPI in China and the SAPI in South Africa.

On a global scale, the results of two meta-analyses (Fischer & Boer, 2015; Parks-Leduc, Feldman & Bardi, 2015) provide support for systematic relationships between personality and Schwartz's (1992) ten value dimensions. These relations are, however, moderated by contextual factors. The strongest correlation coefficients involved A and O, followed by C and E. It now remains to link these connections to cultures' characteristics. At this point, we may conclude that there is at least a moderate association between traits and values.

Traits in Their Relationship to Culture

In developing the Big Five Factor (BFF) model together with instruments for assessing it in various cultures, McCrae and Costa (1997) explicitly proceeded from a biological position. In their view, the fundamental source of individual differences in personality traits was genetic variation, although they recognized that environmental influences modify inherited characteristics. Allik and McCrae (2002) described the characteristic modes of adaptation, biographical experiences, external influences and self-concepts all of which are in continuous interaction with the person's genetic endowment. In a joint study, Hofstede and McCrae (2004) investigated the BFF's relationship with Hofstede's four original cultural dimensions in thirty-three cultures for which both types of scores were available. A total of ten significant correlation coefficients were found, out of the possible twenty. Surprisingly, Individualism-Collectivism, the most investigated Hofstede dimension, yielded only one significant correlation. There was at least one Big Five correlate for each of the Hofstede dimension. Although the correlations were substantial, they did not support the notion that culture is personality writ large or that personality is a reflection of culture.

From their respective theoretical positions, Hofstede and McCrae (2004) wrote two separate discussion sections for their joint article. Hofstede interpreted these findings as indicative of cultures providing distinctive programs for organizing and guiding behavior. McCrae reaffirmed the biogenesis of personality and maintained that personalities shape culture, and not vice versa. This effect can be brought about, among other ways, through selective migration. It has been demonstrated that the E and O scores of some migrants are higher than those of their sedentary counterparts.

A major advance in multicultural data collection occurred as Allik and Realo (2017) assessed ten completed multinational studies with a total of at least 102,984 participants. Across the studies, the number of countries represented varied from twenty-four to fifty-six and that of languages from eighteen to forty-two. Of particular interest are van der Linden, Nijenhuis and Bakker's (2010) factor analyses at several levels with precautions against

contamination by artifacts and response sets. At the intermediate level, they identified two factors, Stability and Flexibility. At the highest level they found the General Factor of Personality (GFP), which initially appeared similar to social desirability. Van der Linden et al. (2010), however, concluded that GFP encompassed open-mindedness, hard work, sociability and emotional stability. They emphasized that their meta-analysis does not overshadow, but only supplements the Big Five model.

Allik and McCrae (2004) demonstrated that countries that are proximate in location tend to be similar in Big Five traits. Beyond geographic proximity, E was associated across nations with quality of life indicators such as self-reported happiness, income level and years of schooling. These links do not imply causation, and real-life social outcomes may be several steps removed from their putative source in personality traits. It is, therefore, essential to clearly separate country-level analyses from individual analyses. Allik and Realo (2017, p. 217) noted: "As a rule, the chain of events from personality dispositions to societal and real-life consequences is rather intricate. ... Nonetheless, and despite the complexities noted here, we believe that large scale cross-cultural comparisons have unique potential to reveal predictive relationships between personality and a variety of important outcomes."

Moreover, Allik and Realo (2017) recognized that the scope of differences in personality traits is limited. An analysis of the NEO-PI-R data collected in the Personality Profiles of Cultures Project by McCrae, Terracciano and 79 Members of the Personality Profiles of Cultures Project (2005) reveals that the standard deviation of personality trait scores at the national level is substantially lower than that of the individual scores. Thus, psychic unity of humanity is confirmed and similarities among humans prevail over differences.

Beyond Traits: National Character based on Observations and/or Stereotypes

The study of national character has waxed and waned. Inkeles and Levinson (1969) pointed out three major issues: relation to authority, conceptions of the self, and nature of primary conflicts and dilemmas, and their resolution. In the ensuing five decades, culturally distinctive selves have emerged as a dominant subject of cultural investigation. Relationship to authority has been studied in conjunction with power distance and individualism-collectivism, and conflict resolution has been investigated in relation to face and indulgence and self-restraint.

Peabody (1985, 1999) focused on evaluative and descriptive adjectives assigned to the inhabitants of six major nations, Great Britain, Germany, France, Italy, Russia and the United States. Their task was to rate their own and the other five nationals. Descriptive ratings yielded much more agreement than evaluative ones while stereotypes were more likely to operate with emotionally

charged spheres. Researchers should study both the “actual” national character and the auto- and hetero-stereotypes (Realo et al., 2009).

Allik et al. (2011) in Estonia coordinated what may be the most ambitious research project on national character in any country. It involved over 7,000 respondents at more than fifty locations throughout the Russian Federation, who were asked to identify a person whom they knew well and to rate him or her on the Russian version of the NEO-PI-R. The resulting profile was well within the limits of international NEO-PI-R norms for fifty countries (McCrae, Terracciano & 78 Members of the Personality Profiles of Cultures Project, 2005). In an attempt to explore the putative core of the Russian personality or “Russian soul,” Allik et al. (2011) systematically sifted the writings of Russian novelists, essayists and thinkers of the nineteenth and early twentieth centuries for descriptions of Russian character. They added fifteen such statements to the translated and revalidated version of the NEO-PI-R (Martin, Costa, Oryol, Rukavishnikov & Senin, 2002). The results obtained bore no resemblance to the portrait of the Russian soul depicted in the literary and philosophical sources.

Some distinctive aspects of Russian values did emerge outside of the Big Five framework. Using the World Value Survey (Schwartz, 1992), Lebedeva (2000) reported that the scores of the older Russian sample were higher in conservatism, harmony and egalitarianism, while those of the younger sample emphasized mastery, intellectual and affective autonomy, and hierarchy.

Researchers should proceed to compare the third-person investigations of national character with the first-person accounts samples by means of the same test such as the NEO-PI-R. Results of such studies may provide information on the relationship between self-reports and stereotypes and on the extent of convergence between these two types of measures.

Ethnopsychology

Ethnopsychology is concerned with the way mental processes, behavior and relationships function in a particular ethnocultural group (White, 1992). Personality research is one of ethnopsychology’s facets. Diaz-Guerrero (1977, 1994, 2004) systematically strove to identify the culturally characteristic Mexican modes of coping with stress in the context of lifelong family obligations. After Diaz-Guerrero’s death in 2004, Diaz-Loving, Rivera-Aragon, Villanueva-Orozco and Cruz-Menendez (2011) continued this programmatic research. Its results point to the prevalence of a sociocentric orientation among Mexicans, organized around father’s power and mother’s love. These lifelong relationships revolve around machismo, or an exaggerated display of masculinity, and marianismo, or an idealized image of female self-sacrifice. Compliance with family authority is valued over self-assertion and emancipation, although this trend is reduced in less

traditional regions and at higher educational levels. Mexicans’ adaptation generally involves reconciling the attainment of personal goals with the imperative of not straying from the network of family ties, values and outlooks. While its particulars vary across cultures, the conflict between the personal and the cultural constitutes part and parcel of adaptation everywhere.

National character is no longer equated with the predominance of one personality type per culture, but there may be cross-cultural differences in personality characteristics. Moreover, national character has been hypothetically construed as a nucleus of shared meaning underlying self-reported or observed characteristics (Stefanenko, 1999) and is open to exploration by the innovative approaches of Allik et al. (2011).

Self: Where Culture and Person Meet

Beginning with William James (1890/1952), Western psychologists have tended to view the self as a core of personality, sharply delineated, highly differentiated and unique. Alternative conceptions posit an interdependent self (e.g., Kimura, 1995; Markus & Kitayama, 1991, 1998; Roland, 1988, 1996; Takata, 2012; Triandis, 1989), more responsive to situational and social influences and allegedly characteristic in East and South Asia. Markus and Kitayama’s predictions of independent versus interdependent self in North America and East Asia respectively have been extensively tested and often confirmed (Kitayama, Duffy & Uchida, 2007; Markus & Kitayama, 2010). Heine (2001) stated that, compared with North Americans, East Asians exhibit less of a striving for consistency across situations, are less likely to assign trait names to themselves, regard their selves more malleable and the external world to be less changeable. Smith and Easterbrook (2017) demonstrated that individualism-collectivism affected the self through identifications, self-construals, and modes of adaptations. Cross and Lam (2017, p. 1) specified that the cultural aspects of the self included “norms, beliefs, injunctions, socialization practices, and institutions that convey a particular conception of the person and persons’ place in society.” Becker et al. (2014) showed in twenty cultural samples of nearly 5,000 adolescents that positive self-evaluation is fostered by collectively reflecting culturally normative values.

Church and his international collaborators have tested hypotheses regarding types of implicit beliefs of self-concepts, and self-reported behavior rated by participants in individualistic versus collectivistic cultures (Church, Anderson-Harumi et al., 2008; Church et al., 2008; Church et al., 2013). Church et al. (2012) examined if satisfaction of needs for autonomy, competence and relatedness are universally salient for the person’s wellbeing in Asian and non-Asian participants from eight countries. An integrative perspective to personality requires transcending individualism-collectivism when considering the contribution of trait and context to the individuals’ adjustment, and wellbeing (Church, 2017).

Going beyond Markus and Kitayama's (1991, 1998) formulations, Vignoles et al. (2016) strove to develop a novel seven-dimensional model of self-reports and to validate the new self-report measure among adults of thirty-three nations. The following aspects of self-concept were assessed: defining the self, experiencing the self, making decisions, looking after oneself, moving between contexts, communicating with others and dealing with conflicting interests.

SOCIALIZATION AND LIFE SPAN DEVELOPMENTAL PERSPECTIVES ON PERSONALITY AND CULTURE

Interpersonal Acceptance-Rejection: A theory Tested on a Worldwide Basis

What are the long-term consequences of parental acceptance-rejection? This is the question Rohner (1975, 1986, 2004) sought to answer through a continuing program of studies on the effects of parental acceptance-rejection in the three domains of personality dispositions, coping with stress, and sociocultural systems. Originally labeled "Parental Acceptance-Rejection theory" (PARTheory), it was renamed Interpersonal Acceptance-Rejection Theory (IPARTheory) as Rohner's (2016) research expanded to include all interactions that involve acceptance-rejection by significant others or attachment figure at any point during the lifespan.

IPARTheory consistently relied on a three-pronged approach consisting of holocultural research based on HRAF samples, community studies in various parts of the world, and experimental and quasi-experimental studies. Observations, interviews and questionnaires were utilized. The Parental Acceptance-Rejection Questionnaire and the Personality Assessment Questionnaire (child and adult versions) have been the principal scales validated, and translated for use at various sites in thirty-five languages.

Rohner (1975, 1986, 2004) systematically traced the effects of four classes of parental behavior: (a) perceived warmth or coldness, (b) hostility-aggression, (c) indifference-neglect and (d) undifferentiated rejection. Seven consequences of rejection were investigated: (a) anger, hostility and aggression, (b) dependence, (c) low self-esteem, (d) feelings of inadequacy, (e) emotional instability, (f) emotional unresponsiveness and (f) a negative worldview. As anticipated, hostility and a pessimistic conception of the world were prominent consequences of rejection. In most of the societies studied, acceptance predominated over rejection. These relationships between perceived parental acceptance-rejection in both children and adults and specific personality dispositions were demonstrated in a series of meta-analyses by Khaleque and Rohner (2012), specifically involving needs for emotional support and affection in interpersonal relationships. This finding was further bolstered by eleven meta-analyses based on 551 quantitative studies with

125,437 respondents in thirty-one countries in all continents except the Antarctic (Rohner, 2016).

Sociocultural aspects of IPARTheory were investigated through the religious beliefs associated with the predominance of parental acceptance, warmth and love, as opposed to that of rejection, coldness, intolerance, neglect and indifference. Where warmth and love prevailed, so did the beliefs in a benevolent deity; malevolent gods and spirits held sway in those settings where parents and other attachment figures were predominantly rejected.

Also determined by culture were the ways in which the attachment figures expressed their acceptance, warmth and love.

Developmental Pathways of Personality: Attachment and Socialization

Keller (2007) went beyond the Western conceptions of attachment (Ainsworth, Blehar, Waters & Wall, 1978; Bowlby, 1969) to explore social interactions between primary caregivers and children in Africa, Asia, Latin America as well as Europe and North America. Based on multidisciplinary approaches and using direct behavioral observation methods at home settings (not in laboratories), Keller and her cross-cultural colleagues identified cultural differences in communicating "nurturance and sensitivity" through differential reinforcement of culturally salient behaviors of infants and children (Keller & Bard, 2017; Otto & Keller, 2018). Acknowledging attachment as a pancultural concept, Keller (2013, 2015) reviewed evidence for cultural variations in caregiving arrangements including alloparenting and multiple caregiving in Sub-Saharan Africa and India and other regions. The Western prototype model of one-on-one relationship between the mother and the child is but only one type of attachment. According to Keller (2013, p. 185), "Indeed, anthropological and culture psychological accounts support the view that different cultural ecologies are related to different views of the self that also have consequences for the definition of attachment relationships." Just as patterns of behaviors that define attachment are culturally variable, conceptions of self are also variable in order to meet the social and ecological demands for adaptation and intergenerational transmission of cultural practices (Keller & Bard, 2017).

Trommsdorff (2009, 2012) examined a culture-specific model of attachment by looking at the goals of socialization of self-regulation in children across cultures. She viewed the parent-child relationship as the basic unit of cultural transmission of attachment patterns and subsequent interpersonal relationships during socialization. Rothbaum and Trommsdorff (2007) studied socialization of autonomy and relatedness in different cultures, especially in physical closeness of care and constancy, and parents' exercise of authority and psychological control. Contrary to Western cultural practice, non-Western cultures value physical proximity between mothers and their

infants. East Asian parents exercise authoritarian parenting and do not engage in extended negotiations with their children as do Western mothers. Rothbaum and Trommsdorff (2007) concluded that Western children are socialized to prioritize trust and autonomy and non-Western children to value assurance and interdependence and relatedness. Research on these key concepts fits within the framework of individualism and collectivism (Triandis, 1995).

Trommsdorff (2012, p. 19) concluded that “culture-specific views on the self and the world influence respective socialization conditions and the development of agentic regulation.” Self-conceptions are closely intertwined with cultural values, and they are transmitted through socialization. Patterns of attachment formed between infants and their caretakers are culturally variable depending on the socialization goals and cultural practice. These developmental observations have been the products of multidisciplinary and multimethodology approaches and appear to be universally valid.

CONCLUSION

Research on culture and personality has been pursued vigorously and flexibly over the past decade, with a number of points of concentration clearly emerging. Traits, especially within the Big Five framework, have continued to be systematically investigated around the world, and the applicability of these dimensions has been confirmed virtually everywhere. The self as a source of cultural variation along the independent versus interdependent axis has yielded a substantial amount of meaningful findings. The lifelong and culturally mediated impact of acceptance-rejection has engaged a worldwide network of researchers who are producing a rich contextualized pattern of data. The consequences of individual versus multiple socializers in various cultural milieus are the subject of ongoing research, expected to continue for as long as the research participants are responsive. Substantial advances have been made in exploring cultural dimensions and in refining approaches to their study. The grand goal of conclusively connecting culture factors and personality attributes remains to be attained.

The worldwide trend has been toward large-scale cross-cultural research, which only a few decades ago would have been unrealizable. It rests on the cooperation of researchers in a great many countries to collect data in the same way and to submit the pooled information to statistical analysis. Meta-analyses have gained ascendancy and have largely replaced impressionistic and subjective judgments of trends and conclusion. Reliance on multiple methods of data collection has been exemplified by acceptance-rejection projects which have utilized HRAF data, individual ethnographies, cross-culturally validated psychological tests administered in many countries, intensive on-site observation of social interaction, and other

methods. We endorse this research strategy and recommend alternation of methods, with no assumption of inherent superiority of any of them. Thus, any finding needs to be demonstrated through a rigorous intergroup comparison, further scrutinized in smaller groups differing in one or few variables and observed in its individual manifestations in a case study. Systematic and focused pursuit of research brings with it the danger of neglect of other topics. Conceptually, trait theory and the cognitive behavioral framework have dominated the field. As a corrective, we suggest turning to other theoretical approaches, such as psychodynamic, humanistic and phenomenological. Challenges for cross-cultural investigation include person in conflict and/or striving to find meaning. Self-report scales have been the instruments of choice in cultural investigation of personality. They should be supplemented, but not replaced, by a host of other approaches: expressive, constructional, behavioral, interactional, even projective. In envisaging the future of culture and personality research, we advocate a multipronged pursuit: Continue investigating the topics that we have reviewed in this chapter and open new vistas some of which have been suggested above and others that may occur on the basis of observers' curiosity and creativity.

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30

Personality and Politics

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INTRODUCTION

Personality assumes an increasingly central role in the analysis of political behavior as traits and values may be more influential than traditional sociodemographic characteristics, such as gender, age, educational level, occupation and income in explaining ideological orientation and political preferences (Caprara, Schwartz, Capanna, Vecchione & Barbaranelli, 2006; Caprara, Schwartz, Vecchione & Barbaranelli, 2008). Ultimately, personality seems to play a crucial role with regard to both the distinctive features of democratic systems – namely, the freedom of voice allowed to citizens by expressing their preferences and priorities about how society should be governed and by choosing the representatives that mostly suits their opinions and interests.

This chapter starts by pointing to two different views of personality that may help to make sense of contemporary politics. Then, a short review of the literature on personality and politics is presented, while the reader is referred to other sources for a thorough and detailed discussion of previous major contributions. Finally, the contribution that a science of personality may offer to a better understanding of ideological orientation and political preferences is discussed.

THE ROLE OF PERSONALITY IN THE PERSONALIZATION OF CONTEMPORARY POLITICS

Personality is a concept, as difficult and as familiar as many others in psychology. In particular, no one can elude such a concept when addressing how people think, feel and behave as part of communities and in relation with each other. The more one is concerned with the functioning of democracy, namely, the free expression of citizen's ideas and dissent and the legitimate exercise of power, the more one cannot avoid the conceptual network that organizes knowledge, impressions and conjectures that, in turn, make sense of leaders' and followers' political choices and behaviors.

Yet, personality is complex as it regards the person as a whole. It includes behavioral tendencies and involves internal systems and processes that guide people towards the attainment of individual and collective goals, account for coherence and behavioral continuity across contexts, and ultimately, explains one's personal identity. Contemporary scholars have addressed personality under two distinct perspectives. On one view, personality is a self-regulatory agentic system that is capable of reflecting on its own experiences and interacts with the environment in conformity with personal criteria and goals. On another view, personality is an architecture of habitual behaviors and behavioral tendencies that allow us both to distinguish one person from another and to make conjectures and predictions regarding individuals' conduct and goals.

These two perspectives produce diverse questions and pave the way to distinct research programs. Some programs focus on the organization of affect and cognitions conducive to beliefs and goals that guide the individual's behavior from within (i.e., *intra*-individual factors and processes). Other research programs focus on the individual features that help to recognize, group and distinguish individuals from one another and that are most likely to influence others' impressions (i.e., *inter*-individual factors and processes). Both perspectives may complement each other in making sense of political choices and preferences given that modern politics of Western democracies point to the increasing importance of personal characteristics of voters and of candidates in political rhetoric and behavior.

By personalization of politics, one generally refers to the personality characteristics of political candidates and to the substantial investments made by political campaigns aimed at crafting and delivering personal images that are most attractive to voters. In reality, the personalization of politics does not only concern the significant impact of the politician's personality characteristics on voter's preferences, but it also relates to the role of both voters' and the politician's personality with respect to their own ideological orientation and decision making. Thus, the same concept encompasses diverse phenomena that reflect two

distinct groups of related factors: voters' and politicians' personality as operating and politicians' personality as perceived. It is likely that the former has primacy over the latter as the personality of voters and of politicians mostly accounts for what of politicians' personality is perceived by voters. Viewing citizens as reasoning agents who pursue the best match between their beliefs and values and political offerings (Himmelweit, Humphreys, Jaeger & Katz, 1981; Popkin, 1991) has led to a focus on the unique organization of affect, cognitions and habits that, taken together, make sense of their political choices. Thus, political preferences appear increasingly dependent on individuals' likes and dislikes, cognitive strategies and personal concerns, rather than on previously identified categorical variables, such as gender, age, educational level and income. While the ideological distinction between left and right or between liberal and conservative continues to be useful for capturing the major divisions in the sphere of political ideals and movements, at least in Western democracies (Bobbio, 1996; Caprara & Vecchione, 2018; Miller & Shanks, 1996), recent findings show significant covariations of ideological self-placement with meaningful individual differences in the domain of personality, in both voters (e.g., Barbaranelli, Caprara, Vecchione & Frabley, 2007; Jost, 2006; Mondak, 2010; Schoen & Schumann, 2007) and politicians (Best, 2011; Caprara, Barbaranelli, Consiglio, Picconi & Zimbardo, 2003; Caprara, Francescato, Mebane, Sorace & Vecchione, 2010; Dietrich, Lasley, Mondak, Rimmel & Turner, 2012).

EARLIER EXPLORATIONS ON PERSONALITY AND POLITICS

The study of personality within the domain of political science is longstanding. Yet, its progress has not been fully continuous. Early generations of theorists have focussed on the personalities of main actors, including leaders and followers (Brewster-Smith, 1968; Eysenck, 1954; Knutson, 1973; Greenstein, 1975; McGuire, 1993). As personality is complex and made up of different kinds of variables, including traits, motives and values that all interact within varied social contexts, a vast literature over the years has attested to the merits and limits of various approaches that have pointed to different personality characteristics and used different methods (Caprara & Zimbardo, 2004; Simonton, 1990; Winter, 2003).

A focus on personality marked the first phase of political psychology by pointing to early experiences and traits as main determinants of political orientation and stability of political attitudes and choices (McGuire, 1993). Personality provided a framework for organizing phenotypic behavioral differences in dispositions, attitudes and motives, and granted a lexicon to tap stable individual tendencies underlying habitual behavioral patterns. In particular, psychoanalysis offered a theoretical basis for addressing the psychological underpinning of political

orientation. Early intuitions drawn on clinical reasoning and the *Authoritarian Personality* exemplify most contributions prior to World War II and during the following decade (Adorno, Frenkel-Brunswick, Levinson & Sanford, 1950; Lasswell, 1930, 1948). These clinical studies turned into psychobiographical studies and continued to develop over the ensuing decades, primarily focussing on the personalities of leaders. Eventually, interest in psychoanalytical exploration declined and most scholars turned toward sophisticated, in depth case studies and historiographical analyses (see Barber, 1965; Cocks, 1986; Erikson, 1969; George & George, 1956; Glad, 1973; Hermann, 1977).

Criticism of psychodynamic approaches promoted a new wave of research using individual differences which, although more limited in scope, aimed at enhancing our understanding of stable behavioral patterns related to political behavior. Championing the nomothetical approach versus more qualitative inquiry were researchers from a host of theoretical perspectives that proposed connections between political behavior and various individual difference constructs in personality and social psychology, such as traits, social attitudes, motives or values. From this foundation, emerged research on tender-mindedness versus tough-mindedness (Eysenck, 1954), conservatism (McClosky, 1958), alienation (Seeman, 1959), dogmatism (Rokeach, 1960) and power (Browning & Jacob, 1964; Winter, 1973). While most of this research examined potential voters and only speculated on the personality of leaders, the research of Di Renzo (1963) was a major contribution to the study of a relevant personality variable, dogmatism, among a large number of active politicians (congressmen and senators in the Italian Parliament). It was subsequently replicated in the United States (Di Renzo, 1977) and later in Japan (Feldman, 1996).

Yet, the lack of a general theory of personality functioning represented a major limitation of earlier approaches to individual differences in politics. This limitation was further aggravated by the lack of consensus on any standardized assessment of personality. Since the study of multiple constructs was not guided by an integrated conceptual vision (Brewer-Smith, 1968; Knutson, 1973), findings regarding individual psychological differences taken in isolation and in disregard of situational variables were difficult to compare and could hardly lead to the development of cumulative knowledge in this domain (Greenstein, 1975).

RECENT AND CURRENT RESEARCH ON PERSONALITY OF POLITICIANS AND VOTERS

Following the cognitive revolution of the late 1960s, studies of political reasoning pointed to a variety of strategies that people use to select and organize political information, to manage complexity and to make reasonable choices (Lau, 2003; Lau & Sears, 1986; Lodge & McGraw, 1995; Simon, 1985, 1995). One branch of research investigated the path people take to deal with political issues, and

the interrelated patterns of affect and cognition that result in stable individual characteristics, such as integrative complexity. This research received considerable attention for examining personalities of members of political elites and of the general public, pointing to two different dimensions that combine in political reasoning, those of differentiation and integration. Differentiation refers to “the individual’s recognition that a topic has more than one dimension or that more than one legitimate viewpoint about it exists.” Integration refers to the recognition of relationships such as interactions or trade-offs among the differentiated dimensions or viewpoints” (Suedfeld & Tetlock, 2014, p. 597; see also Tetlock, 1983, 1984).

Current studies continue to point to individual differences in complexity and sophistication as critical in political reasoning and choice (Knight, 1985; Krosnick, 1990; Luskin, 1987, 1990; Pierce, 1993; Suedfeld & Tetlock, 2001). For example, it has been shown that international conflicts are more likely to end in a peaceful resolution when political leaders exhibit high levels of integrative complexity, being willing to admit the merits of the opponent’s position, and to flexibly balance the variety of issues that arise during an international negotiation in the attempt to reach a compromise (Conway, Suedfeld & Tetlock, 2001).

At the intersection of personality and social psychology, several studies have pointed to social dominance (Pratto, Sidanius, Stallworth & Malle, 1994) and right-wing authoritarianism (Altemeyer, 1981, 1996) as two basic dimensions of social and political ideology. Others have focussed on a variety of individual differences in personality, such as self-esteem, need for order and structure, cognitive closure, intolerance of ambiguity, uncertainty avoidance, dogmatism, and fear of threat or loss (e.g., Gruenfeld, 1995; Jost & Thompson, 2000; Lavine et al., 1999; Rokeach, 1956; Sniderman, 1975).

A meta-analysis of this extensive literature by Jost, Glaser, Kruglanski and Sulloway (2003a) makes a strong case for political conservatism as motivated social cognition. While the core ideology of conservatism stresses justification for social-economic inequality and resistance to change, its motivational dynamism centers around the need to manage uncertainty and threat (see also the challenge by Greenberg & Jonas, 2003, and rebuttal by Jost, Glaser, Kruglanski & Sulloway, 2003b).

Studies of politicians have focussed mostly on leaders’ decisions, interpersonal styles, motives and world views, and have primarily relied on indirect means for assessing personality at a distance such as content analysis of narratives or archival material as well as on biographies or expert evaluation of politicians’ personalities (Barber, 1985; Etheredge, 1978; George & George, 1998; Prost, 2003; Rubenzer, Faschingbauer & Ones, 2000; Simonton, 1986; Winter, 1987, 1992). In comparison, studies of voters’ personality have mostly focussed on traits, values, social attitudes and cognitive styles’ covariation with

ideological self-placement or voting and have primarily relied on self-report methods (Altemeyer, 1996; Barbaranelli et al., 2007; Barnea & Schwartz, 1998; Caprara, Barbaranelli & Zimbardo, 1999; Carney, Jost, Gosling, Niederhoffer & Potter, 2008; Jost et al., 2003a; McCrae, 1996).

Only few individual differences in attitudes like dogmatism, right-wing authoritarianism (Altemeyer, 1996, 1998), motives (Winter, 1987, 1992), and information processing (Suedfeld & Tetlock, 2001; Tetlock, 1983, 1984) have been assessed in both voters and politicians and very few studies have pursued a comprehensive assessment of personality traits which enables comparisons among politicians and voters within and between opposite parties or coalitions (Caprara et al., 2003, 2010; Costantini & Craik, 1980).

In reality, nomothetic studies focussing on multiple aspects of psychological functioning and relying on direct methods of assessment, such as self-reports, from large samples of voters and politicians are crucial for uncovering the distinctive personality characteristics that account for political behavior. Likewise, it is crucial, while focussing on multiple constructs, to be guided by an integrated conceptual vision and to rely upon consensual and standardized methods of personality assessment. In this regard, the real novelty of current studies with respect to the past draws upon the broad consensus on the appropriateness of two taxonomies to assess traits and values, namely, the Big Five or Five-Factor Model (Digman, 1990) and Schwartz’s ten basic values (Schwartz, 1992, 1996). These taxonomies, in particular, served to convey a more comprehensive view of personality and contributed to achieving unexpected findings regarding the role of personality in posing the foundations of ideological orientations.

TRAITS, VALUES AND IDEOLOGICAL ORIENTATION

Traits and values are rooted in different intellectual traditions and tell us different things about personality functioning. Traits are “dimensions of individual differences in tendencies to show consistent patterns of thought, feelings, and actions” (McCrae & Costa, 1990, p. 23). Values are cognitive representations of desirable, abstract, transsituational goals that serve as guiding principles in people’s lives (Schwartz, 1992). Traits concern enduring dispositions; values concern enduring goals. Traits describe what people habitually do; values concern what people consider important. Traits vary in the frequency and intensity of their occurrence; values vary in their priority as standards for judging behavior, events and people. People may explain behavior by referring to traits or to values, but they refer to values when they wish to justify choices or actions as legitimate or worthy (Roccas et al., 2002).

It is likely that values and traits operate in concert as several mechanisms link traits and values (Roccas, Sagiv,

Schwartz & Knafo, 2002). Inborn temperament (e.g., high need for arousal) may give rise to parallel traits (e.g., excitement-seeking) and values (stimulation). Values and traits may also influence one another reciprocally. Values may affect traits because, other things being equal, people try to behave consistently with their values. Traits may affect values because people who consistently exhibit a behavioral trait are likely to increase the degree to which they value the goals that trait serves (Roccas et al., 2002; see also Rokeach, 1973; Schwartz, 1996).

Both earlier and contemporary scholars have pointed to the influence that traits may exert on political orientation (Block & Block, 2006; Eysenck, 1954; Jost, 2006; McCrae, 1996; Tomkins, 1963) and to the central role of values in politics as major organizers of political evaluations (Feldman, 2003; Knutsen, 1995; Mitchell, Tetlock, Mellers & Ordonez, 1993; Rokeach, 1973). Yet, as stated above, only recently can we rely upon consensual taxonomies of traits and values to examine their effect on ideological orientation and political preferences.

Most research on traits relies on the Big Five Model (Digman, 1990; McCrae & John, 1992), which is a reasonably comprehensive framework for addressing major individual differences in personality. The five traits include Extraversion (or Energy), Agreeableness, Conscientiousness, Emotional Stability (or Neuroticism), and Openness to Experience (or Intellect). A growing literature has shown that distinct personality profiles on these traits are associated with people's ideological preferences (Mondak, 2010). Openness to Experience and Conscientiousness, in particular, have proven to be the most consistent predictors.

The Openness trait refers to the tendency to show interest for new experiences, habits and ideas. The Conscientiousness trait refers to the tendency to behave orderly and methodically in the pursuit of one's own obligations. Openness resulted often associated to political preferences for left-wing and liberal political views, whereas conscientiousness was found to be related to a preference for right-wing and conservative ideologies. This occurred in the United States (e.g., Barbaranelli et al., 2007; Carney et al., 2008; Gerber, Huber, Doherty, Dowling & Ha, 2010; Jost, 2006; McCrae, 1996; Mondak & Halperin, 2008) and in several European countries, like Italy, Germany, Belgium, Poland and Greece (e.g., Caprara et al., 1999, 2006, 2008; Riemann, Grubich, Hempel, Mergl & Richter, 1993; Schoen & Schumann, 2007; Van Hiel, Kosowska & Mervielde, 2000; Vecchione et al., 2011).

There is less accord as far as the other Big Five dimensions are concerned. Agreeableness is characterized by the tendency to be altruistic and sympathetic, so this trait could be related to a preference for the welfare state (Schoen & Schumann, 2007). The relation between agreeableness and political orientation, however, seems to be complex and moderated by different factors, such as the characteristics of the cultural context, the way the trait is measured (Jost, 2006), and the focus on the social or

economic dimension of political ideology (Gerber, Huber, Ha, Dowling & Doherty, 2009).

Energy/extraversion predicted political orientation in Italy, while there is some evidence in the United States of a negative association between political conservatism and Sensation Seeking, a specific component of Extraversion (Jost et al., 2003a). There is little empirical evidence that this trait predicts political orientation in other countries.

Emotional stability played a marginal role in most research, and with inconsistent effects across countries. For example, people high in emotional stability showed a preference for liberal parties in Germany (Schoen & Schumann, 2007), whereas an inverse relationship was found in the United States (Gerber et al., 2010; Mondak & Halperin, 2008), with conservative voters showing higher levels of emotional stability than liberal voters.

Results found in the general population were substantially replicated in politicians of rival coalitions (Best, 2011; Caprara et al., 2003, 2010). This suggests that the partisanship of politicians and the voting preferences of ordinary citizens are related to the same traits, although with some differences across studies and political contexts (a more detailed review of the links between personality traits and political orientation of voters and politicians can be found in Caprara & Vecchione, 2017).

Most studies on basic values relied on Schwartz's theory, which includes ten values derived from universal requirements of human condition: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity and security. Each value expresses a distinct motivational goal. Table 30.1 presents the definitions of each of the ten values in terms of its central goal, that is, the end state to which it is directed.

The theory specifies the structure of dynamic relations among the values. Openness to change values (self-direction, stimulation) encourage independence of thought, feeling, action, and receptiveness to change. They conflict with conservation values (conformity, tradition, security) that call for submissive self-restriction, preserving traditional practices and protecting stability. Self-transcendence values (universalism, benevolence) emphasize accepting others as equals and concern for their welfare. They conflict with self-enhancement values (power, achievement) that encourage pursuing one's own relative success and dominance over others. Hedonism values share elements of both openness and self-enhancement.

The ten values form a motivational continuum based on their pattern of compatibility and conflict. Figure 30.1 depicts this continuum in the form of a motivational circle. The order of the values in Table 30.1 follows this circle. Tests of the theory in hundreds of samples from more than seventy countries largely support both the content of the ten values and the structure of relations among them (Schwartz, 1992, 1994, 2005).

Barnea and Schwartz (1998) have investigated the role of the ten values in predicting political choice in

Table 30.1 Definitions of ten value constructs and sample PVQ items

Value and Motivational Goal	Sample Items
<i>Power</i> : social status and prestige, control or dominance over people and resources	"He likes to be in charge and tell others what to do. He wants people to do what he says."
<i>Achievement</i> : personal success through demonstrating competence according to social standards	"Being very successful is important to him. He likes to stand out and to impress other people."
<i>Hedonism</i> : pleasure and sensuous gratification for oneself	"He really wants to enjoy life. Having a good time is very important to him."
<i>Stimulation</i> : excitement, novelty and challenge in life	"He looks for adventures and likes to take risks. He wants to have an exciting life."
<i>Self-direction</i> : independent thought and action – choosing, creating, exploring	"He thinks it's important to be interested in things. He is curious and tries to understand everything."
<i>Universalism</i> : understanding, appreciation, tolerance and protection for the welfare of all people and for nature	"He wants everyone to be treated justly, even people he doesn't know. It is important to him to protect the weak in society."
<i>Benevolence</i> : preservation and enhancement of the welfare of people with whom one is in frequent personal contact	"He always wants to help the people who are close to him. It's very important to him to care for the people he knows and likes."
<i>Tradition</i> : respect, commitment, and acceptance of the customs and ideas that traditional culture or religion provide the self	"He thinks it is important to do things the way he learned from his family. He wants to follow their customs and traditions."
<i>Conformity</i> : restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms	"He believes that people should do what they're told. He thinks people should follow rules at all times, even when no-one is watching."
<i>Security</i> : safety, harmony and stability of society, of relationships and of self	"It is important to him to live in secure surroundings. He avoids anything that might endanger his safety."

Notes. The PVQ forms were gender appropriate, varying only in the pronouns. The table is taken from Caprara et al. (2006).

1988 Israeli elections. They found that voters for right-conservative parties gave higher importance to security values, which endorse protection of the social order and of the status quo, than voters of left-liberal parties. Voters for left-liberal parties, instead, assigned higher importance to universalism and self-direction values, which endorse the acceptance of others as equal, and individual autonomy and self-actualization, respectively, than voters for right-conservative parties. Similar results were found in the 2001 Italian elections by Caprara and colleagues (2006), who found that voters for the center-left attributed higher importance to the self-transcendence values of universalism and benevolence than voters for the center-right, who gave higher importance to the self-enhancement and the conservation values of power, achievement, security and conformity. The same pattern was found among a large sample of politicians, members of the Italian parliaments (Caprara et al., 2010). These results accord with the traditional view in Western democracies that sees right and conservative ideologies as mostly concerned with individual success and social order, and liberal ideologies as mostly concerned with equality and social justice.

Links between values and ideology have subsequently been examined in several cross-national studies (Aspelund, Lindeman & Verkasalo, 2013; Caprara et al., 2017; Piurko, Schwartz & Davidov, 2011; Thorisdottir, Jost, Liviatan & Shrout, 2007). Results from these studies have shown that universalism values were the most consistently related to a preference for left and liberal ideologies in a considerable number of Western democracies. Conservation values (conformity, tradition and security) were consistently related to a right and conservative orientation. This pattern, however, has proven to be less generalizable among Eastern European and post-communist countries, where ideological self-placement may carry different meanings (see Caprara et al., 2017).

As has been remarked by Barnea and Schwartz (1998), each of the ten values can in principle be relevant for predicting people's ideological preferences. However, the values that count more are likely to depend on the nature of the political discourse in each country. Indeed, citizens tend to vote for parties whose platform or image suggest that electing them would promote attainment or preservation of their own cherished, personal values. Conversely, they are inclined to not vote for parties whose election they perceive as threatening these values. Finally, citizens may decide to abstain from voting when the available political offerings do not provide opportunities to affirm or promote their important values (Caprara, Vecchione & Schwartz, 2012).

Findings reported earlier revealed that traits and values are two distinctive personality characteristics that account for a substantial portion of variance in political choice.

The contribution of basic traits to political preferences, however, is substantially weaker in comparison to the contribution of basic values. Indeed, after basic values

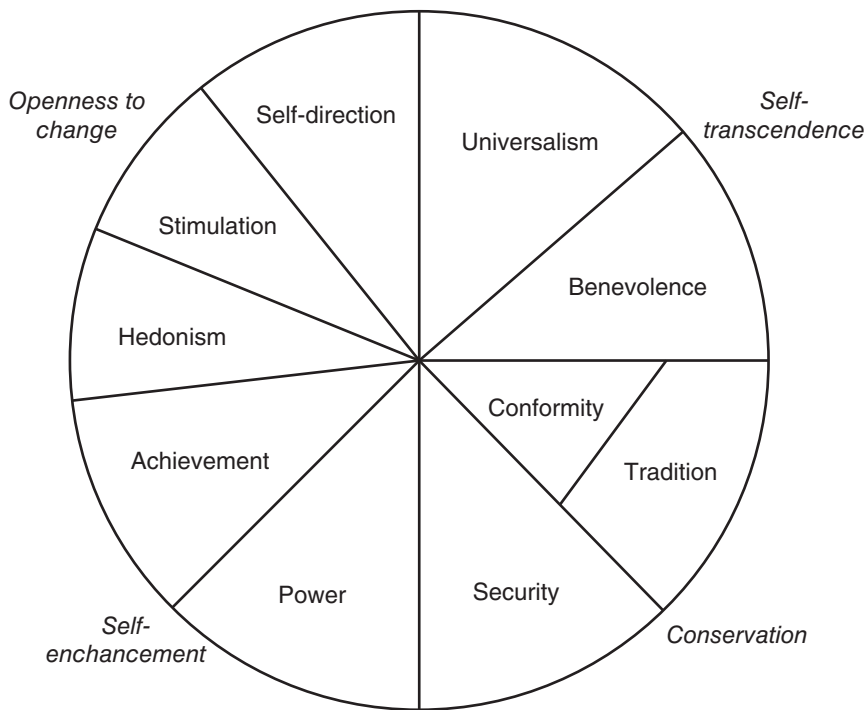


Figure 30.1 The motivational continuum of 10 values according to Schwartz's theory.

were taken into account, traits did not add to the prediction (Caprara et al., 2006, 2008).

A longitudinal study by Caprara, Vecchione & Schwartz (2009) was aimed at examining the pathways through which traits and values contribute to political preferences. The study has revealed that personality traits contributed indirectly to political orientation, through the effect of basic values. Specifically, openness, conscientiousness and agreeableness traits explained significant variance in the politically relevant values of security and universalism, which in turn explained peoples' political orientations. Similar conclusions were drawn by Jost, Basevich, Dickson and Noorbaloochi (2015).

Thus, the available empirical findings seem to assign primacy to basic values over traits in predicting political ideology. Yet traits can be thought of as basic potentials for political orientation, as values that are decisive in political choices are rooted in individuals' predispositions. The view of traits as distal predictors of ideological preference accords with results of other studies aimed at understanding the psychological underpinnings of political behavior (e.g., Lee, Ashton, Ogunfowora, Bourdage & Shin, 2010; Sibley & Duckitt, 2008). According to Duckitt's dual process model, for example, stable individual differences in social conformity and tough- versus tender-mindedness affect sociopolitical attitudes indirectly, through their effect on the tendency to be exposed to particular social environments that lead to different worldviews (Duckitt, Wagner, du Plessis & Birum, 2002; Duckitt & Sibley, 2009).

Although basic values have proven to be powerful predictors of people's political preferences in several countries, they are not the most proximal determinants of ideology. As recent studies have shown (Schwartz, Caprara & Vecchione, 2010; Schwartz et al., 2014), the contribution of basic values to ideology is largely mediated by specific attitudes, preferences and evaluations about the sphere of politics, often referred to as core political values (Feldman, 1988; McCann, 1997), such as the distribution of opportunities and resources in society, the limits of public interference in the economy and the acceptance of ethnically different immigrants.

Whereas basic values are grounded in personality traits, core political values express basic values in the political domain by mediating their effect on people's ideological preferences. Thus abstract, fundamental value priorities, such as security and universalism values, affect individuals' stances on concrete political issues, which in turn affect ideological self-placement and voting (Schwartz et al., 2010, 2014; Caprara & Vecchione, 2017; Vecchione, Caprara, Schoen, González Castro & Schwartz, 2012).

Taken together, these findings attest to the role that personality may play in making sense of ideological orientation, much beyond traditional variables like gender, age, education and income, not only in voters but also in politicians with high education, expertise and political sophistication.

Yet, one should remind that most of the empirical evidence discussed in this chapter derive from Western established democracies and from traditional electorates. One

may wonder about the extent to which left and right ideologies serve to map the political landscape of polities whose trajectories to democracy have been different from the ones of the Western hemisphere. Likewise, one may wonder about the extent to which the various personality features that have proved to be associated to left and right political ideologies may account for political preferences that explicitly reject the traditional ideological cleavages.

PERSONALITY DETERMINANTS OF POLITICAL PARTICIPATION

A related line of research has focussed on the identification of personality characteristics underpinning citizens' political engagement. Traditionally, political scientists have considered socioeconomic factors, such as education, income and occupation, as the most reliable predictors of political commitment (Campbell, Converse, Miller & Stokes, 1960; Verba & Nie, 1972). However, the importance of these factors has progressively declined over the last decades, especially in countries where extended access to education has accompanied the diffusion among citizens of a sense of entitlement to civil and political rights. Within this scenario, the study of personality has addressed the role of traits, motives and values in predisposing citizens to be active in politics, over and above their material conditions of life (Caprara & Vecchione, 2017).

Studies conducted within the framework of the Big Five have found meaningful relations between citizens' personality traits and various forms of political participation (e.g., Gerber, Huber, Doherty & Dowling, 2011; Ha, Kim & Jo, 2013; Mondak, Canache, Seligson & Hibbing, 2011; Mondak & Halperin, 2008; Mondak, Hibbing, Canache, Seligson & Anderson, 2010). Taken together, findings from these studies suggest that the effect of the Big Five in predicting political participation is comparable to that of traditional, socioeconomic predictors of civic commitment, and that this effect tends to persist even after these variables were controlled statistically. Findings also revealed that the traits that are more relevant to the decision to engage in politics are openness and energy/extraversion.

High levels of openness, also referred to as intellect (McCrae & Costa, 1999), predispose people to keep up to date with main social and political events, to interact with people with different backgrounds, to be receptive to different ideas and points of view. These undoubtedly represent important elements of political activity. At the same time, several components of energy/extraversion, such as persuasiveness, dominance and assertiveness, would seem crucial to be successful in politics.

Like in the case of political preference, the available empirical data seem to indicate that the Big Five affect political activity indirectly, through more proximal predictors, such as political knowledge, political interest and party identification (Gallego & Oberski, 2012; Mondak et al., 2010; Schoen & Steinbrecher, 2013).

Perceived political self-efficacy, namely people's beliefs in their ability to achieve desired results in the political domain, is probably one of the most important proxy determinants of political participation. One should note that political efficacy has been a popular notion in the field of political science since the early 1950s (Campbell, Gurin & Miller, 1954). Yet, only recently the study of political efficacy has been addressed within a comprehensive theory of personality functioning, like social cognitive theory (Bandura, 1997; Caprara, Vecchione, Capanna & Mebane, 2009).

Social cognitive theory assigns to self-regulatory processes a decisive role in enabling people to act purposefully in accordance with their own standards and view self-efficacy beliefs as major determinants of the impact that humans may exert across domains of functioning, including politics. People have no reason to engage in politics, unless they believe they can master the various challenges that politics may carry. Indeed, self-efficacy political beliefs proved to be a significant predictor of political activism, subsuming traits and mediating their impact on political participation (Vecchione & Caprara, 2009). Likely traits are not sufficient to ensure that people will invest their talents and virtues in politics, unless properly equipped for the political arena.

Other studies focussed on how basic values relate to various forms of political activity, such as working in political groups or organizations, contacting politicians, participating in public demonstrations and signing petitions (Schwartz, 1994). Whereas traits set the potentials that predispose people to being active in politics and self-efficacy beliefs provide the sense of mastery that is required to affect political processes, basic values provide the reasons that sustain the motivation to engage in politics.

A recent study by Vecchione et al. (2015) aimed to clarify consistency and variability across countries to the effect that basic values exert on political activism. The study showed that the strongest positive associations were observed for self-direction and universalism, two values that are adjacent in the motivational circle of values. Self-direction emphasizes freedom of thought, and may therefore encourage people to generate and express their own political opinions. Universalism promotes social justice and preservation of the environment, which represent typical goals of political activism.

Associations with the other values declined *progressively* as one moves in either direction around the circular structure of values. The most negative correlations with political activism were found for security and conformity values, which express conflicting motivations with respect to self-direction and universalism. Security values may inhibit activism because they emphasize maintaining a safe societal environment, free of disturbances that might threaten the existing order. Conformity values may discourage people from engaging actively in politics because they emphasize restraint of one's impulses and compliance with social expectations (see Vecchione et al., 2015).

This pattern was found to be quite consistent, but the strength of relations between basic values and political activism varied considerably across countries. Interestingly, level of democratization, operationalized in terms of civil liberties, freedom of expression, pluralism and political culture, was found to be a significant moderator of this relation. Personal values, indeed, showed a stronger effect in countries with high levels of democratization. Likely democratization increases citizens' opportunities to express their values through their preferences. Less democratic political systems, instead, restrict citizens' freedom to express their views and thus unavoidably limit the influence that values may exert on political engagement (Vecchione et al., 2015).

CONCLUSION

Several findings have shown that personality, including traits, needs, motives, values and self-beliefs, covary with ideological orientation and political engagement. This is consistent with a view of personality functioning as a self-regulatory agentic system. People are purposive agents that behave in accordance to the goals and standards that guide their life, and derive their sense of agency from the control they exert over their behavior and over the environment in pursuing their goals. When people engage in politics, they express their inclinations, assert their values and prove their efficacy.

Citizens do not come to politics as blank slates, but are equipped with potentials that predispose them to certain choices, within the limits of the available options (Caprara & Vecchione, 2018). Since critical citizens in democratic societies can choose from competing alternatives, their personality can represent an important determinant of political decisions.

Likely traits operate as distant determinants that predispose people to get actively engaged in the political arena, and to make certain preferences regarding the forms of government and how political matters should be handled. Value priorities play a critical role in structuring individuals' ideological orientation, as people express their preferences mostly in accordance with their own values. Likewise, perceived self-efficacy beliefs play a critical role in motivating people to engage in politics, and to afford the sacrifices it may carry.

Findings on voters and politicians contribute to fill a longstanding gap in the personality underpinnings of ideological orientation and political action, and attest to the importance of studying politics from a personological position. Extending our knowledge on these issues is crucial to promote the development of political systems and in particular of democracy if one agrees with the view of democracy as the form of government that is most congenial to the full realization of citizens as free and responsible agents.

As discussed elsewhere, in fact, democracy is not just a matter of constitutional engineering, but also of

psychological development and commitment that rests upon the talents and values of its citizens (Caprara & Vecchione, 2017). Democratic institutions should acknowledge and nurture the talents, the attitudes, the capacities and the moral integrity that effective collective self-governance requires.

The same findings, however, may not replicate to the same extent in political systems where political rights have different status, and in countries where notions like human agency and personal and social identity have different meanings. Thus, it would be important to further extend the investigation of the personality foundations of political behavior to political systems that have been neglected in previous research. It is an empirical task to examine the extent to which personality accounts for the ideological divide in different political contexts. Likewise, it is an empirical task to investigate the contribution of a variety of environmental factors in actualizing individuals' potentials and in channelling and crystallizing individuals' proclivities into a system of political beliefs and habits. In this regard, one should not underestimate the diverse opportunities citizens have to voice their personalities in most countries.

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PART VII

APPLICATIONS OF PERSONALITY PSYCHOLOGY: PERSONALITY TRAITS AND PROCESSES IN ACTION

31

Personality at Work

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INTRODUCTION

The role of personality in work and organizational (W&O) psychology at both a theoretical and an applied level is crucial for predicting and explaining important individual and organizational performance criteria (Anderson, 2005; Woods & Anderson, 2016). For example, personality variables play a prominent role in predicting job performance and other relevant organizational performance outcomes. The relevance of personality at work can be gauged by the number of (a) scientific articles describing the relationship between personality and work behavior and processes, and (b) applied W&O psychologists drawing extensively upon personality measurement and theory to inform their practice.

In this chapter we review the current theoretical models of personality used in W&O psychology and the empirical evidence relating personality and important organizational criteria, processes and behavior. More specifically, we review relationships between personality variables and job performance, training, occupational choice, leadership, and occupational health and wellbeing. In addition, we review the current knowledge on adverse impact of personality measures at work and the applicant reactions to personality measures for making workplace decisions. Finally, we provide several important practical implications arising from the research findings.

PERSONALITY IN THE WORKPLACE: CURRENT STATUS

The study of personality at work can be divided into two main periods: 1920–1990 and 1991 to the present. Over the first seven decades, hundreds of validity studies were conducted and, during this period, the overriding conclusion of the research reviews was that personality measures were poor predictors of organizational criteria, although, paradoxically, personality measures were frequently used in W&O psychology during this period (Anderson, 2005). The second period may be characterized by a resurgence of personality in work settings, with personality

questionnaires becoming increasingly used by organizations engaged in employee recruitment and selection (Anderson, 2005). The resurgence has been due to a number of factors, most of which are concerned with major advances in our understanding of personality and job performance constructs, the development of taxonomies that have allowed for the effective translation of theory into practice (e.g., Salgado & De Fruyt, 2005), the development of psychometric meta-analysis methods that permit aggregate multiple results and to correct for artifactual errors, and to the development of new techniques for assessing personality, as for instance, forced-choice (FC) formats.

The literature regarding personality at work is dominated by descriptions of the relationship of personality as a predictor of job performance (Woods & Anderson, 2016). Therefore, extant personality models will be reviewed initially in this chapter. Then, we briefly review the issue concerning the two main response formats used in personality questionnaires: the single-stimulus format and the FC format. This review is important because of the implications of recent findings about the validity of quasi-ipsative FC questionnaires (Salgado, 2017a; Salgado, Anderson & Tauriz, 2015; Salgado & Lado, 2018; Salgado & Tauriz, 2014) and the nature of the psychometric properties of the scores obtained with the different response models. However, the field is not limited to this, and we also provide an overview of other key areas of personality research in the workplace. For example, in relation to counterproductive behavior at work, leadership, the “dark side” of personality at work, the adverse impact of personality measures, and applicants reactions to personality measures in W&O psychology.

MODELS OF PERSONALITY IN W&O PSYCHOLOGY

The most notable development in terms of a taxonomy of personality has been the development and general acceptance of the Five-Factor Model (FFM) as a latent model of personality and individual differences (Goldberg, 1992),

with growing evidence that inventories based on the FFM demonstrate greater criterion-related validity than do nonFFM inventories (e.g., Salgado, 2003). The FFM has been supported by compelling research findings across several countries, although there is an ongoing debate over its comprehensiveness (e.g., Judge, Rodell, Klinger, Simon & Crawford, 2013). The FFM of the structure of personality posits that there are five basic personality dimensions or factors ("The Big Five"), hierarchically organized (e.g., Goldberg, 1992; Judge et al., 2013). Emotional Stability describes persons who are secure, non-anxious and self-confident versus depressed, unstable. Extraversion describes persons who are sociable, assertive versus timid and reserved. Openness to Experience describes persons who are creative and curious versus practical and with narrow interests. Agreeableness describes persons who are likeable and cooperative versus antagonistic and rude. Conscientiousness describes persons who are hardworking and dependable versus lazy and disorganized.

Three alternative theoretical approaches to the FFM have received research attention. The first approach is the PANAS model of Watson, Clark, and Tellegen (1988), which includes two dimensions referring to positive affectivity and negative affectivity. The second approach is the type one represented by the Myers-Briggs Type Indicator (Myers & Briggs, 1962). The third and more recent taxonomic approach, which has been extensively investigated in recent years, is the HEXACO model of Ashton and Lee (2007; Ashton, Lee & de Vries, 2014). This model consists of six factors including Honesty-Humility (H), Emotionality (E), Extraversion (X), Agreeableness (A), Conscientiousness (C), and Openness to Experience (O), each with four facets. Currently there is a debate about whether the HEXACO model is the FFM plus Honesty-Humility or if it is a substantially different model (Ashton et al., 2014; Viswesvaran & Ones, 2016). In fact, HEXACO emotionality is slightly different from FFM emotional stability, and HEXACO agreeableness is substantially different from FFM agreeableness. The main contribution of the HEXACO model is the addition of the Honesty-Humility factor, which include the facets of sincerity, fairness, greed avoidance and modesty.

As an attempt to consolidate and integrate across these two largely separate personality research traditions, Woods and Anderson (2016) proposed their *Periodic Table of Personality* as a comprehensive, inclusive taxonomy. Drawing from historical advances in the chemical sciences, their taxonomy also included a methodology for loading distinct personality scales from either the FFM or the HEXACO model onto the periodic table.

In addition to these models which addressed normal adult personality in the workplace, other interesting research has used personality conceptualizations that included dysfunctional and maladaptive traits. This last view has been mainly represented by a categorical system,

distinguishing ten more or less discrete symptom configurations, described as Axis-II of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). There is growing evidence that suggests that adult personality disorders can be considered as extreme variants of FFM dimensions, however, with differences between abnormality and normality being gradual and quantitative rather than qualitative. Rolland and De Fruyt (2003) suggested that maladaptive trait models might be of interest to W&O psychologists for studying work outcomes such as negative emotions at work; a range of counterproductive behaviors including theft, voluntary absenteeism, industrial vandalism and drug abuse; and adherence to professional ethics and standards.

RESPONSE FORMAT ISSUES IN PERSONALITY QUESTIONNAIRES

Historically, the measurement of personality variables at work, including the FFM, has mainly been done using two common types of response formats. The first type is known as the single-stimulus (SS) format and includes the well-known Likert-type scales, yes-no or true-false responses, and the widely used yes-indecisive-no. In the SS formats, individuals rate or show their agreement with the content of the items. Consequently, the SS formats permit both comparisons between individuals and comparisons within the individuals. For this reason, the scores obtained from the SS formats are always *normative* scores. The vast majority of questionnaires used in work settings for assessing personality fall in this category. For example, the NEO-PI-R, 16PF, EQP, MMPI-2 and many others are SS inventories.

The second type of response format is called forced-choice format. The FC format gives several sentences or adjectives to the respondent, along with instructions to select the ones that the respondent most or, in some cases also, least likes when it is applied to the respondent. Typically, the number of sentences or adjectives may be pairs, triads or tetrads, which are paired in terms of a preference index (e.g., social desirability). Therefore, the FC format "forces" a choice among the alternatives rather than rating each sentence as occurs in the SS format.

FC questionnaires may produce three types of scores (Hick, 1970): *normative*, *ipsative* and *quasi-ipsative*. The main characteristic of such normative FC questionnaires is that statements representing a given bipolar scale are never paired with items representing another bipolar scale. The Myers-Briggs Type Indicator (MBTI; Myers et al., 1998) is a prototypical normative FC questionnaire. The ipsative questionnaires refer to those instruments that totally meet Clemons's (1966) "criterion of ipsativity" according to which "any score matrix is said to be ipsative when the sum of the scores obtained over the attributes measured for each respondent is constant." The most classical versions of the Occupational

Personality Questionnaire and the Edwards Personal Preferences Schedule are two examples of ipsative questionnaires. The quasi-ipsative questionnaires refer to the instruments that do not totally meet the criterion of pure ipsativity suggested by Clemans (1966), because, for example, not all alternatives ranked by respondents are scored or the scales have different numbers of items. The Gordon Personal Profile-Inventory is an example of a quasi-ipsative inventory.

Each score type has important characteristics. For example, in the case of *normative* scoring, the scores of an individual are statistically dependent on other individuals in the population and independent of other scores of the assessed person (e.g., scores in other attributes). Therefore, normative scoring permits the comparison of persons or groups on each measured trait. In the case of *ipsative* questionnaires, the scores in a trait are dependent on the level of the person in other traits which are evaluated. Therefore, ipsative questionnaires permit comparing the level of the person across traits, but they are inappropriate for comparisons among persons (Cattell & Brennan, 1994; Hicks, 1970). *Quasi-ipsative* scores share some psychometric characteristics with normative and purely ipsative scores. For example, they allow the comparison of individuals and groups but simultaneously some degree of dependence can be found among the scales of the questionnaire. Quasi-ipsative measures do not have the psychometric limitations of ipsative scores (Cattell & Brennan, 1994; Hicks, 1970).

It is important to take into account key differences between SS and FC formats because recent meta-analyses by Salgado and his colleagues (Salgado, 2017a; Salgado et al., 2015; Salgado & Tauriz, 2014) have found that the nature of the scores (i.e., normative, ipsative, and quasi-ipsative) and the format type matters for predicting job performance and other organizational criteria. For example, the meta-analysis of Salgado et al. (2015) compared quasi-ipsative FC questionnaires with SS questionnaires and found that the criterion validity of the quasi-ipsative FC questionnaires was notably higher than the validity of the SS questionnaires (we will comment on these findings in the next section).

PERSONALITY AS A PREDICTOR OF WORK-RELATED CRITERIA

One of the key questions that organizations, and thus W&O psychologists, are concerned to answer is the extent to which personality can predict job performance and relevant work-related behavior and outcomes. At present, there is a general consensus among researchers that the domain of performance at work includes three important subdomains: task performance, citizenship (contextual) performance, and counter-productive work behavior (Moscoso, Salgado & Anderson, 2017). Task performance refers to the proficiency with which the employees

perform core activities that are relevant to the job (Borman & Conway, 2013). Citizenship performance refers to the contributions of the employee to the organizational, social and psychological environment to help to accomplish organizational goals (Hoffman & Dilchert, 2012). Counterproductive work behavior refers to the actions of an employee view by the organization as contrary to its legitimate interests (Sackett & De Vore, 2001). These developments coupled with advancements in meta-analytic techniques have resulted in the publication of a number of important meta-analyses over the last two decades, considering relationships between personality and job performance, citizenship performance and counterproductive work behavior. Each of these will be considered in turn in this section.

PERSONALITY AND JOB PERFORMANCE

The Five-Factor Model and Job Performance

Seminal work on the validity of the Big Five for predicting job performance was carried out by Barrick and Mount (1991), who hypothesized that conscientiousness and emotional stability would be valid predictors of job performance for all occupational groups. Furthermore, they hypothesized that extraversion and agreeableness would be predictors of job performance in occupations with frequent interpersonal interactions (e.g., sales and managerial occupations) and that openness to experience would be a valid predictor of training proficiency. Their meta-analytic results partially supported these hypotheses. The most notable finding from this analysis was that conscientiousness was the strongest predictor across all occupational groups ($\rho = .22$) and across all criteria, e.g., job proficiency ($\rho = .23$); training proficiency ($\rho = .23$) and personnel data ($\rho = .20$). Additionally it was found that training proficiency was predicted by extraversion ($\rho = .26$) and openness ($\rho = .25$). Subsequently, there have been a growing number of meta-analyses investigating the relationship between personality and performance with generally consistent findings (e.g., Hurtz & Donovan, 2000; Salgado, 1997). These additional meta-analyses were summarized in Barrick, Mount and Judge's (2001) second-order meta-analysis (that is, a meta-analysis of existing meta-analyses), which showed conscientiousness to be a valid predictor for all work performance criteria, for instance, overall job performance ($\rho = .27$); supervisor ratings ($\rho = .31$); objective performance ($\rho = .23$); training performance ($\rho = .27$); and teamwork ($\rho = .27$), and for several occupational categories including sales ($\rho = .25$); managers ($\rho = .25$); professionals ($\rho = .24$); police ($\rho = .26$) and skilled or semiskilled workers ($\rho = .23$). Salgado (2003), using meta-analysis, compared the validity of the personality measures based on the Five-Factor Model with those that were not based on the FFM. He found that in both cases conscientiousness and emotional stability

proved to be valid predictors of job performance but that the validity magnitude of the measures based on the FFM were remarkably larger.

In a more recent meta-analysis, Salgado (2004) examined the moderating effects of job complexity on the validity of the Big Five as measured with SS personality questionnaires. The findings showed that job complexity is a relevant validity moderator of personality measures and that the magnitude of validity coefficients was much larger than previously believed. For example, in the case of occupations with a medium level of complexity (around 68 percent of all occupations), three personality dimensions showed validity generalization: conscientiousness, emotional stability and agreeableness. The magnitude of the validity coefficients was .36, .24 and .25, respectively. These coefficients were remarkably larger than the coefficients found in any previous meta-analytic study conducted with large samples. More recently, Judge et al. (2013) conducted the largest meta-analysis on the validity of the SS personality questionnaires and job performance, using the FFM taxonomy. Judge et al. (2013) found that overall job performance correlated with conscientiousness ($\rho = .26$), extraversion ($\rho = .20$) and agreeableness ($\rho = .17$), and that the correlations for openness to experience and emotional stability were very small (.08 and .10, respectively).

Three recently published meta-analyses examined the validity of the FFM when an FC format is used for the measurement of the personality dimensions. Salgado and Tauriz (2014) and Salgado et al. (2015) found that the quasi-ipsative FC formats increase dramatically the validity of the personality inventories. A comparison of the validity coefficients for the quasi-ipsative and SS (e.g., Likert scales) formats shows, for instance, using a quasi-ipsative format, conscientiousness showed a corrected validity of .39 versus a validity of .22 when a SS format is used. The validity of emotional stability is also larger for the quasi-ipsative formats (.20 versus .11), openness to experience (.22 versus .05) and agreeableness (.16 versus .08). In the third meta-analysis, Salgado (2017a) examined the moderator effects of job complexity on the validity of ipsative and quasi-ipsative FC questionnaires for predicting job performance. Salgado found that job complexity moderates largely and negatively the criterion validity of conscientiousness, so that the size of the validity is smaller for the occupations of high and medium complexity in comparison with low complexity. For both emotional stability and conscientiousness, the relationship between job complexity level and criterion validity is described by a negative linear shape. Openness was found to be a valid predictor for high complexity jobs, but that it was not a predictor for occupations of medium and low complexity level. Therefore, the relationship is described by a positive linear shape. Job complexity has no effect on extraversion validity as for both the ipsative and the quasi-ipsative FC inventories the validity size was practically the same across the job complexity levels. Finally, this meta-

analysis showed that agreeableness can be a valid and relevant predictor of job performance for the occupations of medium complexity level if this factor is assessed with a quasi-ipsative FC inventory. For agreeableness, the effects of job complexity on the validity take the shape of an inverted U. The findings of this meta-analysis suggest two relevant conclusions. First, job complexity is a robust moderator of the validity of the ipsative and quasi-ipsative FC personality inventories, with the exception of extraversion. Second, the pattern (shape) of the job complexity effect is not the same for all the personality factors. Job complexity can have positive, negative and inverted U consequences for the validity size of emotional stability and conscientiousness, openness and agreeableness, respectively.

As a whole, the conclusions of this accumulated research into the FFM in the last twenty-five years can be summarized as follows: (1) The taxonomy of personality traits derived from the FFM has proved to be a valid and robust framework for organizing various single measures and is now accepted as the paradigm in the field; (2) conscientiousness is the best personality predictor of job performance and it has shown validity generalization across samples, occupations and countries. Operational validity of conscientiousness was found to be .39 when a quasi-ipsative FC format was used (Salgado & Tauriz, 2014; Salgado et al., 2015); (3) emotional stability is the second most relevant personality predictor of job performance; (4) conscientiousness, emotional stability and agreeableness show incremental validity over general mental ability for predicting overall job performance (Salgado & De Fruyt, 2005); (5) the format of the personality inventory is an important moderator of the criterion-related validity of the Big Five dimensions, so that the validity increases dramatically when quasi-ipsative FC formats are used (Salgado & Tauriz, 2014; Salgado et al., 2015); and (6) the facets of the Big Five do not show evidence of criterion-related validity for predicting job performance when the variance of the factor is partialled out (Harari, Naemi & Viswesvaran, 2019; Salgado, Moscoso & Berges, 2013; Salgado, Moscoso, Sanchez, Alonso, Choragwicka & Berges, 2015; but see also Ashton, Paunonen & Lee, 2014).

COPS and Job Performance

In addition to the measures of the Big Five, integrity tests and other criterion-focused personality scales (COPS) are also important techniques for predicting job performance. Technically, integrity tests and others COPS are compounds of the Big Five personality dimensions (Ones, 1993; Ones & Viswesvaran, 2001). For example, Ones (1993) demonstrated that both types of integrity tests consisted of a combination of conscientiousness, emotional stability and agreeableness, and Ones and Viswesvaran (2001) showed that customer service scales, the drug and alcohol scales, and the stress tolerance scale also

correlated considerably with agreeableness, emotional stability and conscientiousness.

Among the COPS, integrity tests are probably the most researched, with various meta-analyses having been conducted. Based on the content of the items, integrity tests are usually classified in two groups, i.e., overt integrity tests and personality-based tests (Sackett, Burris & Callahan, 1989). As the chapter is restricted to personality measures, we will only present findings concerning personality-based integrity tests. The most comprehensive meta-analysis so far was carried out by Ones, Viswesvaran and Schmidt (1993), who found that the validity of personality-based integrity tests was .37 for predicting overall job performance rated by the supervisor and .35 for predicting all performance criteria (job performance ratings plus production records) (but see also, Van Iddekinge, Roth, Raymark & Odle-Dusseau, 2012).

Ones and Viswesvaran (2001) also examined the validity of other COPS for predicting job performance. For example, they found validities of .19, .42 and .39 for drug and alcohol usage, stress tolerance and customer service, respectively. Ones and Viswesvaran (2001) even reported a validity coefficient of .41 for predicting workplace violence. Therefore, we can conclude that all COPS have substantial validity for predicting widely different aspects of job performance.

Core Self-Evaluations and Job Performance

While the FFM research suggests Conscientiousness to be the strongest and most consistent predictor of job performance, Judge and Bono (2001) have suggested that three of the four core self-evaluations (CSE) traits predict job performance as well as, or better than, Conscientiousness. CSEs have been defined as a higher-order trait of positive self-concept. In their meta-analysis of the relationship between CSE traits (self-esteem, generalized self-efficacy, locus of control and emotional stability [low Neuroticism]) with job performance, Judge and Bono (2001) found the following correlations with job performance: self-esteem (.26), generalized self-efficacy (.23), internal locus of control (.22) and emotional stability (.19). More recently, Chang, Ferris, Johnson, Rosen and Tan (2012) have revised and extended the empirical evidence of the validity of CSEs and found that predicted overall job performance ($\rho = .36$), organizational citizenship behavior ($\rho = .22$), counterproductive work behavior ($\rho = -.19$), task performance ($\rho = .19$), affective commitment ($\rho = .32$), continuance commitment ($\rho = -.18$), turnover intentions ($\rho = -.27$) and goal commitment ($\rho = .14$).

PERSONALITY AND ORGANIZATIONAL CITIZENSHIP

As a third area of performance outcomes, organizational citizenship is widely recognized as an essential element of performance at work, and comprises those behaviors that go beyond the usual calls of duty, for example, volunteering to take on additional duties, responsibility and helping

others with their workload (Borman & Penner, 2001; Dorsey, Cortina, Allen, Waters, Green & Luchman, 2017). Citizenship performance thus refers to the actions and activities that support the broader environment in which the technical core of the organization must operate (e.g., Borman, Penner, Allen & Motowidlo, 2001). This clarification is important for personality psychologists as there is growing evidence that while personality is a more effective predictor of citizenship performance, cognitive ability is a more effective predictor of task performance (see Borman et al., 2001; Salgado, 2017b).

A number of meta-analytic studies have been carried out investigating the relationship between personality and citizenship performance. Borman et al. (2001) provided estimated correlations of .32 between conscientiousness and citizenship performance (.27 with self-rating data excluded). They also found true correlations of .22, .33 and .27 between positive affectivity, other orientated empathy and helpfulness with citizenship performance. In another meta-analysis, Chiaburu, Oh, Berry, Li and Gardner (2011) found that conscientiousness correlated .18 with overall citizenship performance and that the validities of the other four personality factors ranged from .09 to .14. More recently, Judge et al. (2013) conducted the largest meta-analysis on the FFM–citizenship performance relationships. Judge et al. (2013) found that citizenship performance correlated with conscientiousness ($\rho = .32$), extraversion ($\rho = .22$), agreeableness ($\rho = .18$) and emotional stability ($\rho = .16$). Findings also provided evidence confirming conscientiousness to be similarly correlated with citizenship performance rather than with task performance. In summary, it can be seen that there is growing evidence of meaningful relationships between personality variables and citizenship performance.

PERSONALITY AND COUNTER-PRODUCTIVE WORK BEHAVIOR

Counter-productive and deviant behaviors at work are those which can range from the “mildly annoying” to the “criminal” (Schmitt & Kim, 2007), and include theft, alcohol/drug use, damaging property, absence, unauthorized use of time and inappropriate actions towards others (e.g., Sackett & DeVore, 2001). A number of meta-analyses of the relationship between personality and counterproductive work behaviors have been reported. Studies used a variety of personality measures that, for this chapter, are grouped into three broad categories: (a) the Five-Factor Model of personality, (b) occupational personality composites and (c) personality variables developed in other models. Next, we examine the empirical evidence involving each group of personality construct.

Salgado (2002) conducted a meta-analysis using, as criteria, absenteeism, accident rate, turnover and deviant behavior (including actual theft, disciplinary problems, substance abuse, property damage, organizational rule breaking and other irresponsible behavior). With regard

to absenteeism and accidents, none of the Big Five dimensions were predictors of these two criteria. Turnover was predicted by all the Big Five personality dimensions, emotional stability the best predictor ($\rho = -.35$), followed by conscientiousness ($\rho = -.31$) and agreeableness ($\rho = -.22$). With regard to deviant behavior, conscientiousness and agreeableness were valid predictors of this criterion ($-.26$ and $-.20$ respectively). More recently, the meta-analysis of Zimmerman (2008) found similar results to the previous findings by Salgado (2002). Dalal (2005) conducted a third meta-analysis on the relationship between CWB and conscientiousness and the results showed an operational validity of $-.38$. The meta-analysis of Berry, Ones and Sackett (2007) distinguished between interpersonal CWB and organizational CWB. They found similar validities for emotional stability ($-.24$ and $-.18$ for interpersonal and organizational CWB, respectively) and for openness to experience ($-.09$ and $-.03$). Conscientiousness correlated $-.23$ with interpersonal CWB and $-.33$ with organizational CWB. Agreeableness correlated $-.46$ and $-.24$ with interpersonal and organizational CWB, respectively; and the coefficients for extraversion were $.02$ for interpersonal CWB and $-.07$ for organizational CWB.

Several studies have examined relationships between facets of the Big Five and CWBs. Dudley, Orvis, Lebiecki and Cortina (2006) examined relations between facets of conscientiousness and several CWBs (e.g., theft, disciplinary problems, and not adhering to policies and procedures) yielded corrected mean correlations of $.00$, $-.30$, $-.06$ and $-.10$ for achievement, dependability, order and cautiousness, respectively. With regard to COPS, Ones et al. (1993) found that personality-based integrity tests predicted CWBs very efficiently, given that the operational validity was $.32$ when the criterion included both narrow and broad disruptive behavior, such as actual theft, admitted theft, illegal activities, absenteeism, tardiness, dismissals for actual theft, and violence. Ones et al. (1993) also reported an operational validity of $.36$ for personality-based integrity tests in predicting voluntary absenteeism. In addition to the validity of integrity tests, Ones and Viswevaran (2001) have also meta-analyzed the validity of other types of COPS for predicting CWBs. For example, they reported mean validity estimates of $.29$ for drug and alcohol scales, $.42$ for stress tolerance and customer service scales, and $.46$ for violence scales. All these coefficients are substantial, suggesting that COPS are robust predictors of CWB.

Several other meta-analyses have also examined relationships between a number of personality variables traditionally considered to fall outside the FFM and CWBs. Among others, negative affectivity, positive affective, self-efficacy, self-esteem, locus of control, trait anger and narcissism were correlated with overall CWB, interpersonal CWB, organizational CWB, withdrawal, absenteeism, interpersonal aggressive behavior, organizational aggressive behavior and occupational injuries. Three meta-analyses by Dalal (2005), Hershcovis et al. (2007), and

Kaplan, Bradley, Luchman and Haynes (2010) examined relationships between positive affectivity and overall CWB, withdrawal, interpersonal aggressive behavior and organizational aggressive behavior. With regard to overall CWB, Dalal's (2005) results showed operational correlations of $-.34$ and $.41$, respectively, for positive affectivity and negative affectivity, and Kaplan et al.'s (2010) research found that negative affectivity correlated $.30$ with CWB. With respect to overall CWB, Credé et al. (2007) reported correlations of $-.25$ and $.42$ for positive affectivity and negative affectivity, respectively. In connection with withdrawal, Kaplan et al. (2010) found very small correlations between this criterion and positive and negative affectivity ($.05$ and $.16$, respectively). They also found that negative affectivity correlated $.20$ with occupational injuries. Finally, the relationship of negative affectivity with interpersonal and organizational aggressive behavior was researched by Hershcovis et al. (2007). They found a similar correlation for the two types of aggressive behavior ($.29$ and $.28$, for interpersonal and organizational, respectively). The meta-analysis by Hershcovis et al. (2007) found a larger correlation between trait anger and aggressive behavior. With regard to interpersonal aggressive behavior, the correlation was $.43$, and for organizational aggressive behavior, the correlation was $.33$. A meta-analysis by O'Boyle et al. (2012) found that Machiavellianism and narcissism correlated with CWB ($.25$ and $.43$, respectively). In summary, research has showed unambiguously that some of the Big Five personality dimensions have substantial relationships with CWBs. The strongest relations are for conscientiousness. Agreeableness and emotional stability are also related with CWBs.

It can be seen that personality is a useful predictor of deviant or counterproductive behavior at work. To this end, Salgado and De Fruyt (2005) have advocated the use of personality measurement in employee selection when the objective is to reduce such deviant behavior. While screening for counter-productive and deviant behavior in employee selection appears to be a worthwhile approach for organizations, it is important to note the distinction between counterproductive behavior and organizational citizenship behavior, that is, these are two distinct constructs, rather than two ends of a continuum (Sackett, Berry, Wiemann & Laczko, 2006). Therefore, it is necessary for separate predictions to be made in relation to these two constructs (Schmitt & Kim, 2007). Paradoxically, there may be a positive side to the mildest aspects of counterproductive behavior. For example, as Anderson and Gasteiger (2007) have argued, some of these behaviors correlate with the early phases of creativity and innovation in the workplace (especially rule-challenging, "stealing" of time for unauthorized projects and pursuing intrinsic job role objectives). Thus, it has been suggested that the very mild aspects of CWBs may well be "necessary evils" to incubate creative ideas and innovative improvements at work, and thus that strict conformity to organizational regulations and authority structures may conversely

inhibit innovation attempts. We explore this issue further under our later section on the “dark side” of personality in the workplace, again suggesting that overly simplistic conceptualizations suggesting either “good” or “bad” personality traits in workplace settings need to be challenged as being inaccurate in the light of recent research findings.

PERSONALITY AND LEADERSHIP

The study of leadership is an area of interest for both personality research and the more pragmatic concerns of organizations. The largest meta-analytic study on personality and leadership was carried out by Judge, Bono, Ilies and Gerhardt (2002), who examined relations between the Big Five personality dimensions including a number of subdimensions and leadership. With regard to the Big Five, Judge et al. (2002) found that emotional stability ($\rho = .24$), extraversion ($\rho = .31$), openness to experience ($\rho = .24$) and conscientiousness ($\rho = .28$) were correlated with leadership, while agreeableness showed a very small correlation ($\rho = .08$). Furthermore, emotional stability, extraversion, openness and conscientiousness generalized the correlation across the studies and samples, but agreeableness did not. The multiple correlation between the Big Five and leadership was robust ($R = .48$), suggesting that the Big Five taxonomy is very useful for explaining the dispositional basis of leadership.

Judge et al. (2002) also examined the relationships between the Big Five and two leadership criteria: leadership emergence and leadership effectiveness. With regard to leadership emergence, the validity was .24, .33, .24 and .33 for emotional stability, extraversion, openness and conscientiousness, respectively. The multiple correlation was also robust ($R = .53$). In the case of leadership effectiveness, the validities were .22, .24, .24, .21 and .16 for emotional stability, extraversion, openness, agreeableness and conscientiousness, respectively. The multiple correlation was also strong ($R = .39$). This last analysis showed that the key difference between leadership emergence and leadership effectiveness is agreeableness, which, although not relevant for emergence, is important for maintaining leadership.

In another meta-analysis of the relationship between the FFM and transformational leadership, Bono and Judge (2004) found extraversion to be the most significant and consistent correlate with transformational leadership dimensions and the strongest predictor of overall transformational leadership ($\rho = .24$).

As can be seen from the literature described, there do appear to be some consistent findings in the personality and leadership research that suggest that personality is a highly relevant variable in explaining the individual differences between leaders.

THE “DARK SIDE” OF PERSONALITY AT WORK

The FFM assumes that the Big Five personality factors comprehensively describe the normal variation of traits

in adults. However, there are also alternative models based on clinical and psychopathological conceptualizations of personality. For example, DSM-IV and DSM-5 as well as the International Classification of Diseases-10 (ICD-10; World Health Organizations) suggest that there are a number of maladaptive personality styles and further offer an alternative classification system for personality (Guenole, 2014).

Research has shown that the number of individuals presenting dysfunctional personality styles at work is very small, but it is also true that the negative consequences of the maladaptive personality styles may be greater in terms of the negative effects on productivity than the consequences of normal personality dimensions. Furthermore, the number of individuals presenting maladaptive tendencies at work could be larger than the number of individuals presenting personality disorders. For example, there have been numerous publications in the management literature describing disordered personalities at work, most notably related to narcissism (e.g., Rosenthal & Pittinsky, 2006) and psychopathy (e.g., Babiak & Hare, 2006). However, these have tended to be clinically descriptive or based on case studies rather than empirical findings.

There are mainly two approaches to the study of maladaptive personality at work. The first approach is that of Paulhus and Williams (2002) Dark Triad (DT) of personality. DT consists of the combination of three personality negative traits, Machiavellianism, Narcissism, and sub-clinical Psychopathy. Narcissistic personality is characterized by a sense of entitlement or requiring excessive admiration. Machiavellianism describes a manipulative personality, motivated by cold selfishness and pure instrumentality. Psychopathy is a personality trait characterized by callousness, impulsive thrill seeking and criminal behavior. According to Paulhus and Williams (2002) “individuals with these traits share a tendency to be callous, selfish, and malevolent in their interpersonal dealings” (p. 100).

The second approach has been proposed by Hogan and Hogan (2009) and it is based on the DSM-IV Axis II personality disorders. The Hogan and Hogan approach is rooted in the Hogan Development Survey (HSD; Hogan & Hogan, 2009) a questionnaire that measures eleven dark side personality dimensions associated with job derailment, including Excitable, Skeptical, Cautious, Reserved, Leisurely, Bold, Mischievous, Colorful, Imaginative, Diligent, and Dutiful scales.

At present, only a small number of studies have examined the criterion-related validity of these taxonomies of maladaptive personality styles for predicting job performance. With respect to the DT approach, a meta-analysis by O’Boyle et al. (2012) has examined the relationships of the DT with job performance and CWB. They found that the DT is a poor predictor of job performance but that two traits, Machiavellianism and narcissism, were correlated with CWB (.25 and .43, respectively). More recently, the meta-analysis of Grijalva and Newman (2015) confirmed

the findings of O'Boyle et al. (2012) regarding Narcissism and also suggests that the entitlement/exploitative facet of Narcissism is a determinant moderator of its predictive validity for CWB. With respect to Hogan and Hogan's (2009) approach, a small-scale meta-analysis by Gaddis and Foster (2015) found that four maladaptive styles showed small correlations with overall management performance (validities ranging from $-.14$ to $-.20$).

Aside of management, Moscoso and Salgado (2004) investigated the relationship between "dark side" personality styles with task, contextual and overall job performance. Their results found that paranoid, avoidant, depressive, passive aggressive, self-defeated, schizotypal and antisocial personality scores negatively predicted task performance, contextual performance and overall performance, while narcissistic personality negatively predicted contextual performance and dependent personality negatively predicted task performance.

PERSONALITY, OCCUPATIONAL HEALTH AND WELLBEING

Three constructs – job satisfaction, life satisfaction, and burnout – are typically considered as components of a broader construct of subjective wellbeing (SWB) and they are intimately associated with stress and occupational health.

The role of personality variables in job satisfaction has been acknowledged in the last two decades and many studies have been conducted in this area, clearly contrasting with the emphasis on the topic in the past. Judge and his colleagues must be credited as the main researchers in this area. For example, Judge, Heller and Mount (2002) have meta-analytically examined the relationships between the Big Five and job satisfaction. They found correlations of .29, .25, .17 and .16 for emotional stability, extraversion, agreeableness and conscientiousness, respectively. The multiple correlation was strong ($R = .41$) suggesting that individuals' personality characteristics have a causal impact on job satisfaction. In another meta-analysis, Thoresen, Kaplan, Barsky, Warren and de Chermont (2003) found that positive affectivity and negative affectivity correlated with job satisfaction ($\rho = .33$ and $\rho = -.37$, respectively). For their part, Chang et al. (2012) found that the CSEs strongly correlated with job performance ($\rho = .44$).

With regard to life satisfaction, Steel, Schmidt and Shultz (2008) found that conscientiousness, emotional stability, extraversion, and agreeableness correlated with life satisfaction. Their validity were .27, .45, .35 and .19, respectively. In addition, the meta-analysis of Chang et al. (2012) showed that CSEs predicted life satisfaction ($\rho = .57$).

Two recent meta-analyses examined the relationships among personality and the three burnout components. The first meta-analysis was conducted by Alarcon, Eschleman and Bowling (2009), who found that that four out of five personality factors were correlated to the three

dimensions of burnout. As a whole, they showed a true multiple correlation of .54 with emotional exhaustion, .51 with depersonalization and .48 with personal accomplishment. They also found that positive and negative affectivity showed a true multiple correlation of .57 with emotional exhaustion, .52 with depersonalization and .50 with personal accomplishment. Finally, they found that CSEs showed a true multiple correlation of .51 with emotional exhaustion, .41 with depersonalization and .55 with personal accomplishment. Therefore, these meta-analytic results indicate that personality is strongly correlated with burnout. The second meta-analysis was carried out by Swider and Zimmerman (2010), who found that the FFM showed a true multiple correlation of .57 with emotional exhaustion, .46 with depersonalization and .52 with personal accomplishment. These results confirmed the previous findings of Alarcon et al. (2009). Swider and Zimmerman (2010) also found that the three burnout components showed a true multiple correlation of .33 for predicting turnover, a true multiple correlation of .23 for predicting absenteeism and a true multiple correlation of .36 for predicting job performance. Finally, Swider and Zimmerman (2010) found that the relationships of the FFM with job performance and turnover was partially mediated by job burnout and fully mediated with absenteeism.

Research into relationships between personality and the components of SWB suggest two relevant conclusions. First, that personality is a crucial factor in occupational health. Second, that personality might have both direct and indirect effects on job performance, CWB and others organizational criteria through the SWB components and, therefore, the importance of personality would be greater than is reflected in the meta-analyses that only examined the direct relationship personality-organizational criteria.

ADVERSE IMPACT AND APPLICANT REACTIONS

Longstanding concerns that poorly constructed personality inventories might adversely affect the employment selection ratios of minority groups have led to ongoing research efforts, both independently and by commercial test publishers themselves, to minimize and mitigate such undesirable unequal opportunity differences. Ones and Anderson (2002), for instance, compared the subgroup differences (male versus female, and white versus ethnic minorities) across three popular and commercially published personality inventories in the United Kingdom. They found only small effect size differences on all three measures between majority (male; white) and minority (female; ethnic minority) groups and concluded that these three measures showed an encouraging lack of subgroup differences across all of their scales. Research in other countries generally supports this conclusion.

Hough, Oswald and Ployhart (2001) summarized the empirical evidence of the adverse impact in personality,

comparing the mean score differences between whites and several ethnic minorities, between men and women, and between young and older people. Essentially, Hough et al. (2001) found no differences between whites and ethnic minorities for the Big Five personality factors. In a more recent meta-analysis of group differences in personality, Foldes, Duerh and Ones (2008) replicated the previous findings. Consequently, research has shown that personality measures are practically not affected by adverse impact (Hough & Dilchert, 2017).

With regard to applicant reactions to the personality questionnaires, a large number of primary studies have been conducted in the five continents over the last two decades. The findings were very similar in all the studies, despite of the cultural differences among the countries. A meta-analysis carried out by Anderson, Salgado and Hülshager (2010) examined applicant perceptions and reactions using studies conducted in seventeen countries spread worldwide through Europe, North America, Asia and Africa. In this meta-analysis personality inventories were perceived quite favorably overall.

IMPLICATIONS FOR PRACTICE

In the previous sections of this chapter, we have reviewed a number of advances in the research base in this area, all of which suggest that personality variables and personality measures are important concerns for practicing W&O psychologists and Human Resource Management (HRM) professionals. We move on here to consider these practical recommendations more directly and propose six major recommendations that can be gleaned from the advances in research. These are as follows:

1. In order to predict job performance, training proficiency, counterproductive behavior, leadership and emotions at work, the Big Five are important variables practitioners should consider. Due to the fact that conscientiousness, emotional stability and agreeableness have been found to be strong predictors of job performance for the majority of occupations, and that they added validity over cognitive ability tests (or GMA tests) (Salgado & De Fruyt, 2005), an optimal combination of measures for personnel selection purposes should include one GMA test and a Big Five questionnaire.
2. To assess the Big Five in the workplace, practitioners should take into account the model on which the measure is based. The findings of the meta-analytic research have shown unequivocally that the model used to develop the personality measures directly affects predictive validity (Salgado, 2003). Therefore, our suggestion is that FFM-based measures should be utilized primarily as these have been found to have stronger predictive validity than non FFM based personality measures (Salgado, 2003; Judge et al., 2013).
3. The practitioner should also take into account the type of questionnaire used for assessing the personality

variables, particularly, the Big Five. The best option is to use a quasi-ipsative questionnaire explicitly developed for assessing the five factors, given that the alternative measures based on single-stimulus methods and in alternative conceptualizations produced estimates of the Big Five showed smaller operational validities.

4. If the practitioner wishes to use measures of maladaptive personality styles, one should take into account that the current research is still very limited. Such measures appear to be good for predicting job performance and leadership, but these findings were only found for a small number of occupations.
5. Personality questionnaires should have norms specifically developed for job applicants (Ones & Viswesvaran, 2003) in order to avoid or reduce the effects of the intentional distortion of the test scores. This can also be valuable in many countries as part of showing job-relatedness with regard to equal opportunities legislation and concerns.
6. With regard to CWB and deviants' behavior at work, our initial suggestion is to identify the particular type of CWB in question that is of concern to the organization. Next, the practitioner should include some personality measures (e.g., an integrity test or a compound of conscientiousness, agreeableness and emotional stability).

CONCLUSION

In this chapter we have reviewed several of the major areas of developments in research, practical importance and applications of personality theory in the workplace. From this review it can be seen that personality has an important role to play in the workplace (at both a theoretical and applied level), with a number of meaningful relationships reported. The important progress made over the last three decades has shown that the FFM and several additional personality constructs and compounds may be useful predictors of work-related behavior, outcomes and processes.

Future research into workplace personality should be done in several topics, including: (1) new developments in assessment methods, particularly quasi-ipsative FC questionnaires based on the FFM; (2) a specific examination of the evidence of the resistance to faking of these new assessment techniques; (3) additional research on the effects of faking on the reliability and validity of the personality questionnaires; (4) facet-specific outcomes and lower-level traits of the FFM; (5) personality variable interactions and work-related behavior and performance; (6) expanded research into ethnic and gender differences; (7) new studies on the applicant reactions to the new assessment methods (e.g., quasi-ipsative FC questionnaires), and (8) the relationship between personality and innovative work behavior (Woods, Mustafa, Anderson & Sayer, 2018).

In a short review chapter such as this, it has been impossible to cover all developments in the field, but rather we have attempted to highlight major research findings on response formats, job performance, citizenship performance, counterproductive behavior, leadership, health and wellbeing, adverse impact and applicant reactions. While there has been considerable growth in this research base, several of the trends we reviewed have been both positive and promising in the richness of the applied research findings that they have generated. It is our hope that these findings can be applied to organizational practice by HRM specialists and W&O psychologists in the various arenas in which personality assessment can make meaningful contributions to the real-life performance of individual and organizations alike.

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32 Educational Psychology

ADAR BEN-ELIYAHU AND MOSHE ZEIDNER

INTRODUCTION

This chapter examines the role of personality in the applied domain of Educational Psychology, with primary interest in uncovering the association between personality traits and student learning, classroom achievement, academic motivation and emotional processes. Attempts to explicate the role of personality in educational settings have met with varying degrees of success over the years. These attempts are characterized by short-lived periodic spurts of interest by psychologists and educational researchers.

In the first part of this chapter we review the role of broad dimensional constructs, under the rubric of the Five-Factor Model (FFM), in school learning and attainment. This is followed by a discussion of the role of contextualized cognitive-social and motivational traits in school performance (e.g., self-concept and self-regulated learning), as they may more directly impact on learning and achievement and mediate, in part, the effects of broader personality dimensions on academic outcomes. We then discuss the role of emotions and emotion regulation in influencing student performance and mental health.

STABLE PERSONALITY FACTORS AND EDUCATIONAL OUTCOMES

In this section we review the role of broad dimensional constructs – under the rubric of the FFM – in Educational Psychology. We aim to inform researchers and practitioners in psychology and education about the essential role personality factors can play in student achievement, motivation, emotional competencies and affective outcomes. We begin by briefly sketching the nature of personality from a trait perspective.

Personality Factors: A Brief Sketch

Personality refers to relatively stable individual differences in behavioral and affective dispositions that generalize

across a range of environments (Matthews, Deary & Whiteman, 2009; Möttus, Kandler, Bleidorn, Riemann & McCrae, 2017). What the child makes of the classroom learning environment, including teachers and peers, may depend on the child's personality. Personality plays out its role in educational settings by shaping students' goal orientations, self-esteem, wellbeing and cognitive attainment. Personality influences teacher–student rapport, social interactions in the classroom, classroom atmosphere and conduct, and prosocial behavior. Because personality traits are linked to both negative and positive emotions, they most likely color the entire gamut of students' affective and motivational experiences at school (Matthews, Zeidner & Roberts, 2006). Personality factors also influence vulnerability to a range of disorders including anxiety, depression, externalizing behaviors and related personality dysfunctions (Abram & DeYoung, 2017; Uliaszek, Al-Dajani & Bagby, 2015).

The construct of *personality*, as used in this chapter, is based on the *dimensional* paradigm, as opposed to typological descriptive schemes, psychodynamic models or idiographic case studies. This contemporary approach to personality conceptualization and research describes multiple continuous and relatively enduring traits (Zachar & First, 2015). Personality traits are not viewed as a fixed “destiny,” but rather are assumed to probabilistically impact on behaviors in interaction with situational stimuli. Although many different personality traits have been linked to individual differences in educational outcomes, much of modern personality research is increasingly organized around the Five-Factor Model (FFM) or the “Big Five” (Bagby, Gralnick, Al-Dajani & Uliaszek, 2016; McCrae & Costa, 2008). These five factors have been separately identified in many studies, and appear quite stable in adults over time (Donnellan & Robbins, 2009).

Individual differences researchers traditionally make a sharp distinction between personality traits, discussed herein as reflecting styles of behavior or preferences, and abilities, which represent individual differences in aptitude for performance. Overall, the study of personality traits in relation to academic outcomes has been limited

in comparison to a plethora of studies in the area of cognitive abilities and achievement in educational psychology. Furthermore, as already noted, the relationship between intelligence and scholastic attainment generally is stronger than those observed for personality traits (for an interesting exception, see Duckworth & Seligman, 2005).

A major working assumption underlying our discussion is that any attempt to understand the complete causal chain associated with student school performance, as well as other important educational outcomes, needs to consider the effects of nonintellective factors, such as personality and motivational processes, in concert with ability and social and economic factors at home and in the community (Ben-Eliyahu & Bernacki, 2015; Kanfer et al., 2010). Given the importance of performing well in school for children's future mental and physical health and economic productivity, understanding the personality factors relating to school success is of considerable significance to educators, policy makers and academic professionals.

A number of arguments link individual FFM measures with academic performance. For one, the idea that both personality and intelligence affect educational achievement is consistent with the notion that academic attainment is determined by factors relating to both the *capacity* or aptitude to perform along with the *willingness* or disposition to perform. Capacity typically involves ability, knowledge and skills, whereas willingness to perform generally reflects personality, motivation, cultural and social norms, and opportunities to perform. Personal factors associated with willingness to perform in school, such as class attendance, initiative, involvement in nonacademic activities and interest in school subjects, have been shown to yield incremental predictions of academic performance – beyond that provided by mental ability (O'Connor & Paunonen, 2007; Willingham, Pollack & Lewis, 2002).

Furthermore, dimensions of the FFM are indirectly linked to academic performance through associations with narrow-band motivational processes (and possibly intelligence). Narrow-band contextualized traits (e.g., academic self-concept and esteem, self-efficacy, achievement motivation, perfectionism, evaluative state anxiety), a number of which we discuss here, may be useful predictors of achievement and adjustment (see Matthews et al., 2006, for an extended discussion). These contextualized traits may direct the investment of general or "fluid" ability in particular domains, leading to the honing and development of specific student abilities and skills (Ackerman & Beier, 2003). Having provided some theoretical rationale, we now proceed to probe the conceptual and empirical association between each of the "Big-Five" factors and educational achievement.

Openness (O)

O entails perceived intellect, creativity, curiosity, originality, developed imagination, foresight, unconventionality, and a wide range of intellectual, artistic and aesthetic

interests. These attributes potentially contribute to student learning and achievement, suggesting a meaningful association between O and achievement. O may have particularly positive effects when artistic and creative processes are engaged in college students (Chamorro-Premuzic & Furnham, 2003). O has also been positively associated with final school grades, even when statistically controlling for the effects of cognitive ability (Farsides & Woodfield, 2003; O'Connor & Paunonen, 2007), and positively correlated with learning motivation, critical thinking, low school absenteeism (e.g., Bidjerano & Dai, 2007), and individual differences in intrinsic motivation to engage in and enjoy effortful cognitive endeavors (or "need for cognition"; Fleischhauer et al., 2010). Ackerman and Heggestad's (1997) meta-analysis revealed a positive modest relation between O and standardized measures of knowledge and achievement. Furthermore, recent research has suggested that whereas O predicts creative achievement in the arts, intellect better predicts creative achievement in the sciences (Kaufman et al., 2016).

The positive relation frequently reported between O and scholastic achievements is possibly mediated by an interest and openness to learning activities and learning strategies. Furthermore, open children may seek more novel educational experiences and thus profit from education more than their less open peers (Hair & Graziano, 2003). O may also work through heightened value of academic materials, higher expectations for success, intrinsic value of learning, greater perceived utility of learning, and sensation value of encountering new materials.

Conscientiousness (C)

Meta-analytic research demonstrates that among the Big Five, C is the personality facet most consistently related to academic attainment (Poropat, 2009). Meta-analytic data reported by Judge and Ilies (2002) shows that C is modestly related to goal setting, expectancy of outcomes, as well as self-efficacy in academic settings. It is plausible that high C students succeed because of their tendency to favor learning oriented goals, thus contributing to their competence and success in school.

A number of mediating factors may be at play in the association of C and academic attainment. Specifically, C has been associated with personal attributes necessary for learning and academic pursuits, including striving for success, dutifulness, exercising self-control, being organized, dependable and efficient (Chamorro-Premuzic & Furnham, 2003). Richardson and Abraham (2009) showed that the link between conscientiousness and grade point average (GPA) they observed in 611 British students was mediated in full by achievement motivation.

Self-discipline, a trait closely related to C, has been shown to predict school performance more strongly than intelligence among girls (Duckworth & Seligman, 2005). Emotional control and self-discipline may be particularly important early on in learning, when the task is likely to appear most daunting to the learner and when failure of

emotional control can divert attentional resources away from the task (Kanfer & Ackerman, 1996).

The research reviewed above has assumed that C is the independent variable which directly and causally impacts upon academic performance, as criterion variable (C→Attainment). However, it is not implausible that the causal effect runs in the opposite direction as well, i.e., from academic performance to C (Attainment→C). Consequently, higher achieving students, who do well in school or college, are motivated to maintain their higher grades and thus persist in their studying behaviors and self-regulate their learning, stay focused on their task and score higher on C as well. It is most likely, however, that C and performance are reciprocally related and mutually determined during the course of the child's development.

Extraversion (E)

Students high on E are characterized as being outgoing, sociable, energetic, enthusiastic, adventurous and assertive. On the one hand, high E students are expected to perform better academically than their low E counterparts: Their higher energy levels, along with a positive emotional disposition, should evoke a keen desire to learn (De Raad & Schouwenburg, 1996). On the other hand, Eysenck (1992) argued that very extraverted students would be more likely to socialize and pursue other activities than to study; this would lead, in turn, to *lower*, rather than higher, levels of performance. In addition, compared to extraverts, introverts have been claimed to possess a number of attributes conducive to academic success, including lower distractibility, better study habits, along with greater ability in concentrating on tasks, thus more effectively consolidating their learning (Entwistle & Entwistle, 1970).

Each of these two discrepant views regarding the effects of E on scholastic attainment has some supporting evidence and these views may actually be reconcilable. Thus, it has been suggested that age is a moderating variable and that the effects of E on academic success are age-dependent: Research suggests that E *facilitates* academic success in elementary school but then *debilitates* success in later years, including during high school and college (Entwistle & Entwistle, 1970; Chamorro-Premuzic & Furnham, 2003). This change in the direction of the E-attainment association is attributed to the transition from the sociable and relatively collaborative atmosphere of primary school to the rather formal and highly competitive atmospheres of secondary school and higher education, in which introverted behaviors, such as avoidance of intensive socializing, become advantageous. In fact, one study found that sociability, a component of E, was inversely, though modestly, related to GPA over four years of assessment (Martin, Montgomery & Saphian, 2006).

Agreeableness (A)

It has been suggested that high A, characterized by traits of trust, altruism, compliance, warmth and empathy, has a

positive impact on academic performance by facilitating cooperation with learning processes (De Raad & Schouwenburg, 1996). This idea is consistent with research indicating that A is linked to student compliance with teacher instructions, effort and staying focused on learning tasks (Vermetten, Lodewijks & Vermunt, 2001). Notwithstanding, relations between A and academic attainment are consistently found to be of negligible importance and there is very little convincing empirical data to support the direct role of A in academic performance (Shiner, Masten & Roberts, 2003).

Neuroticism (N)

High N subsumes elements that are plausibly related to poor cognitive achievement, such as anxiety, fear of failure, procrastination, vulnerability, impulsiveness, low self-esteem, poor perceived effectance, and difficulty in coping with environmental stress and challenges (De Raad & Schouwenburg, 1996). People who are high on N (i.e., low on emotional stability) tend to focus on their tense emotional state and experience self-related cognitions that frequently interfere with their cognitive performance (Zeidner, 1998). In addition, N is meaningfully associated with low self-efficacy (Judge & Bono, 2002), which in turn, is negatively correlated with academic achievement (Robbins et al., 2004).

A number of early meta-analyses have suggested a correlation of around -0.20 between trait anxiety, construed either as a component or by-product of N, and academic achievement measures (e.g., Hembree, 1988; Seipp, 1991). However, further studies of school children (Heaven, Mak, Barry & Ciarrochi, 2002; Poropat, 2009) and university students (Busato et al., 2000) failed to find any significant correlations between N and attainment.

With respect to the inconsistencies found in the research in the association between N and achievement this may reflect the role of moderator factors. For example, McKenzie and Tindell (1993) showed that N was related to lower achievement only in students with weak superegos. These authors suggested that positive motivations, such as self-control and achievement motivation, may compensate for the debilitating effects of negative emotionality. Additionally, emotional factors may be a more prominent cause of student attrition in college than academic factors, with anxious students being more likely to drop out and depressed students having a lower grade point average (Pritchard & Wilson, 2003).

Furthermore, the literature suggests that the relationship between N and achievement may be moderated by ability levels and age. For example, a positive correlation was found between N and achievement for twelve- to thirteen-year-old students; no significant correlation was found for thirteen- to fourteen-year-olds; and a negative correlation was found for college students (Leith & Davis, 1972). These findings may be explained by the changes occurring in educational settings which become increasingly formal and competitive, thus enhancing the

evaluative atmosphere, and concomitantly, student anxiety, so that high anxious students perform worse than their low N counterparts.

MOTIVATIONAL PROCESSES

In the passages that follow, we discuss a number of motivational variables and their association with adaptive criterion outcomes in the classroom. To some extent, these may be thought of as social-cognitive variables that serve as mediating processes between broader personality variables and school learning and attainment.

Goal Orientations

Goal orientations refer to the reasons students have for achievement-related tasks or work. According to achievement goal theory, there are two main goal orientations: Students focus on learning and developing (mastery goal orientations) or on outshining and besting others (performance goal orientations) (Ames, 1992; Pintrich, 2000; see Anderman & Wolters, 2006, for a review). Additionally, students can approach or avoid these goals (Elliot & Thrash, 2001). Most commonly, researchers use the trichotomous framework for achievement goals according to which students focus on developing and learning (mastery goal orientation), on demonstrating their ability and outperforming others (performance-approach goal orientation), or on attempting to avoid looking stupid or incompetent and avoiding failure (performance-avoidance goal orientation).

A body of literature supports the claim that mastery goal orientations are related to various adaptive outcomes, including performance, interest, engagement, persistence and positive affect (Ben-Eliyahu et al., 2018; Hulleman, Schrager, Bodmann & Harackiewicz, 2010; Liem, Lau & Nie, 2008; Pekrun, 2006; Pekrun, Elliot & Maier, 2009). Performance-avoidance goal orientations were found to be fairly consistently related to maladaptive outcomes, such as anxiety and avoidance of help seeking (Pekrun, 2006; Pekrun et al., 2009). Performance-approach goal orientations have been found to be associated with adaptive outcomes, such as achievement, positive emotions and behavioral-cognitive engagement (Ben-Eliyahu et al., 2018; Elliot & Church, 1997; Elliot & McGregor, 2001; Harackiewicz et al., 1997), as well as maladaptive outcomes, such as negative emotions (Pekrun, 2006; Pekrun et al., 2009; Roeser, Midgley & Urdan, 1996).

There has been a growth in attention to mindsets as antecedent to goal orientations. According to Carol Dweck's theory of intelligence, mindsets refer to a belief of whether intelligence is fixed or malleable (Dweck, 2017; Dweck & Legget, 1988). A fixed mindset refers to the belief that intelligence is stable and fixed and cannot be changed. In contrast, a growth mindset refers to the belief that intelligence is malleable and can grow and develop.

Mindsets are a part of personality because they can create characteristics and behavioral patterns. In fact, research shows that learners with a fixed mindset tend to be concerned with demonstrating their competence (performance goal orientations), fear challenges and setbacks, and adopt a helpless response in the face of failure. Learners who have a growth mindset, view challenges as opportunities to thrive in the face of failure and are mastery oriented.

Self-Regulated Learning and Meta-Processes

Self-regulated learning (SRL) refers to self-directive processes through which learners transform their mental abilities into task-related academic skills (Zimmerman, Schunk & DiBenedetto, 2015). Common to all models of self-regulated learning is a feedback loop between the monitoring/awareness and change/control of the learning process (Corno & Mandinach, 1983; Pintrich, 2000; Winne & Hadwin, 1998). Self-regulated students are generally characterized as efficiently managing their own learning through goal setting, monitoring, strategy use and self-evaluation (Boekaerts, Pintrich & Zeidner, 2000; Boekaerts, 2011). SRL addresses the mechanisms that control the execution of actions during task engagement and is more proximate to actual academic performance than broader personality traits, thus possibly mediating the effects of personality on academic attainment and success.

The knowledge and information about how cognitions work, and hence the ability to regulate them, is termed "metacognition." Up until recently learning processes were defined as cognitive learning and information retaining, aligned with information processing models of intelligence. Within the literature on self-regulation, metacognition has been highly researched as one's knowledge and ability to recognize, analyze, utilize, and adjust cognitions willfully. However, behavioral and emotional aspects of learning are increasingly integrated into models of SRL suggesting that metabehaviors and metaemotions (or metaaffect) refer to similar knowledge and information about how behaviors and emotions work and how they can be actively monitored and adjusted (Ben-Eliyahu, 2019; Ben-Eliyahu & Linnenbrink-Garcia, 2015).

Whereas more precise definitions of SRL vary depending on the theoretical perspective of the researcher, most theoretical models of SRL include the following key components:

- (a) A goal, a standard or a criterion by which individuals assess their current performance, thus guiding their regulation processes (Pintrich, 2000; Winne & Hadwin, 1998);
- (b) Tactics and strategies toward achieving the goal, chosen after the goal composites and its requirements are analyzed (Butler, 1998);
- (c) A multilevel process of monitoring and control in light of a perceived feedback to and awareness of one's

behavior (Mace, Belfiore & Shea, 1989), including perceiving external/internal cues, establishing internal feedback and acting accordingly;

- (d) Self-efficacy beliefs, which are regarded both as related to the motivational aspect of SRL (Bandura, 1997) and as one of the personal traits related to self-regulation (Matthews, Schwean, Campbell, Saklofske & Mohamed, 2000).

A good number of studies have documented the important contribution of SRL to learning and academic success (Pintrich & DeGroot, 1990; Schunk & Zimmerman, 1994). Learners who believe in their capability to perform a specific task reveal perseverance and enact a great number of metacognitive skills while low efficacy learners might avoid future performance of similar tasks. Also, self-regulated learners exhibit higher levels of involvement, effort and consistency while performing academic tasks than do their low self-regulated peers (Ruban, McCoach & Reis, 2002), with students' achievements related to their self-reported SRL (Corno, 1986). Work by Zimmerman and Kitsantas (2005) shows that female high school students who held self-efficacious beliefs regarding use of learning processes (organizing materials, memory, etc.) also held richer perceptions of academic responsibility for outcomes, which in turn, predicted end of school term GPA. Furthermore, self-regulated learning may serve as a buffer against procrastination, a prevalent phenomena among student populations (Schouwenburg, 1995).

Subjective Value

Evaluation of the activity or content plays a determining role in student engagement, persistence, choice and achievement. Subjective value refers to the extent to which students value the activity (Eccles et al., 1983; Wigfield & Eccles, 2000). Eccles and her colleagues focused on three task values of interest or intrinsic value, utility value, and attainment value, within the expectancy-value model.

Interest (or intrinsic value) is a cognitive-emotional inclination to reengage with content knowledge because of positive feelings and a desire to acquire knowledge related to the subject or activity. Interest has been referred to with different terms such as intrinsic value in Eccles's expectancy-value model (Eccles, Adler, Futterman, Goff, Kaczala, Meece & Midgley, 1983). Interest is thought of as either individual interest which emanates from the self and can be considered as personality, or situational interest that is instigated from the context (Mitchel, 1993; Hidi, Renninger & Krapp, 2004). Whatever the source of the interest, across all of these definitions, interest is considered a motivational process that leads to positive emotional and cognitive engagement.

Personal (or individual) interest refers to a relatively stable predisposition to reengage with a particular content over time (Hidi et al., 2004). This sort of interest stems from the self and can be thought of as personality-based,

whereas situational interest stems from aspects of the learning context such as an alluring video clip. Situational interest can be internalized and integrated into the self, thereby emerging as individual interest. Individual interest can be elicited by the learning context and eventually internalized and maintained (Hidi & Renninger, 2006). In this case, there is great importance to the learning context in shaping personality.

Personal interest plays a crucial role in learning. Research findings support the notion that interest facilitates self-regulated learning and is positively related to persistence, attention, engagement, cognitive strategy use and academic achievement, and future intent to engage and complete goals (Renninger & Wozniak, 1985; Sansone & Harackiewicz, 1996; Sansone & Thoman, 2005; Schiefele, 2001; Shirey & Reynolds, 1988).

Some achievement tasks may not be interesting, yet learners may find other reasons to engage, such as their practical utility. The extent to which a task, activity or content domain has useful implication illustrates its utility. Perceived utility or utility value refers to an appreciation of the usefulness of the task or content domain (Eccles, 1983; Wigfield & Eccles, 2000). The practical value of learning this task or subject matter can have short- or long-term implications. For example, there is practical value to mathematics as it is useful when calculating expenses and for purchasing proximal needs (e.g., expected grade) and distal acquisitions (e.g., house). Utility value has been found to be related to intentions and actual decisions to take a course (Eccles, 1984a,b; Eccles, Adler & Meece, 1984; Wigfield & Eccles, 1992).

Attainment value refers to the extent to which the learning task, activity or domain is important to the learner (Eccles, 1983). The more the task or content resonates with the individual's identity, the more important it is and therefore has higher attainment value. Two kinds of attainment value can be distinguished (Battle, 1965). Absolute attainment value refers to the importance attached to doing well in a subject or on a task regardless of the importance toward other subjects. Relative attainment value refers to the importance of competence compared with other school subjects or tasks. Relative and absolute attainment value are positively correlated, and in the extension of this work, Eccles (1983) defines attainment value as a social-cognitive construct linked to the student's identity. For example, a student who considers herself "smart" would have high attainment value in courses she defines as intellectually challenging and for highly intelligent peers. Attainment value has been found to be related to behavioral and cognitive engagement (Marchand & Gutierrez, 2016).

In considering how motivational dimensions from the expectancy-value model and goal achievement theory combine, Conley (2012) took a person-centered approach (Magnusson, 2003). Using cluster analyses, Conley (2012) found that seventh graders ($N = 1,859$) can be grouped into three main types of people based on motivational

constructs of goal orientations, expectancies and values. One group of students were low motivated in all aspects. Another group was average on all forms of motivation with a subgroup high in cost and another subgroup adopting multiple goals. A third group of students were high on motivation with a subgroup high in cost and a subgroup low in cost evaluations. Thus, overall, seven types of motivational combinations were found. These findings suggest that motivations combine within individuals (Linnenbrink-Garcia et al., 2018). These individual differences can be thought of as personality-based, though more work is needed to understand how and why motivations combine differently for different groups of students.

EMOTIONAL PROCESSES

In this section we consider emotional components of personality that shape learning. Following a brief review of personality and emotion, we describe the current state of research on achievement emotions, and focus on the highly researched emotion of anxiety. We complete the section by considering ways for adjusting emotions through emotion regulation (ER).

Personality and Emotion

Understanding human emotion and affect has been one of the most enduring topics in philosophy (Ben-Zeev, 2000) and a principal driver in the development of a modern science of psychology (Feldman-Barrett, 2017). There are two fundamental dimensions of affect, positive affect, referring to pleasant, excited emotion, and negative affect, bringing together anxiety, sadness and anger. The role of personality in emotional responses assumes particular importance in the educational context. Personality traits, as we will show, are linked to negative and positive affect, and so may influence the educational experience.

Extraversion–introversion and neuroticism–emotional stability are recognized as the two personality factors or traits most relevant to emotion (see Watson, Clark & Tellegen, 1988). Broadly, extraverts are more prone to positive, happy emotional states than are introverts, although, as always, emotions are strongly influenced by the social context and specific situation. In addition, neurotic individuals experience more negative states such as anxiety and anger than do emotionally stable persons.

Biological models of personality (Corr & McNaughton, 2008; Zuckerman, 2005) attribute these links between personality and emotion to fundamental brain systems controlling the person's sensitivity to reward and punishment stimuli. Accordingly, extraverts are more sensitive to rewards (including potential rewards) in the environment, and so become more easily happy than introverts. Neurotic persons, by contrast, are especially sensitive to punishment (including potential punishment), which impairs mood (McNaughton, DeYoung & Corr, 2016).

However, there is more to the link between personality and emotion than brain systems for reward and punishment. Personality also affects cognitive processes that may influence emotional states. Extraverts tend to appraise life events as challenging. Therefore, they tend to use active, problem-focused coping strategies – ways of thinking about and handling events that may promote positive moods (e.g., Matthews et al., 2009). Similarly, neurotic individuals are biased toward perceiving events as involving threat or loss. As a result, they tend to use coping strategies such as self-criticism that may strengthen negative moods.

Personality traits may also exert indirect effects on emotion that follow from life events and encounters with others. N, for example, is linked to interpersonal conflicts and self-inflicted life problems (Matthews et al., 2009). Extraverts, however, typically have more social engagement than introverts do, and social activities are known to promote positive emotion (Watson, Clark & Tellegen, 1988). Thus, personality relates to emotional experience via multiple pathways. These include fundamental brain systems, modes of understanding and managing life events, and the consequences of different styles of social interaction with others.

Evaluative Anxiety

When one considers the many uses of tests in modern society, and the ways in which they can determine the lives of people who take them, it comes as no surprise that the testing situation may evoke anxiety. Very early in life, many children in Western culture become test-oriented and test anxious. The continued academic and public interest in test anxiety over the past half-century or so is due, in part, to the increasing personal salience of evaluative situations for people in modern society, making tests and their long-term consequences significant educational, social and clinical problems for many.

Test anxiety refers to the set of phenomenological, physiological and behavioral responses that accompany concern about possible negative consequences or poor performance in evaluative situations (Zeidner, 1998). Test anxiety is incontestably the most researched of all situation-specific personality traits in education and one of the personality factors most consistently related to educational achievement (Schutz & Pekrun, 2007). The experience of test anxiety is near universal across people differing in age, gender and culture, although mean test anxiety levels vary somewhat across cultures.

Zeidner's (1998) integrative review of the literature along with comprehensive meta-analysis of predictors of student performance by Richardson, Abraham and Bond (2012) suggests that test anxiety correlates negatively, though modestly, with a wide array of conventional measures of school achievement and ability at both high school and college level. Cognitive measures (i.e., aptitude and achievement measures combined) correlate more strongly

with the Worry than Emotionality component of test anxiety. Thus, intrusive cognitions are often more damaging to performance than negative affect itself. Higher effect sizes are reported for low than high ability students and for tasks perceived as difficult as those perceived as being easy. The anxiety-related deficits at various stages of processing suggest some general impairment in attention and/or working memory (Owens, Stevenson, Hadwin & Norgate, 2014). These various performance deficits are often attributed to high levels of worry and cognitive interference. Furthermore, test anxiety is quite consistently but modestly associated with a variety of performance indices in lab studies (Zeidner & Matthews, 2005).

Behavioral avoidance, generated in part by performance-avoidance goals, in high test anxious students (Elliot & McGregor, 2001), plays a key role in maintenance of evaluative anxiety and concomitant skill degradation. High fear of failure, low classroom engagement and low self-determination are among the possible antecedent factors underlying the low performance of college students characterized by avoidance-performance goals (Cury et al., 2002).

Furthermore, evaluative anxiety and fear of failure frequently lead to failure to complete homework assignments or study for the test, thus resulting in a deficiency in acquiring the required knowledge to succeed in classroom assessments (Dewitte & Lens, 2000). This lack of preparation leads to poor performance and anxiety in the test situation (Naveh-Benjamin, 1991), increasing subsequent test anxiety and avoidance.

Emotion Regulation (ER)

ER are processes and strategies that individuals have to monitor and modify emotions to align with desired outcomes. In other words, ER refers to managing the emotional experience and expression. For example, down-regulating happiness from a high test score in order to be empathic to a peer who received a lower grade. Up-regulating positive emotions to enable course engagement is another example of emotion regulation. ER is studied as a personality trait (Gross & John, 2003). We focus on four forms of ER that have been investigated within educational contexts. A brief sketch of ER strategies relevant to educational psychology follows.

Receiving much attention, research has focused on reappraisal and suppression as ER strategies (Gross & John, 2003). Reappraisal refers to adjusting the emotion by changing the way the situation is interpreted, hence appraising the situation again in a different light to adjust the experienced emotion. Suppression refers to the inhibition of the emotion-expressive behaviors so as not to experience or express the emotion. Rumination is a form of dysregulation in which overthinking leads to the experiencing of negative affect (Noelen-Hoeksema, Morrow & Fredrickson, 1993). Recent work has also looked at

integrative ER which refers to perceiving negative emotion as a source of information to understand and guide the self and behaviors, thus integrating it as part of the experience rather than changing the emotion (Roth & Assor, 2012). The understanding that there are different ways to adjust emotions, knowledge of how these emotional processes work, when to use them and the monitoring of how ER is progressing is termed metaemotion (or metaaffect) (Ben-Eliyahu, 2019; Ben-Eliyahu & Linnebrink-Garcia, 2015).

ER is related to a host of outcomes such as achievement in reading and math as early as kindergarten (Kwon, Hanrahan & Kupzyk, 2017) including processes that shape students' availability to focus and learn. For example, the use of reappraisal was positively associated with positive emotions, looking for something good during stressful events, efficacy of negative mood regulation, and openness, and negatively predicted negative emotions and maladaptive outcomes such as neuroticism (Gross & John, 2003; John & Gross, 2004). In contrast, suppression positively predicted negative emotions and maladaptive outcomes such as inauthenticity, maladaptive forms of coping (e.g., venting), and negatively predicted positive emotions and adaptive outcomes such as efficacy of negative mood regulation, openness and conscientiousness (Butler et al., 2003; Gross & John, 2003; John & Gross, 2004; Richards & Gross, 2000). Thus, in general, reappraisal is considered an adaptive form of ER whereas suppression is considered a maladaptive form of ER. Interestingly, when measured as a trait, suppression and reappraisal were unrelated to standardized test scores (i.e., Scholastic Aptitude Tests [SATs]; Gross & John, 2003). Rumination is considered a maladaptive form of emotion regulation as it consistently predicted higher levels of depression and decreased willingness to be active (Aldao et al., 2010; Nolen-Hoeksema et al., 1993).

Despite the research on positive relations between ER and achievement outcomes, a recent meta-analysis has not found relations between emotion regulation and academic outcomes (Compa et al., 2017). The lack of significant findings could be due to differing measures assessing ER. Another reason could be that, within specific learning context, trait-level ER interacts with specific contextual aspects. Recent work focusing on the interaction of ER with the learning context found some evidence for the use of ER strategies varying by course liking (Ben-Eliyahu & Linnenbrink-Garcia, 2013, 2015). In particular, the authors found that students report higher levels of self-regulated emotions in their favorite courses than their least favorite courses. Rumination and reappraisal were positively related to negative and positive emotions, respectively, in both liked and disliked courses. Whereas suppression was related differently to emotions based on course preference (Ben-Eliyahu & Linnenbrink-Garcia, 2013) such that in favored courses, suppression was negatively related to positive emotions, replicating work that conceptualizes emotion regulation as a trait (e.g., Gross &

John, 2003), while in disliked courses, suppression was positively related to positive emotions. This finding suggests that, even though ER has a personality component, it may not function in the same way across all learning contexts. In fact, a latent class analysis to investigate how ER strategies combine revealed that in preferred courses, a group of students tended to be regulated in suppression, reappraisal and rumination while a group of students were high in reappraisal and suppression though low in rumination (Ben-Eliyahu & Linnenbrink-Garcia, 2013). In courses that students nominated as least favorite, there was a similar group of students who were regulated in all forms of ER, a group who were high on reappraisal in comparison to suppression and rumination, and a group low on reappraisal in comparison to suppression and rumination. It is becoming clear that within educational contexts personality interacts with aspects of the classroom.

CONCLUSION

In this chapter we focused on the pivotal role of personality in impacting important educational criteria – achievement, motivation, emotion and affect, and mental health. Contemporary research lends weight to the rapidly growing support among educators for assessing and considering personality and other noncognitive constructs, beyond those currently covered by traditional academic assessments, both at the K-12 and college level.

Within the field of Educational Psychology there is ongoing tension between contextual versus person-based or intraindividual components. On the one hand the context is shaped by educators, shifting the responsibility for student successes and failures to accountable adults. On the other hand, student personality, predispositions and innate physiological limitations restrict the extent to which educational contexts can infiltrate and entice learning.

Child development models articulate how a wide range of social spheres shape development through microsystems and exosystems (Bronfenbrenner, 1977). The surge in research on contextual influences had an effect on educational research and practice as it shifted responsibility for educating towards educators, consequently research focused on ways to shape classroom settings (e.g., Ames, 1992). An unrelated independent program of research focused on, what we refer to as the *intraindividual system* (Ben-Eliyahu, 2019), comprised by internal processes such as personality and self-regulated learning (Matthews et al., 2006; Pintrich, 2000). Today, we realize that development is an orchestra of cultural and contextual aspects interrelated with internal personal aspects. It is now readily apparent that any attempt to understand the complete causal chain associated with students' school achievements, motivations, social-emotional competencies, and adjustments requires examining the effects of personality and affective processes, in concert with ability

and social, cultural and economic factors at home and in the community.

Notwithstanding the importance of context, the call for the chapter was to focus on personality factors within educational psychology. Overall, our review suggests that personality does matter when it comes to key educational outcomes. Personality traits constitute one of several non-intellective factors that may impact a host of facets of classroom learning and adjustment. Furthermore, specific traits of the FFM appear to be differentially related to different educational outcomes. For example, high C, low N and high O, to a lesser degree, were shown to be positive predictors of learning and achievement outcomes. C has consistently been found to be associated with student SRL behaviors. Similarly, achievement motivation tendencies are related to achievement outcomes. The tendency to focus on learning and developing (mastery goal orientations) is related to interest, engagement, persistence and positive affect whereas a focus on avoiding failure (performance-avoidance goal orientations) is related to anxiety and avoidance of help seeking. These findings echo antecedents of goal orientations such as theories of intelligence, with individuals who have a growth mindset perceiving failure as a challenge and opportunity to learn and those with a fixed mindset perceiving failure as a fearful setback.

Future research examining the effects of broad motivational and personality dispositions on educational outcomes may find it profitable to consider grain-size (Ben-Eliyahu & Bernacki, 2015). Fine-grained refers to specific aspects of learning, such as specific behaviors during a particular task. Broader-grained aspects refer to more generalized characteristics such as motivation toward academics in general or a predisposition or trait. Considering these different grain-sizes is pertinent especially when considering how personality interacts with educational contexts. The question of whether a learner has predispositions for particular motivational or regulatory tendencies has yet to be investigated and compared across particular contexts. It may be the case that general personality predispositions interact with particular content or contextual structures such that learning contexts have the power to override dispositional tendencies (Ben-Eliyahu, 2017). A curious individual may find disinterest in a particular topic at school delivered by a certain technique such as math taught by a teacher through lecture, whereas changing the activity or the topic might allow the student to revert to her curious nature. A generally anxious student may find solace when immersed studying to the degree that flow sensations emerge emitting positive emotions and loss of sense of self or time (Csikszentmihalyi, 1990). In such cases temperament or trait-based tendencies may be diverted or shaped by the context and content. Alternatively, personality may be comprised of these building blocks. Each course or topic may be a component of personality resulting in a sort of weighted sum derived to depict the person as a whole. In which case

the sum may be greater than its parts and such differentiation may be worthwhile for field-based practices though less relevant for personality theorists.

An untouched subject within the achievement motivation literature relates to mastery-avoidance goal orientations that pertain to avoidance of not learning as a motivator. Over the past decade, the rise in technology-based classrooms has provided students with alternative ways of communicating and consuming information. Students may disengage because they are afraid of either not learning how to use new technology or because they prefer digital over manual work (e.g., typing over handwriting). Future work should venture into this untouched territory.

With the advent of statistical software, more work is investigating individual difference from a person-centered perspective (Magnusson, 2003). This approach allows investigating whether there are different types of people based on the data. Such analyses reveal a different though complimentary picture to the variable-centered analyses (Ben-Eliyahu & Linnenbrink-Garcia, 2013; Conley, 2012; Linnenbrink-Garcia et al., 2018). Most studies have looked at linear relations between personality and adaptive outcomes. Future research needs to test for the presence of nonlinear relationships between personality and adaptive outcomes, including achievement, motivation and mental health. For example, Cucina and Vasilopoulos (2005) reported the presence of a curvilinear relationship between achievement and O and C, in turn. Also, researchers need to correct for restrictions in range, which may have led to substantial underestimates of the strength of correlations.

From a practical point of view, personality assessment of students may be informative about a student's strengths and weaknesses at the process level (Matthews et al., 2006). For example, high E students may need help with managing social distractions and keeping their mind focused on their learning goals instead of socializing and partying, or alternatively providing groupwork to satiate the social need through academic work. Furthermore, there are potentially multiple ways to handle personality differences seen in the classroom. For example, in addressing excessive negative emotionality in high anxious children, the educator may need to choose between restructuring negative appraisals, training more effective ER skills, training interpersonal skills to reduce conflict with others or teaching the child to actively seek non-stressful settings and activities.

The research to date works under the paradigm that personality shapes learning and educational outcomes. However, it may be the case that personality is shaped by learning experiences. Reverting to the prior example of the anxious student immersed into a state of flow while studying, increasing such experiences may shape the learner's personality over time and decrease overall anxiety. Clinical attempts at shaping externalized behaviors build on the assumption that small successful experiences accumulate within the individual experience over time thereby influencing

personality. The spotlight should focus on the interaction between contextual aspects such as school policy and intraindividual components, such as personality.

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33 Personality in Clinical Psychology

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INTRODUCTION

Clinical psychology is the psychological specialty that provides mental and behavioral health care for individuals and families, seeking to improve persons' mental health, physical health and quality of life. Clinical psychology integrates science, theory and clinical experience as a means to understand, prevent and relieve distress and dysfunction and promote wellbeing and personal development. Personality is inherently intertwined with outcomes related to health and quality of life; therefore, an understanding of personality is of fundamental importance to the goals of clinical psychology. There was a time when the importance of personality – if not its very existence – were called into question. Some contended that behaviors were merely situationally specific responses to environmental stimuli rather than the result of any stable dispositions (Mischel, 1968). This period of doubt and skepticism has long since passed, as it has become undeniably evident that personality traits are not only real but are of clinical significance. The purpose of the current chapter is to present the predominant model of personality (the Five-Factor Model [FFM]), and indicate its importance to the development of psychopathology, including in particular the personality disorders. The implications of the particular importance of personality to the development of psychopathology are then discussed (e.g., perhaps treatment should begin early and focus on personality itself).

THE FIVE-FACTOR MODEL

The predominant model of personality structure is arguably the FFM, or the Big Five (John, Naumann & Soto, 2008). Historically, the approach to identifying the basic personality dimensions was relatively subjective, such that the selection of relevant domains relied almost exclusively on the review of previous literature by an esteemed psychologist. This approach was utilized by leading personality theorists and researchers, such as Jung (1923), Jackson (1984), Millon (1994), Cloninger (2000), and many others. The “lexical paradigm,” in contrast to this traditional

approach, is purely empirical. The lexical paradigm rests on the assertion that the aspects that are of the most importance, interest, or meaning to persons when describing themselves and others will naturally be heavily encoded within their respective language. Language can be understood as a sedimentary deposit of the observations of personality made by all persons using and transforming that language over the thousands of years of its existence. Therefore, when identifying the primary domains of personality, language – rather than one's own opinion – should be the arbitrator. The domains of personality with the greatest number of terms to describe and differentiate their various manifestations and nuances are viewed as most important, and the structure of personality is determined by the empirical relationship among these terms (Goldberg, 1993). The lexical research of all the languages considered have converged well onto the Big Five or the FFM (John et al., 2008). The FFM consists of the following broad domains: extraversion (versus introversion), agreeableness (versus antagonism), conscientiousness (versus disinhibition), neuroticism (versus emotional stability) and intellect (or openness). Each of these five broad domains can be broken down into more specific, underlying facets. For example, the six primary traits of agreeableness have been said to be trust, straightforwardness, altruism, compliance, modesty and tender-mindedness (Costa & McCrae, 1992).

One of the strengths of the FFM is its robustness, which is a natural result of its lexical foundation. It would be unlikely that there would be many, if any, traits for which persons have not yet developed words to identify them. As such, the lexical Big Five captures virtually all traits. Indeed, the FFM has been shown to account well for all the traits and scales within alternative models of personality (Costa & McCrae, 2017; McCrae & Costa, 2003). For example, O'Connor (2002) conducted integrative factor analyses of previously published findings from approximately seventy-five studies involving FFM scales along with the scales of twenty-eight other commonly used self-report inventories of personality. He concluded that “the factor structures that exist in the scales of many

popular inventories can be closely replicated using data derived solely from the scale associations with the FFM" (O'Connor, 2002, p. 198). O'Connor (2002) further suggested that "the basic dimensions that exist in other personality inventories can thus be considered 'well captured' by the FFM" (p. 198). The FFM has also amassed a considerable body of construct validity support, including a strong documentation of childhood antecedents (Caspi, Roberts & Shiner, 2005; Mervielde & De Fruyt, 2002), multivariate behavioral genetics with respect to its structure (Jarnecke & South, 2017), temporal stability across the life span (Roberts & DelVecchio, 2000), and cross-cultural replication (Allik & Realo, 2017). One purpose of this chapter is to emphasize the importance of personality within clinical psychology by providing an overview of the social and clinical implications of the FFM personality traits as they relate to health and quality of life.

PERSONALITY AND IMPORTANT LIFE OUTCOMES

Personality has been shown to have serious and substantial implications for a wide variety of public health care concerns. One historically notable study was provided by Friedman and colleagues (1993), who analyzed the raw data from the Terman Life-Cycle Study of children, which had begun in 1922. Terman's initial sample consisted of 1,500 bright eleven-year old children whom he continued to assess every five to ten years. Approximately seventy years later, Friedman and colleagues (1993) coded the original parental personality ratings at age eleven on twenty-five trait dimensions, developing proxy scales for FFM extraversion, conscientiousness and neuroticism (regrettably, there was insufficient data to code for agreeableness or openness). Despite the homogeneous nature of the original sample (i.e., intelligent, mostly White and mostly middle-class), the findings demonstrated that, even when controlling for other obvious predictors, "conscientiousness in childhood was clearly related to survival in middle to old age" (Friedman et al., 1993, p. 176). These findings suggest that conscientiousness may be a powerful predictor of one's life expectancy. Friedman et al. further suggested, "this may help us identify younger people at higher risk for later health problems" (p. 184).

The potential contributions of personality to a wide variety of mental, medical and other important life outcomes have since been demonstrated in a vast body of subsequent research. A number of meta-analyses have established substantial links between personality and many important life outcomes, including academic performance (Poropat, 2009), job performance, organizational citizenship behavior and counterproductive work behavior (Sackett & Walmsley, 2014), as well as happiness, life satisfaction, job satisfaction and marital satisfaction (Heller, Watson & Ilies, 2004; Malouff, Thorsteinsson, Schutte, Bhullar & Rooke, 2010; Steel, Schmidt & Shultz, 2008). Ozer and Benet-Martinez (2006) organized this

considerable body of research with respect to the five domains of the FFM. They documented the significant impact of personality on many individual life outcomes, such as happiness, subjective wellbeing, spirituality, virtues, physical health, longevity, self-concept and identity; interpersonal outcomes, such as peer relationships, family relationships and romantic relationships; and social-institutional outcomes, such as occupational choice, performance, political attitudes, values, volunteerism, community involvement, and criminality. With the exception of openness on interpersonal outcomes, each of the Big Five domains had a significant and meaningful impact on all of these outcomes. Ozer and Benet-Martinez (2006) concluded, "personality effects are ubiquitous, influencing each of us all the time, and when aggregated to the population level such effects are routinely consequential" (Ozer & Benet-Martinez, 2006, p. 416). The strength of the associations were, in some cases, not large in terms of their quantitative effect size, a point of emphasis in the days of Mischel (1968), but as they noted, even a small effect size would have substantial implications when considered across the entire population (Meyer et al., 2001). For instance, "even a small change in mean agreeableness scores might increase by thousands the number of volunteers serving community needs in AIDS clinics and elsewhere" (Ozer & Benet-Martinez, 2006, p. 416).

Roberts, Kuncel, Shiner, Caspi and Goldberg (2007) conducted a meta-analysis of prospective longitudinal studies that considered the impact of personality on mortality, divorce and occupational attainment. Roberts et al. documented that the impact of personality equaled the impact of such well-established risk factors as socioeconomic status and cognitive ability. They also reiterated the point of Ozer and Benet-Martinez with respect to effect size, comparing their results with influential studies in other areas of public health. For example, Danner, Snowden and Friesen (2001) indicated that the association between positive emotion and longevity was associated with a gain of almost seven years of additional life, despite having an average effect size of around only .20.

A primary focus of clinical psychology is, of course, the treatment and prevention of psychopathology, and a considerable amount of research has examined the relationship of personality to psychopathology. "Over the past 15 years, research on personality and psychopathology has generally increased, from just over 8,000 new research products in 2001 to over 20,000 new research products every year for the past five years, based on cited works indexed in Google Scholar" (Tackett & Mullins-Sweatt, in press). Many qualitative reviews of this literature have been conducted (e.g., Andersen & Bienvenu, 2011; Bagby, Uliaszek, Gralnick & Al-Dajani, 2017; Klein, Kotov & Bufferd, 2011; Lengel, Helle, DeShong, Meyer & Mullins-Sweatt, 2016; Tackett & Mullins-Sweatt, in press; Watson & Naragon, 2008; Widiger & Smith, 2008). Likewise,

many quantitative meta-analyses have been conducted, addressing the relationship of personality with various mental disorders (Jeronimus, Kotov, Riese & Ormel, 2016; Malouff, Thorsteinsson & Schutte, 2005). For example, previous work has established connections between personality and substance use disorders (Kotov, Gamez, Schmidt & Watson, 2010; Malouff, Thorsteinsson, Rooke & Schutte, 2007), eating disorders (Cassin & von-Ranson, 2005), anxiety disorders (Kotov et al., 2010), and mood disorders (Hakulinen et al., 2015; Kotov et al., 2010).

The strongest relationship with psychopathology has been found for FFM neuroticism. Neuroticism (or negative emotionality) is the trait disposition characterized by an array of negative affective experiences, including anger, anxiety, self-consciousness, vulnerability, irritability, emotional instability and depression (Tackett & Lahey, 2017). Individuals with high levels of neuroticism tend to respond poorly to environmental stress, interpret ordinary situations as threatening, and can experience minor disappointments as hopelessly overwhelming (Widiger, 2009a). Neuroticism has been shown to contribute to the development of a wide variety of psychopathology (Bagby et al., 2017; Klein et al., 2011; Kotov et al., 2010; Ozer & Benet-Martinez, 2006), and a comparably wide array of physical maladies, such as cardiac problems, disrupted immune functioning, asthma, atopic eczema, irritable bowel syndrome and even increased risk for mortality (Tackett & Lahey, 2017). Neuroticism has also been linked with several central components of quality of life, such as occupational success, subjective wellbeing, emotional exhaustion and marital dissatisfaction (Lahey, 2009). Elevated levels of neuroticism leave individuals vulnerable to the development of the aforementioned disorders while creating a disposition to exaggerate their importance and a barrier to respond effectively to their respective treatments (Tackett & Lahey, 2017; Widiger, 2009a). This was demonstrated by Cuijpers et al. (2010), who, in a large representative sample ($N=5504$) of the Dutch general population compared the economic costs of neuroticism (i.e., uptake in primary and secondary mental health care, out-of-pocket costs and production losses) with the costs associated with common mental disorders (e.g., mood, anxiety, substance use and somatic disorders). Their results suggest that the costs of neuroticism vastly outweigh those associated with mental disorders. Specifically, the excess costs of neuroticism were approximately 2.5 times greater than those of included mental disorders.

PERSONALITY DISORDERS

Personality not only contributes to the development of various forms of psychopathology, but it can itself be a variant of psychopathology. The authoritative nomenclature for psychopathology within clinical psychology is provided by the American Psychiatric Association's (APA)

Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013) and the World Health Organization's (WHO) International Classification of Diseases (ICD-10; WHO, 1992). Included within section II of DSM-5 (the section of the diagnostic manual for the officially recognized mental disorders) are ten disorders of personality: the antisocial, avoidant, borderline, dependent, histrionic, narcissistic, obsessive-compulsive, paranoid, schizoid and schizotypal, which are themselves the focus of considerable clinical research and treatment (Livesley, 2001; Oldham, Skodol & Bender, 2005; Widiger, 2012). The five personality disorders that have been most heavily researched are briefly discussed below.

Borderline Personality Disorder

Borderline personality disorder (BPD) is the most heavily researched (Blashfield & Intoccia, 2000). The primary diagnostic criteria for BPD include frantic efforts to avoid abandonment, affective instability, unstable and intense relationships, impulsivity (e.g., substance abuse, binge eating or sexual promiscuity), recurrent suicidal thoughts and gestures (that at times can be manipulative, but as well fatal), self-mutilation, and episodes of rage and anger (APA, 2013). Persons with BPD will often have a history of treatment failures, visits to the emergency room, hospitalizations secondary to suicidal ideation or gestures, and treatment for an array of accompanying problems, including mood disorder, substance use, eating disorders and anxiety disorders.

BPD is the only personality disorder for which there are effective, empirically validated therapies. The two most predominant forms of treatment are mentalization-based treatment (MBT; Bateman & Fonagy, 2012) and dialectical behavior therapy (DBT; Lynch, Trost, Salsman & Linehan, 2007). MBT is a psychodynamic treatment that addresses the tendency for individuals with BPD to misperceive the intentions and feelings of others, interpreting, for instance, innocent remarks as signs of rejection, responding with intense negative emotions. MBT, through the use structured techniques, helps patients "mentalize" (i.e., more accurately perceive the feelings within themselves and others). DBT is a cognitive-behavioral therapy that addresses the natural tendency for the thoughts of individuals with BPD to drift to feelings and memories of rejection and abuse. DBT incorporates Zen Buddhist principles of overcoming suffering through acceptance (Linehan, 1993), which are taught in part through the meditative techniques of mindfulness, acceptance and relaxation.

Antisocial (Psychopathic) Personality Disorder

Antisocial personality disorder (ASPD; APA, 2013), more commonly known as psychopathy (Hare, Neumann & Widiger, 2012), is the second-most heavily researched personality disorder. Psychopaths are "social predators who

charm, manipulate, and ruthlessly plow their way through life... Completely lacking in conscience and feeling for others, they selfishly take what they want and do as they please, violating social norms and expectations without the slightest sense of guilt or regret" (Hare, 1993, p. xi). Some of the most notorious criminals in history, both real or imagined, are considered to be psychopathic (e.g., Clyde Barrow, Ted Bundy, Tony Soprano, Hannibal Lector, Bernie Madoff, Henry Hill).

For many years there was a contrast between psychopathy as defined by Hare's (2003) Psychopathy Checklist Revised (PCL-R) and ASPD as defined by the APA diagnostic manual (Crego & Widiger, 2015). The PCL-R places more emphasis on personality traits (e.g., glib charm, manipulation, arrogance, impulsivity, irresponsibility and callous lack of empathy), whereas the APA diagnostic criteria place more emphasis on behavioral indicators, particularly criminal acts. Hare's conceptualization of the disorder is now largely accepted as the preferred version (Hare & Neumann, 2008). Despite this preference for Hare's model, though, the optimal definition for psychopathy remains unclear.

More recently, three new models of psychopathy have been developed that deviate substantially from Hare's psychopathy. Yet, these models have converged on one important component. This component is referred to as boldness within the Triarchic Model of Psychopathy (TriPM; Patrick, Fowles & Krueger, 2009), fearlessness within the Psychopathic Personality Inventory (PPI-R; Lilienfeld & Widows, 2005), and invincibility within the Elemental Psychopathy Assessment (EPA; Lynam et al., 2011). These traits are somewhat controversial as they are conceptualized and assessed as adaptive strengths (Miller & Lynam, 2012). For example, Lilienfeld et al. (2012) suggested that Theodore Roosevelt, John F. Kennedy and Ronald Regan were psychopathic presidents, not because they were exploitative, callous or ruthless, but because they were bold. Lilienfeld et al. did make it clear that they were not suggesting that these presidents were actual psychopaths, as they did not have all of the traits of psychopathy. However, they were stating that the success of these presidents was due, at least in part, to the presence of psychopathic traits, which then clearly implies that the presidents were, to some extent, psychopathic.

Most personality disorders are ego-syntonic, such that individuals do not consider themselves to have a mental disorder. As such, psychopathic individuals are quite comfortable with their personality. In fact, the life of a psychopath is at times romanticized, and can be appealing at a young age. Henry Hill, for example, was a member of the Lucchese crime family. His life story was portrayed in the critically acclaimed Martin Scorsese movie, *Goodfellas*. As an adolescent, Hill famously stated, "At the age of twelve my ambition was to be a gangster" (Pileggi, 1985, p. 13). However, the exciting lifestyle of a psychopath can be quite costly. That is, although psychopathic individuals are clearly dangerous

to others, they may also be dangerous to themselves. The prognosis for their future is often bleak. Individuals with high levels of psychopathic traits have a very difficult time maintaining employment, maintaining stable relationships, are at risk of spending a considerable amount of time imprisoned, and are at risk for incurring serious injury and even death (Hare et al., 2012). Much of this applied to Henry Hill.

Dependent Personality Disorder

Dependent personality disorder (DPD) involves an excessive attachment to others with submissiveness, clinging and fears of separation (APA, 2013; Bornstein, 2012). Its diagnostic criteria include extreme difficulty making decisions without the input of others, need for others to assume responsibility for most aspects of daily life, difficulty voicing disagreement with others, inability to initiate projects due to lack of self-confidence, and going to excessive lengths to obtain the approval of others. The diagnosis was slated for deletion in DSM-5 (Skodol, 2012), despite there being a considerable body of research to support the validity and clinical significance of dependent personality traits (Bornstein, 2012; Gore & Pincus, 2013; Mullins-Sweatt, Bornstein & Widiger, 2012).

Dependency is one of the few personality traits with a well-established role in the etiology of future episodes of depression (Bornstein, 2005). Multiple prospective longitudinal studies have demonstrated that dependent cognitions and behaviors can result in increased depressive symptoms in response to interpersonal loss or rejection (Hammen, 2005). Insecure interpersonal attachment is considered to be central to the etiology and pathology of DPD (Bornstein, 2005; Luyten & Blatt, 2013), such that individuals with DPD may come to believe that their self-worth is contingent upon their importance to another person. Their self-esteem depends substantially on the maintenance of a nurturing, loving and secure relationship, yet their intense needs for continued reassurance can have the paradoxical effect of driving away the targets of their dependence, which can lead to experiences of depression.

Narcissistic Personality Disorder

Narcissistic personality disorder (NPD) is a pervasive pattern of grandiose fantasy or behavior paired with a need for admiration and a lack of empathy (APA, 2013). Its diagnostic criteria include an inflated sense of self, arrogance, preoccupation with success, power, brilliance or beauty; the belief that one is special and can only be understood by high status individuals; a strong sense of entitlement; and a tendency to exploit others.

Narcissistic persons are often skilled in making a good first impression, but their likability often diminishes with time and increased familiarity (e.g., Back, Schmukle & Egloff, 2010). Over the course of time, narcissism has a

negative impact on relationships as it is linked to game-playing, infidelity and high levels of unrestricted sociosexuality (e.g., Campbell, Rudich & Sedikides, 2002). Despite the tendency for narcissistic individuals to employ a variety of self-enhancement strategies, they remain extremely sensitive to rejection or criticism (Campbell & Miller, 2013; Miller, Widiger & Campbell, 2010). This makes narcissistic individuals highly volatile, as they may respond to negative feedback with anger or even displaced aggression (Martinez, Zeichner, Reidy & Miller, 2008; Twenge & Campbell, 2003).

Conflicts and deficits with respect to self-esteem are considered to be central to the pathology of the disorder (Ronninstam, 2005). Narcissistic persons must continually obtain signs and symbols of recognition to compensate for feelings of inadequacy. There has been some concern that diagnostic criteria place too much emphasis on a grandiose narcissism, which has been shown to associate with certain positive life outcomes (for example, professional success; e.g., Campbell, Hoffman, Campbell & Marchisio, 2011) while failing to adequately recognize a vulnerable narcissism indicated by a need for admiration, self-devaluation, and feelings of vulnerability, humiliation or rage in response to criticism or rebuke (Miller et al., 2010; Pincus & Lukowitsky, 2010). Persons with grandiose traits of narcissism will often subsequently display the traits of vulnerable narcissism (Gore & Widiger, 2016). Oltmanns and Widiger (2018) developed a self-report measure for the fluctuation between grandiose and vulnerable narcissism. NPD, like DPD, was also initially slated for deletion in DSM-5 (Skodol, 2012) despite the presence of a considerable amount of clinical interest (Pincus & Lukowitsky, 2010; Ronningstam, 2005) and supportive empirical research (Miller et al., 2010; Pincus & Lukowitsky, 2010). In response to the objections from colleagues within the personality disorders field, the proposal for its deletion was rescinded (Skodol, 2012).

Schizotypal Personality Disorder

The diagnostic criteria for schizotypal personality disorder (STPD) were developed from studies of biological relatives of schizophrenic individuals designed to confirm a family history of schizophrenia (Spitzer, Endicott & Gibbon, 1979). They found a surprisingly low rate of actual schizophrenia but they did find a curious prevalence of odd, eccentric persons with subthreshold symptoms. The diagnostic criteria for STPD include social withdrawal, odd speech, inappropriate or constricted affect, social anxiety, social withdrawal, odd beliefs and magical thinking that are below threshold for a delusion, and unusual perceptual experiences that are below threshold for a hallucination (APA, 2013).

The classification of STPD as a personality disorder is not universally agreed upon. For example, the WHO's (1992) ICD-10 classifies STPD as a form of schizophrenia. There is compelling empirical support for a genetic

association of STPD with schizophrenia (Kwapil & Barrantes-Vidal, 2012), which is not surprising given that the diagnostic criteria were obtained from the observations of biological relatives of schizophrenic individuals. Additionally, many of the neurobiological risk factors and psychophysiological correlates of STPD are shared with schizophrenia (e.g., eye tracking, orienting, startle blink and neurodevelopmental abnormalities), and the treatments that are effective in alleviating schizotypal symptoms overlap with treatments used for persons with schizophrenia (Lenzenweger, 2006). The close relationship of STPD to the phenomenology, genetics and pathology of schizophrenia might then suggest that it should in fact be classified in future editions of the APA nomenclature as a variant of schizophrenia (Skodol, 2012). However, there may be considerable validity in maintaining STPD's current classification as it is much more comorbid with other personality disorders than with psychotic disorders. Persons with STPD very rarely develop schizophrenia, and schizotypal symptomatology is evident within the general population in persons with no apparent genetic relationship to schizophrenia (Raine, 2006). In DSM-5, STPD is included in both the personality disorders and the schizophrenia spectrum sections (APA, 2013).

PERSONALITY AND PERSONALITY DISORDER

Although there is research to support the clinical utility and validity for the borderline, psychopathic, dependent, narcissistic and schizotypal personality traits, there is also a considerable body of research to indicate that they are not well understood as distinct diagnostic categories. The many problems with the DSM-IV (now DSM-5 section II) categorical model of personality disorder classification have been well documented, including the heterogeneity in the traits among persons sharing the same diagnosis, the absence of a distinct boundary with normal personality functioning, and substantial overlap and diagnostic co-occurrence (Clark, 2007; Livesley, 2007; Skodol, 2012; Widiger & Trull, 2007). For example, individuals with the same personality disorder diagnosis are unlikely to share similar levels of each of the traits associated with that particular personality disorder (Clark, 2007). These limitations produce a considerable amount of difficulty in identifying specific etiologies, pathologies and treatments, a fundamental goal and purpose of clinical psychology (Widiger et al., 2019).

DSM-III (APA, 1980) was the first version of the APA diagnostic manual to include specific criterion sets (Spitzer, Williams & Skodol, 1980). For some of the personality disorders, all of the features were required (APA, 1980). These monothetic criterion sets ensured that everyone who was provided the same diagnosis would share all of the features of that personality disorder. However, it quickly became clear that, by these rigid standards, most patients would fail to meet the threshold for a personality disorder. Therefore, DSM-III-R (APA, 1987) converted to

polythetic criterion sets in which only a subset of features was required (Widiger, Frances, Spitzer & Williams, 1988). These polythetic criterion sets more accurately reflected the actual personality structure of those with personality disorders, but they resulted in a considerable amount of heterogeneity among individuals sharing the same diagnosis. For example, there are eight features for the diagnosis of obsessive-compulsive personality disorder (OCPD), any four of which are required (APA, 2013). This means that two persons could meet the threshold for an OCPD diagnosis yet not share a single feature in common. As expressed by Skodol (2012), the chair of the DSM-5 Personality and Personality Disorders Work Group, referring to the DSM-IV diagnostic criteria for borderline personality disorder, “use of the polythetic criteria of DSM, in which a minimum number (e.g., 5) from a list of criteria (e.g., 9) are required, but no single one is necessary, results in extreme heterogeneity among patients receiving the same diagnosis” (p. 36). There are indeed 256 different possible ways to meet criteria for BPD (Johansen, Karterud, Pedersen, Gude & Falkum, 2004). While this degree of heterogeneity substantially complicates efforts to identify a specific etiology, pathology or treatment of personality disorders, it also more accurately reflects the reality that the DSM-IV personality disorders are not homogeneous syndromes (Clark, 2007; Widiger & Trull, 2007).

Research into individual differences has established that, beyond the characteristics included within diagnostic criterion sets, individuals vary in the extent to which they possess other, potentially maladaptive, traits (Skodol, 2012). Individuals rarely meet the diagnostic criteria for just one personality disorder, such that multiple diagnoses can be the norm rather than the exception (Clark, 2007; Trull & Durrett, 2005; Widiger & Trull, 2007). The DSM-5 PPDWG considered this diagnostic cooccurrence to be so problematic that they proposed deleting half of the diagnoses to correct the problem (Skodol, 2012), which would have been a rather harsh solution (Widiger, 2011), given that a lack of adequate coverage is arguably just as problematic (Verheul & Widiger, 2004). Nevertheless, it is a clear testament as to the magnitude of the problem.

This excessive heterogeneity and diagnostic cooccurrence are clear indicators that individuals are not accurately described by one word, one specific diagnosis. Each person has a relatively unique constellation of personality traits, with both adaptive and maladaptive qualities that are unlikely to be duplicated in others. In sum, the complex patterns of personality structure are not effectively described by diagnostic categories. More accurate description will be dimensional rather than categorical (Skodol, 2012; Widiger, Simonson, Krueger, Livesley & Verheul, 2005).

The APA's (2013) position that personality disorders represent distinct diagnostic categories has proven consistently problematic. An alternative to this position is that personality disorders are simply maladaptive variants of FFM personality structure (Widiger & Costa, 1994). There

is indeed a substantial body of research to indicate that each DSM-5 section II personality disorder can be well accounted for in terms of the FFM personality traits. Widiger, Gore, Crego, Rojas and Oltmanns (2017) provide a reasonably comprehensive summary of this large body of research. The research concerning individual personality disorders has been provided for the borderline (Trull & Brown, 2013), schizotypal (Edmundson & Kwapil, 2013), antisocial or psychopathic (Derefinko & Lynam, 2013), dependent (Gore & Pincus, 2013), and narcissistic personality disorder (Campbell & Miller, 2013).

For example, from the perspective of the FFM, borderline personality disorder includes such traits as affective dysregulation, dysregulated anger, behavioral dysregulation, self-disturbance, despondence, anxious uncertainty and fragility (which includes self-harm; Mullins-Sweatt et al., 2012), all of which are within the FFM domain of neuroticism, along with traits of low conscientiousness (e.g., disinhibition) and antagonism (e.g., manipulation). The Five Factor Borderline Inventory includes scales for the assessment of each of these traits, and a number of studies have documented large effect size relationships with, for instance, FFM neuroticism (convergent validity), as well as weak relationships (discriminant validity) with the other domains of the FFM (DeShong et al., 2015; Mullins-Sweatt et al., 2012). There are also FFM self-report measures for the schizotypal, narcissistic, dependent, antisocial (psychopathic), histrionic, obsessive-compulsive and avoidant personality disorders (Widiger et al., 2012) which have demonstrated similarly large effect size relationships with the respective FFM domains (e.g., Crego et al., 2015; Samuel et al., 2012).

The DSM-5 PPDWG included within their proposed revisions to DSM-IV a five-domain dimensional trait model of personality structure that is aligned with the FFM. This dimensional model included within section III of DSM-5 (for emerging measures and models), consists of the domains of negative affectivity, detachment, antagonism, disinhibition and psychoticism, which are in turn aligned with the FFM domains of neuroticism, introversion, low agreeableness, low conscientiousness and openness, respectively. As expressed in DSM-5, “these five broad domains are maladaptive variants of the five domains of the extensively validated and replicated personality model known as the ‘Big Five’ or Five Factor Model of personality (FFM)” (APA, 2013, p. 773). Research has supported the alignment of the DSM-5 trait model with the FFM (e.g., De Fruyt et al., 2013; Gore & Widiger, 2013; Thomas et al., 2012; Wright & Simms, 2014), albeit the alignment of DSM-5 psychoticism with FFM openness has been more inconsistent and complex. The strength of the relationship appears to depend on how both openness (Crego & Widiger, 2017; Gore & Widiger, 2013; Samuel & Widiger, 2008) and psychoticism (Crego & Widiger, 2017) are conceptualized and/or assessed.

A five-domain dimensional trait model has also been proposed for ICD-11, including negative affective,

detachment, dissocial, disinhibited and anankastic, that are again aligned with the FFM neuroticism, introversion, low agreeableness, low conscientiousness and high conscientiousness domains, respectively (Mulder, Horwood, Tyrer, Carter & Joyce, 2016). The ICD-11 trait model is assessed by the Personality Inventory for ICD-11 (Oltmanns & Widiger, 2018). The ICD-11 personality disorders section is in fact considerably more innovative than was proposed for DSM-5. The next edition of the ICD will no longer include, with one exception, the categorical syndromes. The five-domain dimensional trait model is replacing these categorical syndromes (Tyrer, 2014). The exception will be the retention of one of the categories: borderline, given its substantial clinical interest (Tyrer, Mulder, Kim & Crawford, 2019). Once ICD-11 is officially implemented, the clinicians in all member countries of the WHO (e.g., England, Germany, Spain, France, China, Brazil, Japan, and almost every other country in the world) will be shifting to this new model of personality disorder classification. Each member country of the WHO is obligated to use the ICD-11, or at least use a nomenclature that is in compliance with and/or is not fundamentally inconsistent with ICD-11 (First, Reed, Hyman & Saxena, 2015). Indeed, continuing to use the DSM-5 section II (APA, 2013) personality disorder diagnostic categories (e.g., antisocial, obsessive-compulsive, paranoid histrionic, dependent and narcissistic), could be said to be fundamentally inconsistent with the ICD-11 and with the practice of psychiatry throughout the rest of the world. In sum, there will be considerable pressure on the APA to shift the DSM-5 to be consistent with ICD-11, as it has now been formally approved by the WHO.

IMPLICATIONS

There are a number of advantages for clinicians in considering the DSM-5 personality disorders from the perspective of the FFM. Understanding the DSM-5 section II personality disorders in terms of their FFM structure helps to address many of the controversies and limitations of the existing diagnostic categories. For example, diagnostic cooccurrence is largely explained by the extent to which personality disorders share FFM traits (Lynam & Widiger, 2001; O'Connor, 2005). Another controversy facing personality disorders are sex differences (Oltmanns & Powers, 2012), but the differential sex prevalence rates are again consistent with the sex differences predicted when personality disorders are understood to be maladaptive variants of FFM personality structure (Lynam & Widiger, 2007). Additionally, very little is known about the childhood antecedents for most of the personality disorders. In contrast, there is a considerable body of research on the childhood antecedents of FFM personality structure (Caspi, Roberts & Shiner, 2005; Mervielde, De Clercq, De Fruyt & Van Leeuwen, 2005). De Clercq, De Fruyt, Van Leeuwen and Mervielde (2006) have even

developed an instrument aligned with the FFM personality structure to assess maladaptive personality traits in childhood.

One of the major failings of the DSM-5 section II personality disorders has been the absence of empirically based treatment guidelines (Mullins-Sweatt & Lengel, 2012), even though treatment selection is the primary goal of identifying and diagnosing psychiatric disorders (APA, 2013). In 1992, the APA began publishing empirically based practice guidelines, some of which are now in their third edition. However, to date, guidelines have been published for only one personality disorder: borderline (APA, 2001), whereas none have been successfully developed for the schizotypal, antisocial, narcissistic, dependent, avoidant, obsessive-compulsive, histrionic, paranoid or schizoid personality disorders.

There are perhaps multiple reasons for the absence of treatment protocols for the majority of personality disorders. One potential reason is simply that persons generally do not seek treatment for these disorders. Rarely would individuals seek treatment to become less psychopathic or less narcissistic. However, one clear exception has been for BPD (Tyrer, 2009), the reason for which is again well understood from the perspective of the FFM (Widiger, 2009b). BPD is defined largely by traits of neuroticism (Mullins-Sweatt et al., 2012) and the traits of neuroticism (e.g., vulnerability, anxiousness and depressiveness) are inherently troubling. Individuals with high levels of neuroticism (and BPD) experience substantial amounts of pain and suffering. Individuals maladaptively high in other poles of the FFM (e.g., agreeableness and antagonism) will undoubtedly experience negative consequences as a result of their personality traits but will be unlikely to consider these traits as the source of their problems and/or will feel quite comfortable in their skin. Personality traits are typically "ego-syntonic," experienced as simply the way one is and likely always will be.

An additional reason for the absence of treatment protocols is the extensive heterogeneity of the DSM-5 section II personality disorders (Watson et al., 2016; Widiger & Presnall, 2013). It would be very difficult to develop uniform treatment protocols for vastly heterogeneous personality syndromes. This fundamental limitation though does not apply to the domains of general personality structure. The five domains of the FFM are considerably more distinct and homogeneous and therefore are far better suited for treatment planning than the DSM-5 section II personality syndromes (Watson et al., 2016; Widiger & Presnall, 2013).

Given the implications of personality for important life outcomes, there is a growing recognition, even a call, for the identification of personality dispositions early in life (Lahey, 2009; Tackett & Lahey, 2017; Widiger & Trull, 2007). This has been particularly evident for the personality domain of neuroticism. "Not only would such efforts help identify those at potentially high risk for a range of adverse outcomes, information about levels of

neuroticism could be incorporated into more personalized and, ideally, more effective treatments” (Tackett & Lahey, 2017, pp. 47–48). It is routine to screen for blood pressure and cholesterol levels, and would seem only natural and sensible to do the same for a trait with so many public health care implications (Widiger & Oltmanns, 2017). “Even if the indirect reduction in the prevalence of each individual adverse outcome were modest, it is possible that such a strategy could be cost-effective because of the sheer number of adverse outcomes associated with neuroticism” (Lahey, 2009, p. 14). Cuijpers et al. (2010) had suggested, based on the greater economic costs of neuroticism compared to common mental disorders, that “we should start thinking about interventions that focus not on each of the specific negative outcomes of neuroticism but rather on the starting point itself” (p. 1086).

Early identification would be particularly useful as Armstrong and Rimes (2016) have developed an empirically validated mindfulness protocol for the treatment of neuroticism. Likewise, Barlow and colleagues (2011) have developed an empirically validated Unified Protocol (UP) for the transdiagnostic treatment of neuroticism. Barlow et al. suggested that current psychological treatments, having been driven largely by the fragmented categorical approach embodied in the APA diagnostic manual, have become overly specialized, focusing on disorder-specific symptoms (Barlow, Sauer-Zavala, Carl, Bullis & Ellard, 2014). The UP protocol was initially designed to be transdiagnostic with respect to mood and anxiety disorders, but it has become evident that it is indeed “a cognitive-behavioral intervention designed to address core temperamental processes in emotional disorders” (Barlow et al., 2014, p. 357). The UP targets identification and modification of the strong negative reactions to emotions that lead to problematic, avoidant coping across emotional disorders. “Amelioration of negative reactions to emotions in turn changes the frequency and intensity of future emotional experiences and thereby affects temperamental constructs” (Barlow et al., 2014, p. 357). Given the exorbitant impact of neuroticism on a wide range of both mental and medical disorders and on quality of life more generally, reducing levels of neuroticism could have substantial implications for public health care. “The public-health implications of directly treating and even preventing the development of neuroticism would be substantial” (Barlow et al., 2014, p. 344). “Targeting neuroticism itself may represent a more efficient and cost-effective means of addressing the wide swath of public health problems associated with it” (Sauer-Zavala, Wilner & Barlow, 2017, p. 192).

Other domains of personality are also receiving treatment consideration. Magidson, Roberts, Collado-Rodriguez and Lejuez (2014) have made a similar recommendation for improving levels of conscientiousness. “Efforts to change conscientiousness may hold great public health significance in enabling changes across key outcomes related to health, functioning, and quality of

life” (Magidson et al., p. 1443). Conscientiousness has been shown to predict a wide array of significant life outcomes, including occupational success, marital stability, academic achievement, and even health and longevity (Jackson & Roberts, 2017; Kern & Friedman, 2017). “Succinctly, conscientiousness is a personality trait that promotes better success in school, work, relationships, and physical and mental health” (Roberts, Hill & Davis, 2017, p. 199).

CONCLUSION

The current chapter documented the particular importance of personality to the development of psychopathology, including in particular the personality disorders. One clear implication of this importance is that perhaps personality assessment and change should itself be a focus of clinical intervention. Rather than wait for the development of physical and mental disorders that are largely the result of personality, perhaps further clinical attention should be given to the treatment of the personality dispositions themselves (Widiger et al., 2019). The benefits of lowering levels of neuroticism and raising conscientiousness within the general population are undeniable. Comparable gains may not be so evident for the other three domains of the FFM. Nevertheless, lowering levels of antagonism would likely lead to increased prosocial behavior and social cohesion and lower levels of future psychopathy and crime; and increasing levels of extraversion would likely enhance future relationships and personal engagement. Perhaps it is indeed time to develop treatment protocols for all five domains of the FFM.

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34 Personality and Crime

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INTRODUCTION

At its most basic level, personality refers to relatively consistent patterns of thinking, feeling and behaving manifested by individuals. Personality is internal; it refers to characteristics that reside within the individual. Personality has broad effects and accounts for stable behavior patterns across time and situations. Personality is important to a variety of negative and positive outcomes including academic achievement (Poropat, 2009), work performance (Barrick & Mount, 1991) and satisfaction (Judge, Heller & Mount, 2002), leadership (Judge, Bono, Ilies & Gerhardt, 2002), physical (Bogg & Roberts, 2004) and psychological health (Malouff, Thorsteinsson & Schutte, 2005; Samuel & Widiger, 2008), subjective well-being (DeNeve & Cooper, 1998) and relationship satisfaction (Malouff, Thorsteinsson, Schutte, Bhullar & Rooke, 2010).

One underappreciated outcome associated with personality is criminal behavior. We seek to remedy this oversight in the present chapter. First, we discuss the advantages that accompany using basic personality as an explanatory mechanism for crime. Next, we describe the Five-Factor Model (FFM) of personality – a very well-supported model derived from basic personality research, separate from interest in any specific outcome. We then describe results from a large meta-analysis on the relations between traits from the FFM and various antisocial and aggressive outcomes. Finally, we discuss potential mechanisms that may help account for the findings, describe how basic research on personality might be leveraged to help explain crime, and suggest future directions for research.

PERSONALITY IN THE CRIME LITERATURE

Despite its ubiquity in psychology, personality has remained relatively absent in the criminology literature. This is unfortunate as there are advantages that personality offers the study of crime.

First, the epidemiological facts of personality mirror those of crime. Personality is relatively stable over time (Roberts & DelVecchio, 2000), which may explain the relative stability of antisocial behavior (ASB; Loeber, 1982). In addition, despite its relative stability, many of the personality domains related to ASB show age-related changes (e.g., individuals generally become more agreeable, more conscientious and more emotionally stable as they get older; e.g., Roberts & Mroczek, 2008) that coincide with age-related changes in rates of ASB.

Second, individual differences fit well within many sociological theories. There is evidence that personality moderates the relations between certain criminological constructs and ASB. Agnew's (1992) general strain theory indicates that when individuals experience strain (i.e., pressure to achieve socially accepted goals in the absence of means to do so), one possible reaction is to engage in delinquency. An individual's underlying personality traits may help explain why some individuals react to stress by engaging in externalizing behaviors (e.g., drug use) rather than internalizing behavior (e.g., anxiety). For instance, Agnew, Brezina, Wright and Cullen (2002) found that individuals who scored high on negative emotionality and low on constraint were more likely to engage in delinquent behavior in reaction to strain. Similarly, the study of the relations between personality and ASB has also yielded insights into why individuals living under the same criminogenic conditions may respond quite differently. For example, several studies have found that impulsive individuals are more susceptible to criminogenic neighborhood conditions (Jones & Lynam, 2009; Lynam et al., 2000; Meier, Slutske, Arndt & Cadoret, 2008; cf., Zimmerman, 2010).

Finally, personality may provide process explanations for several findings within criminology. For example, the heritability of personality (Jang, Livesley & Vernon, 1996; Reimann, Angleitner & Strelau, 1997) may explain the heritability of ASB (Mason & Frick, 1994). It seems more likely that broad dispositions to think, feel and act in certain ways are inherited than are tendencies to break

laws. Additionally, it is well known that individuals who engage in ASB tend to associate with similar others (Matsueda & Anderson, 1998), a process well-studied within the personality field.

Despite the potential benefits of including personality traits as central constructs in our understanding of ASB, the role of personality has been largely ignored within mainstream criminology (see Caspi et al., 1994; Miller & Lynam, 2001). Until recently, with the possible exception of the construct of self-control, no major criminological theory incorporates personality. Even here, the authors of the general theory (i.e., Gottfredson & Hirschi, 1990) argue that their notion of self-control should not be considered a personality trait. This position is clearly advanced in Hirschi's (2004) revised notion of self-control in which he acknowledges that their original description of self-control resembled personality. He stated, however, that he and Gottfredson "introduced a language [we] did not understand, championed ideas contradicting our theory, and otherwise muddled the waters...[W]e can now see the errors introduced by our excursion into psychology" (pp. 541–542).

More recently, personality has been incorporated into the study of crime in the form of psychopathy, a personality disorder with a long and robust history in clinical and forensic psychology. DeLisi (2009) has even argued that psychopathy should be considered the unified theory of crime because of its embodiment of the "pejorative essence of antisocial behavior" as well as its ability to accommodate both dimensional and categorical conceptualizations of antisocial behavior across diverse populations. Research has shown that psychopathy may be useful in identifying the prolific but small group of offenders identified as "career criminals" (Wolfgang et al., 1972; Tracy, Wolfgang & Figlio, 1990; Hare, 1999). Vaughn and DeLisi (2008) found that psychopathic traits nearly doubled the total explanatory power for career criminality when demographic and mental health variables had been taken into account. In addition, psychopathic traits demonstrated 70–88 percent accuracy when predicting career criminal membership.

Although psychopathy is a relatively robust correlate and predictor of ASB, crime and violence (Hemphill, Templeman, Wong & Hare, 1998), its multidimensional nature makes it difficult to ascertain which basic elements of this personality disorder are related to which outcomes – this multidimensionality is made even more difficult by disagreements as to the number and nature of the underlying components (e.g., Lilienfeld et al., 2015; Miller & Lynam, 2012). For instance, psychopathy can be understood as a configuration of extreme scores on general personality dimensions from the Five-Factor Model (Lynam & Widiger, 2001; Miller, Lynam, Widiger & Leukefeld, 2001). Specifically, psychopathy comprises extremely low scores on traits related to agreeableness and conscientiousness, as well as a mixture of high and low scores on traits related to neuroticism (e.g., high

anger, low anxiety, depression) and extraversion (e.g., high assertiveness, excitement seeking, low warmth). Parsing this construct into its constituent parts allows for a clearer delineation of the roles that these various traits play in the commission of externalizing behaviors (e.g., Lynam et al., 2011a). In what follows, we demonstrate the utility of using general personality models to study and understand ASB, and how a focus on narrower traits yields insights into the causes of ASB.

THE FIVE-FACTOR MODEL OF PERSONALITY

To examine the relations between personality and crime, we utilize the FFM – one of several structural models of personality that might be employed. Structural models use multiple dimensions or superfactors to organize the vast array of personality traits into a smaller, more parsimonious model (Wiggins & Pincus, 1992). They share fundamental assumptions: (1) Traits are the basic building blocks, (2) there are a finite number of traits, and (3) traits provide full coverage of human personality. There are multiple benefits to using these models to understand clinical or criminological constructs. First, these models were developed in research efforts to identify and organize the primary building blocks of personality. Second, because these models were identified in basic science efforts and not in efforts to predict specific criteria, problems with predictor–criterion overlap, a recurring objection to personality within criminology, are minimized. Third, each of these models has been widely used and well validated in various kinds of research.

Several structural models have been examined in relation to antisocial behavior, including Eysenck's PEN model, Tellegen's three-factor model, and the FFM/Big Five. Eysenck's PEN model includes factors of Neuroticism, Extraversion and Psychoticism (Eysenck & Eysenck, 1970): Neuroticism entails emotional stability and adjustment; Extraversion reflects traits related to sociability and agency; and Psychoticism, despite its name, encompasses egocentricity, (lack of) interpersonal warmth, (lack of) empathy and impulsiveness. Tellegen's (1985) model also posits three basic dimensions: Positive Emotionality which refers to the tendency to be positively engaged with others and the world, Negative Emotionality which reflects an individual's tendency to experience negative emotions (e.g., fear, anxiety and anger) and his or her tendency to break down under stress, and Constraint which assesses an individual's ability to control impulses, act deliberately, avoid potentially dangerous situations, and endorse traditional values and standards.

The FFM was derived from studies of the English language to identify the personality traits most important in describing oneself and others (Digman, 1990; John & Srivastava, 1999; Wiggins & Pincus, 1992). This research emphasized five broad domains: Extraversion,

Agreeableness, Conscientiousness, Neuroticism and Openness (John & Srivastava, 1999). Extraversion entails an individual's proneness to positive emotions and sociability. Agreeableness is concerned with an individual's interpersonal relationships and strategies; people high in Agreeableness tend to be trusting, straightforward and empathic, whereas those who score low tend to be manipulative, arrogant and unconcerned about others. Conscientiousness relates to the "control of impulses," as well as to the ability to plan, organize and complete behavioral tasks. The domain of Neuroticism entails emotional adjustment and stability. The fifth domain, Openness, refers to an individual's interest in culture, and the preference and interest in experiencing and exploring new activities, ideas and emotions. Each of these five broad domains can be further divided into finer-grained facets or components. Costa and McCrae (1995a) proposed six facets within each domain on the basis of their research with the NEO Personality Inventory – Revised (NEO PI-R; Costa & McCrae, 1992). For example, they parse the domain of Agreeableness (versus antagonism) into more specific facets of trust (vs. suspicion), straightforwardness (versus deception), altruism (versus exploitation), compliance (versus aggression), modesty (versus arrogance), and tender-mindedness (versus tough-mindedness). The domains and facets of the FFM, along with sample items, are given in Table 34.1 from one particular instantiation – the IPIP-NEO (Maples, Guan, Carter & Miller, 2014).

Despite being derived independently and including different numbers of basic traits, there is substantial agreement across the models. All include explicit representations of the "Big Two" – Extraversion (Positive Emotionality) and Neuroticism (Negative Emotionality). Additionally, the FFM and Tellegen's model both contain dimensions related to control of impulses and orientation to convention – Conscientiousness from the FFM and Constraint from Tellegen's model. Eysenck's model does include Conscientiousness, although not as a unique and single factor: Research indicates that Eysenck's Psychoticism dimension can be considered a blend of low Conscientiousness and low Agreeableness (Costa & McCrae, 1995b). All models also include Agreeableness. In Eysenck's model, it is a component of the Psychoticism dimension. In Tellegen's model, it is represented primarily by subscales of the Negative Emotionality dimension (i.e., aggression and alienation). Thus, these structural models are far from discrepant with one another. In fact, Watson, Clark and Harkness (1994) have argued that "the Big Three and Big Five models define a common 'Big Four' space in which (a) two traits are equivalent (Neuroticism and Extraversion), (b) the third Big Three dimension (Constraint or Psychoticism) represents some combination of two Big Five factors (Conscientiousness and Agreeableness) and (c) the final Big Five trait (Openness or imagination) is excluded" (p. 24).

Table 34.1 FFM domains and facets with example items from the IPIP-NEO

Domain/Facet	Descriptors from IPIP NEO
Neuroticism (vs. Emotional Stability)	
N1: Anxiety	+ Am afraid of many things – Am relaxed most of the time
N2: Angry Hostility	+ Lose my temper – Am not easily annoyed
N3: Depression	+ Dislike myself – Seldom feel blue
N4: Self-Consciousness	+ Am afraid to draw attention to myself – Am not easily embarrassed
N5: Impulsiveness	+ Do things I later regret – Am able to control my cravings
N6: Vulnerability	+ Become overwhelmed by events – Am calm in tense situations
Extraversion (vs. Introversion)	
E1: Warmth	+ Make friends easily – Often feel uncomfortable around others
E2: Gregariousness	+ Enjoy being part of a group – Want to be left alone
E3: Assertiveness	+ Take control of things – Don't like to draw attention to myself
E4: Activity	+ Am always on the go – Like a leisurely lifestyle
E5: Excitement-Seeking	+ Am willing to try anything once – Would never go hang gliding or bungee jumping
E6: Positive Emotions	+ Look at the bright side of life – Am not easily amused
Openness (vs. Closedness) to Experience	
O1: Fantasy	+ Love to daydream – Have difficulty imagining things
O2: Aesthetics	+ Believe in the importance of art – Do not like art
O3: Feelings	+ Experience my emotions intensely – Am not easily affected by my emotions
O4: Actions	+ Prefer variety to routine – Don't like the idea of change

Continued

Table 34.1 (cont.)

Domain/Facet	Descriptors from IPIP NEO
O5: Ideas	+ Enjoy thinking about things – Avoid difficult reading material
O6: Values	+ Believe there is no absolute right and wrong – Believe laws should be strictly enforced
Agreeableness (vs. Antagonism)	
A1: Trust	+ Believe that others have good intentions – Suspect hidden motives in others
A2: Straightforwardness	+ Stick to the rules – Use others for my own ends
A3: Altruism	+ Am concerned about others – Am indifferent to the feelings of others
A4: Compliance	+ Hate to seem pushy – Get back at others
A5: Modesty	+ Consider myself an average person – Believe that I am better than others
A6: Tender-mindedness	+ Feel sympathy for those who are worse off – Believe people should fend for themselves
Conscientiousness (vs. Disorder/ Dyscontrol)	
C1: Competence	+ Know how to get things done – Have little to contribute
C2: Order	+ Want everything to be “just right” – Often forget to put things back in their place
C3: Dutifulness	+ Try to follow the rules – Break my promises
C4: Achievement-Striving	+ Do more than what’s expected of me – Put little time and effort into my work
C5: Self-Discipline	+ Carry out my plans – Need a push to get started
C6: Deliberation	+ Choose my words with care – Jump into things without thinking

META-ANALYSES

There have been two previous meta-analyses of the relations between basic dimensions of personality and antisocial behavior. Miller and Lynam (2001) conducted a meta-analysis of four widely used models of personality (i.e., Eysenck’s P-E-N model; FFM; Tellegen’s three-factor model; Cloninger’s seven-factor model of temperament and character) in relation to a single ASB outcome. Across fifty-nine studies, they identified several traits with moderate effect sizes (e.g., Novelty Seeking, Psychoticism, Constraint, Agreeableness and Conscientiousness), each of which could be understood as an indicator of Agreeableness and/or Conscientiousness from the FFM.

Jones, Miller & Lynam (2011) extended and improved upon that initial study and meta-analyzed relations between the dimensions of the Five-Factor Model and two broad antisocial outcomes – general antisocial behavior and aggressive behavior. For each domain and outcome, they identified between twenty-nine and thirty-five studies yielding between 8,837 and 10,311 participants. The results were quite consistent across both outcomes with Agreeableness showing the largest correlation (i.e., $-.31$ and $-.33$ for general ASB and general aggression respectively), followed by Conscientiousness (i.e., $-.18$ and $-.23$), followed by Neuroticism (i.e., $.09$ and $.17$). Neither Extraversion nor Openness were significantly related to either outcome.

For the present chapter, we update and extend the meta-analysis of Jones et al. (2011). Specifically, we meta-analyze 125 studies that provide 138 separate effect sizes. We work with partially disattenuated effect sizes and examine five different antisocial outcomes: general antisocial behavior, general aggression, sexual aggression, child molestation and nonviolent antisocial behavior.

Method

Literature Search

In order to ensure a comprehensive search of the extant literature, the following FFM search terms were used in the PsycINFO database: FFM, Big Five, HEXACO, NEO-PI-R, Neuroticism, Extraversion, Openness, Agreeableness, Conscientiousness and personality. These terms were crossed with the following: aggression, violence, antisocial, crime, delinquency, bullying, offending, sex offen*, sexual violence, rape, rapi*, pedo* and child molest*. For the sexually related antisocial search terms (sex offen* through child molest*), there was no time restriction used for the literature search. For the other antisocial search terms, we confined our search to studies published since 2011.

To be included, the study had to be in English, report on some feature of antisocial behavior and include a measure of personality that assessed the FFM domains and/or facets. We used the correlation coefficient as our effect size. In cases where correlation coefficients could have

been but were not reported, the authors were contacted for the relevant data. In cases where a correlation coefficient could be computed from the available data, online effect size calculators were used to compute a correlation coefficient.

In order to examine the partially disattenuated relations between the FFM domains and study outcomes, we also extracted the reliability coefficients for each domain scale. In cases where authors did not report this information, the authors were contacted by e-mail. We also attempted to solicit unpublished data from authors active in this research area. After reviewing papers for inclusion in the meta-analysis, any author who had published at least two separate papers on the relations between the FFM and antisocial behavior were contacted by e-mail and asked to contribute any available unpublished data. Only one author provided unpublished data, but from seven independent samples. We also reviewed the included studies of the Jones et al. (2011) meta-analysis in order to extract additional effect sizes that were not initially analyzed due to the paucity of studies that had similar outcomes (e.g., a study may have reported a verbal aggression outcome and a physical aggression outcome, but only the physical aggression outcome was taken from the study).

Literature Search Results

For our literature search on the FFM and antisocial behavior, 582 studies were initially returned using our search terms. Based on a review of article titles and abstracts, 101 studies were identified for further review. For our separate literature search on the FFM and sexually motivated antisocial behavior, a total of eighty-two studies were returned using our search terms. After review of the titles and abstracts, a total of thirty-four studies were identified for further review. A total of 135 studies were identified for potential inclusion across the two separate literature searches.

The texts of the 135 studies were more thoroughly reviewed to ensure that they met the inclusion criteria. In addition, the review identified studies with missing information and the authors were contacted by e-mail. A total of seventy-seven authors were contacted regarding missing information and/or to inquire about the availability of data that were not reported in a published paper but otherwise might be available. Of the seventy-seven authors contacted, forty-one authors responded and provided either all or some of the requested data when available.

A more thorough review of the 135 studies resulted in elimination of sixty-two studies that did not meet inclusion criteria. After combining the seventy-three new studies with the studies originally included in the Jones et al. (2011) meta-analysis, a total of 125 studies ($k = 138$) were included in the present meta-analysis. Figure 34.1 displays a flow chart mapping how studies were included in the present meta-analysis. The full list of included studies, along with the information each study contributed (e.g.,

correlational effect sizes, type of outcome) is available from the authors.

Coded Information and Study Outcomes

We also extracted information for use in moderator analyses. This information included: demographics (average age, ethnic composition of sample, percentage of males in the sample, etc.), FFM measure (NEO-PI-R, NEO-FFI, BFI, etc.), source of information (self-report, observer report, official records, etc.), type of sample (prison sample, college sample, MTurk sample, etc.), and publication status (published versus unpublished).

After reviewing the final 136 studies, a total of five antisocial behavior outcomes were identified for analyses. An average antisocial outcome was derived by averaging the multiple effect sizes reported in a given sample across different types of antisocial behaviors. For example, if a sample reported correlations for Neuroticism with non-violent delinquency, physical aggression and relational aggression, the average correlation across the three outcomes was taken and used as the single effect size for that sample in the analysis of the broad antisocial outcome. If a sample only reported one effect size, the single effect size was used for the broad antisocial outcome. The same approach was used for a broad aggression outcome, but only correlations derived from measures of aggression were used (e.g., nonviolent delinquency effect sizes would be excluded). Additional outcomes identified for analyses included sexual assault/rape, child molestation and non-violent antisocial behavior.

After finalizing the set of studies for inclusion as well as which effect size outcomes would be examined, an independent coder reviewed nineteen randomly selected studies from the eighty-one new studies that had been selected for inclusion. The independent coder extracted the coding information for each study along with the effect sizes for each study. There was very high agreement between the independent coders (99 percent agreement across all information).

All domain analyses were conducted using the “metafor” package (Viechtbauer, 2010) in R (R Development Core Team, 2016). Separate meta-analyses were conducted for each outcome and all meta-analyses were conducted using random-effects models. All models utilized inverse variance weights to weight sample effect sizes. The DerSimonian-Laird estimator (DerSimonian & Laird, 1986) was used to estimate τ^2 , the additional variance component incorporated into random-effects models’ estimates of effect sizes.

Results

The meta-analytic results for each FFM domain and outcome can be seen in Table 34.2. Results for the two general outcomes, antisocial and aggressive behavior, showed similar rank-ordering, with Agreeableness and

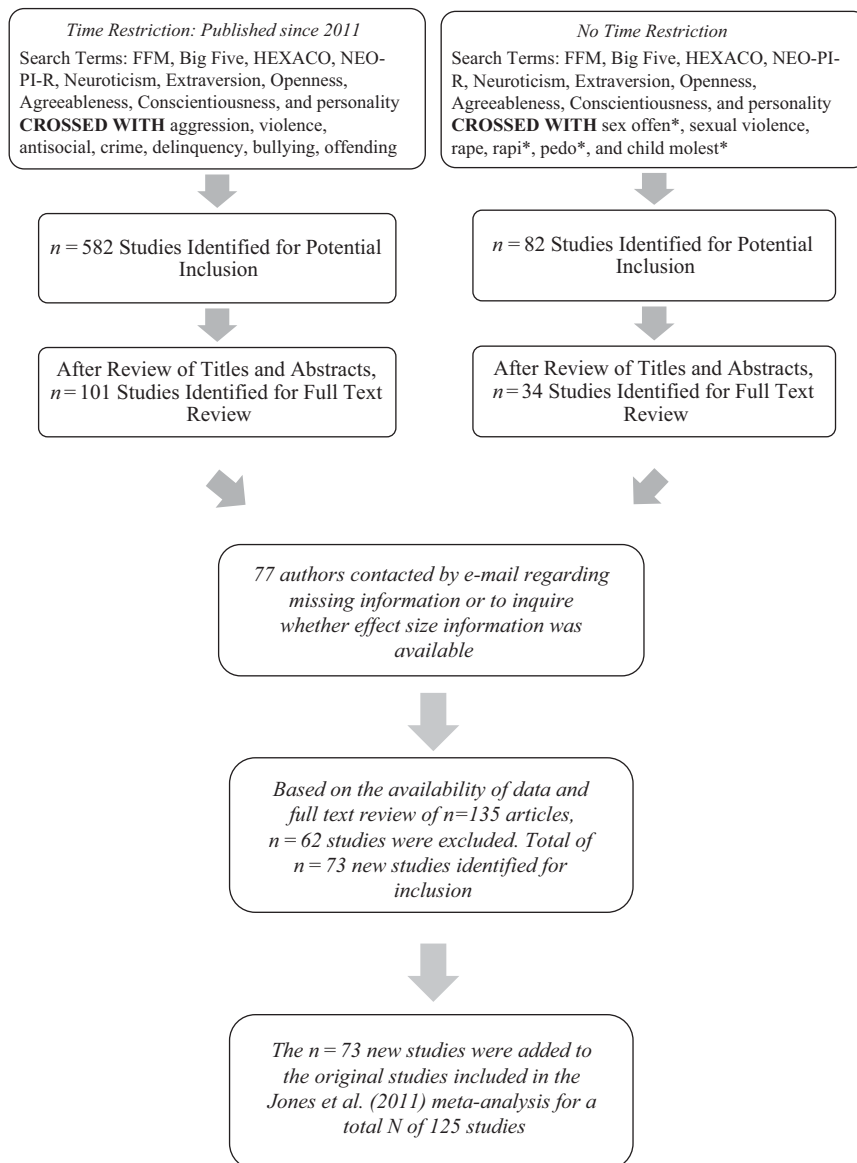


Figure 34.1 Flow chart of the search and study inclusion process for new studies.

Conscientiousness having moderate negative relations with the outcomes. Neuroticism showed similarly sized relations compared to Conscientiousness, but Neuroticism was positively related. Openness showed a small negative relation with the two averaged outcomes, whereas Extraversion was unrelated to both.

The results for the more specific nonviolent antisocial behavior showed the same rank-ordering, with both Agreeableness and Conscientiousness' relations being largest in magnitude compared to the other FFM domains, though Conscientiousness' effect size was slightly larger for nonviolent antisocial behavior and Agreeableness' effect size was slightly smaller. Neuroticism was similarly related to nonviolent antisocial behavior as it was for the averaged antisocial and aggression outcomes, while both Openness and Extraversion showed small, negative effect sizes for the nonviolent antisocial behavior outcome.

The results for the two sexually related antisocial behavior outcomes differed from other results. For the sexual aggression outcome, though the rank-ordering of the effect sizes remained the same, both Agreeableness' and Conscientiousness' effect sizes were notably smaller in magnitude, and Conscientiousness' effect size was non-significant. Though Neuroticism's relation with the outcome was similar in magnitude when compared to other antisocial outcomes, Neuroticism's effect size was non-significant for the sexual aggression outcome. Both Extraversion and Openness remained essentially unrelated to sexual aggression.

In contrast, results for the child molestation outcome diverged drastically from the other outcomes for all domains but Conscientiousness – Conscientiousness was similarly related to child molestation when compared to its relations with other antisocial outcomes. However,

Table 34.2 Disattenuated meta-analytic results for FFM domains

General Antisocial Behavior							
	K	N	Weighted ES	Std. Error	95% CI	I ²	ES Diff.
Neuroticism	129	58,217	.16	.02	.12 to .19	92%	.02
Extraversion	125	57,042	.00	.01	-.02 to .02	78%	.00
Openness	125	57,042	-.05	.01	-.07 to -.03	83%	.00
Agreeableness	133	59,096	-.38	.02	-.42 to -.35	96%	.05
Conscientiousness	128	58,179	-.22	.01	.24 to -.19	89%	.03
General Aggressive Behavior							
Neuroticism	94	32,708	.19	.02	.15 to .22	92%	.02
Extraversion	90	31,533	.00	.01	-.03 to .02	77%	.00
Openness	90	31,533	-.06	.01	-.09 to -.04	73%	.00
Agreeableness	97	33,321	-.40	.02	-.44 to -.36	95%	.06
Conscientiousness	93	32,670	-.21	.01	-.23 to -.18	82%	.03
Sexual Aggression							
Neuroticism	5	1282	.10	.07	-.04 to .24	83%	.01
Extraversion	5	1282	-.01	.09	-.19 to .17	89%	.00
Openness	5	1282	-.04	.05	-.15 to .06	66%	.00
Agreeableness	5	1282	-.22	.04	-.29 to -.15	31%	.03
Conscientiousness	5	1282	-.14	.09	-.31 to .02	88%	.01
Child Molestation							
Neuroticism	5	354	.38	.06	.27 to .49	26%	.02
Extraversion	5	354	-.22	.11	-.41 to -.01	74%	.02
Openness	5	354	-.25	.13	-.47 to .01	83%	.04
Agreeableness	5	354	.42	.13	.18 to .61	83%	.04
Conscientiousness	5	354	-.21	.11	-.40 to -.01	73%	.01
Nonviolent Antisocial Behavior							
Neuroticism	16	7,223	.15	.04	.08 to .22	89%	.02
Extraversion	15	6,726	-.03	.02	-.08 to .02	73%	.00
Openness	15	6,726	-.03	.02	-.07 to .02	66%	.00
Agreeableness	16	7,223	-.34	.04	-.40 to -.27	90%	.04
Conscientiousness	16	7,223	-.28	.03	-.33 to -.23	82%	.03

Note: Bolded effect sizes indicate that the effect is significant at $p < .01$; k = number of independent samples included in effect size calculation; N = number of total participants across samples; ES = effect size; Std. Error = standard error of the weighted effect size; ES Diff. = the absolute difference in values between the disattenuated effect size and the nondisattenuated effect size.

Agreeableness showed a moderate positive relation with child molestation, opposite to its relations with other study outcomes. Though Neuroticism still showed a positive relation with the child molestation outcome, the magnitude of the relation increased compared to the other outcomes in Table 34.2. Both Extraversion' and Openness' relations also increased in magnitude, with both domains showing moderate negative relations, though Extraversion's relation was nonsignificant. Importantly, the I^2 value for nearly all effect sizes indicated notable heterogeneity. Meta-regression analyses were conducted to examine the potential effect of relevant moderators on the observed effect sizes.

Moderator Analyses

In most cases, moderation of the observed effect sizes was absent or very small. However, notable moderation was present in a few cases. For Neuroticism's relation with the average antisocial outcome, the ethnic make-up of the sample affected the relation such that samples with a greater number of white participants had smaller effect sizes. Similarly, Conscientiousness' relation with the average antisocial outcome became less negative as samples included more whites. Conscientiousness' effect size was also less negative for prison samples compared to nonprison samples.

Notable moderation effects were also observed for Neuroticism's relation with sexual aggression and Openness' relation with nonviolent antisocial behavior. However, for both of these outcomes there were significantly fewer samples used for the analyses. In turn, there was very little variability in levels of the moderators and the results should be interpreted cautiously. For sexual aggression, only one prison sample was available for moderator analyses, and for the nonviolent antisocial outcome, only one sample deviated from the others in terms of ethnic make-up (i.e., most samples were composed of 80–90 percent white participants).

FFM Facets, Antisocial Behavior and Aggressive Behavior

There were enough studies to allow us to update the facet-level analyses of Jones et al. (2011) and to examine whether domain level effects were driven by specific facets for the two broadest outcomes – antisocial behavior and aggressive behavior. The results show that the facets of both Agreeableness and Conscientiousness demonstrate consistent negative relations with these outcomes, ranging in magnitude from small to moderate (see Table 34.3). The majority of Openness' facet relations were negative, though they were smaller in magnitude than the relations observed for Agreeableness and Conscientiousness and most of Openness' facet relations were close to zero. Relative to the other three domains, the facets of Neuroticism and Extraversion showed greater heterogeneity. Within Neuroticism, the Angry Hostility (N2) facet showed the

largest positive relations with the average antisocial and aggressive behavior outcomes, followed by Impulsiveness (N5) and Depression (N3). The Vulnerability (N6) facet also showed small positive relations with these outcomes. However, the facets of Anxiety (N1) and Self-Conscientiousness (N4) were essentially unrelated to the average antisocial and aggressive behavior outcomes. The facets of Extraversion showed the greatest heterogeneity, with some facets showing effect sizes of similar magnitude, but in opposite directions. Specifically, the Warmth (E1) and Positive Emotions (E6) facets showed significant negative relations with the average antisocial and aggressive behavior outcomes, while the Excitement Seeking (E5) facet was positively related to the same outcomes.

Discussion of Results

In general, results were broadly consistent across four of the five outcomes. Before discussing the consistencies, it is important to note that results for child molestation were discordant from all others. While other outcomes showed no relation to E, a small positive relation to N, and a moderate negative relation with A, child molestation was negatively related to E, strongly positively related to N and positively related to A. Recent work aimed at categorizing sex offenders, more specifically child molesters, provides important insight into our findings. Marshall, Smallbone & Marshall (2014) distinguished between “affiliative” and “nonaffiliative” child molesters. They write that the majority of child molesters use noncoercive strategies such as “grooming,” which requires perpetrators to develop a seemingly nurturing relationship with the victim. The authors highlight that this method is more characteristic of child molesters who have molested relatives or who are acting in some type of caretaking role (e.g., step-father). A divergent method, found for the minority of child molesters, involves a lack of grooming behaviors and is more likely to be characterized by a use of force or coercive tactics. This method of offending is more characteristic of perpetrators who do not know their victims. It appears that the child molester samples included in our analyses fall under the “affiliative” category. From the perspective of the FFM, child molesters may be most obviously distinguished by Agreeableness scores, with “affiliative” child molesters expected to score higher on Agreeableness compared to “non-affiliative” child molesters. Our meta-analytic results also suggest that Neuroticism and Extraversion may also serve as relevant personality characteristics for child molestation.

Results for the other antisocial outcomes underscore several important points. The first is the ubiquitous influence of low Agreeableness (or high Antagonism) on antisocial outcomes. It bears the strongest relation to each of the outcomes with average effect sizes ranging from $-.22$ for sexual aggression to $-.40$ for general aggressive behavior. These results held across all facets of Agreeableness. These results are consistent with the role of Agreeableness

Table 34.3 Meta-analytic relations between FFM facets, antisocial behavior and aggressive behavior

	General Antisocial Behavior				General Aggressive Behavior			
	k	N	Weighted ES	95% CI	k	N	Weighted ES	95% CI
N1-Anxiety	20	6,347	.04	-.02 to .10	15	4,949	.03	-.05 to .11
N2-Angry Hostility	21	6,437	.27	.20 to .33	16	5,039	.27	.19 to .35
N3-Depression	20	6,347	.13	.08 to .17	15	4,949	.11	.06 to .17
N4-Self-Consciousness	20	6,347	.01	-.03 to .05	15	4,949	-.01	-.04 to .03
N5-Impulsiveness	21	6,437	.19	.14 to .24	16	5,039	.16	.09 to .22
N6-Vulnerability	20	6,347	.10	.03 to .16	15	4,949	.07	.00 to .14
E1-Warmth	19	5,850	-.18	-.23 to -.13	14	4,452	-.16	-.20 to -.12
E2-Gregariousness	19	5,850	-.02	-.06 to .02	14	4,452	-.01	-.04 to .02
E3-Assertiveness	20	5,940	.05	.01 to .08	15	4,542	.08	.03 to .12
E4-Activity	19	5,850	-.01	-.04 to .02	14	4,452	-.01	-.05 to .03
E5-Excitement Seeking	20	5,940	.17	.10 to .23	15	4,542	.13	.06 to .20
E6-Positive Emotions	19	5,850	-.11	-.16 to -.06	14	4,452	-.11	-.16 to -.06
O1-Fantasy	19	5,850	.03	-.01 to .07	14	4,452	.02	-.03 to .07
O2-Aesthetics	19	5,850	-.03	-.06 to .00	14	4,452	-.07	-.10 to -.04
O3-Feelings	19	5,850	-.04	-.08 to .00	14	4,452	-.04	-.10 to .01
O4-Actions	19	5,850	.01	-.02 to .05	14	4,452	-.03	-.07 to .00
O5-Ideas	19	5,850	.00	-.06 to .05	14	4,452	.00	-.05 to .06
O6-Values	19	5,850	-.06	-.10 to -.01	14	4,452	-.07	-.12 to -.02
A1-Trust	21	6,437	-.21	-.25 to -.17	16	5,039	-.21	-.27 to -.16
A2-Straightforwardness	20	6,347	-.32	-.36 to -.27	15	4,949	-.29	-.35 to -.24
A3-Altruism	21	6,437	-.23	-.28 to -.18	16	5,039	-.22	-.26 to -.17
A4-Compliance	21	6,437	-.36	-.43 to -.27	16	5,039	-.37	-.47 to -.27
A5-Modesty	20	6,347	-.16	-.19 to -.13	15	4,949	-.17	-.22 to -.13
A6-Tender-mindedness	21	6,437	-.16	-.21 to -.12	16	5,039	-.18	-.21 to -.15
C1-Competence	20	6,484	-.15	-.20 to -.09	15	4,949	-.08	-.14 to -.02
C2-Order	20	6,484	-.08	-.12 to -.04	15	4,949	-.07	-.12 to -.02
C3-Dutifulness	20	6,484	-.22	-.28 to -.17	15	4,949	-.16	-.23 to -.10
C4-Achievement Striving	20	6,484	-.10	-.14 to -.05	15	4,949	-.06	-.11 to -.01
C5-Self-discipline	20	6,574	-.12	-.17 to -.07	16	5,039	-.07	-.13 to -.02
C6-Deliberation	20	6,484	-.25	-.30 to -.20	15	4,949	-.22	-.27 to -.17

Note: Bolded effect sizes are significant at $p < .01$; N = Neuroticism; E = Extraversion; O = Openness; A = Agreeableness; C = Conscientiousness; k = number of independent samples used to compute effect size; N = total number of participants across samples.

in FFM profiles of psychopathy, antisocial personality disorder and narcissistic personality disorder (e.g., Lynam & Widiger, 2001; Samuel & Widiger, 2008). Whether one meta-analyzes the relation between the FFM and psychopathy (O'Boyle, Forsyth, Banks, Story & White, 2015), "translates" a psychopathy inventory into the language of the FFM (Widiger & Lynam, 1998) or asks experts to rate the prototypical psychopath on the FFM (Miller, Lynam, Widiger & Leukefeld, 2001), Agreeableness emerges as one of the largest, most robust and most important elements of psychopathy. In fact, each of its six facets is included in the composite profile for psychopathy (Lynam, Gaughan, Miller, Mullins-Sweatt & Widiger, 2011). For example, in the O'Boyle et al. meta-analysis, Agreeableness manifested an average weighted correlation of $-.53$ with psychopathy, and with facet-level relations ranging from $-.19$ for modesty to $-.41$ for straightforwardness. These findings have led us to argue elsewhere that high levels of Antagonism are the core feature of psychopathy, a necessary and nearly sufficient condition (Lynam & Miller, 2015; Miller & Lynam, 2015).

There are several places to look to understand why Agreeableness is so robustly related to antisocial behavior. The first is through its extensional definition. Crowe, Lynam and Miller (2018) recently examined the underlying, joint factor structure of Agreeableness items from twenty-two scales assessing Agreeableness from five different inventories in a large sample of participants (i.e., $n = 1,205$). An optimal five-factor solution was identified consisting of Compassion (versus Callousness), Morality (versus Immorality), Modesty (versus Arrogance), Affability (versus Combateness), and Trust (versus Distrust). Thus, the antagonistic individual feels little empathy, has little sense of morality, thinks himself/herself better and more important than others, is oppositional and confrontational and is suspicious of others' motives. It is easy to see how such an individual can hurt others, disregard norms and flout the law.

Another place to look to understand how Antagonism might lead to antisocial behavior lies in process accounts of Agreeableness, the most comprehensive of which has been offered by Robinson and colleagues (e.g., Meier & Robinson, 2004; Meier, Robinson & Wilkowski, 2006; Robinson, 2007; Wilkowski, Robinson & Meier, 2006). These authors highlight that multiple processes intervene between the time a stimulus is first processed and subsequent emotional and behavioral outcomes. In turn, there are important stages throughout the course of this process at which personality traits such as agreeableness can exert influence.

Robinson (2007) highlights that Agreeableness is likely to be most important to two stages of processing: affect control and emotion control, where the former is related to processes that counteract affective priming and the latter reduces the likelihood that affective thoughts lead to downstream emotional reactions. At both of these stages, Agreeableness has been argued to have an

inhibitory effect. In regard to affect control, Wilkowski and Robinson (2007) propose that Agreeableness-related processes lead to reappraisals of initially hostile interpretations of stimuli. In relation to emotional control, the authors argue that Agreeableness-related processes may work to actively suppress outward manifestations of anger (e.g., facial expressions, aggression).

In support of Agreeableness' influence on affective control, research has found that individuals high in Agreeableness are able to more quickly categorize prosocial target words following a hostility-related priming word, whereas those low in Agreeableness were slower to categorize the same prosocial target words following the hostility-related prime (Meier et al., 2006). In other words, the accessibility of supposed prosocial thoughts actually increases following a hostile prime for individuals high in Agreeableness, suggesting an automatic defusing process that starts to take place after recognition of a hostile stimulus. In regard to emotional control, research has shown that Neuroticism's relation with anger and aggression is moderated by agreeableness, such that the relation is attenuated for individuals who are also high in Agreeableness (Ode, Robinson & Wilkowski, 2008). Moreover, though individuals high in Agreeableness are just as quick to characterize words in terms of their blameworthiness (e.g., words like negligence or malpractice), the ability to quickly characterize such words was only a predictor of aggression for those low in Agreeableness (Meier & Robinson, 2004). These results suggest that the accessibility of hostile thoughts may not differ between individuals low and high in Agreeableness, but the presence of high Agreeableness may serve to inhibit the initially activated hostile thoughts from leading to emotional reactions, and in turn, aggressive behaviors. Additional evidence, based off of Gross's (1998) model of emotion regulation stages, found that Agreeableness was related to the first stage of emotion regulation, situation selection (Bresin & Robinson, 2015). Using a picture viewing task where participants could view positively and negatively valenced pictures for as long as they wanted, Bresin and Robinson (2015) found that individuals low in Agreeableness spent a longer amount of time viewing negative pictures compared to positive pictures, while individuals high in Agreeableness showed no such preference. In a separate study (Study 3; Bresin & Robinson, 2015), the authors found that individuals high in agreeableness showed a stronger preference for positively/negatively valenced activities. These results were taken to suggest that Agreeableness plays a role in the earliest stage of emotion regulation: The types of stimuli one is likely to be exposed to in the first place can be influenced by agreeableness-related processes.

A second consistency at the domain level is the general importance of Conscientiousness to antisocial behavior. Although it was not statistically significantly related to sexual aggression, the domain of Conscientiousness was significantly negatively related to antisocial behavior, aggressive behavior and nonviolent antisocial behavior

with r s ranging from $-.21$ to $-.28$. At the facet level, there was less consistency than was observed for the Agreeableness facets; Dutifulness and Deliberation were generally more strongly negatively related to outcomes than were the other four facets. Again, the importance of Conscientiousness and these particular facets to antisocial behavior mirror their importance to psychopathy where Conscientiousness is the second largest and robust correlate of psychopathy (Lynam & Miller, 2015; Miller & Lynam, 2015). In the O'Boyle et al. (2015) meta-analysis, the effect size of $-.21$ for Conscientiousness and psychopathy was the only other significant domain level effect observed. In the meta-analysis, after Deliberation ($r = -.35$) and Dutifulness ($r = -.29$), Self-discipline manifested the third largest facet-level relation ($r = -.24$). These are the three Conscientiousness facets that appear in prototypic descriptions of psychopathy (Lynam et al., 2011).

The reason Conscientiousness is important to antisocial behavior can be understood by reference to the divergence among its facets. The three facets that show relations to psychopathy, two of which show statistically significant relations to antisocial behavior, have to do with impulse control or hedonism. According to Costa and McCrae (1992), low scorers on Deliberation are "hasty and often speak or act without considering the consequences" (p. 18). Similarly, low scorers on Self-discipline "cannot force themselves to do what they want themselves to do" (p. 18). Finally, low scorers on Dutifulness are described as being casual about ethics and moral obligations and "may be somewhat undependable or unreliable" (p. 18). In fact, Deliberation and Self-discipline correspond to two of the original four impulsogenic traits identified within the UPPS model of impulsive behavior (Whiteside & Lynam, 2001) with low Deliberation corresponding to (lack of) Premeditation and low Self-discipline corresponding to (lack of) Perseverance. Interestingly, the other two facets within the UPPS model, Impulsiveness from Neuroticism (i.e., UPPS Urgency) and Excitement Seeking from Extraversion (i.e., UPPS Sensation Seeking) also show statistically significant relations to antisocial behavior (r s = $.19$ and $.17$ for Impulsiveness and Excitement Seeking) and aggressive behavior (r s = $.16$ and $.13$ for Impulsiveness and Excitement Seeking).

A third consistency lies in Neuroticism's small to moderate relations with antisocial behavior ($r = .16$), aggressive behavior ($r = .19$) and nonviolent antisocial behavior ($r = .15$). An examination of facet-level effects suggests these relations are driven primarily by two specific facets: Angry Hostility ($r = .27$ for both antisocial behavior and aggressive behavior) and Impulsiveness (r s = $.19$ and $.16$ for antisocial behavior and aggressive behavior). These relations are interesting given the secondary loadings that these facets have on other domains (Costa & McCrae, 1992). Specifically, Angry Hostility has a large secondary loading on Agreeableness (loading = $-.48$), whereas Impulsiveness has a secondary loading on Conscientiousness

(loading = $-.32$). This pattern of secondary loadings is essentially replicated by the two Extraversion facets that bear significant but opposite relations to antisocial behavior and aggressive behavior. Whereas Warmth bears small, negative relations to both outcomes, Excitement seeking bears similarly sized but positive relations to the outcomes. Each of these facets shows substantial but opposite secondary loadings on Agreeableness (i.e., loadings = $.38$ for Warmth and $-.38$ for Excitement Seeking). Thus, even when other domains are implicated in antisocial behavior, their effects can be understood by reference to Agreeableness and Conscientiousness.

ADVANTAGES OF FFM APPROACH

There are multiple advantages to linking antisocial behavior outcomes to general models of personality, particularly the FFM. Although we articulated some of these earlier in the chapter, we offer additional ones here. First, the FFM domains were derived from a natural language approach, ensuring that important aspects of personality are represented (John & Srivastava, 1999). Second, the FFM, as represented by the NEO PI-R, provides a reasonably extensive and fairly comprehensive lexicon of thirty facets. Although McCrae and Costa (2013) note that there are important traits that are not included within the thirty facets (e.g., punctuality), the NEO PI-R represents the most complete FFM model and assessment available. The few existing alternative FFM assessments are less well articulated and provide less, rather than more, coverage at the facet level. The Big Five Aspects Scale created by DeYoung, Quilty and Peterson (2007) offers two aspects per domain; individuals low in Agreeableness would be described as impolite and callous, whereas those low in Conscientiousness would be described as low in orderliness and industriousness. One widely used assessment, the Big Five Inventory (John, Naumann & Soto, 2008), provides scores only for the five domains and a small number of underlying facets. Third, the FFM, both at the domain and facet levels, enjoys considerable empirical support in the form of convergent and discriminant validation across self, peer and spouse ratings (Costa & McCrae, 1988), temporal stability across the life span (Roberts & DelVecchio, 2000), etic and emic cross-cultural support (Church, 2001; McCrae, Martin & Costa, 2005), behavioral genetic support for the FFM structure (Yamagata et al., 2006), and relations to important outcomes including academic achievement (Poropat, 2009), physical (Bogg & Roberts, 2004) and psychological health (Malouff, Thorsteinsson & Schutte, 2005; Samuel & Widiger, 2008), work (Judge, Heller & Mount, 2002), leadership (Judge, Bono, Ilies & Gerhardt, 2002), antisocial behavior (Jones, Miller & Lynam, 2011), substance use and abuse (Kotov et al., 2011), and risky sexual behavior (Hoyle, Fejfar & Miller, 2000).

Fourth, and perhaps most importantly, in addition to the research base supporting the FFM, there is a

tremendous research base emanating from this model. Multiple researchers have used this model to study the development and continuity of FFM traits over time (e.g., Caspi, Roberts & Shiner, 2005; Tackett et al., 2012), as well as the levels of these traits as a function of gender, age and culture (e.g., Schmitt, Realo, Voracek & Allik, 2008; Soto & John, 2012). Similarly, researchers have used this model to study the processes underlying and outcomes attributable to specific domains within the FFM, such as the basic processes underlying Agreeableness discussed previously. Over the last decade, Roberts and colleagues have systematically studied the composition (e.g., Roberts, Chernyshenko, Stark & Goldberg, 2005), consequences (e.g., Bogg & Roberts, 2004), and correlates (e.g., Roberts, Jackson, Burger & Trautwein, 2009) of Conscientiousness. There are multiple research programs aimed at the basic processes underlying the facet-level traits within the FFM, including the work of Whiteside and Lynam (2001) on diverse personality pathways to impulsive behavior. Understanding antisocial behavior from the FFM framework allows this massive body of basic research to be brought to bear on research to inform theorizing on assessment, etiology, course, treatment and prevention.

FUTURE DIRECTIONS

There are obvious extensions of this work. Although we were able to extend our meta-analysis to new outcomes, there remain outcomes to be examined. For example, our general aggressive behavior outcome remains quite broad including physical aggression, verbal aggression, social/relational aggression, reactive aggression and proactive aggression. Different FFM profiles may characterize different types of aggression. For example, Miller and Lynam (2006) found that while both reactive and proactive aggression were negatively related to Agreeableness and Conscientiousness, only reactive aggression was positively related to neuroticism. Similarly, different personality profiles were discovered in the present chapter when child molestation was split from the more general sexual aggression category.

More research at the facet level is also required. A much more fine-grained picture of antisocial and aggressive behavior emerged when facets were examined. Although all facets of Agreeableness were generally related to these outcomes, this was not the case for Conscientiousness, Neuroticism, or Extraversion. An examination of which facets were involved led to more nuanced understandings of the nature of the relations. For example, finding that Angry Hostility and Impulsiveness were primarily responsible for the observed relations for Neuroticism suggests a different theory than what might have been suggested had facets associated with self-directed negative affect (e.g., Anxiety, Depression and Self-consciousness) been shown to be important.

Finally, more research on the mechanisms by which these traits might lead to antisocial behavior needs to be

conducted. We offered some speculations based on process research on Agreeableness but such research requires replication and extension to explicitly antisocial outcomes. Similarly, we speculated on the process by which traits associated with impulsivity (i.e., high Impulsiveness, high Excitement Seeking, low Self-discipline and low Deliberation) might be linked to antisocial behavior via a failure to consider consequences. But these speculations require more direct testing.

CONCLUSION

With this chapter, we attempted to ignite interest in personality within the field of criminology. We did so by detailing the advantages that come with using a well-supported basic taxonomy of individual differences in thinking, feeling and acting. Further, we described in some detail a consensus model of personality, the FFM, which consists of five broad domains (i.e., Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness), each underlain by six facets or subtraits. Next, we quantitatively summarized a fairly large body of empirical work relating the FFM to a number of antisocial and aggressive outcomes. Results highlighted the importance of all facets of Agreeableness and several facets of Conscientiousness (i.e., Dutifulness and Deliberation). Our discussion of these results offered several possible mechanisms through which these relations might be mediated. Finally, we pointed to remaining gaps in the literature and called for additional research. Hopefully it is obvious by now that personality has much to offer the field of criminology.

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INTRODUCTION

Three fundamental questions have tasked philosophers and scientists across time: “Where do we come from?”, “Why are we here?” and “Why do people do what they do?” Academics working within behavioral economics (i.e., the application of economic and psychological approaches to understand how individuals make economic decisions) and personality psychology (i.e., the study of relatively stable patterns of behavior and experience) have addressed the third question. Behavioral economists examine how certain incentive structures, frames or choice architectures nudge people’s choices (preferences). Similarly, personality psychologists explore how different traits interact with context to predict behavior. Both traditions have developed their own theoretical frameworks, analytic strategies and methods. Accordingly, personality psychologists and economists have much they can learn from each other with the aim of answering the third fundamental question and by doing so offer better and more nuanced answers about determinants of behavior (Borghans, Duckworth, Heckman & ter Weel, 2008; Cunha & Heckman, 2008; Ferguson, 2015; Ozer & Bennet-Martinez, 2006; Roberts, Kuneel, Shiner, Caspi & Goldberg, 2007). The aim of this chapter is to offer some suggestions that may guide this integration.

Personality psychology provides psychometric methods that can inform the meaning and structure of economic preferences (Borghans et al., 2008; Ferguson, Heckman & Corr, 2011) which in turn predict many economic outcomes (e.g., Becker et al., 2012). Furthermore, recent theoretical and empirical work by Heckman and colleagues reveals the important role played by personality in predicting major socioeconomic outcomes (e.g., Almlund, Duckworth, Heckman & Kautz, 2011; Heckman & Kautz, 2012; Conti & Heckman, 2014). This work has highlighted how traits develop and change – e.g., exposure to socioeconomic events, and investment in personal development efforts – making them promising targets for interventions (Borghans et al., 2008; Heckman & Kautz, 2012;

Heckman, 2007). Likewise, psychologists can learn protocols from economists concerning (a) causal inferences, (b) the role of incentives, (c) trait measurement with respect to the “identification problem,” and (d) supplementation of self-report methods with behavioral paradigms (Borghans et al., 2008).

To examine the synergy between economics and personality psychology we first explore the link between personality and preferences to better understand prosociality and cooperation in microeconomic social interactions. We then explore how personality can predict macroeconomic outcomes such as GDP. Finally, we will explore the lessons that can be learned from both economics and personality psychology.

PERSONALITY AND PREFERENCES: THE EXAMPLE OF PROSOCIALITY

Economic preferences capture how people order alternative choices and are traditionally divided into: (1) *time* (e.g., temporal discounting: how long people prefer to wait for a larger delayed reward versus a smaller immediate reward, to index patience or impulsivity), (2) *risk* (e.g., risk aversion), (3) *leisure* (preferences between income and nonwork leisure time) and (4) *social or other regarding preferences* (preferences between self- and other-interests, for example to index altruism). Preferences can be assessed in the laboratory, using single-person decision-making tasks, economic games with multiple people, as well as with survey questions (e.g., “Are you the sort of person who likes to take risks?”).

Personality psychology can contribute to the understanding of preferences with respect to their: (1) construct validity, (2) predictive power, particularly as personality traits and preferences are not the same (Borghans et al., 2008), and (3) psychometric properties, particularly the structure and stability of preferences (Ferguson, Heckman & Corr, 2011). We will illustrate these issues with respect to social preferences, but the argument equally applies to risk, time and leisure preferences.

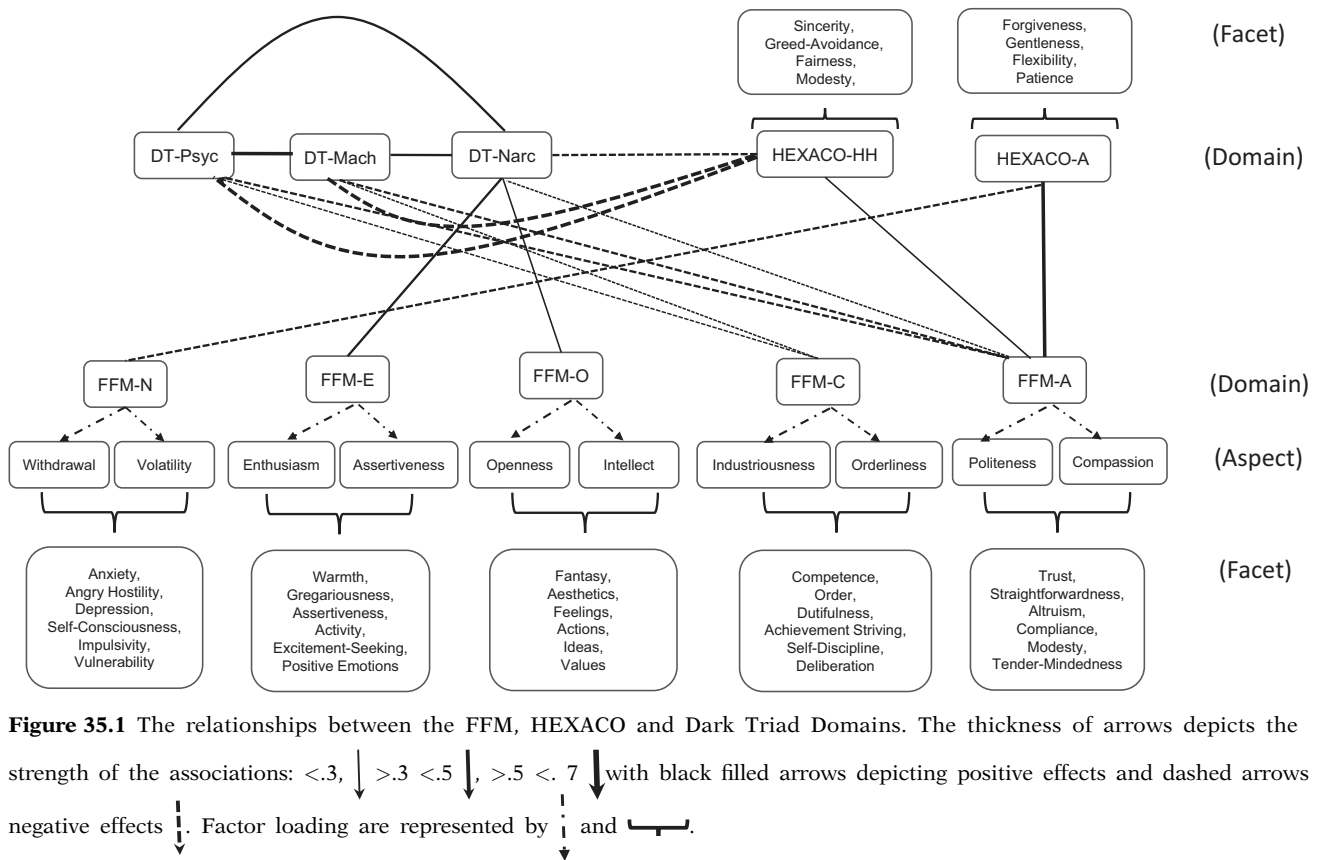


Figure 35.1 The relationships between the FFM, HEXACO and Dark Triad Domains. The thickness of arrows depicts the strength of the associations: $<.3$, $.3 \leq .5$, $.5 \leq .7$, $>.7$ with black filled arrows depicting positive effects and dashed arrows negative effects. Factor loading are represented by $\vdash$ and $\dashv$.

Prosocial Traits

Prosocial personality traits capture relatively stable patterns of other-regarding behaviors and tendencies (e.g., compassion, trustworthiness, respect; see Zhao & Smillie, 2015 for a review). In the Five-Factor Model (FFM) of personality these traits are grouped together within the “domain” of Agreeableness. In the HEXACO model, an alternative, six-factor taxonomy of personality (Ashton & Lee, 2007; Lee & Ashton, 2004), prosocial tendencies are divided between Honesty-Humility and HEXACO-Agreeableness. Honesty-Humility, reflects the tendency to be sincere, modest, and fair, representing *active cooperation* (i.e., cooperating with others despite the opportunity for exploitation). In contrast, HEXACO-Agreeableness reflects the tendency to be patient, forgiving and tolerant, representing *reactive cooperation* (i.e., cooperating with others despite their misgivings; Ashton et al., 2014; Hilbig, Zettler, Leist & Heydasch, 2013). The relations between HEXACO and FFM prosocial domains are shown in Figure 35.1.

Antisocial Traits

While this section deals primarily with prosocial traits and preferences, we also describe the Dark Triad (DT), which focuses more narrowly on subclinical malevolent aspects of personality and antisocial traits. The DT consists of *narcissism* (i.e., self-aggrandizing, inflated view of self that

needs to be reinforced by others), *Machiavellianism* (i.e., a cynical view of humanity that promotes self-interest and gain by manipulating others), and *psychopathy* (i.e., a lack of empathy and remorse from harming others, and marked antisocial behaviors) (Muris et al., 2017; Furnham et al., 2013; Paulhus & Williams, 2002). While the DT traits are associated with domains both from the FFM and HEXACO models, they are not merely the opposite poles of agreeableness and conscientiousness (Muris et al., 2017; O’Boyle et al., 2012). As can be seen, the DT traits relate most closely to Honesty-Humility (Lee & Ashton, 2005), and thus it has been suggested that the HEXACO model encompasses both the FFM and the DT in a single model (Lee & Ashton, 2005). We will return to the DT when we examine workplace deviance later.

Prosocial Preferences

As an organizing framework for other-regarding preferences we distinguish between bargaining games (usually involving an allocation of resources between two people) and social dilemmas (situations depicting a conflict between short-term self-interest and the long-term collective interests). We further differentiate bargaining games between: (1) *unidirectional games*, where outcomes depend only on the choices of one individual with whom the power resides (the decision-maker), and (2) *bidirectional games*, where outcomes depend on a combination of the decisions of all individuals.

(a) Dictator game (Forsythe, Horowitz, Savin & Sefton, 1994)  Player A Decides how much of endowment to allocate to partner Player B	(b) Ultimatum game (Güth, Schmittberger & Schwarze, 1982)  Player A Decides how much of endowment to allocate to partner Player B
Potential Constructs and processes measured: fairness, preferences for equality, prosocial preferences, altruism, unconditional kindness, self-interest Broad trait predictors: Big Five agreeableness (politeness aspect), HEXACO honesty-humility	Potential Constructs and processes measured (Player A): fairness, preferences for equality, prosocial preferences, altruism, self-interest, “strategic” fairness. Constructs and processes measured (Player B): punishment, negative reciprocity, retaliation, spite Broad trait predictors (Player B): Big Five agreeableness, HEXACO agreeableness

Figure 35.2 Summary findings for unidirectional and bidirectional economic bargaining games.

Note: Summary findings taken from Zhao & Smillie (2015) and Zhao, Ferguson & Smillie (2017c).

Unidirectional Bargaining Games

The one-shot dictator game (DG; Forsythe, Horowitz, Savin & Sefton, 1994) (Figure 35.2) consists of a single decision-maker who begins with a financial endowment and chooses to transfer some, none, or all to a powerless recipient. While the rational choice is to give nothing, dictators allocate 20–30 percent on average, which is generally taken to index altruism and fairness preferences (Engel, 2011).

Bidirectional Bargaining Games

The ultimatum game (Figure 35.2, UG; Güth, Schmittberger & Schwarze, 1982) consists of two players: a proposer who chooses how much of the endowment to allocate to a responder, who chooses to accept or reject this offer. If the responder accepts, the proposer's division stands, but if they reject the offer, both get nothing. From a traditional economic point of view, the responder should accept any nonzero offer as this is better than the zero they started with, and the proposer, knowing this, should offer a minimal amount. However, responders reject offers as they become increasingly unfair, providing evidence of punishment of unfairness and spite.

Social Dilemmas

Social dilemmas are multiplayer models of cooperation where immediate self-interest is pitted against long-term collective interests. The classic social dilemma is the one-shot public goods game (PGG), played in groups of four anonymous players (Figure 35.3). Each player begins with an equivalent endowment (private account) and can contribute some, none or all to a group (public account). The sum of the contributions is then multiplied by an efficiency factor and redistributed equally to players regardless of their initial contribution. Each player's payoff is determined by the amount they keep in their private

accounts plus what is returned from the public account. The group's payoff is maximized when everyone contributes maximally and equally, while each individual's payoff is maximized by not contributing (i.e., free-riding), provided other group members contribute.

Other examples of social dilemmas are the prisoner's dilemma and trust games (Figure 35.3). In the prisoner's dilemma (PDG; Flood, 1958), two players simultaneously decide whether to cooperate or to defect, with these actions determining payoffs. Joint payoffs are highest when both players cooperate and lowest when both players defect. However, individual payoffs are highest for a defecting player and lowest for a cooperating player when one player defects while the other cooperates. This creates a self-interested incentive to defect that leads to suboptimal payoffs overall.

The trust game (TG; Berg, Dickhaut & McCabe, 1995) taps into trustfulness, trustworthiness, cooperation and reciprocity, by separating cooperation decisions into two stages. The investor begins with a financial endowment and can choose to invest any portion of this with the trustee. The endowment is then multiplied by an efficiency factor, and the trustee decides how much of this multiplied sum to return to the investor.

Punishment

A variation of the standard one-shot PGG is to include an option to punish free-riders (2nd party punishment) at a personal cost (Fehr & Gächter, 2002). Punishment options typically lead to increased cooperation, but reduced efficiency (less overall resources for the group). It is believed that punishing enforces norms of fairness and is potentially motivated by anger or moral emotions such as guilt (Fehr & Fischbacher, 2004a,b; Ma, Tunney & Ferguson, 2017). It can also, however, lead to 2nd order free-riding, in which nonpunishers receive the benefits of collective cooperation by free-riding on others' punishment.

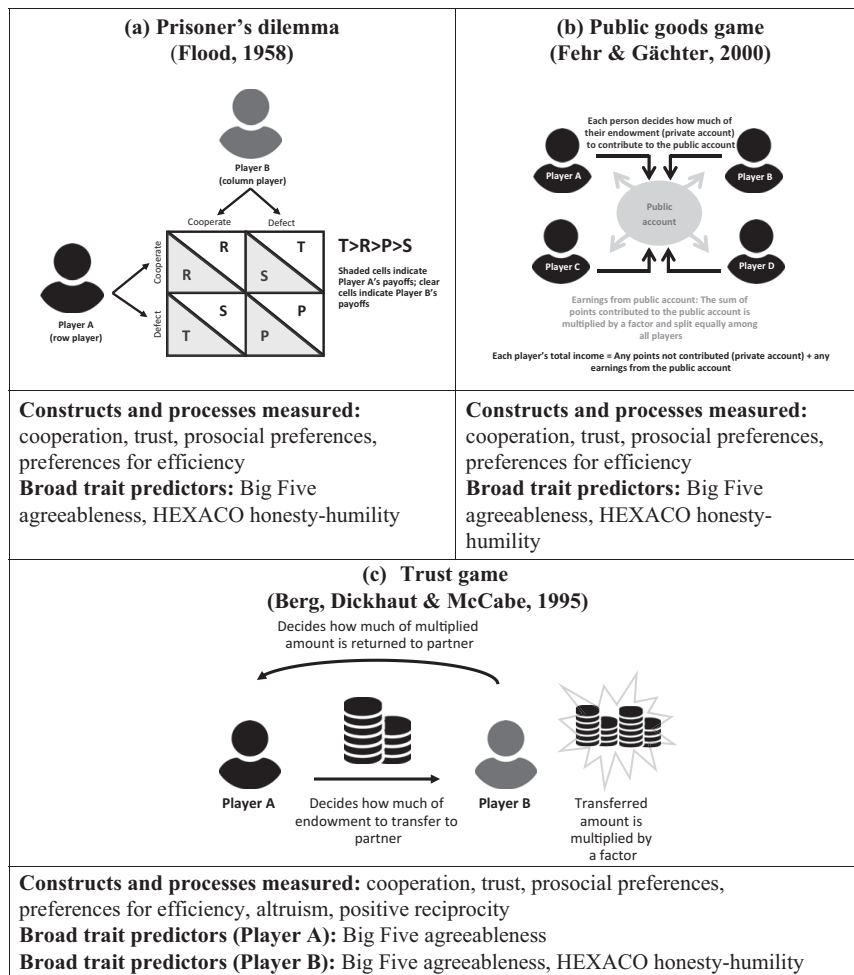


Figure 35.3 Social dilemmas summary findings taken from Zhao and Smillie (2015) and Thielmann and Hilbig (2015).

Punishment, along with recompensation, can be extended to 3rd party instances whereby a neutral bystander witnesses a game and chooses, at personal cost, to punish an unfair decision-maker or recompense a powerless recipient (Fehr & Fischbacher, 2004a,b; Leliveld, Van Dijk & Van Beest, 2012) (Figure 35.4).

PSYCHOMETRICS, PREFERENCES AND PROSOCIAL PHENOTYPES

The application of factor analytic procedures has confirmed the existence of a general cooperative phenotype based on behavioral (Brocklebank, Lewis & Bates, 2011; Yamagishi, Mifune, Li, Shinda, Hashimoto, Horita, Miura, Inukai, Tanida, Kiyonari, Takagishi & Simunovic, 2013), as well as a mixture of self-report, behavioral and neuroimaging data (Hubard, Harbaugh, Srivastava, Degras & Mayr, 2016). Recent developments in this area have focused on multiple dimensions within the cooperative phenotype (Böckler, Tusche & Singer, 2016; but see Wilhelm, Kaltwasser & Hilderbrandt, 2018, and Böckler, Tusche & Singer, 2018, for a debate about these data) as well as the distinction between costly and costless

prosocial phenotypes (Ferguson, Zhao, O'Carroll & Smillie, 2019).

Finally an important paper by Peysakhovich, Nowak and Rand (2014) extends this work further to show, using a variety of one-shot cooperation and punishment games, the existence of two clear factors reflecting a "cooperative" and "norm enforcing punishment" phenotype, both of which were stable over time. Conceptually, these "cooperative" and "norm-enforcing" behavioral phenotypes correspond with the personality traits of HEXACO-honesty-humility (characterized by fair and cooperative tendencies) and HEXACO-agreeableness (characterized by retaliatory tendencies), respectively.

Personality and the Construct Validity of Preferences

We can examine prosocial preferences through the lens of personality traits to get a clearer sense of the psychological processes they measure. Importantly, the role of personality in driving individual differences in economic game behavior depends on the context in which the game is played. Consider a decontextualized one-shot DG game

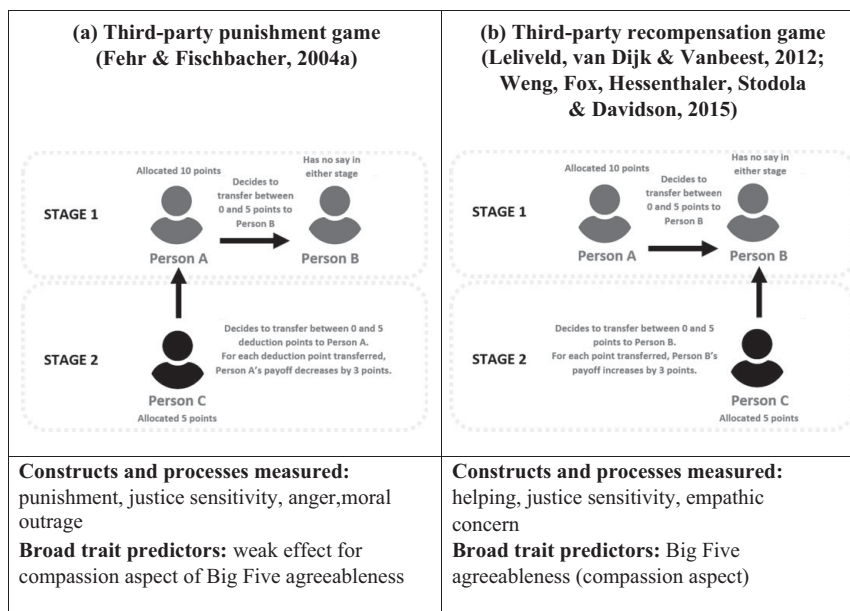


Figure 35.4 Third party punishment and recompensation games (dictator variant).
Note: Summary findings taken from Zhao, Ferguson and Smillie (2017c).

that is traditionally assumed to assess altruism (e.g., Benenson, Pascoe & Radmore, 2007). Camerer and Thaler (1995) argue, however, that allocation in the decontextualized DG reflects “manners” and etiquette around norms of fairness. From a personality perspective these two views reflect empathic concern or compassion for another’s wellbeing (Batson, 2010), as distinct from politeness, etiquette, “manners” and norm adherence. Compassion and politeness are two major aspects of FFM-agreeableness that can be used to test these explanations of the motivations underlying the decontextualized DG. Using this logic, Zhao et al. (2017c) showed that politeness, but not compassion, was uniquely associated with DG allocations (Zhao et al., 2017a,b). Honesty-Humility is another robust predictor of decontextualized allocations in the DG, but not HEXACO-Agreeableness (see Zhao & Smillie, 2015). This may reflect the fact that honesty-humility and politeness are closely aligned, with both describing tendencies toward fairness, norm adherence and active cooperation (Barford, Zhao & Smillie, 2015).

What happens when the DG becomes contextualized? There is evidence that the dictator changes their behavior as the nature of the recipient changes (Eckel & Grossman, 1996), the choice set changes (Ferguson & Flynn, 2016) or the property rights of the dictator change (Cherry, Frykblom & Shogren, 2002). Again, we can look at personality traits of the dictator to examine their motivations under different contexts. For example, Zhao, Smillie and Ferguson (2017b) showed that both politeness and compassion were important predictors when the DG was framed to highlight real-world concerns of equity and need. Another example concerns norms around distributive justice, in which decision makers decide to compensate a victim and/or punish a transgressor. Zhao, Ferguson and Smillie,

(2017c) showed that, whereas politeness predicts greater allocations to an anonymous stranger in a DG, compassion predicts greater allocations of wealth to recompense a victim in a 3rd party recompensation game. The studies above suggest that two cooperative phenotypes emerge when differentiating allocations of wealth by situational contextualization – one reflecting “politeness” in the decontextualized format and one reflecting “compassion” in the contextualized format that reflect recipient need or equity.

These examples serve to show how personality traits can clarify the psychological processes that underlie behavior within economic games, and help to explain some of the heterogeneity and stability of game behavior (Volk et al., 2011, 2012), as well as the heterogeneity observed both within and across games (Ferguson, Heckman & Corr, 2011).

PERSONALITY AND MACROECONOMIC OUTCOMES

We now explore work that has examined the FFM, HEXACO models, as well as the Dark Triad (DT) in relation to macrolevel socioeconomic outcomes. We divide macrolevel socioeconomic outcomes into those based on economic productivity and wellbeing (e.g., productive work behaviors and GDP), versus those with negative consequences (unemployment, counterproductive work behaviors, turnover and absenteeism). The main findings from the literature are summarized in Table 35.1.

Positive Productive Work Behaviors

A large and consistent body of evidence supports conscientiousness as a consistent positive predictor of success at work, with validity coefficients of about .25 (Schmidt &

Table 35.1 Summary of the relation between broad personality traits and major socioeconomic outcomes

Socioeconomic outcomes	Traits
Job performance and productive work behaviors	+ Conscientiousness (Barrick & Mount, 1991; Barrick et al., 2001; Hunter & Hunter, 1984; Hurtz & Donovan, 2000; Salgado, 1997; Schmidt & Hunter, 1998) – Neuroticism (Barrick et al., 2001; Salgado, 1997) – Machiavellianism, psychopathy (O'Boyle et al., 2012) + Extraversion (occupations involving management and sales; Barrick & Mount, 1991) + Honesty-Humility (occupations involving caregiving roles; Johnson et al., 2011)
Entrepreneurialism	+ Conscientiousness (Brandstätter 2011; Zhao & Seibert, 2006; Zhao et al., 2010) + Openness (Brandstätter, 2011; Zhao & Seibert, 2006; Zhao et al., 2010) + Extraversion (Brandstätter, 2011; Zhao et al., 2010) – Agreeableness (Brandstätter, 2011; Zhao & Seibert, 2006) – Neuroticism (Brandstätter, 2011; Zhao & Seibert, 2006; Zhao et al., 2010)
Gross Domestic/State Product	+ Extraversion (Stolarski et al., 2013) + Openness (Stolarski et al., 2013; Yang & Lester, 2016) – Neuroticism (Yang & Lester, 2016)
Unemployment	– Conscientiousness (Egan et al., 2017; Uysal & Pohlmeier, 2011) + Openness (Viinikainen & Kokko, 2012) + Neuroticism (Uysal & Pohlmeier, 2011)
Turnover and absenteeism	– Conscientiousness (absenteeism: Judge, Martocchio & Thoesen, 1997; turnover: Salgado, 2002; absenteeism: Störmer & Fahr, 2013; turnover: Zimmerman, 2008) + Neuroticism (turnover: Salgado, 2002; absenteeism: Störmer & Fahr, 2013; turnover: Zimmerman, 2008) – Agreeableness (absenteeism: Störmer & Fahr, 2013; turnover: Zimmerman, 2008) + Extraversion (absenteeism: Judge, Martocchio & Thoesen, 1997)
Counterproductive work behaviors	– Agreeableness (Berry et al., 2007; Bolton et al., 2010; Mount, Ilies & Johnson, 2006; Salgado, 2002) – Conscientiousness (Berry et al., 2007; Bolton et al., 2010; Mount, Ilies & Johnson, 2006; Salgado, 2002) – Honesty-Humility (Lee, Ashton & de Vries, 2005; Lee, Ashton & Shin, 2005; Marcus, Lee & Ashton, 2007; Wiltshire et al., 2014) + Machiavellianism, psychopathy, narcissism (Furnham et al., 2013; O'Boyle et al., 2012) + Neuroticism (Berry et al., 2007; Chi et al., 2015)

Note: + (–) indicates a positive (negative) relation between the trait and outcome.

Hunter, 1998; Hunter & Hunter, 1984; Salgado, 1997). While the validity generalization of conscientiousness is observed across all occupations, it is important to remember that (1) conscientiousness may also have a dark-side (i.e., links with obsessive compulsive behaviors) and (2) other traits such as Honesty-Humility (see Johnson, Rowatt & Petrini, 2011) and Extraversion (Barrick & Mount, 1991) are predictive of success in specific jobs (caregiving and sales roles, respectively). Finally, and in contrast, the DT traits show a much weaker negative association with productivity that may reflect the fact that they are more likely to be predictive of counterproductive work behaviors (O'Boyle et al., 2012). However, the negative association for narcissism is stronger for those in positions of power, suggesting that occupational status is an important moderator of the effect of narcissism on work performance (O'Boyle et al., 2012).

Entrepreneurialism

Entrepreneurs are often viewed as wealth creators and innovators. In case-control analyses contrasting entrepreneurs with managers, entrepreneurs are characterized by high conscientiousness, openness and extraversion, and low neuroticism (Zhao & Seibert, 2006; Zhao, Seibert & Lumpkin, 2010). Although agreeableness is often lower in entrepreneurs this effect is not consistent (Zhao et al., 2010).

Gross Domestic/State Product (GD/SP)

When considering GD/SP, the association between personality, aggregated at the level of countries or states, with indices of national productivity and economic success has been examined. Stolarski et al. (2013) reported that GDP is positively associated with extraversion and openness, with

the latter dropping out when IQ is modeled. Yang and Lester (2016) explored the FFM with respect to predicting GSP in the USA, as an index of production capacity, and GSP *per capita* as an index of living standards. When controlling for other economic variables, openness predicted GSP and extraversion predicted GSP per capita. While such associations are interesting, these findings should be interpreted cautiously. First, there is a potential *selection bias* with more creative and curious (i.e., open) people attracted to more productive regions in the US (e.g., California, New York) (e.g., Rentfrow, Gosling, Jokela, Stillwell, Kosinski & Potter, 2013). However, that said, regional level variation in personality does predict regional variation economic indicators such as wealth (e.g., median household income per capita) and innovations (e.g., number of patents in an area), with a “relaxed and creative” trait cluster (very low neuroticism, low extraversion and agreeableness, average conscientiousness, and very high openness) predictive of these economic indicators (Rentfrow et al., 2013; see also Rentfrow, Jokela & Lamb, 2015). Second, one must be mindful of the *ecological fallacy*, which states that we cannot apply aggregated data to individuals. For example, the risk of heart disease based on certain life style factors (e.g., smoking), estimated at an epidemiological level, does not mean that risk of developing heart disease is the same for everyone who smokes and does not smoke.

Unemployment

Unemployment has serious consequences in terms of economic costs to the nation (welfare payments) as well as consequences for personal wellbeing (see Egan et al., 2017). Using data on adolescent personality, Egan et al. (2017) showed that high conscientiousness mitigated against future episodes of unemployment, with this mediated by academic motivation. Viinikainen and Kokko (2012) controlled for reverse causality using earlier measures of the FFM as instrumental variables and showed that openness predicts periods of unemployment. They suggested that this may be due to open people being less choosy in their work and having worse person-job fit. However, this may also reflect a greater willingness to explore and experiment with new jobs/career paths, thus experiencing more career disruptions. There is also evidence that high neuroticism predicts unemployment (Uysal & Pohlmeier, 2011). In short, the traits that predict unemployment are not yet clearly established.

Turnover and Absenteeism

High levels of turnover are costly in terms of recruitment costs, lack of role continuity and loss of organization knowledge, and reduced staff morale. Salgado (2002) and Zimmerman (2008) show that higher conscientiousness and lower neuroticism are linked to reduced turnover. Predicting absence from work has produced variable findings, for

example, absenteeism from work has been predicted by both low agreeableness (Stormer & Fahr, 2013) and low conscientiousness (Judge, Martocchio & Thoesen, 1997).

Counter-Productive Work Behaviors (CPWB)

CPWBs have been variously defined in terms of: (a) *abuse* (e.g., physical or verbal abuse to coworkers), (b) *production deviance* (e.g., deliberately doing work incorrectly), (c) *sabotage* (e.g., deliberately damaging work property), (d) *theft* (e.g., stealing work property) and (e) *withdrawal* (e.g., leaving work early) (Spector et al., 2006). Other accounts of CPWBs distinguish between: (1) *interpersonal deviance* (ID; e.g., violence, gossip towards coworkers), which is represented by abuse, and (2) *organizational deviance* (OD; e.g., deliberately working slowly, damaging company property), which is represented by production deviance, sabotage and withdrawal (Bennett & Robinson, 2000). Low agreeableness and low conscientiousness are linked to greater “general deviant behavior” (Salgado, 2002). However, low agreeableness is linked to ID (through abuse) and low conscientiousness to OD (through sabotage and withdrawal), and higher levels of neuroticism are associated with both (Berry et al., 2007; Bolton et al., 2010). Higher Honesty-Humility is associated with lower general CPWB (Marcus, Lee & Ashton, 2007; Wilshire, Bourdage & Lee, 2014). O’Boyle et al. (2012) argued that, although traits like Machiavellianism may carry some benefits at work (e.g., behaving as a social chameleon), all three DT traits are broadly linked with increased CPWBs. This prediction is supported with narcissism and Machiavellianism having the strongest effects with a weaker positive effect for psychopathy. However, effect of psychopathy (but not narcissism and Machiavellianism) are context dependent with psychopaths in positions of workplace authority showing less CPWBs than those with low workplace authority (O’Boyle et al., 2012).

Summary

Several broad observations concerning macro socioeconomic outcomes and personality can be drawn (see Table 35.1). However, most research has considered broad trait domains, revealing a need for investigation at the aspect and facet levels. This would inform which of the narrower aspects or facets is driving the relationship between broad domains and socioeconomic outcomes and shed light on potential mechanisms (e.g., whether conscientiousness drives work performances through its rule-following aspect – orderliness – or through its goal-prioritization aspect – industriousness).

WHAT PERSONALITY PSYCHOLOGY ADDS TO ECONOMICS

In this section we briefly describe some important features and recent developments in personality psychology, drawing implications for economists.

Trait Hierarchy and Different Taxonomic Models of Personality Traits

An important feature of personality structure is its hierarchical organization of traits. That is, lower level facets represent narrower and more specific traits, which are nested within aspects at the intermediate level and within broad domains at the highest level (Figure 35.1) (DeYoung, 2015; DeYoung et al., 2007). While different levels of the hierarchy may be suited to addressing different questions, research has tended to focus on the upper domain level (John, Naumann & Soto, 2008). When designing any study on economic outcomes, careful reference needs to be made to the most pertinent level in the hierarchy given the question or theory under investigation. Furthermore, care is needed when interpreting the predictive power of personality traits in panel datasets as most panel datasets have only domain-level measures, usually assessed by relatively few questions and at a single time point. If prediction is weak, it may reflect the breadth, level, appropriateness and reliability of the personality measure used.

Furthermore, while the FFM has dominated the literature, important personality domains outside the FFM contained within the HEXACO and DT models offer useful explanatory power. Thus, economists should consider examining these subclinical malevolent (e.g., DT) and morally relevant traits (e.g., HEXACO honesty-humility).

Personality Change

While personality shows a degree of stability, individuals vary in their expression of trait-relevant behaviors, and expression of these behaviors is context specific (Sherman et al., 2010, 2015). That is, extraverts will tend to display more extraverted behaviors than introverts on average, but all individuals will behave in a more extraverted or introverted way depending on the context in which they find themselves (Fleeson, 2004; Sherman et al., 2015). It is the mean of an individual's distribution that is relatively stable over time and which correlates with their personality trait score (Fleeson, 2004; Fleeson & Gallagher, 2009). In addition, major economic events, such as unemployment, may serve to shift that distribution, resulting in individual mean change, though not all individuals will necessarily change to the same degree (Boyce et al., 2010, 2015).

Personality traits also show predictable patterns of change throughout development and across the lifespan (Roberts et al., 2006; see Caspi et al., 2005; Roberts & Mroczek, 2008, for reviews), as well as in response to socioeconomic events, including transitions to university, entering work and becoming unemployed (Denissen, Luhmann, Chung & Bleidorn, 2019; Ludtke et al., 2011; Robins et al., 2005; Roberts et al., 2003; Boyce et al., 2015). In fact, therapeutic and psychological interventions targeting personality change have been tested successfully (Tang et al., 2009; Hudson & Fraley, 2015; for a

meta-analysis, see Roberts et al., 2017). The degree of personality change is itself subject to individual differences (Ludtke et al., 2011) and is influenced by beliefs about the changeability of personality (Robins et al., 2005).

How and why do traits change? The *sociogenomic model* offers an explanation of individual personality change (Roberts & Jackson, 2008). This provides a framework for the dynamic interactions among traits, biology and the environment in the context of personality development. It postulates that environmental factors influence the development (change) of personality traits indirectly via changes in biological systems (e.g., changes in genetic expression and brain structures) which produce thoughts, feelings and behaviors. This model can be complemented by two approaches from evolutionary biology that contribute to explaining why traits might change: (1) *evo-devo models* (Laland et al., 2011) and (2) *niche construction theories* (Odling-Smee et al., 2013) (see Ferguson & Leivens, 2017). Evo-devo models offer a synthesis of evolutionary and developmental biology, whereby development enhances the adaptive quality of a phenotype. Niche construction theories describe organisms as “eco-engineers” who adapt and change their environments in such a way that any evolutionary gains are passed on, with these changes also likely to affect trait change. Thus, traits lead organisms to both select, as well as change/shape their environments. Such trait selection, shaping and socialization has long been observed with respect to human personality (Caspi et al., 2005).

Implications of Trait Change for Socioeconomic Studies

Many economists and psychologists mistakenly view traits as fixed entities, but the dynamic nature of traits needs to be accommodated in models. Two major issues arise as a consequence. First, large panels often only include traits at one time point or they are added late in the life of the panel. Thus, the effects of earlier events on personality and how they have changed cannot be assessed. Second, if the analyst assumes that the traits examined are fixed (see Uysal & Pohlmeier, 2011), then this may underestimate the effects of a changing trait.

Good Guys versus Bad Guys and Curvilinear Relationships with Socioeconomic Outcomes

There is also growing evidence to indicate that the effect of a trait depends on context. Any trait may produce beneficial outcomes in one context and detrimental outcomes in others (Nettle, 2006). For example, neuroticism has anxiety as one of its facets, which brings benefits in terms of increased vigilance to danger, but is also costly in terms of the negative impact of stress (Nettle, 2006). For example, Ferguson et al. (2014) have shown in medical students that, although neuroticism is often disadvantageous at

work, it is a positive predictor of performance of medical skills (where a degree of vigilance is likely helpful). Conversely, high conscientiousness, a broad positive predictor of job performance, was detrimental with respect to the application of clinical knowledge (where flexibility of thought is needed Ferguson et al., 2003). Indeed, Widiger and Mullins-Sweatt (2008) suggest the FFM traits may be related to behaviors that are associated with being either maladaptive or normal, with these further divided into high and low. Thus, maladaptive high conscientiousness (rigid, single minded), maladaptive low conscientiousness (careless, sloppy) and normal low conscientiousness (disorganized) would all hinder good performance, whereas normal high conscientiousness (organized, resourceful) would enhance it. This supports a “Goldilocks hypothesis” (Martin & Keyes, 2015), in which a curvilinear function links the trait to performance. Therefore, economists utilizing traits in their research should carefully consider the context in which both the outcome and trait are being assessed.

WHAT PERSONALITY PSYCHOLOGISTS CAN LEARN FROM ECONOMISTS

Having detailed how personality traits can help understand and predict microeconomic economic preferences as well as macroeconomic socioeconomic outcomes, we now explore how economics can inform and strengthen this work.

The Identification Problem

Across a number of papers, Heckman and colleagues (Heckman & Kautz, 2012) have discussed the *identification problem*. Starting from the position that traits are measures of behavior on a production task – the completion of a personality inventory – then performance on such a task, at any one time-point, will be determined by multiple parameters (Conti & Heckman, 2014). These include (1) incentives, (2) other traits and (3) previous experiences (habitual or investments).

Incentivizing Personality Test Completion

Incentives are often thought to help standardize the effort put into a task (Hertwig & Ortmann, 2001) and may be financial or nonfinancial. Financial incentives are known to influence cognitive ability test scores (Almund et al., 2010), but at present there are no data examining the effect of financial incentives on personality trait endorsements. One approach for ensuring that participants are at least adequately engaging with the task has been to use incentivized attention checks in which participants must respond in a certain way based on instructions embedded in the personality measure (e.g., Zhao, Ferguson & Smillie, 2016).

Another way to do this is to ask people to complete their personality inventory under instructions to be as honest as

possible and that their responses will be compared to close friends/acquaintances’ assessment of their personality. The closer the two scores align the greater the financial reward. This of course relies on the idea that self- and peer-assessed personality measure the same thing. Almund et al. (2010) argue that self- and peer-reports, like all behavior, are proxies of the same underlying trait. However, others argue that self- and peer-reports might tap into different aspects of personality: *trait*, *identity* (unique self-perceptions) and *reputation* (presentation of self to others) (McAbee & Connelly, 2016). Indeed, while some evidence shows that self- and peer-reports of personality are associated (Connelly & Ones, 2010; Oh et al., 2011), this is complicated by the fact that some traits are more accurately judged by informants (e.g., intellect), whereas other traits are not (e.g., neuroticism; see Vazire, 2010). Thus, incentivizing personality test scores is likely to be difficult.

Influence of Other Traits

At any one time-point, a trait score will be affected by other traits. For instance, it is well established that performance on cognitive tests is influenced by both neuroticism and conscientiousness (Almund et al., 2010, and Borghans et al., 2008), with this further complicated by incentive effects. For example, certain traits associated with neuroticism (anxiety) are known to influence responsiveness to incentives and rewards (Gu et al., 2017). Traits related to socially desirable responding such as *impression management* (i.e., the conscious effort to present oneself in a favourable light) and *self-deception* (i.e., the unconscious mechanisms leading people to deceive themselves about their personality) will also influence the endorsement of FFM trait items (Paulhus, 1984). However, the effect of a socially desirable response set as a threat to the predictive validity of personality test scores has been questioned or thought to be less serious than previously believed (Ones, Viswesvaran & Reiss, 1996).

Influence of Socioeconomic Events

As we have seen, personality expression changes not only as a function of time, but also as a consequence of the very economic events being studied (e.g., unemployment), as well as investments (or interventions) to enhance personality. These antecedent factors influence current personality score endorsement and need to be considered in models, especially with a move from prediction to causation.

Econometrics and Causality

While personality psychologists have traditionally been concerned with how traits predict outcomes, there have been recent calls to go beyond prediction to examine the causal role of personality and personality change (Heckman & Kautz, 2012; Borghans et al., 2008; Conti & Heckman, 2014). To do this, a number of threats to causality for personality research first need to be considered, including

(1) reverse causality, (2) measurement error and (3) the identification problem.

Reverse causality is a particular concern given the evidence that personality traits change as a function of potential socioeconomic outcomes under consideration. Economists have developed an extensive arsenal of econometric approaches to allow the researcher to infer causality in the absence of random allocation. We focus on two of many: instrumental variables and adjusted factor models (see Antonakis, Bendahan, Jacquart & Lalive, 2010).

Instrumental Variables

Instrumental variables (IVs) have a long tradition in the economic literature. IVs are designed to deal with problems of *endogeneity* (i.e., the explanatory predictor is correlated with the error term, leading to threats to causality due to missing variables and/or reverse causality) by isolating the variability in the predictor that is causally related to the outcome (Angrist, Imbens & Rubin, 1996; Angrist & Krueger, 2001; Newhouse & McClellan, 1998). IVs have to be highly correlated with the predictor (instrumental relevance) (Greenland, 2000), influence the outcome only via the predictor, and be orthogonal to the error in the predictive model (instrumental exogeneity), and large sample sizes are required (Angrist & Krueger, 2001). A good example of the use of an IV model is given by Howard (2000), who examined the causal effect of waiting time on liver transplant graft rejection. Certain blood types (e.g., O) are less likely to find a match and, therefore, have to wait longer, but blood type will not affect the outcome (graft-host rejection) because this is immune system dependent. Howard's (2000) findings reveal that waiting time is a causally significant predictor of graft-host rejection in a sample of 12,616 cases.

A major challenge with IV models is the a priori identification of an IV that predicts the trait but not the outcome. There are two fruitful avenues for exploring potential IVs in personality research. First, researchers could adopt a Mendelian IV approach and look for genes that predict levels of the trait but are unrelated to the outcome (Didelez & Sheehan, 2007; Lawlor, Harbord, Sterne, Timpson & Davey Smith, 2008). Second, split-sample IV models may be applied whereby the sample is randomly split, with the first half used to estimate initial parameters (known as first-stage estimates in a two-stage least square approach). These serve as first-stage estimates for attaining the main model parameters using the second random half (Angrist & Krueger, 1995).

Adjusted Factors and Dynamic Factor Models

Heckman, Stixrud and Urzua (2008) present a dynamic factor model that does not require identifying an IV. Instead, they adjusted factor scores by calculating regression estimates that take into account contextual factors at the time that the personality test was taken. They provide

an example in which different regression equations predicting scholastic choice and other linked outcomes are estimated for people with different levels of schooling at the time the personality test was taken (see also Urzua, 2008). Cunha and Heckman (2008) also have developed an approach that extends dynamic factor models to arrive at a latent factor score on a trait that accounts for previous experiences, investments (habitual and planned), and measurement error. These approaches also help alleviate, to some extent, issues related to the identification problem.

GRAPHICAL APPROACHES TO CAUSALITY: SOME LESSONS FOR BOTH PERSONALITY PSYCHOLOGY AND ECONOMICS

Causality is a key question in both economics and personality psychology, as such the work of Pearl (2009a,b) is worth highlighting. Pearl developed a graphical approach (Directed Acyclic Graphs: DAGs) as well as a causal calculus to explore causality in complex systems. This can be used to indicate specific causal hypotheses and inform data analytic approaches (see Lee, 2012, for a recent example for personality and Rohrer, 2018, for application to psychology in general).

DAGs

From the discussion above it is clear that events (1) at the time of the personality assessment (e.g., other traits), and (2) prior to the personality assessment (e.g., life events) may influence the trait score. Furthermore, personality traits may also influence subsequent events – including the event being considered – along with associated cognitions and emotions. The work of Pearl (2009a, b) offers a framework for considering the role of both antecedents and consequences of a focal personal-outcome link, with respect to inferring causality. Pearl (2009a,b) considers a set of focal variables such as the causal link between X (exposure: traits) and Y (outcome: unemployment). Both X and Y have predictors termed *ancestors* (parents, grandparents, etc. depending how far back they are in the causal chain) and *descendants* (children, grandchildren, etc.). Within this framework Pearl (2009a,b) develops the idea of DAGs that allow for the graphical representation of the relationship between X and Y and their ancestors and descendants (Figure 35.5). While DAGs look very much like Structural Equation Models they differ in that they contain no-linearities and do not allow for bidirectional arrows. DAGs offer some solutions for testing causality in SEM (e.g., *D-separation*). Pearl's approach also offers a system for deciding which variables should and should not be controlled in any statistical analysis. This system consists of confounder, collider and mediator variables, which are briefly described below.

Confounders concern ancestor variables that are related directly (Figure 35.4A) or indirectly (Figure 35.5B and

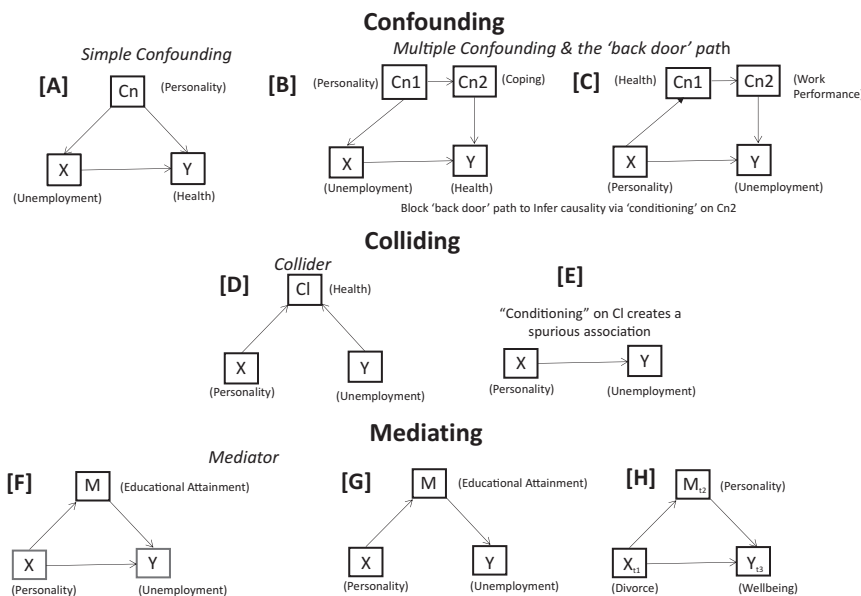


Figure 35.5 Representation of Confounders, Colliders and Mediators.

35.5C) to X and Y. Paths from, and passing through confounders open up “backdoor paths” to causality. Controlling (conditioning on) confounders reduces or eliminates back-door paths and potentially the association between X and Y. *D-separation* (directional separation) is a case whereby controlling an appropriate set of theoretically relevant confounding ancestors, results in the association between X and Y becoming statistically independent. D-separation is a prediction that can be tested in any DAG/SEM, using partial correlations, by tracing the ancestor variables back in “time” to identify confounders (Hayduk et al., 2003; Foster, 2010; Lee, 2012). If the causal model in the DAG suggests D-separation when confounders are controlled then that should be the case (Hayduk et al., 2003; Lee, 2012). If a DAG suggests that conditioning on one ancestor is sufficient to cause D-separation, then adding others will make no difference as the back-door path is already closed. As is seen in Figure 35.5B personality may not need to be controlled for the unemployment and health association if personality is associated with coping. If coping is controlled, unemployment and health should be D-separated, and personality does not need to be controlled as the path from personality to health is blocked by conditioning on coping.

Another major insight from Pearl’s work (2009a) is what happens when conditioning on *descendants* of focal variables that arise temporally after the main X-Y link. These are called *collider variables* and should not be controlled in any analyses (Elwert & Winship, 2014). A collider variable is codetermined by the predictor and outcome and the inclusion of a collider variable in a model will result in spurious association between X and Y. In terms of personality and socioeconomic outcomes, personality traits like neuroticism may increase the risk of depression (Ferguson, 2013), as does unemployment (Karten & Moser,

2009). If depression is considered a descendent of both neuroticism and unemployment then conditioning this model to include depression may result in a “spurious” association between neuroticism and unemployment. While collider variables resemble suppressor effects reported in regression models (MacKinnon, Krull & Lockwood, 2000), the difference is that the collider is part of a causal structure and not just a statistical effect (Arah, 2008).

Finally, Pearl discusses *mediation*. Here a mediator (M) is a process variable that transmits the effect from X to Y. As personality traits can change they may also act as mediators, especially in longitudinal research. However, collider variables can be a problem in mediator models. If the mediator and outcome have a joint descendent, then conditioning on this will open up a back-door link by causing a spurious association with the predictor (see Foster, 2010; Glymour, 2006). Recent developments in causal mediation, based on a counter-factual approach by Pearl (2014), has led to two key terms: The *natural direct effect* (NDE) and the *natural indirect effect* (NIE). The NDE is the proportion of the *total effect* (TE) transmitted to the outcome, in the absence of the mediator’s ability to respond to the predictor, and the NIE is the outcome’s ability to respond to the predictor only through changes that the predictor has on the mediator, absent of any direct effect of the predictor on the outcome. The approach requires that there are no unmeasured predictor-outcome, mediator-outcome, and predictor-mediator confounds (Valeri & VanderWeele, 2013).

Applying DAGs to personality and socioeconomic work to identify potential confounders, colliders, back-door paths and tests for D-separation would inform analytic strategies. The DAG can be used to explore potential ancestor variables within the Heckman, Stixrud and

Urzua (2008) system to control for reverse causality or even identify a suitable IV. Programmes such as DAGitty (www.dagitty.net/) are a useful tool in this respect (Textor, van der Zander, Gilthorpe, Liskiewicz & Ellison, 2016).

FUTURE DIRECTIONS

We have shown that personality psychologists and economists have a lot to learn from each other. We conclude this chapter by outlining a number of opportunities and recommendations for future collaborative research in these areas.

Greater Recognition of Personality Change

There is no question that personality traits change. This needs to be accounted for in statistical models, especially in panel datasets where, very often, there is only a single assessment of personality. We encourage researchers to focus on datasets with multiple personality assessments and to ensure that these are included in future protocols.

Moving beyond Prediction to Establishing Causality and Identification

We hope that psychologists will start to think more about causality. Indeed, there are a number of studies showing a causal role for personality with respect to socioeconomic outcomes, although they have not used the FFM (e.g., Heckman, Stixrud & Urzua, 2006 and Heckman & Kautz, 2012 for a review). We argue that applying DAGs with respect to the causal model will inform both choice of statistical controls, so as to avoid problems with collider variables and to help to establish testable causal predictions for personality. Furthermore, adopting IV approaches and dynamic models to control for endogeneity is encouraged. Ultimately, clearly measured and unconfounded personality traits can help establish causality in predicting major socioeconomic outcomes. A number of suggestions have been made to help address problems of identification (Cunha & Heckman, 2008), which could be employed by psychologists to attain cleaner trait assessments. Conditioning on confounders and taking temporal change into account, along with trait assessments from multiple perspectives (self, acquaintances, family) will help in this respect.

Broader Traits and Narrow Aspects and Facets

At present, many researchers who incorporate personality into their research have primarily focused on the broad domains of the FFM. We suggest that economists also consider other models such as the HEXACO, as well as subclinical malevolent traits of the Dark Triad. As shown

by work on prosocial preferences, considering traits lower down the trait hierarchy, at the aspect and facet levels, should also be considered. These lower levels often show greater specificity with outcomes and have greater predictive/causal power. Therefore, a comprehensive theoretical analysis of which traits to assess for the question being studied is crucial. Including only a measure of the FFM domains with a posthoc analysis will result in limited findings, as is the case with using brief measures of personality that provide a limited representation of FFM traits (Credé et al., 2012).

Greater Consideration of Interactions between Traits and Curvilinear Relationships

Traits are often correlated and interact with each other to jointly affect behavior (Weiss et al., 2009). These interactive effects are important when considering the identification problem and causality. Nonlinear and curvilinear effects of personality arise theoretically from models of normal personality (Widiger & Mullins-Sweatt, 2008), and again such effects should be routinely explored.

Psychometrics of Preferences

Another avenue for development within this psychometric approach would be to examine the potential hierarchical structure of preferences using confirmatory factor models, as well as their stability over time. Furthermore, traits from personality psychology can be used to understand behavioral distinctions within economic games, such as mapping HEXACO honesty-humility and agreeableness onto *active and reactive prosociality*, captured by the first and second movers' decisions in economic games respectively.

CONCLUSION

We hope that this chapter will open up constructive lines of dialogue between psychologists, personality theorists and economists. Specifically we have highlighted how traits help us understand some of the heterogeneity in economic preferences, in particular, the relation between prosocial personality traits and social preferences involving fairness, cooperation and punishment. These can shed light on the psychological processes underlying behaviors in economic games, as well as explaining the sources of heterogeneity within games. We have also examined how traits are robust predictors of a range of macrolevel economic behaviors such as workplace behaviors and unemployment. Finally, we discussed a number of ways in which economics can inform and strengthen personality psychology, such as offering approaches to model causality and trait change, which need to be regularly

incorporated into both theorizing and analyses. We hope these observations will inspire, encourage and enable new insights into understanding the links between personality traits, economic preferences, and socioeconomics.

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Addendum: Statistical Analyses and Computer Programming in Personality

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PROLOGUE: A BRIEF HISTORY OF OPEN SOURCE STATISTICAL SOFTWARE

It is hard to imagine early in the twenty-first century that many of the statistical techniques we think of as modern statistics were developed in the late nineteenth and early twentieth centuries. What we now call regression was the degree of “reversion to mediocrity” as introduced by Francis Galton (1886). A refinement of regression was the measure of “co-relations” (Galton, 1888) which was specified as the relationship of deviations as expressed in units of the probable error. Galton’s insight of standardization of units became known as “Galton’s coefficient” which, when elaborated by Pearson (1895, 1896, 1920) became what we now know as the Pearson Product Moment Coefficient. Because the Pearson derivations were seen as too complicated for psychologists, Charles Spearman (1904b) explained the developments of Pearson and his associates to psychologists where “the meaning and working of the various formulae have been explained sufficiently, it is hoped, to render them readily usable even by those whose knowledge of mathematics is elementary” (Spearman, 1904b, p. 73). Later in that same paper, he then developed reliability theory and the correction for attenuation. In his second amazing publication that year, he developed the basic principles of factor analysis and laid out his theory of general intelligence (Spearman, 1904a).

Fundamental theorems of factor analysis (Thurstone, 1933; Eckart & Young, 1936) and estimates of reliability (Brown, 1910; Spearman, 1910; Kuder & Richardson, 1937; Guttman, 1945) came soon after and were all developed when computation was done by “computers” who were humans operating desk calculators. If not difficult, computation was tedious in that it required repeatedly finding sums of squares and sums of cross products. When examining the correlation structure of multiple items, the number of correlations went up by the square of the number of items, and thus so did the computational load. Test theory as developed in the 1930s and 1940s led to a number of convenient short cuts by which the sums of test and item variances could be used to estimate what the

correlations of composites of items would be if certain assumptions were met. Thus, the coefficients of Cronbach (1951); Guttman (1945); and Kuder and Richardson (1937) (α , λ_3 and KR20) were meant to be estimates based upon the structure of covariances without actually finding the covariances.

Another short cut was to dichotomize continuous data in order to find correlations. For example, in an ambitious factor analysis of individual differences in behavior among psychiatric patients, Eysenck (1944) made use of this shortcut by dichotomizing continuous variables and then finding the Yule (1912) coefficient. Unfortunately, such a procedure produced a nonpositive definite matrix which makes reanalysis somewhat complicated.

With the need to calculate flight paths for large artillery shells and rockets, the ideas developed by Babbage for his “Analytical Engine” in 1838 (Bromley, 1982) and algorithms for programming (Lovelace, 1842) were converted from punched cards and automatic looms into the electrical tubes and circuit boards of von Neuman (Isaacson, 2014). The age of computation had arrived. It was now possible to properly analyze covariance structures.

For personality psychologists, these were exciting times, for it allowed for the calculation of larger correlation matrices and the use of factor analysis with more elegant algorithms than the centroid approach. Indeed, Raymond Cattell moved from Harvard to the University of Illinois because he was promised access to the new “ILLIAC” computer (and would not have to teach undergraduates).

Main Frame Computers and Proprietary Software

At first, software for these new devices was tailor made for the particular machine, and there was a plethora of programming languages and operating systems. In the late 1950s, the programming language FORTRAN (later renamed Fortran when computers learned about lower case) was developed at IBM for the numeric computation necessary for scientific computing and then translated for other operating systems. While some programs would run

on IBM 709 and 7090s, others would only work on the super computers of the time, the Control Data Corporation's 1604 and 6400. An early package of statistical programs, developed for the IBM 7090 in 1961 at UCLA, was the BioMedical Package (BMDP). At first, BMDP was distributed for free to other universities but BMDP (Dixon & Brown, 1979) eventually became a commercial package which has since disappeared. Two other statistical systems (SAS[®] and SPSS), originally developed at other universities (North Carolina State and Stanford) and shared with others, were also developed.

These three major software systems for doing statistics came from three somewhat different traditions. BMDP was developed for biomedical research, SAS[®] for agriculture research, and SPSS for statistics in the social sciences (SPSS, 2008). Although all three systems were originally developed at universities and were freely distributed to colleagues, all three soon became incorporated as for-profit corporations. All were developed for main frame computers where instructions were originally given in stacks of Hollerith Cards (known to many as IBM cards), containing eighty characters per card. All of the programs made use of the FORTRAN programming language and still, many years later, have some of their main frame genealogy embedded in their systems. Older researchers still shudder at the memories of needing to wait for twenty-four hours after turning in a box of cards only to discover one typo negated the entire exercise.

S and R: Interactive Statistics

In contrast to the statistical analyses done on mainframes, S and subsequently R were developed for interactive statistics. The S computing "environment" was developed for Unix in the 1970s at Bell labs by John Chambers and his associates (Becker, Chambers & Wilks, 1988). It was meant to take advantage of interactive computing where the user could work with his/her data to better display it and understand it. After several iterations it became the defacto statistical package for those using the Unix operating system. In 1992, two statisticians, Ross Ihaka and Robert Gentleman, at the University of Otago, in New Zealand, started adapting S to run on their Mac computers. It incorporated the list oriented language Scheme and emphasized object-oriented programming. Most importantly, they shared the design specifications with other interested developers around the world and intentionally did not copyright the code. Rather, they, with the help of John Chambers and the rest of the R Development Core Team, deliberately licensed R under the GNU General Public License of the Free Software Foundation, which allows users to copy, use and modify the code as long as the product remains under the GPL (R Core Team, 2018).

Perhaps the real power of R is that because it is open source, it is extensible. That means that anyone can contribute packages to the overall system. That, and the power of the GPL and open source software movement

has led to an amazing effect. From the original functions in R and the ones written by the R Core Team, more than 15,555 packages have been contributed to the CRAN, the Comprehensive R Archive Network, and at least (as of this writing) more than 34,000 packages are available on GitHub. R has become the lingua franca of statistics and many new developments in psychological statistics are released as R functions or packages. When writing methodology chapters or articles, the associated R code to do the operations may also be given (as we do in this chapter).

With the growing recognition of the importance of replicable research, the publication of the R scripts and functions to do the analysis, as well as the release of R readable data sets is an essential step in allowing others to understand and repeat what we have done. Because the source code of all of the R packages is available, users can check the accuracy of the code and report bugs to the developers of the particular package. This is the ultimate peer review system, in that users use, review and add to the entire code.

Given its open source nature and growing importance in scientific computing, much of the rest of this chapter will be devoted to discussing how particular analyses can be done in R. This is not to deny that commercial packages exist, but to encourage the readers of this handbook to adopt modern statistics. The actual code used for the tables and figures is included in this addendum.

Finally, little appreciated by many users of R is that it is not just a statistical environment, it is also a very high level programming language. Although some of the packages in R are written in Fortran or C++, many packages are written in R itself. R allows operations at the higher matrix level and allows for object-oriented programming. Each function operates on "objects" and returns another "object." That is, functions can be chained together to add value to previous operations. This allows users to include standard functions in their own functions with the output available for even more functions. Actual programming in R is beyond the scope of this chapter, but is worth learning for the serious quantitative researcher. Without developing packages, a willingness to write more and more complicated scripts is a positive benefit.

Getting and Using R

R may be found at www.r-project.org and the current release is distributed through the Comprehensive R Archive Network <https://cran.r-project.org>. Popular interfaces to R include Rstudio (www.rstudio.com) which is particularly useful for PCs (the Mac version comes with its own quite adequate interface). Once R is downloaded and installed, it is useful to install some of the powerful packages that have been added to it. We will make use of some of these packages, particularly the *psych* package which has been specifically developed for personality and

psychological research (Revelle, 2018). See the [appendix](#) for detailed instructions.

DATA, MODELS AND RESIDUALS

The basic equation in statistics is that:

$$Data = Model + Residual \Leftrightarrow Residual = Data - Model. \quad (1)$$

That is, the study of statistics is the process of modeling our data. Our models are approximations and simplifications of the data (Rodgers, 2010). Our challenge as researchers is to find models that are good approximations of the data but that are not overly complicated. There is a tradeoff between the two goals of providing simple descriptions of our data and providing accurate descriptions of the data. Consider the model that the sun rises in the East. This is a good model on average and as a first approximation, but is actually correct only twice a year (the equinoxes). A more precise model will consider seasonal variation and recognize that in the northern hemisphere, the sun rises progressively further north of east from the spring equinox until the summer solstice and then becomes more easterly until the fall equinox. An even more precise model will consider the latitude of the observer.

If we think of degrees of freedom in models as money, we want to be frugal but not stingy. Typically, we evaluate the quality of our models in terms of some measure of *goodness of fit*. Conceptually, fit is some function of the size of the residuals as contrasted to the data. Because almost all models will produce mean residuals of zero, we typically invoke a cost function such as ordinary least squares to try to find a model that minimizes our squared residual. As an example, the algebraic mean is that model of the data that minimizes the squared deviations around it (the variance).

The following pages will consider a number of statistical models, how to estimate them, and how to evaluate their fit. All of what follows can be derived from a serious consideration of [Equation 1](#).

We discuss two types of variables and three kinds of relationships. In a distinction reminiscent of the prisoners in the cave discussed by Plato in the *The Republic* (Plato, 1892), we consider two classes of variables: those which we can observe, and those which we can not observe but are the latent causes of the observed variables. Our observations are of the movement of the shadows on the cave's wall; we need to infer the latent causes of these shadows. Many of our tools of data analysis (e.g., factor analysis, reliability theory, structural equation modeling and item response theory) are just methods for estimating latent variables and their inter-relationships from the pattern of relationships between observed variables. Traditionally we make this distinction by using Greek letters for unobserved (latent) population values and Roman letters for observed values. When we portray patterns of relationships graphically (e.g., [Figure A1](#)), we show observed

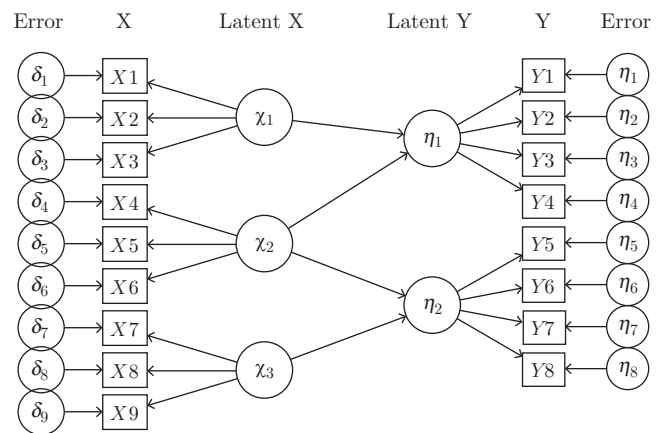


Figure A1 The basic set of statistical relationships may be seen as relations among and between observed variables (boxes) and latent variables (circles).

variables as boxes and latent variables as circles. As may be seen in [Figure A1](#), there are three kinds of relationships between our variables: relations between observed variables, relations between latent and observed variables, and relations between latent variables. Theories are organizations of latent variables as they represent the relationships between observed variables.

BASIC DESCRIPTIVE STATISTICS

Before any data analysis may be done, the data must be collected. This is more complicated than it seems, for it involves consideration of the latent variables of interest; presumed observed markers of these latent variables; the choice of subjects (are they selected randomly, systematically, are they volunteers, are they WEIRD (Henrich, Heine & Norenzayan, 2010)), the means of data collection (self report, observer ratings, life narratives, computerized measurement, web based measures, etc.); the number of times measures are taken (e.g., once, twice for test-retest measures or measures of change, multiple times in studies of growth changes or of emotions over time); the lags between repeated measures (minutes, hours, days or years) and whether there are experimental manipulations to distinguish particular conditions (Revelle, 2007).

Once the data are collected, it is of course necessary to prepare them for data analysis. That is to say, to transfer the original data into a form suitable for computer analysis. If hand coding must be done (e.g., scoring life narratives, Guo, Klevan & McAdams, 2016), the separate ratings must be entered in a way that allows for computer-based analysis (e.g., a reliability calculation) to be made.

Typically the data are organized as a two dimensional table (e.g., a spreadsheet in EXCEL or OpenOffice) with subjects as rows and variables as columns. If there are repeated measures per subject, the data might have a separate row for each occasion, but with one column identifying the subject and another the occasion. Consider

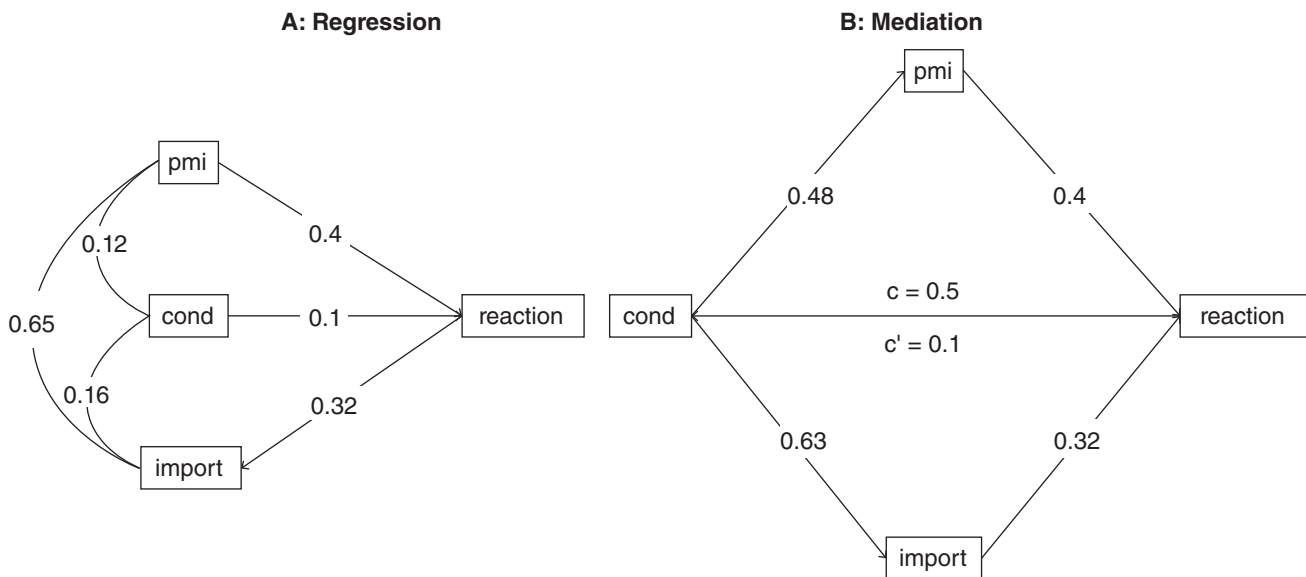


Figure A2 Regression and mediation approaches to the Tal-Or et al. (2010) data set. The curved lines represent covariances, the straight lines, regressions. Panel A shows the full regression model, Panel B shows the total effect ($c = .5$) and the direct effect ($c' = .1$) removing the indirect effect (ab) through PMI (.19) and through import (.20).

the data in Table A1 which are taken from an example data set *msqR* in the *psych* package (Revelle, 2018) from R¹. The *msqR* data set was collected over about ten years as part of a long term series of studies of the interactive effect of personality and situational stressors on cognitive performance.

An underappreciated part of data analysis is the basic data cleaning necessary to work with real data. Mistakes are made at data entry, participants fall asleep, other participants drop out, some do not answer every question, some participants are intentionally deceptive in their responses. It is important before doing any analysis to find basic descriptive statistics to look for impossible responses, to examine the distribution of responses, and to attempt to detect outliers. However, as discussed by Wilcox (2001), merely examining the shape of the distribution is not enough to detect outliers and it is useful to apply *robust estimators* of central tendency and relationships. The *WRS2* package (Mair, Schoenbrodt & Wilcox, 2017) implements many of the robust statistics discussed by Wilcox and his colleagues (Wilcox & Keselman, 2003; Wilcox, 2005). For example, the algebraic mean is just the sum of the observations divided by the number of observations. The trimmed mean is the same after a percentage (e.g., 10 percent) are removed from the top and bottom of the distribution. The trimmed mean is more robust to outliers than is the algebraic mean. The median is the middle observation (the 50th percentile) and is an extreme example of a trimmed mean (with $\text{trim}=.5$). The minimum and maximum observations, and the resulting range, are

most useful for detecting improper observations. Skew and Kurtosis are functions of the third and fourth power of the deviations from the mean (Mardia, 1970). The *describe* function will also report various percentiles of the distribution including the Inter Quartile Range (25th to 75th percentiles) (Table A2).

TESTS OF STATISTICAL SIGNIFICANCE: NORMAL THEORY AND THE BOOTSTRAP

Those brought up in the Fisherian tradition of Null Hypothesis Significance Testing (NHST) traditionally compare fit statistics to their expected value given normal theory. Fits are converted into standardized scores (z scores) and then probabilities are found from the normal distribution. This works well with large samples where errors are in fact random. For smaller samples, the variation of estimates of mean differences compared to the sample based standard error are larger than expected given the normal. This problem led to the introduction of the t statistic for comparing the means of smaller groups (Student, 1908) (`t.test`) and the r to z transformation (`r2z`) for tests of correlations (Fisher, 1921). (Use `cor.test` for one correlation, `corr.test` for many correlations.) Most functions in R will return both the statistic and the probability of that statistic. Many will also return a confidence interval for the statistic. But the probabilities (and therefore the confidence intervals) are a function of the *effect size*, the sample size and the distribution of the parameter being estimated. Unfortunately, not all tests can be assumed to be normally distributed and it is unclear how to find the distribution of arbitrary parameters of a distribution (e.g., the median). Extending ideas such as the

¹ In the following pages, we use fixed pitch font text for functions and *italics* for packages.

Table A1 A representative sample of eight subjects with time 1 and time 2 observations on ten emotion terms. The data are from the `msqR` data set ($N = 3,032$) which has repeated measures for 2,086 participants. The full data set is used for many of following examples. It is included in the `psych` package. The data are shown in “long” format with repeated measures “stacked” on top of each other to represent multiple time points. “Wide” format would represent the different time points as separate columns for each subject.

Line #	id	time	anxis	at.es	calm	cnfdn	cntnt	jttry	nervs	relxd	tense	upset
1	1	1	1	2	2	2	2	1	0	2	0	0
2	2	1	1	2	2	1	2	0	1	2	1	1
3	3	1	2	2	2	2	2	0	1	2	1	0
4	4	1	0	2	2	2	3	0	0	2	0	0
5	5	1	0	3	3	2	2	1	0	2	0	0
6	6	1	1	3	2	3	3	0	0	3	0	0
7	7	1	0	1	1	1	1	0	0	2	0	0
8	8	1	0	2	3	1	2	0	0	2	0	0
69	1	2	1	2	2	2	2	1	0	1	0	0
70	2	2	1	2	2	1	2	1	1	2	1	1
71	3	2	1	2	1	2	2	0	1	2	1	0
72	4	2	1	1	0	2	3	1	1	1	1	0
73	5	2	0	2	3	2	1	0	0	2	0	0
74	6	2	1	2	2	3	3	1	0	3	0	0
75	7	2	0	1	1	1	1	1	0	1	0	0
76	8	2	0	2	2	1	2	0	0	2	0	0

“Jackknife” proposed by Tukey (1958), Efron (1979) proposed the “bootstrap” (having considered such names as the “shotgun”), a powerful use of random sampling (Efron & Gong, 1983).

The basic concept of the bootstrap is to treat the observed sample as the entire population, and then to sample repeatedly from this “population” with replacement; find the desired estimate (e.g., the mean, the median, the regression weight) and then do this again, and again, and many times again. Each sample, although the same size as the original sample, will contain (on average) 63.2 percent of the subjects in the original sample, with 36.8 percent being repeated at least once.² The resulting distribution of the estimated value can be used to find confidence intervals without any appeal to normal theory.

For those who use NHST, it is important to understand the probability that a real effect is detected, the power, is

² This perhaps unintuitive amount is $1 - \frac{1}{n}$ and is the limit of the probability of an item not being repeated as the number of cases increases ($p = 1 - (1 - \frac{1}{n})^n$).

not the same as the probability of rejecting the “nil” hypothesis that an effect is 0 (Cohen, 1988, 1992, 1994; Streiner, 2003). A number of R packages (e.g., *pwr*, Champely, 2018) include easy to use power calculators to find the the power of a design given an effect size, sample size and desired α level.

One of the great advances of modern statistics is the use of the bootstrap and other randomization tests. In the space of seconds, 1,000 to 100,000 bootstrap resamples can be calculated for almost any statistic. We will use this procedure when we find the confidence intervals for correlation coefficients (Table A5) and in particular for the effect of mediation in a regression model.

CORRELATION AND REGRESSION

Originally proposed by Galton (1888) and refined by Pearson (1895) and Spearman (1904b), the linear regression coefficient and its standardized version, the correlation coefficient, are the fundamental statistics of research. In terms of deviation scores ($x = \bar{X} - X$ and $y = \bar{Y} - Y$)

Table A2 Descriptive statistics for the data in [Table A1](#). An important step before doing any more advanced analysis is to search for outliers by examining the data for impossible values and comparing the values of the algebraic versus trimmed mean versus the median.

Variable	vars	n	mean	sd	medin	trmmd	mad	min	max	range	skew	kurtosis	se	IQR
id	1	16	4.50	2.37	4.5	4.50	2.97	1	8	7	0.00	−1.45	0.59	3.50
time	2	16	1.50	0.52	1.5	1.50	0.74	1	2	1	0.00	−2.12	0.13	1.00
anxious	3	16	0.62	0.62	1.0	0.57	0.74	0	2	2	0.35	−0.96	0.15	1.00
at.ease	4	16	1.94	0.57	2.0	1.93	0.00	1	3	2	−0.02	−0.19	0.14	0.00
calm	5	16	1.88	0.81	2.0	1.93	0.00	0	3	3	−0.51	−0.20	0.20	0.25
confident	6	16	1.75	0.68	2.0	1.71	0.74	1	3	2	0.29	−1.04	0.17	1.00
content	7	16	2.06	0.68	2.0	2.07	0.00	1	3	2	−0.06	−0.98	0.17	0.25
jittery	8	16	0.44	0.51	0.0	0.43	0.00	0	1	1	0.23	−2.07	0.13	1.00
nervous	9	16	0.31	0.48	0.0	0.29	0.00	0	1	1	0.73	−1.55	0.12	1.00
relaxed	10	16	1.94	0.57	2.0	1.93	0.00	1	3	2	−0.02	−0.19	0.14	0.00
tense	11	16	0.31	0.48	0.0	0.29	0.00	0	1	1	0.73	−1.55	0.12	1.00
upset	12	16	0.12	0.34	0.0	0.07	0.00	0	1	1	2.06	2.40	0.09	0.00

Table A3 A number of correlations are Pearson r in different forms, or with particular assumptions. The first four use $r = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2 \sum y_i^2}}$. The last three are based upon assumptions of normality of a latent X and Y , with an artificial dichotomization or categorization into discrete (but ordered) groups.

Coefficient	symbol	X	Y	Assumptions
Pearson	r	continuous	continuous	
Spearman	ρ (ρ)	ranks	ranks	
Point bi-serial	r_{pb}	dichotomous	continuous	
Phi	ϕ	dichotomous	dichotomous	
Bi-serial	r_{bis}	dichotomous	continuous	normality
Tetrachoric	r_{tet}	dichotomous	dichotomous	bivariate normality
Polychoric	r_{pc}	categorical	categorical	bivariate normality

$$r_{xy} = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}. \quad (2)$$

Depending upon the characteristics of the data, the correlation as defined in Equation 2 has many different names. If both X and Y are continuous, then the resulting correlation is known as the Pearson Product Moment Correlation Coefficient (or just Pearson r). If converted to ranks, as Spearman's ρ , and if both X and Y are dichotomous as the ϕ coefficient (Table A3). Three of the correlations shown are estimates of what the latent continuous correlation would be if two continuous latent variables (χ and ψ) were artificially dichotomized (the tetrachoric), or split into multiple levels (the polychoric) correlation.

Because the first four of these correlations are just different forms of the Pearson r (albeit in different forms), the same estimation function can be used. In core R this is just the `cor` function or to find covariances the `cov` function. The last three require specialized functions written for polytomous (or dichotomous) data (i.e., the *psych* package functions `polyserial`, `tetrachoric` and `polychoric`. All of these functions are combined in `mixed.cor`.)

The tetrachoric correlations of ability data (answers are right or wrong) and the polychoric correlations of self report temperament scales (typically on a 1–4, 1–5 or 1–6 scale), being the modeled correlation of continuous latent scores, will be larger in absolute value than the Pearson correlations of the same data. In addition, these estimates of the latent correlations are not affected by differences in distributions the way the Pearson r on the observed variables is. An example of the difference between a Tetrachoric and a Pearson ϕ is seen in Table A7 where $\phi = .32$ but the inferred relationship between two continuous variables was .54.

The Ubiquitous Correlation Coefficient

The correlation is also a convenient measure of the size of an effect (Ozer, 2007). It has long been known that

the difference in means compared to the within group standard deviation: the d statistic of Cohen (1962, 1988, 1992) is a better way to compare the difference between two groups than Student's t statistic. For it is the size of the difference that is important, not the significance. An undue reliance of “statistical significance” has ignored the basic observation that the test of significance = size of effect $\times$ size of study (Rosenthal, 1994) and that the resulting p value is a nonlinear function of the size of the effect. To remedy this problem, Cohen (1962) developed the d statistic for the comparison of two groups (use `cohen.d`). Generalizations for multiple groups or continuous variables allow the translation of many alternative indices of effect size into units of the correlation coefficient (see Table A4). Robust alternatives to d (found by `d.robust`) express differences in terms of trimmed means and Winsorized variances (Algina, Keselman & Penfield, 2005; Erceg-Hurn & Mirosevich, 2008). Basic principles in reporting effect sizes are available in a recent tutorial (Pek & Flora, 2018).

Multiple Regression and the General Linear Model

Just as the t -test and the F -test may be translated into correlations units, so they can be thought of in terms of the general linear model (Judd & McClelland, 1989):

$$\hat{Y} = \mu + \beta X + \epsilon. \quad (3)$$

X can be an experimental *design matrix* with one or more independent grouping variables but it can also include a set of person variables. In the case of just one dichotomous grouping variable, then Equation 3 is just the regression of the two levels of X with the dependent variable and is similar to the comparison of the means of Student's t (Student, 1908). t is typically expressed as difference of means compared to the standard error of that difference but is better expressed as an effect size multiplied by one half the square root of the degrees of freedom

Table A4 Alternative estimates of effect size. Using the correlation as a scale free estimate of effect size allows for combining experimental and correlational data in a metric that is directly interpretable as the effect of a standardized unit change in x leads to r change in standardized y .

Statistic	Estimate	r equivalent	as a function of r
Pearson correlation	$r_{xy} = \frac{C_{xy}}{\sigma_x \sigma_y}$	r_{xy}	
Regression	$b_{y,x} = \frac{C_{xy}}{\sigma_x^2}$	$r = b_{y,x} \frac{\sigma_y}{\sigma_x}$	$b_{y,x} = r \frac{\sigma_x}{\sigma_y}$
Cohen's d	$d = \frac{X_1 - X_2}{s_x}$	$r = \frac{d}{\sqrt{d^2 + 4}}$	$d = \frac{2r}{\sqrt{1-r^2}}$
Hedge's g	$g = \frac{X_1 - X_2}{s_x}$	$r = \frac{g}{\sqrt{g^2 + 4(df/N)}}$	$g = \frac{2r\sqrt{df/N}}{\sqrt{1-r^2}}$
t - test	$t = \frac{d\sqrt{df}}{2}$	$r = \sqrt{t^2 / (t^2 + df)}$	$t = \sqrt{\frac{r^2 df}{1-r^2}}$
F-test	$F = \frac{d^2 df}{4}$	$r = \sqrt{F / (F + df)}$	$F = \frac{r^2 df}{1-r^2}$
Chi Square		$r = \sqrt{\chi^2 / n}$	$\chi^2 = r^2 n$
Odds ratio	$d = \frac{\ln(OR)}{1.81}$	$r = \frac{\ln(OR)}{1.81 \sqrt{(\ln(OR)/1.81)^2 + 4}}$	$\ln(OR) = \frac{3.62r}{\sqrt{1-r^2}}$
requivalent	r with probability p	$r = r$ equivalent	

(df) or the ratio of the correlation times the square root of the degrees of freedom to the coefficient of alienation ($\sqrt{1-r^2}$, Brogden, 1946)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{d\sqrt{df}}{2} = \frac{r}{\sqrt{1-r^2}} \sqrt{df} \quad (4)$$

where the degrees of freedom are $n_1 + n_2 - 2$ (Rosnow & Rosenthal, 2003). The slope of the regression is the effect size, dividing this by the coefficient of alienation and multiplying by the square root of df converts the regression to a t . It is found in R with the `t.test` function.

If $\mathbf{X}$ has two categorical grouping variables (e.g., x_1 and x_2), then we have

$$\hat{y} = \mu + \beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2 + e \quad (5)$$

which for categorical values of $\mathbf{X}$ is just the traditional analysis of variance of two main effects and an interaction (Fisher, 1925). This may be found using the `anova` function which acts on categorical variables and returns the traditional ANOVA output. With unbalanced repeated measures designs, the `lme` function included in the `lme4` package (Bates, Maechler, Bolker & Walker, 2015) allows a specification of random and fixed effects.

The advantage of the general linear model for psychologists interested in individual differences is that continuous person variables can be included in the same model as experimental variables. This is a great improvement from prior approaches which would artificially dichotomize the person variable into high and low groups in order to use an

ANOVA approach. By retaining the continuous nature of the predictor, we improve the power over the ANOVA test.

As an example of using the general linear model, we use a data set from Tal-Or, Cohen, Tsfati and Gunther (2010) that is discussed by Hayes (2013). Tal-Or et al. (2010) measured the effect of an experimental manipulation of salience of a news article (cond) on presumed media influence (PMI), perceived importance of the issue (import), and reported willingness to change one's behavior (reaction).³ The observed correlations are found by using the `lowerCor` function and are given in Table A5.

There are multiple ways to analyze these data. We could naively do three t-tests of the experimental manipulation, find all of the intercorrelations, or do a regression predicting reaction from the condition, perception of media influence (PMI) and perceived importance of the message (Importance). All of these alternatives are shown in the appendix. The `setCor` and `mediate` functions will also draw the regressions as path diagrams (Figure A3).

Mediation and Moderation

In the Tal-Or et al. (2010) data set, the experimental manipulation affected the dependent variable of interest (reaction) but also two other variables (perception of media influence and perceived importance of the

³ With the kind permission of Nurit Tal-Or, Jonathan Cohen, Yariv Tsfati and Albert C. Gunther, these data were added to the *psych* package as the `Tal_Or` data set.

Table A5 Correlations of the conditions with Perceived Media Influence, Importance of the message, and Reaction to the message (Tal-Or et al., 2010). As is traditional in NHST, correlations that are larger than would be expected by chance are marked with 'magic astericks'. Confidence intervals for these correlations are shown given normal theory (upper and lower normal) as well as estimated by 1,000 bootstrap resamplings of the data (lower and upper empirical).

The Tal-Or et al. correlation matrix from lowerCor

Variable	cond	pmi	imprt	rectn
cond	1.00			
pmi	0.18*	1.00		
import	0.18*	0.28**	1.00	
reaction	0.16	0.45***	0.46***	1.00

Note: *** $p < .001$; ** $p < .01$; * $p < .05$.

Empirical and normal theory based confidence intervals from cor.ci.

Variable	lwr. m	lwr. n	estmt	uppr. n	uppr. m
cond-pmi	0.01	0.01	0.18	0.36	0.36
cond-imprt	0.02	0.00	0.18	0.35	0.35
cond-rectn	-0.01	-0.01	0.16	0.33	0.33
pmi-imprt	0.09	0.09	0.28	0.45	0.45
pmi-rectn	0.31	0.31	0.45	0.57	0.56
imprt-rectn	0.32	0.32	0.46	0.60	0.61

message). There is a direct effect of condition on reaction, as well as indirect effects through PMI and Importance. Conventional regression shows the direct effect of reaction controlling for the indirect effects that go through PMI and import. The *total effect* of condition on reaction is their covariance divided by the condition variance and is known as the *c* effect ($c = \frac{\sigma_{xy}}{\sigma_x^2} = \frac{.125}{.25} = .5$). If we label the paths from cond to PMI ($a_1 = .48$) and from condition to import ($a_2 = .63$), then the *indirect effects* are the sum of the products through the two mediators ($b_1 = .40$, $b_2 = .32 \rightarrow a_1b_1 + a_2b_2 = .48 * .40 + .63 * .32 = .4$) then the *direct effect* is the total less the indirect effect ($c' = c - ab = .1$). We say that the effect of the experimental manipulation is *mediated* through its effect on perceived importance and perceived media influence. The error associated with the mediating term (ab) or the sum of product terms ($a_1b_1 + a_2b_2$) needs to be found by bootstrapping the model multiple times (Hayes, 2013; MacKinnon, 2008; Preacher, 2015; Preacher, Rucker & Hayes, 2007). By default, the mediate function in *psych* does 5,000 bootstrap iterations.

See the Appendix 0.11.3 for sample output. Other packages in R that are specifically designed to test mediation hypotheses include the *mediation* (Tingley, Yamamoto, Hirose, Keele & Imai, 2014) and *MBESS* (Kelley, 2017) packages.

When doing regressions, we sometimes are interested in the interactions of two of the predictor variables. For instance, when examining how women react to discriminatory treatment of a hypothetical other, Garcia, Schmitt, Branscombe and Ellemers (2010)⁴ considered the interactive effects of beliefs about inequality and type of protest (individual versus collective versus none) as they affected the appraisal of the other person. This example of a moderated regression is discussed by Hayes (2013).

Interactions (also known as moderation, or moderated regression) are found by entering the product term of the two interacting variables. There are several questions to ask in this analysis that will change the interpretability of the results. For example, should the data be mean-centered before finding the product term, and should the path models be done using standardized or unstandardized regressions? The recommendation from Aiken and West (1991) and Cohen, Cohen, West and Aiken (2003) is to mean center. However, Hayes (2013) rejects this advice. In both cases, the interaction terms will be identical, but the main effects will differ depending upon centering or not centering. The argument for mean centering is to remove the artificial correlation between the main effects and the interaction term. For with positive numbers X and Y, their product XY will be highly correlated with X and Y. This means that the linear effects of X and Y will be underestimated. The *setCor* and *mediate* functions will by default mean center the data before finding the product term, however this option can be modified. The *lm* function does not and so we need to take an extra-step to do so. The function *scale* will mean center (and by default standardize). The second question, whether to standardize or not, is one of interpretability. Unstandardized coefficients are in the units of the predictors and the criteria and show how much the DV changes per unit change in each IV. The standardized coefficients, on the other hand, are unit free and show how much change occurs per standard deviation change in the predictors. Standardization allows for easier comparison across studies but at the cost of losing the direct meaning of the regression slope. In the Appendix, we show the code for mean centering using *scale* and then using the *lm* function to do the regression with the interaction term. We also show how the *setCor* function combines both operations.

⁴ With the kind permission of Donna M. Garcia, Michael T. Schmitt, Nyla R. Branscombe and Naomi Ellemers, the data are included as the Garcia data set in the *psych* package.

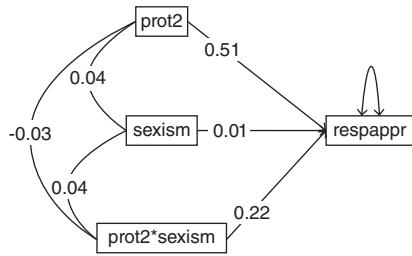
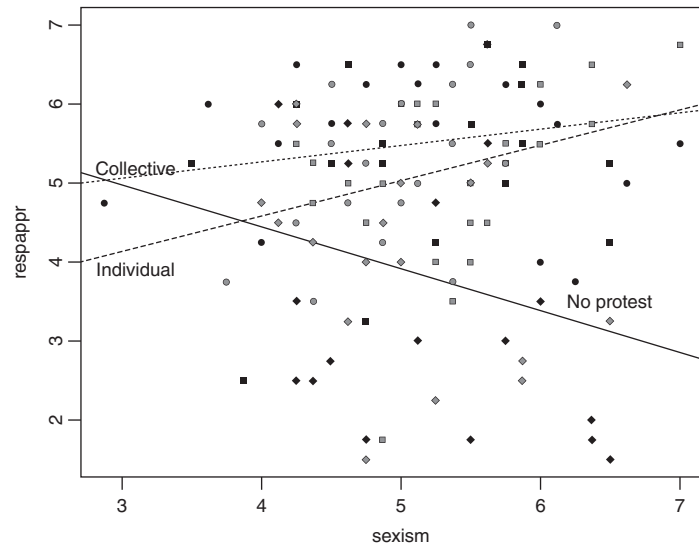
A: Moderated regression (std. and mean centered)**B: Response to sexism varies as type of protest**

Figure A3 Two ways of showing moderation effects: Panel A, as a path diagram with the product term or Panel B, as a plot of the continuous variable (sexism) showing the individual regression slopes for the three protest conditions. Data from Garcia et al. (2010)

Correlation, Regression and Decision Making

When reporting standardized regression weights (β_i) the amount of variance in the dependent variable accounted for by the regression model is $R^2 = \sum \beta_i^2 r_i^2$. However, it is important to recognize that the slopes (β_i) are the optimal fit for the observed data and that the fit will probably not be as good in another sample. This problem of overfitting is particularly problematic in machine learning when the number of variables used in the regression is very large. Thus, regression functions will report the R^2 as well as shrunken or adjusted R^2 which estimate what the fit would be in another sample. For n subjects and k variables, the adjusted $\tilde{R}^2 = 1 - (1 - R^2) \frac{n-1}{n-k-1}$ (Cohen et al., 2003), that is, there will be more shrinkage for small sample sizes and a large number of predictors.

The R^2 for a particular model is maximized by using the regression weights, but because of what is known as the “Robust beauty of improper linear models” (Dawes, 1979) or the principal that “it don’t make no nevermind” (Wainer, 1976), as long as the predictors are moderately correlated with the criterion, using unit weights (1, 0, -1) works almost as well. Weights are said to be “fungible” (Waller, 2008; Waller & Jones, 2010) in that an infinite set of weights will do almost as good a job as the optimal weights.

Although the variance in the criterion accounted for by the predictors is R^2 , it is better to report the actual R , which reflects the amount of change in the criterion for unit changes in the predictors (Ozer, 2007). Change is linear with R , not R^2 . This is particularly important when discussing the correlation of a dichotomous predictor with a dichotomous outcome (e.g., applicants are selected or not selected for a job, they succeed or they fail). Consider the four outcomes shown in Table A6 applied to a decision

study by Danielson and Clark (1954) and elaborated on by Wiggins (1973). Of 504 military inductees, 89 were later diagnosed as having psychiatric problems requiring their discharge. How well could this future diagnosis be predicted? Using a screening test given to all of the inductees, 55 percent of the future psychiatric diagnoses could be predicted, with a false alarm (false positive) rate of 19 percent. This leads to an accuracy of classification (Valid Positives + Valid Negatives) of .76 and a *sensitivity* of .55 and a *specificity* of .81 (Table A7). In this kind of binary decision, the ϕ coefficient is a linear function of the difference between the percent of Valid Positives and the number expected due to the base rates (BR) times the selection ratio (SR):

$$\phi = \frac{VP - BR \cdot SR}{\sqrt{(BR)(1 - BR)(SR)(1 - SR)}} \quad (6)$$

In the case of $BR = SR = .5$, 50 percent accuracy means a 0 correlation, 60 percent a correlation of .2, 70 percent a correlation of .4, etc. That is, the number of correct predictions is a linear function of the correlation (Ozer, 2007; Rosenthal & Rubin, 1982; Wiggins, 1973).

An alternative approach when considering accuracy in decision making is known as “signal detection theory” which was developed to model the detection of a signal in a background of noise (Green & Swets, 1966). d' (d -prime) reflects the sensitivity of the observer and β the criterion the observer was using to make the decision. Similar ideas are seen in the NHST approach to significance testing, where effect size is equivalent to d' and the criterion used (.05, .01) is the decision criterion. The relationship predicted accuracy as a function of the selection ratio, the base rates, and the size of the correlation was discussed by Taylor and Russell (1939) who present tables

Table A6 The four outcomes of a decision. Subjects above a particular score on the decision axes are accepted, those below are rejected. Similarly, the criterion of success is such that those above a particular value are deemed to have succeeded, those below that value to have failed. All numbers are converted into percentages of the total.

Decision = Predicted Outcome				
Outcome	Accept		Reject	
	Success	Valid Positive (VP)	False Negative (FN)	Base Rate (BR)
	Failure	False Positive (FP)	Valid Negative (VN)	1 - Base Rate (1-BR)
		Selection Rate (SR)	1- Selection Rate (1-SR)	
Accuracy = Valid Positive + Valid Negative				
Sensitivity = Valid Positive / (Valid Positive + False Negative)				
Specificity = Valid Negative / (Valid Negative + False Positive)				
Phi = $\frac{VP - BR * SR}{\sqrt{BR(1-BR) * SR * (1-SR)}}$				

for different values. The equivalence of these various procedures is seen in (Figure A4) which presents graphically the cell entries in Table A7. The AUC (area under the curve) function will take the two by two table of decision theory and report d' , ϕ , $r_{tetrachoric}$ as well as total accuracy, sensitivity and specificity.

LATENT VARIABLE MODELING: EFA, CFA AND SEM

There has long been tension in psychological research between understanding and causal explanation versus empirical prediction and control. The concept of the underlying but unobservable cause that accounts for the patterns of observed correlations was implicit in the measurement models of Spearman (1904a) and considered explicitly by Borsboom, Mellenbergh and van Heerden (2003). This is the logic of the effect of the reflective latent variable indicated by the paths in the paths of Figure A1 from the latent variables χ_1 or χ_2 to the observed variables $X_1 \dots X_6$. Figure A1 represents multiple causal paths: from the latent $\chi_{1..3}$ to the observed $X_{1..9}$ and from the latent $\eta_{1..2}$ to the observed $Y_{1..6}$ as well as from the latent predictors ($\chi_{1..3}$) to the latent criteria ($\eta_{1..2}$). In this perspective, items are reflective measures of the latent trait (Loevinger, 1957;

Table A7 Applying decision theory to a prediction problem: The case of predicting future psychiatric diagnoses from military inductees (Data from Danielson and Clark (1954) as discussed by Wiggins (1973)).

Raw Data			
	Predicted Positive	Predicted Negative	Row Totals
True Positive	49	40	99
True Negative	79	336	406
Column Totals	118	376	505
Fraction of Total			
	Predicted Positive	Predicted Negative	Row Totals
True Positive	.097	.079	.196
True Negative	.157	.667	.804
Column Totals	.234	.746	1.00
Accuracy = .097 + .667 = .76			
Sensitivity = .097 / (.097 + .079) = .55			
Specificity = .667 / (.667 + .157) = .81			
Phi = $\frac{.097 - .196 * .234}{\sqrt{.196 * .804 * .234 * .747}} = .32$			

Bollen, 2002) and can be thought to be caused by the latent trait. The contrasting approach of prediction and control was traditionally the domain of behaviorists emphasizing the power of environmental stimuli upon particular response patterns. Stimulus-response theory had no need for latent variables; outcomes were perfectly predictable from the stimulus conditions. In personality research this was the appeal of empirical keys for the MMPI (Hathaway & McKinley, 1943; Butcher, Dahlstrom, Graham, Tellegen & Kaemmer, 1989), or Strong's Vocational Interest Test (Strong, 1927), and continues now with the statistical learning procedures we will discuss later. In this empirical approach, scales are composites formed of not necessarily related items. The items are said to be formative indicators that "cause" the latent variable.

Exploratory Factor Analysis

The original concept for factor analysis was Spearman's recognition that the correlations between a number of cognitive ability tests was attenuated due to poor measurement. When correcting for measurement error (see the

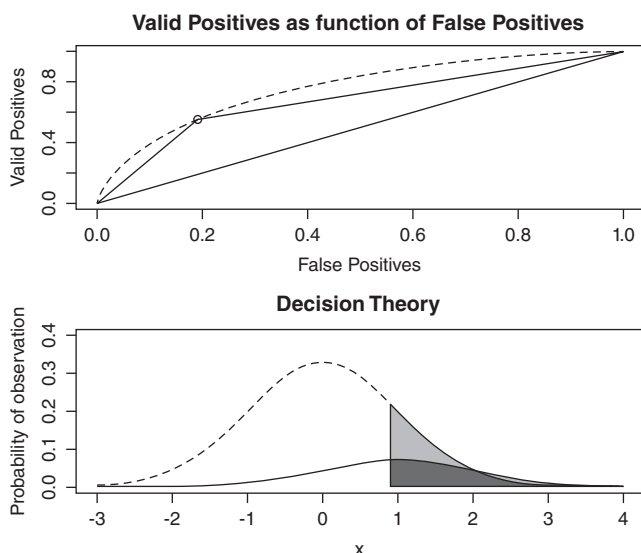


Figure A4 Signal detection theory converts the frequencies of a 2×2 table into normal equivalents and shows the relative risks of false positives and false negatives. The number of valid positives will increase at a cost of increasing false positives. Figure from the AUC function with input from Table A7.

reliability section where we discuss such corrections for attenuation) all of the cognitive domains were correlated almost perfectly. The underlying latent factor of these tests was thought to be a measure of general intelligence.

Although the initial calculations were done on tables of correlations, when a kindly mathematician told Thurstone in 1931 that his generalization of Spearman's procedure was just the taking of the square root of a matrix (Bock, 2007), Thurstone immediately applied this new matrix algebra to his ability measures and produced his *Vectors of the Mind* (Thurstone, 1933). Correlations were no longer arranged in tables, they were now elements of "correlation matrices." Factor analysis was seen as the approximation of a matrix with one of lesser rank. In modern terminology, factor analysis is just an *eigen decomposition* problem and is a very straightforward procedure.

For any symmetric matrix, $\mathbf{R}$ of rank n there is a set of *eigen vectors* that solve the equation $\mathbf{x}_i \mathbf{R} = \lambda_i \mathbf{x}_i$ and the set of n eigenvectors are solutions to the equation

$$\mathbf{X} \mathbf{R} = \lambda \mathbf{X}$$

where $\mathbf{X}$ is a matrix of orthogonal eigenvectors and λ is a diagonal matrix of the *eigenvalues*, λ_i . Finding the eigenvectors and eigenvalues is computationally tedious, but may be done using the `eigen` function. That the vectors making up $\mathbf{X}$ are orthogonal means that $\mathbf{X} \mathbf{X}' = \mathbf{I}$ and they form the *basis space* for $\mathbf{R}$ that is: $\mathbf{R} = \mathbf{X} \lambda \mathbf{X}'$. In plain terms, it is possible to recreate the correlation matrix $\mathbf{R}$ in terms of an orthogonal set of vectors (the *eigenvectors*) scaled by their associated *eigenvalues*.

We can find the *principal components* of $\mathbf{R}$ by letting

$$\mathbf{C} = \mathbf{X} \sqrt{\lambda}$$

and therefore

$$\mathbf{R} = \mathbf{C} \mathbf{C}' \quad (7)$$

But such a decomposition is not very useful, because the size (rank) of the $\mathbf{X}$ matrix is the same as the original $\mathbf{R}$ matrix. However, if the components are in rank order of their eigenvalues, the first k ($k < n$) components will provide the best fit to the $\mathbf{R}$ matrix when compared to any other set of vectors. Such a principal components analysis (*PCA*) is useful for optimally describing the observed variables. The components are merely weighted sums of the variables and may be used in applied prediction settings. The components are the k orthogonal sums that best summarize the the total variability of the correlation matrix. The `pca` function will do this analysis.

An alternative model, the *common factor* model attempts to fit the variance that the n variables have in common and ignores that variance which is unique to each variable.

$$\mathbf{R} \approx \mathbf{F} \mathbf{F}' + \mathbf{U}^2 \quad (8)$$

where $\mathbf{F}$ is of rank k , and $\mathbf{U}^2$ is a diagonal matrix of rank n . The $\mathbf{U}^2$ matrix may be thought of as the residual variance when we subtract the model ($\mathbf{F} \mathbf{F}'$) from the data ($\mathbf{R}$) $\mathbf{U}^2 = \mathbf{R} - \mathbf{F} \mathbf{F}'$. Although it would seem that these two equations (7, 8) are quite similar, they are not. For in the first case, the components are formed from linear sums of the variables, while in the second, the variables reflect the linear sums of the factors.

Equation 7 can be solved directly for $\mathbf{C}$, but equation 8 has different solutions for $\mathbf{F}$ depending upon the values in the $\mathbf{U}^2$ matrix which in turn depend upon the value of k . If we know the amount of variance each variable shares in common with all of the other variables (this is known as the *communality* and is $h_i^2 = 1 - U_i^2$) then we can solve for the factors. But, unfortunately, we do not know $\mathbf{U}^2$ unless we know $\mathbf{F}$. The solution to this conundrum takes advantage of the power of computers to do *iterative* solutions. Make an initial guess of $\mathbf{U}^2$, solve equation 8 for $\mathbf{F}$ and take the resulting $\mathbf{U}^2$ as the input for the next iteration. Repeat these steps until the change in $\mathbf{U}^2$, from one step to the next is very small and then quit (Spearman, 1927; Thurstone, 1933, 1934, 1935).

Consider the correlation matrix in Table A8. A conventional initial estimate for the communalities ($\text{diag}(\mathbf{I} - \mathbf{U}^2)$) might be the Squared Multiple Correlation (SMC) of each variable with all the others (the last line of Table A8 shows these values). Enter these in the diagonal of the matrix and solve for $\mathbf{F}$. Unfortunately, exploratory factor analysis is not quite as simple as this for there are at least four decisions that need to be made: what kind of correlation to use, which factor extraction algorithm to use, how many factors to extract, and what rotation or transformation should be applied?

Which Correlation?

If the data are continuous (or have at least 8–10 response levels), then the normal Pearson r is the appropriate measure of relationship. But if the data are dichotomous (as would be the case for items if scoring correct/correct on an ability test) or polytomous (as is normally the case when

Table A8 The Thurstone correlation matrix is a classic data set discussed in detail by R. P. McDonald (1985, p. 9) and is used as example in the sem package as well as in the PROC CALIS manual for SAS. These nine tests were grouped by Thurstone and Thurstone (1941) (based on other data) into three factors: Verbal Comprehension, Word Fluency, and Reasoning. The original data came from Thurstone and Thurstone (1941) but were reanalyzed by Bechtoldt (1961), who broke the data set into two. McDonald, in turn, selected these nine variables from the larger set of seventeen found in Bechtoldt.2. The sample size is 213.

Variable	Sntnc	Vcblr	Snt.C	Frs.L	F.L.W	Sffxs	Ltt.S	Pdgrs	Ltt.G
Sentences	1.00								
Vocabulary	0.83	1.00							
Sent.Completion	0.78	0.78	1.00						
First.Letters	0.44	0.49	0.46	1.00					
Four.Letter.Words	0.43	0.46	0.42	0.67	1.00				
Suffixes	0.45	0.49	0.44	0.59	0.54	1.00			
Letter.Series	0.45	0.43	0.40	0.38	0.40	0.29	1.00		
Pedigrees	0.54	0.54	0.53	0.35	0.37	0.32	0.56	1.00	
Letter.Group	0.38	0.36	0.36	0.42	0.45	0.32	0.60	0.45	1.00
SMC	0.74	0.75	0.67	0.55	0.52	0.43	0.48	0.45	0.43

Table A9 The minres solution using the *fa* function of the Thurstone data set. The factor solution was then transformed to simple structure using the oblimin transformation. h^2 is the communality estimate, u^2 is the unique variance associated with the variable, *com* is the degree of item complexity. The pattern coefficients are shown as well as the correlation (ϕ) between the factors. Because this is an oblique solution, the correlation matrix is reproduced by $F\phi F' + U^2$. The sums of squares for an oblique solution are the diagonal elements of $\phi F'F$.

Variable	MR1	MR2	MR3	h2	u2	com
Sentences	0.90	−0.03	0.04	0.82	0.18	1.01
Vocabulary	0.89	0.06	−0.03	0.84	0.16	1.01
Sent.Completion	0.84	0.03	0.00	0.74	0.26	1.00
First.Letters	0.00	0.85	0.00	0.73	0.27	1.00
Four.Letter.Words	−0.02	0.75	0.10	0.63	0.37	1.04
Suffixes	0.18	0.63	−0.08	0.50	0.50	1.20
Letter.Series	0.03	−0.01	0.84	0.73	0.27	1.00
Pedigrees	0.38	−0.05	0.46	0.51	0.49	1.96
Letter.Group	−0.06	0.21	0.63	0.52	0.48	1.25
SS loadings	2.65	1.87	1.49			
MR1	1.00	0.59	0.53			
MR2	0.59	1.00	0.52			
MR3	0.53	0.52	1.00			

Table A10 Comparing the Varimax orthogonally rotated PCA ($RC_{1..3}$) Minimum Residual ($MR_{1..3}$), obliquely transformed PCA ($TC_{1..3}$) and oblique Minimum Residual ($MR_{1..3}$) solutions. In order to show the structure more clearly, loadings $> .30$ are boldfaced.

Variable	RC1	RC2	RC3	MR1	MR2	MR3	TC1	TC2	TC3	MR1	MR2	MR3
Sentences	0.86	0.24	0.23	0.90	0.01	0.03	0.83	0.25	0.26	0.90	-0.03	0.04
Vocabulary	0.85	0.31	0.19	0.88	0.10	-0.02	0.83	0.32	0.22	0.89	0.06	-0.03
Sent.Completion	0.85	0.26	0.19	0.89	0.04	-0.01	0.78	0.28	0.23	0.84	0.03	0.00
First.Letters	0.23	0.82	0.23	0.03	0.84	0.07	0.23	0.79	0.23	0.00	0.85	0.00
Four.Letter.Words	0.18	0.79	0.30	-0.03	0.81	0.16	0.21	0.71	0.29	-0.02	0.75	0.10
Suffixes	0.31	0.77	0.06	0.17	0.79	-0.14	0.31	0.62	0.13	0.18	0.63	-0.08
Letter.Series	0.25	0.16	0.83	0.10	-0.01	0.84	0.23	0.18	0.80	0.03	-0.01	0.84
Pedigrees	0.53	0.08	0.61	0.49	-0.14	0.55	0.45	0.17	0.52	0.38	-0.05	0.46
Letter.Group	0.10	0.31	0.80	-0.11	0.21	0.82	0.16	0.31	0.63	-0.06	0.21	0.63

scoring personality questionnaires with a 1–5 or 1–6 rating scale), then it is better to use the *tetrachoric* correlation (for dichotomous items) or its generalization to polytomous items, the *polychoric* correlation. The principal reason for doing so is that the Pearson correlation for items that differ in their mean endorsement rate can not have a high correlation value and is attenuated. As discussed earlier, the tetrachoric is the modeled correlation of the latent traits affecting the scores on the items not the observed scores of the items themselves.

Unfortunately, using tetrachoric correlations will frequently produce correlation matrices which are said to be nonpositive-definite, which means some of the eigen values of the matrix are negative. With appropriate assumptions, such matrices can be corrected (*smoothed*) by adding a small number to any negative eigen value, adjusting the positive ones to keep the same total, and then recreating the matrix from the original eigen vectors and the adjusted eigen values (Wothke, 1993). This is done in the `cor.smooth` function.

Factor extraction. Factors are approximate solutions to Equation 8 and have a degree of misfit. Each factoring method attempts to minimize this misfit. The basic fitting equation is

$$E = \frac{1}{2} \text{tr}[(\mathbf{R} - \mathbf{F}\mathbf{F}')\mathbf{W}]^2 \quad (9)$$

where *tr* means the trace (sum of the diagonals) of a matrix. If $\mathbf{W}$ is the identity matrix, minimizing E is equivalent to ordinary least squares (OLS); if $\mathbf{W} = \mathbf{R}^{-1}$, it is generalized least squares (GLS), and if $\mathbf{W} = \mathbf{F}\mathbf{F}'^{-1}$ it is maximum likelihood (ML) (Loehlin, 2004). Maximum likelihood (Lawley & Maxwell, 1962, 1963) has the advantage that under normal theory it finds the model that maximizes the likelihood of the data given the model, but with the disadvantage that it requires taking the inverse of the model. GLS is a close approximation of

ML, but requires that the original correlation matrix be invertible. OLS does not require taking inverses, but will not produce “optimal” solutions (in the ML sense). OLS (and the variant known as minimum residual (Harman & Jones, 1966)) has the advantage that it is more robust to violations of the model and will produce meaningful solutions even in the presence of many, minor, “nuisance” factors (MacCallum, Browne & Cai, 2007). Empirically, although not minimizing the ML criterion, *minres* solutions are very close to it. All of these factor extraction techniques are available in the `fa` function in the *psych* package as are alpha factoring (Kaiser & Caffrey, 1965) and minimum rank factoring (Shapiro & ten Berge, 2002).

Number of factors. An unsolved problem in EFA is how many factors to extract. Henry Kaiser is said to have solved the problem every day before breakfast, but the challenge is to find *the* solution (Horn & Engstrom, 1979). Perhaps the best known solution (Kaiser, 1970) is also the worst: Extract as many factors as the number of principal components with eigen values larger than 1. This procedure, although the default for many commercial packages, routinely will extract too many factors (Revelle & Rocklin, 1979). Statistical criteria (e.g., extract factors as long as the χ^2 of the residual matrix is significant) suffer from the problem of being dependent upon sample size: the larger the sample, the more factors are extracted. An appealing technique is to plot the successive eigen values and look for a sharp break. Where the *scree* of trivial factors suddenly jumps to larger values, stop factoring (Cattell, 1966b). Another useful technique involving the plot of the eigen values is to compare observed values versus those from random data (Horn, 1965). When the observed eigen values are less than those from random data, too many factors have been extracted. This is a useful rule of thumb, but seems to break down with more than about 500–1000 subjects, at which point the random eigen

values are all essentially 1.0. Yet another approach is to plot the size of the average minimum partial correlation of the residual matrix. Where this achieves a minimum is an appropriate place to stop (Velicer, 1976). For factoring items, a comparison of the goodness of fit of models which zero out all except the largest loading for each item seems to produce a reasonable estimate (Revelle & Rocklin, 1979). Finally, continuing the the extraction of factors as long as they are interpretable is not unreasonable advice, although those of us unable to interpret many factors will tend to be biased towards extracting fewer. The `nfactors` function applies all of these tests, but unfortunately the typical result is that none of them agree.

Rotations and Transformation. Given a factor solution $\mathbf{F}$ with elements (loadings) of f_{ij} what is the best way to interpret it? The loadings reflect the correlation of the factors with the items and differ by item and by factor. The sum of the squared loadings for each item (row wise) is the amount of variance in that item accounted for by all of the factors. This is known as the communality ($h_i^2 = \sum f_{ij}^2$). Items with high communality are well explained by all of the factors, those with low communality are badly explained. For the same value of communality, a variable is said to be more complex if several variables are needed to explain its variance (have high loadings) and less complex if just one variable has a high loading. An index of item complexity is $c_i = \frac{(\sum f_{ij}^2)^2}{\sum f_{ij}^4}$ which will achieve a minimum of 1 if all of the explained variance in an item is due to one factor (Hofmann, 1978). A similar measure of factor complexity is to do the operation column wise. Multiplying the $\mathbf{F}$ matrix by a orthogonal transformation matrix ($\mathbf{T}$) will not change the communalities but can change the item and factor complexities. In the orthogonal case, this is known as rotation, if the resulting solution has correlated factors, we should refer to this as an oblique transformation. We want to chose a transformation that provides a more “simple structure” (Thurstone, 1947) than the original $\mathbf{F}$ matrix. A number of different solutions to this problem take advantage of the *GPArotation* package (Bernaards & Jennrich, 2005) and are included in the `fa` function. Browne (2001) discusses how many of these are part of the (Crawford & Ferguson, 1970) family of rotations. Some of the most frequently used include *Varimax* (Kaiser, 1958, p. 9) and *Quartimax* (Neuhauss & Wrigley, 1954) for orthogonal rotations and *oblimin* (Harman, 1976; Jennrich, 1979), *Promax* (Hendrickson & White, 1964) *Bifactor* (Holzinger & Swineford, 1937; Reise, 2012) and *Geomin* (Yates, 1988) for oblique solutions. Unfortunately, some of these rotation procedures achieve local minima in their fitting functions and it is recommended to do multiple random restarts to confirm solutions. The net result of an oblique tranformation is the factor *pattern* matrix ($\mathbf{F}$) and the factor *structure* matrix ($\mathbf{S} = \mathbf{F}\phi$) where ϕ is the correlation between the factors. When reporting an oblique

transformation, it is important to show both the pattern ($\mathbf{F}$) and the correlation (ϕ).

Factor score indeterminacy. A problem with factor analysis is that although the model is well defined at the structure level (modeling the covariances of the variables) it is indeterminate at the individual score level (Grice, 2001). Factor scores are best estimates of an individual's score but should not be equated with the factor. Factor score estimates correlate with the latent factors, but this correlation may be far from unity. The `fa` function returns the correlation of the factor scores with the factor. If the correlation is less than .707 (an R^2 of .5), then two estimates of the factor score vector may actually be negatively correlated with each other. Correlations of the factors with the factor score estimates are a function of the number of variables marking the factor as well as the communality of the variables.

Confirmatory Factor Analysis

With the introduction of statistical measures of fit, it is now possible to fit and then test particular factor models (Jöreskog, 1978; Rindskopf & Rose, 1988). Because most models do not fit in an absolute sense, model comparison is recommended. Fit statistics include χ^2 , the Root Mean Square Error of Approximation (RMSEA) which adjusts the χ^2 for the degrees of freedom and sample size (N) ($\text{RMSEA} = \sqrt{\frac{\chi^2 - df}{df(N-1)}}$), the standard deviation of the residuals (RMSR), the Akaike Information Criterion ($AIC = \chi^2 + k(k-1) - 2df$) which also considers the number of variables in the model (k), and the Bayesian Information Criterion ($BIC = \chi^2 + \ln(N)(k(k+1)/2 + df)$). These fits are actually estimates of misfit. That is, the larger the χ^2 , the less well the model fits the data. The question then becomes how bad is bad? Barrett (2007) gives very strict interpretation of what makes a good model; Marsh, Hau and Wen (2004) suggests there is no golden rule of fit, and Loehlin and Beaujean (2017) give a very useful discussion of how to report fit statistics. The most important thing to remember is that this is a model comparison procedure where we compare multiple models to see which is better, not which is correct.

EFA is seen as a hypothesis generation procedure and CFA as a hypothesis confirmation procedure: the initial model might be derived from an EFA and then tested using CFA on a different data set. A powerful but easy to use package to do this is *lavaan* (Rosseel, 2012). Other CFA packages include *sem* (Fox, Nie & Byrnes, 2016) and *OpenMX* (Neale et al., 2016). *lavaan* syntax is very straightforward, and allows one to specify and test any particular model.

An important use of CFA is evaluating whether the factor structure of a set of variables is the same across time, or across groups. These are important questions when comparing people across groups or people over time, for it is not possible to make comparisons if the measures are different. Three tests of *factor invariance*

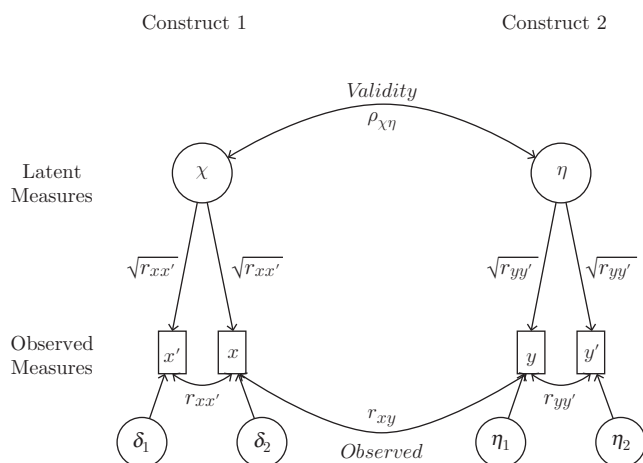


Figure A5 The basic concept of reliability and correcting for attenuation. All four observed variables (x , x' , y , y') reflect the latent variables χ and η but are contaminated by error ($\delta_{1..2}$, $\epsilon_{1..2}$). Adjusting observed correlations (r_{xy}) by reliabilities (r_{xx} , r_{yy}) estimates underlying latent correlations ($\rho_{\chi\eta}$). (See Equation 11.) Observed variables and correlations are shown in conventional Roman fonts, latent variables and latent paths in Greek fonts.

are typically considered: configural, metric, and scalar (also known as weak, strong and strict). Configural asks whether the structure is the same across groups, metric asks whether the loadings are the same (or do not differ very much), and scalar ask whether the means and intercepts of the factors are the same. Testing for invariance is thus a set of comparisons of structures across groups. The `measurementInvariance` function in the *semTools* package (semTools Contributors, 2016) has been developed to do this in *lavaan*.

Structural Equation Modeling

Combining observations, latent variables and regression into one structural model (see Figure A1) seems to be an obvious step. How to combine the path tracing rules of Wright (1920, p. 9) with factor analysis and reliability theory by using modern estimation algorithms was, however, an important insight. Developed independently by Keesling (1972), Jöreskog (1977) and Wiley (1973), the use of fitting regression models with latent variables was soon identified with a computer algorithm for Linear Structural Relations (LISREL) (Jöreskog, 1978; Jöreskog & Sorbom, 1993) (see Tarka (2018) for a thorough history). Very influential texts on SEM include those of Bollen (1989, 2002), Loehlin and Beaujean (2017) and Mulaik (2009). How to report SEM is discussed by McDonald and Ho (2002) and others.

In addition to LISREL, the development of the proprietary programs EQS (Bentler, 1995) and MPLUS (Muthén & Muthén, 2007) made SEM available to many. Now, with the introduction into R of the *sem* (Fox, Nie & Byrnes, 2013), *lavaan* (Rosseel, 2012) and *OpenMx* (Neale et al., 2016) packages, SEM and CFA are part of the open source

armamentarium for all. Bayesian approaches are available in the *blavaan* (Merkle & Rosseel, 2016,) which takes advantage of the *lavaan* package.

Combining formative causal variables with reflective indicator variables is done in MIMIC models (multiple indicators, multiple causes) where a latent variable is seen as formed from a set of causal variables but in turn causes another latent variable which is indicated by a number of reflective measured variables. An early example of a MIMIC model is the causative effect of education, occupation and income on the latent variable of social status, which in turn effects the latent variable of social participation which is measured by church attendance, memberships and the number of friends seen (Jöreskog & Goldberger, 1975).

Perhaps one of the most powerful uses of SEM techniques is in examining growth curves over time. Given a set of participants at time 1, what happens to them over weeks, months or years? Growth curve models allow for the separation of trait and state effects (Cole, Martin & Steiger, 2005) as well as an examination of change (McArdle & Bell, 2000; McArdle, 2009). Tutorials for using *lavaan* include growth curve analysis and are included in the help pages for *lavaan*.

In an important generalization of the problem of fungible regression weights (Waller, 2008; Waller & Jones, 2010) Lee, MacCallum and Browne (2018) showed how with a very small decrease in fit (increase in RMSEA), path coefficients in equivalent models that fit equally well can actually differ in sign. This is just one of the many cautions in how to interpret SEM results. For SEM fit statistics are merely fits of a model to the data. What is needed is comparisons of the fit of alternative/equivalent models. It is important to realize that reversing the direction of causal arrows in many SEM models does not change the fit, but drastically changes the interpretation (MacCallum, Wegener, Uchino & Fabrigar, 1993).

RELIABILITY: CORRELATING A TEST WITH A TEST JUST LIKE IT

A powerful use of correlation is assessing reliability. All measures are contaminated with an unknown amount of error. Reliability is just the fraction of the measures that is not error and is the correlation of a measure with another measure that is just like the first measure (Revelle & Condon, 2018, 2019). Using V_x to represent observed total test variance and σ_e^2 to represent unobserved error variance then the reliability (r_{xx}) of a measure is

$$r_{xx} = 1 - \frac{\sigma_e^2}{V_x}. \quad (10)$$

In terms of the observed and latent variables in Figure A5, $x = \chi + \epsilon_1$, and a test just like it is $x' = \chi + \epsilon_2$ with correlation r_{xx} . To infer the latent correlation between χ and η , $r_{\chi\eta}$, we can correct the observed correlation r_{xy} for the reliabilities r_{xx} and r_{yy}

$$r_{\eta\eta} = \frac{r_{xy}}{\sqrt{r_{xx}r_{yy}}}, \quad (11)$$

Equation 11 was proposed by Spearman (1904b) and the problem since then has been how to estimate the reliability. This is important because if we underestimate the reliability, we will overestimate the disattenuated correlation (Equation 11). There are several different ways to estimate reliability. All agree on the basic principle that items represent some unknown amount of latent score and another unknown amount of error score; the problem is how to measure the relative contributions. Before the era of modern computers, several shortcuts were proposed that – with some very strong assumptions – would allow reliability to be found from the total test variance and the sum of the item variances. Equivalent forms of this procedure are known as (KR20, Kuder & Richardson, 1937) (λ_3 , Guttman, 1945) and (α , Cronbach, 1951). Essentially these coefficients are a function of the average interitem correlation and do not depend upon the structure of the test items. They are all available in the `alpha` function in *psych*.

Model- Based Reliability Measures

Procedures that take into account the internal structure of the test using factor analysis (so called model-based procedures) include ω_t and ω_h of McDonald (1999), and various estimates of the *greatest lower bound* of the test reliability (Bentler, 2017). By applying factor analytic techniques, it is possible to estimate the amount of variance in a test that is attributable to a general factor (ω_h) (Revelle & Zinbarg, 2009; Zinbarg, Revelle, Yovel & Li, 2005), as well as the general plus all group factors (total reliability or ω_t). With modern computing techniques, these model based estimates are easy to find (e.g., `omega` will find ω_h and ω_t as well as α). Estimates of ω_h and ω_t are preferred over α because they are sensitive to the actual structure of the test. α is an estimate based upon the average correlation and the very strong assumption that all the items are equally good measures of the latent trait. (More formally, the items are assumed to be τ equivalent: they all have equal loadings on the latent trait.) This was a reasonable assumption to make as a shortcut before we had computers. Now, there is no reason to settle for the shortcut. It is not uncommon to find tests with moderate levels of α that actually measure two unrelated or only partially related constructs. It is only by applying model-based techniques that we can identify the problem (e.g., Rocklin & Revelle, 1981).

Reliability of Raters

Rather than evaluating the reliability of a test, sometimes we want to know how much raters agree with each other when making judgments. If the ratings are numeric, this is done by finding one of several Intraclass Correlations

(ICC). Depending upon whether we view raters as random or fixed, and whether the raters rate all subjects or just one each, and whether we pool the judgments of different raters, we end up with six different ICCs (Shrout & Fleiss, 1979; Revelle & Condon, 2018b), all of which are found by the `ICC` function. `ICC` uses the power of R to chain functions together: It performs a one- or two-way analysis of variance, extracts the mean squares or estimates of variance components and find the appropriate ratio of variance components.

If the ratings are categorical rather than numeric, it is possible to compare the agreement of two raters in terms of Cohen's Kappa statistic (Cohen, 1960, p. 9) which corrects the observed proportions of agreement for the expectations given the marginal base rates. This is done by the `cohen.kappa` function. An example of such ratings is given by Guo et al. (2016) who had raters evaluate the presence or absence of particular themes in a set of life narratives.

STRUCTURE VERSUS PROCESS

Factor analysis and estimates of reliability typically examine the structure of personality items and tests. In terms of Cattell's data box of people by measures by occasions (Cattell, 1946, p. 9) this an example of what Cattell called "R" analysis (people over measures). They do not tell us about how people differ over time. Repeated measures allow us to examine the process of change. With the use of multi-level modeling techniques, it is possible to examine individual differences in within person structure over time (Cattell called this "S" analysis).

Statistical Analysis of Within-Subject Variability

Although initially done using daily diaries (Bolger, Davis & Rafaeli, 2003), with the use of personal digital assistants and now cell phone apps, it is possible to collect intensive within subject data once to many times per day for several weeks or even months (Fisher, 2015; Wilt, Funkhouser & Revelle, 2011; Wilt, Bleidorn & Revelle, 2016, 2017; Wilt & Revelle, 2017). Excellent reviews of how to analyze these intensive longitudinal data include Hamaker, Ceulemans, Grasman and Tuerlinckx (2015) and Hamaker and Wichers (2017). Shrout and Lane (2012) and Revelle and Wilt (2019) provide useful tutorials for examining multi-level reliability, and the `multilevel.reliability` function will do all these calculations in R. A basic question is whether the data are *ergodic* (each individual subject can be seen as representing the entire group) or whether the patterning of each individual is a meaningful signal in its own right. Different approaches to ergodicity include those of Nesselroade and Molenaar (2016) and Revelle and Wilt (2016).

Functions to do these within-subject analyses include multilevel regression using `lme4` and `nlme`, correlational

structures within and between groups using `statsBy` and examining factor structures for invariance across subjects using `measurementinvariance` in the *semTools* package. The *multilevel* package (Bliese, 2016) comes with very useful documentation on doing some of the more complicated forms of multilevel analyses.

Computational Modeling of Process

Another very powerful approach to studying within person processes is computational modeling. This is not a statistical approach so much as a way to develop and test the plausibility of theories. It is, however, an important use of computer analysis for it can compare and test the fit of alternative dynamic models. Read and Miller and their colleagues (Read et al., 2010; Read, Brown, Wang & Miller, 2018; Read, Vanman & Miller, 1997; Yang et al., 2014) have implemented a neural network model of the structure and dynamics of individual differences (Read et al., 2010). Pickering (2008) has implemented several different representations of Gray's Reinforcement Sensitivity Theory (Gray, 1991; Gray & McNaughton, 2000). Although written in MatLab, it is straightforward to translate them into R. A model of the dynamics of action (DOA, Atkinson and Birch, 1970) was implemented as a program for main frame computers (Atkinson, Bongort & Price, 1977) and then reparameterized as the Cues-Tendency Action model and implemented as the `cta` function (Revelle, 1986; Revelle & Condon, 2015). The CTA model has been combined with the RST model into the `cta.rst` function by Brown (2017) and provided good fits to empirical data.

OTHER STATISTICAL TECHNIQUES

Aggregating Data by Geographic Location

Most personality analysis focuses on individuals, but many interesting questions may be asked concerning differences in the aggregated personality of groups. Whether aggregating the scores of subjects by college major, socioeconomic status or geographic location, the typical first step is the same: Find the mean score for each group. The `statsBy` function provides mean values for any number of variables by a selected grouping variable, as well as a suite of statistics and output for analysis of aggregated variables. For example, the `statsBy` function outputs a correlation matrix for both between groups (the `rbg` object) and within groups (the `rwg` object). The correlation between aggregated groups is known to sociologists as the ecological correlation (Robinson, 1950). The `rbg` object weights correlations by the number of subjects in each group due to the fact that estimates of a mean are more accurate with more subjects. A nonweighted between-groups correlation matrix could be obtained by applying the `cor` function to the `mean` object of `statsBy` output.

When analyzing aggregated data, it is critical to keep in mind that a correlation between two variables may not be consistent between groups and within groups (Simpson, 1951; Yule, 1903). Kievit, Frankenhuis, Waldorp and Borsboom (2013) provide some excellent illustrations of this phenomenon, known as the Yule-Simpson paradox, where the within-group correlations are of the opposite sign of the between-groups correlations; for example, although a higher dosage of a medication is positively related to the likelihood of patient recovery across genders, dosage is negatively correlated with patient recovery within each gender. Another striking example of the effect is the finding that although at the aggregate level, the University of California seemed to discriminate against women in their admission policy, the individual departments actually discriminate in their favor (Bickel, Hammel & O'Connell, 1975). The *simpsons* package (Kievit & Epskamp, 2012) allows for detailed examination of data that can produce this effect. The important point, as made by Kievit et al. (2013) and Robinson (1950) is not to dismiss aggregate level relationships, but to realize that the level of generalization depends upon the level of analysis.

How large are the effects of aggregation? Two coefficients (intraclass correlations or ICCs) are reported when examining aggregated data. ICCs describe variance ratios for each aggregated variable in terms of within and between group variance components. ICC1 is an effect size that indicates the percentage of variance in subjects' scores that is explained by group membership (Shrout & Fleiss, 1979). Although sometimes expressed in terms of the between-group and within group-means squares from the traditional analysis of variance approach, a clearer definition may be expressed as the variance ratio of between group variance (σ_{bg}^2) to the total variance. The total is the sum of the between- (σ_{bg}^2) and within-group (σ_{wg}^2) variance. ICC2 (also known as ICC1k) takes into account the average number of observations within group ($\bar{n}$) and is a measure of the reliability of the group mean differences. It is the Spearman-Brown reliability formula applied to ICC1:

$$ICC1 = \frac{\sigma_{bg}^2}{\sigma_{bg}^2 + \sigma_{wg}^2} \quad ICC2 = \frac{\sigma_{bg}^2}{\sigma_{bg}^2 + \sigma_{wg}^2/\bar{n}}. \quad (12)$$

In plain English, ICC2 indicates the extent to which the aggregated scores of a variable are reliably different from one another. Assuming one's current data are a random sample, if a new random sample is collected with the same average number of participants per group, ICC2 estimates the correlation between the group scores of the first sample and the second sample (James, 1982). ICC2 indicates that aggregated scores are still reliable (i.e., a high ICC2) even if there is a miniscule amount of variance explained in aggregation (i.e., a low ICC1), provided one has enough subjects per group (i.e., a large $\bar{n}$). The `statsBy` function outputs ICC1 (the `ICC1` object), ICC2 (the `ICC2` object) and the number of subjects in each group who responded to each variable (the `n` object).

In the last two decades, international collaborations and online personality assessments have collected enormous data sets with samples an order of magnitude larger than what was possible a few decades ago (e.g., Gosling, Vazire, Srivastava & John, 2004; Revelle, Condon, Wilt, French, Brown & Elleman, 2016). *Geographical psychology* is a subfield that has taken advantage of these large data sets, investigating how and why psychological phenomena are aggregated by residence of geographic locations (Rentfrow & Jokela, 2016), both large (e.g., countries; McCrae & Terracciano, 2008) and small (e.g., postal codes; Jokela, Bleidorn, Lamb, Gosling & Rentfrow, 2015). Relatively straightforward correlational analyses at an aggregated geographic level (e.g., Rentfrow, Gosling & Potter, 2008) are replicable (e.g., Elleman, Condon, Russin & Revelle, 2018). Geographical psychology researchers have started to explore novel approaches, such as determining the extent to which a psychological phenomenon is spatially clustered between locations; for a psychological variable, is a given location more similar to neighbor locations than more distant locations (e.g., Jokela et al., 2015). Bleidorn et al. (2016) explored both individual and aggregated levels of their data to calculate “person-city personality fit” and found that this fit was related to the life satisfaction of individuals. The complexities of spatial analysis are beyond the scope of this chapter, but see Rentfrow and Jokela (2016) for an overview and Rentfrow (2014) for details. The *spdep* package (Bivand & Piras, 2015) supplies functions pertaining to spatial autocorrelation, weights, statistics and models.

Statistical Learning Theory

The study of individual differences has expanded beyond academic personality research to computer scientists who are taking advantage of the “big data” possible to collect through web-based techniques. Algorithms popular among computer scientists to analyze individual differences data in a prediction context are known generically as “machine learning” or “statistical learning theory.” Although some of these techniques are new, some of them repackage traditional methods with new labels (e.g., the ϕ coefficient of Pearson & Heron, 1913, has been “rediscovered” as a measure of fit but with a new name: the Matthews Correlation Coefficient). We include a brief discussion of these techniques as many personality researchers will likely interact with computer scientists and it is worth learning the “new” vocabulary.

“Machine learning” is a term without a universally agreed-upon definition. In general, it concerns the prediction of outcome variables from models trained on other data sets and it can be used to refer to a broad range of techniques from logistic regression to neural networks (Hastie, Tibshirani & Friedman, 2001). The core emphasis in machine learning is on generalization of algorithmic performance to new data, meaning that researchers must shift their focus away from explanation of underlying

constructs and toward prediction when using these techniques (Yarkoni & Westfall, 2017). For the purposes of this chapter, it is useful to illustrate some of the methods in the domain of machine learning that are distinct from the traditional regression-based modeling that is more common in psychology.

One such method falls underneath the umbrella term of classification and regression tree (CART) methods. CART methods involve the recursive separation of observations into distinct subgroups with a goal of enhancing subgroup homogeneity. The algorithm will first segment the observations based on the value of the variable that it has found to lead to the largest reduction in impurity, the exact measure of which depends on the type of problem at hand (e.g., Gini impurity index, entropy). Each of the subgroups created in this split will then be considered separately for further partitioning, until a desired fit to the training data has been reached. This process can be computed automatically through the *rpart* package (Therneau & Atkinson, 2018). CART methods are readily amenable to the creation of attractive output in the form of decision trees, which graphically display a series of sequential steps constituting the final partitions determined by the algorithm. These figures are interpretable by nonstatisticians with little training, enhancing the applicability of these methods to a variety of applied contexts. Unfortunately, there is a downside to these methods: Classification and regression trees tend to overfit the training sample data, meaning that they tend to extend beyond interpretable signal in a data set to incorporate noise. Decision tree methods tend to produce models with a high amount of variability. As such, while predictive accuracy may be acceptable on the training data set, these methods tend to not perform as well as simpler models when applied to out-of-sample data. Fortunately, their predictive capabilities can be dramatically enhanced by incorporating a class of techniques called “ensemble methods,” which aggregate many different trees to harness their power.

In general, ensemble methods take advantage of the power of averages to create estimates that have lower variance than any of the constituent observations. The logic behind the utility of averages can be understood through an extension of the Central Limit Theorem, in which the variance of the mean of a group of n independent observations, each with a variance of σ^2 , is σ^2/n . As such, if we were able to create trees from many different training datasets and aggregate the results, the resultant model would have lower variance than any individual model alone (James, Witten, Hastie & Tibshirani, 2013). Unfortunately, this is not typically a feasible process as it would be rare to have many different training datasets at the ready. However, we are able to approximate this process through a method of bootstrap random sampling in which we repeatedly take random samples with replacement from our training dataset, creating many different bootstrapped datasets. This method of aggregation can be applied to a variety of statistical techniques, but applying

this method to decision trees, we are able to fit a tree to each of these bootstrapped training data sets, aggregate the results, and get an ultimate prediction that does not suffer as much from the high variance concerns of the individual trees. Thus, ensemble methods form a relatively simple means by which the predictive power of classification and regression trees can be enhanced, making them compelling options for personality researchers with the goal of enhancing prediction.

Three of the most popular ensemble techniques used in the context of tree-based machine learning methods are bagging, random forests, and boosting. In bagging, observations are randomly sampled from the training data set through bootstrapping methods to create many distinct datasets. A different tree is then grown based on each of these bootstrapped data sets, resulting in many trees, each of which have a potentially different set of decision rules on which they based their predictions. The results of these trees are then aggregated to create a final prediction for each observation. Predictions are evaluated on the “out-of-bag” observations that were left out of the bootstrap samples, providing a validation set of all observations not used in the creation of a subset of trees (James et al., 2013). Random forest methods can be viewed as special forms of bagging in which variables are randomly selected alongside the observations in the training data set. More specifically, during the process of growing the tree from the training data set, variables are randomly selected at each node to be used in the creation of the tree. Why add this additional step? While the general process of bagging reduces variance by bootstrapping multiple trees, each of the trees will be correlated due to the inclusion of identical variables at every split. In certain cases (i.e., when one variable is much more important in the prediction of the outcome than others) this will lead to many trees that are nearly identical. Averaging trees that are very similar will not lead to as large a reduction in variance as averaging uncorrelated trees. Random forest methods address this by changing the variables made available at each potential node split in the trees, effectively decorrelating the trees and theoretically decreasing the variance of a given predictive model. In general, if p is the number of predictors, $\sqrt{p}$ is the number of variables selected at each split for classification problems and $p/3$ variables are selected at each split for regression problems, although this number should be determined based on hyperparameter tuning given the data set at hand (Hastie et al., 2001). Both bagging and random forest techniques can be computed in R using the *randomForest* package (Liaw & Weiner, 2002). By setting the “mtry” argument to equal the number of variables in the model, a bagged model will be run, otherwise it will be random forest.

Boosting methods are conceptually similar to bagging and random forests, but alter the way that the trees update their information. Specifically, boosting involves sequentially updating each tree by fitting the residuals of the tree before it. In this manner, boosting attempts to target the

areas of weakness of the previous trees and update them accordingly. The boosting algorithm completes this procedure slowly to avoid overfitting, each time fitting the residuals of the previous model before adding this fitted tree back to the original tree after applying a shrinkage parameter, thus updating the residuals. The power in the predictive ability of boosting comes from its slow progression and sequential growth based on residuals of previous trees. However, this practice of fitting residuals can lead to overfitting if the tree grows too fast and thus we want the algorithm to proceed slowly. Boosting tends to outperform bagging and random forest on prediction metrics, but may not be as conceptually clear as those methods due to the fitting of residuals. The preference is up to the researcher. Popular packages in R to fit boosted models include *xgboost* (Chen et al., 2018) and *gbm* (Greenwell, Boemke, Cunningham & GBM Developers). *Python* is another language commonly used in machine learning as it allows somewhat faster processing of very large data sets.

Taken together, these ensemble methods are referred to as “black box” methods, which means that their exact inner workings remain unknown to the practitioner. In other words, while a researcher may be able to tell that a random forest model provides excellent predictive accuracy, they would not be able to view each decision tree used in the crafting of the prediction. As such, these ensemble methods are best used when the major aim of a project is prediction and they may not be appropriate for situations in which a precise theoretical model is desired. This may be discomforting to personality psychologists who have largely been trained to prioritize theoretical modeling, but it is simply another possible way to analyze data with a predictive focus. Researchers are not left completely in the dark about the inner workings of the models, however; they are able to influence the way that the model constructs and aggregates the individual trees in these ensemble methods through the selection of various hyperparameters. These hyperparameters include the number of trees grown in all three methods, the number of variables selected at each node in random forests, and how slowly the trees grow in boosting. Adjusting these hyperparameters to influence the performance of the ensemble methods is critical to predictive performance and can be done with through trial and error or cross validation.

The aforementioned methods are intriguing in that they provide the tools for creating a more prediction-focused study of individual differences. While promising in their potential impact on the field in the future, machine learning results should generally be viewed through a lens of caution as many complicated methods may be outperformed by comparatively simpler methods of linear and logistic regression. A shift toward a more predictive science would be welcomed, but we must be sure to select methods to suit the problem at hand and not just apply these methods with abandon.

CONCLUSION

Personality research has come a long way from the simple correlation of Galton (1888), Pearson (1895) and Spearman (1904b). Advances in the past few years have brought powerful computation to the desk or lap of the individual researcher. Open source software has made complex research questions answerable by people anywhere in the world. Computational model techniques that used to take days on multimillion dollar computers can now be done in seconds on very affordable laptops. Data can be shared across the web, analyses can be duplicated using published and open source computer code. Statistical testing and modeling of psychological data and theory has never been easier for those willing to learn the modern methods.

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APPENDIX

The R code for the various examples is shown here.

[Table A1](#) was a subset of the `msqR` data set which is included in the *psych* package. Here we show the size of the entire data set (6411 rows by 79 columns), the number of subjects with repeated measures (2086), and how to form a subset of the first eight cases for both time 1 and time 2.

R code

```
msq.items <- c("anxious" , "at.ease" , "calm" , "confident", "content",
  "jittery", "nervous", "relaxed" , "tense" , "upset" ) #these overlap with the sai
dim(msqR) #show the dimensions of the data set
colnames(msqR) #what are the variables

table(msqR$time) #show the number of observations with various repeated values
example <- msqR[c(1:8,69:76),c(cs(id,time),msq.items)]
df2latex(example) #make a \LaTeX table of the example data
```

Descriptive Statistics

[Table A2](#) shows descriptive statistics.

R code

```
describe(msqR[c(1:8,69:76),c(cs(id,time),msq.items)],IQR=TRUE) #for the data in table 1
describe(msqR[c(cs(id,time),msq.items)) #describe the entire data set
```

Correlation and Regression

[Table A5](#) shows the correlation matrix from the Tal-Or et al. (2010) data set. Here we show several different ways to show those correlations and to test for their significance. In this and the subsequent examples, we use the standard notation for $y \sim x$. Unfortunately, the $\sim$ symbol renders poorly and for those who want to directly copy from the pdf; the $\sim$ symbol should be written in by hand.

R code

```
describe(Tal_Or) #the descriptive statistics for the data.

t.test(reaction ~ cond, data=Tal_Or) # The t.test of interest
t.test(pmi ~ cond, data=Tal_Or) # Also test the effects on pmi
t.test(import ~ cond, data=Tal_Or) #and import

cor(Tal_Or) #the core-R command displays to 9 decimals

#or just show the lower diagonal of the correlations,
lowerCor(Tal_Or) #round the results to two decimals and abbreviate the names

corr.test(Tal_Or) # find the correlations, the raw p values and the adjusted p values

cor.ci(Tal_Or[1:4], n.iter=1000)
cor2latex(Tal_Or[1:4],stars=TRUE,adjust="none") #create the Table
```


Produces this output:

```
> describe(Tal_Or) #the descriptive statistics for the data.
```

	vars	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
cond	1	123	0.47	0.50	0.00	0.46	0.00	0	1	1	0.11	-2.00	0.05
pmi	2	123	5.60	1.32	6.00	5.78	1.48	1	7	6	-1.17	1.30	0.12
import	3	123	4.20	1.74	4.00	4.26	1.48	1	7	6	-0.26	-0.89	0.16
reaction	4	123	3.48	1.55	3.25	3.44	1.85	1	7	6	0.21	-0.90	0.14
gender	5	123	1.65	0.48	2.00	1.69	0.00	1	2	1	-0.62	-1.62	0.04
age	6	123	24.63	5.80	24.00	23.76	1.48	18	61	43	4.71	24.76	0.52

```
> t.test(reaction ~ cond, data=Tal_Or) # The t.test of interest
```

Welch Two Sample t-test

data: reaction by cond

t = -1.7964, df = 120.98, p-value = 0.07492

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

-1.04196792 0.05058861

sample estimates:

mean in group 0 mean in group

1 3.25000 3.74569

... output omitted

```
cor(Tal_Or) #the core-r command
```

	cond	pmi	import	reaction	gender	age
cond	1.00000000	0.180773560	0.18091083	0.16026292	-0.12717905	0.025245417
pmi	0.18077356	1.000000000	0.28207107	0.44649392	-0.02112095	-0.004947199
import	0.18091083	0.282071074	1.00000000	0.46477681	0.02700985	0.073431563
reaction	0.16026292	0.446493916	0.46477681	1.00000000	0.01436459	-0.083728952
gender	-0.12717905	-0.021120953	0.02700985	0.01436459	1.00000000	-0.318450715
age	0.02524542	-0.004947199	0.07343156	-0.08372895	-0.31845072	1.000000000

```

lowerCor(Tal_Or) #round the results to two decimals and abbreviate the names

      cond  pmi  imprt rectn gendr age
cond      1.00
pmi      0.18  1.00
import    0.18  0.28  1.00
reaction  0.16  0.45  0.46  1.00
gender   -0.13 -0.02  0.03  0.01  1.00
age       0.03  0.00  0.07 -0.08 -0.32  1.00
>
> corr.test(Tal_Or) # find the correlations, the raw p values and the adjusted p values

```

```
Call:corr.test(x = Tal_Or)
```

```
Correlation matrix
```

	cond	pmi	import	reaction	gender	age
cond	1.00	0.18	0.18	0.16	-0.13	0.03
pmi	0.18	1.00	0.28	0.45	-0.02	0.00
import	0.18	0.28	1.00	0.46	0.03	0.07
reaction	0.16	0.45	0.46	1.00	0.01	-0.08
gender	-0.13	-0.02	0.03	0.01	1.00	-0.32
age	0.03	0.00	0.07	-0.08	-0.32	1.00

```
Sample Size
```

```
[1] 123
```

```
Probability values (Entries above the diagonal are adjusted for multiple tests.)
```

	cond	pmi	import	reaction	gender	age
cond	0.00	0.50	0.50	0.69	1	1
pmi	0.05	0.00	0.02	0.00	1	1
import	0.05	0.00	0.00	0.00	1	1
reaction	0.08	0.00	0.00	0.00	1	1
gender	0.16	0.82	0.77	0.87	0	0
age	0.78	0.96	0.42	0.36	0	0

To see confidence intervals of the correlations, print with the short=FALSE option

```
>
> cor.ci(Tal_Or[1:4], n.iter=1000)
Call:corCi(x = x, keys = keys, n.iter = n.iter, p = p, overlap = overlap,
  poly = poly, method = method, plot = plot, minlength = minlength)
```

Coefficients and bootstrapped confidence intervals

```
      cond pmi  imprt rectn
cond    1.00
pmi     0.18 1.00
import  0.18 0.28 1.00
reaction 0.16 0.45 0.46 1.00
```

scale correlations and bootstrapped confidence intervals

	lower.emp	lower.norm	estimate	upper.norm	upper.emp	p
cond-pmi	0.02	0.02	0.18	0.35	0.34	0.03
cond-imprt	0.00	0.00	0.18	0.35	0.34	0.05
cond-rectn	-0.02	-0.02	0.16	0.33	0.32	0.09
pmi-imprt	0.10	0.11	0.28	0.44	0.43	0.00
pmi-rectn	0.30	0.30	0.45	0.57	0.58	0.00
imprt-rectn	0.32	0.31	0.46	0.60	0.59	0.00

To see confidence intervals of the correlations, print with the short=FALSE option

```
> cor2latex(Tal_Or[1:4], stars=TRUE, adjust="none") #create the Table
.... omitted
```

Mediation and Moderation

Mediation is just a different way of thinking of regression. It can be done using the mediate function. The first example just shows the regression analysis and draws the figure. The second example adds pmi and import as mediators. Compare the two outputs. See [Figure A3](#).

R code

```
reg <- mediate(reaction ~ pmi + cond + import, data=Tal_Or)
moderate.diagram(reg, main="Regression")
reg

med <- mediate(reaction ~ cond + (pmi) + (import), data=Tal_Or)
print(med, short=FALSE)
```

```
> reg <- mediate(reaction ~ pmi + cond + import, data=Tal_Or)
> moderate.diagram(reg, main="Regression")
> reg
```

Mediation/Moderation Analysis

Call: mediate(y = reaction ~ pmi + cond + import, data = Tal_Or)

The DV (Y) was reaction . The IV (X) was pmi cond import . The mediating variable(s) = .

	slope	se	t	p
pmi	0.40	0.09	4.26	4.0e-05
cond	0.10	0.24	0.43	6.7e-01
import	0.32	0.07	4.59	1.1e-05

With R2 = 0.33

R = 0.57 R2 = 0.33 F = 19.11 on 3 and 119 DF p-value: 3.5e-10

```
>
> med <- mediate(reaction ~ cond + (pmi) + (import), data=Tal_Or)
> print(med, short=FALSE)
```

Mediation/Moderation Analysis

Call: mediate(y = reaction ~ cond + (pmi) + (import), data = Tal_Or)

The DV (Y) was reaction . The IV (X) was cond . The mediating variable(s) = pmi import .

Total effect (c) of cond on reaction = 0.5 S.E. = 0.28 t = 1.79 df= 119
with p = 0.077

Direct effect (c') of cond on reaction removing pmi import = 0.1
S.E. = 0.24 t = 0.43 df= 119 with p = 0.67

Indirect effect (ab) of cond on reaction through pmi import = 0.39

Mean bootstrapped indirect effect = 0.4 with standard error = 0.17

Lower CI = 0.09 Upper CI = 0.73

R = 0.57 R2 = 0.33 F = 19.11 on 3 and 119 DF p-value: 3.5e-10

Full output

Total effect estimates (c)

	reaction	se	t	df	Prob
cond	0.5	0.28	1.79	119	0.0766

Direct effect estimates (c')

	reaction	se	t	df	Prob
cond	0.10	0.24	0.43	119	6.66e-01
pmi	0.40	0.09	4.26	119	4.04e-05
import	0.32	0.07	4.59	119	1.13e-05

'a' effect estimates

	cond	se	t	df	Prob
pmi	0.48	0.24	2.02	121	0.0454
import	0.63	0.31	2.02	121	0.0452

'b' effect estimates

	reaction	se	t	df	Prob
pmi	0.40	0.09	4.26	119	4.04e-05
import	0.32	0.07	4.59	119	1.13e-05

'ab' effect estimates

	reaction	boot	sd	lower	upper
cond	0.39	0.4	0.17	0.09	0.73

'ab' effects estimates for each mediator

	pmi	boot	sd	lower	upper
cond	0.19	0.19	0.11	0.01	0.42

	import	boot	sd	lower	upper
cond	0.2	0.2	0.11	0.01	0.45

To show moderation, we use the Garcia et al. (2010) data set. We use the `scale` and `lm` functions from `Core-R` to do the regressions. We compare the mean centered versus non-mean centered results. Then we use `setCor` to combine these two steps. We include a demonstration of how to create the interaction plot of Figure 3.

R code

```
#First do the regular linear model
mod1 <- lm(respappr ~ prot2 * sexism ,data=Garcia) #do not mean center
centered <- scale(Garcia,scale=FALSE) #mean center, do not standardize
centered.df <- data.frame(centered) #convert to a data frame
mod.centered <- lm(respappr ~ prot2 * sexism ,data=centered.df)
summary(mod1) #the uncentered model
summary(mod.centered) #the centered model
```



```

par(mfrow=c(1,2))
#compare two models (bootstrapping n.iter set to 5000 by default
# 1) mean center the variables prior to taking product terms
mod <- setCor(respappr ~ prot2 * sexism, data=Garcia,
,main="A: Moderated regression (std. and mean centered)")
mod
#demonstrate interaction plots
plot(respappr ~ sexism, pch = 23- protest, bg = c("black","red", "blue")[protest],
data=Garcia, main = "B: Response to sexism varies as type of protest")
by(Garcia,Garcia$protest, function(x) abline(lm(respappr ~ sexism,
data =x),lty=c("solid","dashed","dotted")[x$protest+1]))
text(6.5,3.5,"No protest")
text(3.1,3.9,"Individual")
text(3.1,5.2,"Collective")

```

```
> summary(mod1) #the uncentered model
```

Call:

```
lm(formula = respappr ~ prot2 * sexism, data = Garcia)
```

Residuals:

Min	1Q	Median	3Q	Max
-3.4984	-0.7540	0.0801	0.8301	3.1853

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	6.5667	1.2095	5.429	2.83e-07 ***
prot2	-2.6866	1.4515	-1.851	0.06654 .
sexism	-0.5290	0.2359	-2.243	0.02668 *
prot2:sexism	0.8100	0.2819	2.873	0.00478 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.144 on 125 degrees of freedom

Multiple R-squared: 0.2962, Adjusted R-squared: 0.2793

F-statistic: 17.53 on 3 and 125 DF, p-value: 1.456e-09

```
> summary(mod.centered) #the centered model
```

Call:

```
lm(formula = respappr ~ prot2 * sexism, data = centered.df)
```

Residuals:

Min	1Q	Median	3Q	Max
-3.4984	-0.7540	0.0801	0.8301	3.1853

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.01184	0.10085	-0.117	0.90671
prot2	1.45803	0.21670	6.728	5.52e-10 ***
sexism	0.02354	0.12927	0.182	0.85579
prot2:sexism	0.80998	0.28191	2.873	0.00478 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.144 on 125 degrees of freedom

Multiple R-squared: 0.2962, Adjusted R-squared: 0.2793

F-statistic: 17.53 on 3 and 125 DF, p-value: 1.456e-09

```
> #compare two models (bootstrapping n.iter set to 5000 by default
```

```
> # 1) mean center the variables prior to taking product terms
```

```
> mod <- setCor(respappr ~ prot2 * sexism ,data=Garcia,
```

```
+ ,main="A: Moderated regression (std. and mean centered)")
```

```
> mod
```

Call: setCor(y = respappr ~ prot2 * sexism, data = Garcia,

main = "A: Moderated regression (std. and mean centered)")

Multiple Regression from raw data

```
DV = respappr

      slope   se    t      p VIF
prot2      0.51 0.08 6.73 5.5e-10  1
sexism      0.01 0.08 0.18 8.6e-01  1
prot2*sexism 0.22 0.08 2.87 4.8e-03  1
```

Multiple Regression

```
      R  R2  Ruw R2uw Shrunken R2 SE of R2 overall F df1 df2      p
respappr 0.54 0.3 0.42 0.18      0.28      0.06      17.53  3 125 1.46e-09
```

```
> #demonstrate interaction plots
> plot(respappr ~ sexism, pch = 23- protest, bg = c("black","red", "blue")[protest],
+ data=Garcia, main = "B: Response to sexism varies as type of protest")
> by(Garcia,Garcia$protest, function(x) abline(lm(respappr ~ sexism,
+ data =x),lty=c("solid","dashed","dotted")[x$protest+1]))
```

Garcia\$protest: 0

NULL

Garcia\$protest: 1

NULL

Garcia\$protest: 2

NULL

```
> text(6.5,3.5,"No protest")
> text(3.1,3.9,"Individual")
> text(3.1,5.2,"Collective")
>
```

Decision Theory and Area under the Curve

Table A6 and Figure A4 are examples of signal detection theory. This is done by giving the four cells to the AUC function.

R code

```
AUC(c(49,40,79,336))
```

Decision Theory and Area under the Curve

The original data implied the following 2 x 2 table

	Predicted.Pos	Predicted.Neg
True.Pos	0.097	0.079
True.Neg	0.157	0.667

Conditional probabilities of

	Predicted.Pos	Predicted.Neg
True.Pos	0.55	0.45
True.Neg	0.19	0.81

Accuracy = 0.76 Sensitivity = 0.55 Specificity = 0.81

with Area Under the Curve = 0.76

d.prime = 1 Criterion = 0.88 Beta = 0.15

Observed Phi correlation = 0.32

Inferred latent (tetrachoric) correlation = 0.53

>

EFA

The factor analysis of the `Thurstone` data set was done using the `fa` function. We specify that the number of subjects was 213. By default, we find a *minres* solution and use the *oblminin* rotation. We also show how to specify other factor extraction techniques, and other rotations. We just show the first solution.

R code

```
fa(Thurstone,nfactors=3,n.obs=213)
fa(Thurstone,nfactors=3,n.obs=213,fm="mle") #use the maximum likelihood algorithm
fa(Thurstone,nfactors=3,n.obs=213, rotate="Varimax") #use an orthogonal rotation.
```

```
> fa(Thurstone,nfactors=3,n.obs=213)
```

```
Factor Analysis using method = minres
```

```
Call: fa(r = Thurstone, nfactors = 3, n.obs = 213)
```

```
Standardized loadings (pattern matrix) based upon correlation matrix
```

	MR1	MR2	MR3	h2	u2	com
Sentences	0.90	-0.03	0.04	0.82	0.18	1.0
Vocabulary	0.89	0.06	-0.03	0.84	0.16	1.0
Sent.Completion	0.84	0.03	0.00	0.74	0.26	1.0
First.Letters	0.00	0.85	0.00	0.73	0.27	1.0
Four.Letter.Words	-0.02	0.75	0.10	0.63	0.37	1.0
Suffixes	0.18	0.63	-0.08	0.50	0.50	1.2
Letter.Series	0.03	-0.01	0.84	0.73	0.27	1.0
Pedigrees	0.38	-0.05	0.46	0.51	0.49	2.0
Letter.Group	-0.06	0.21	0.63	0.52	0.48	1.2

	MR1	MR2	MR3
SS loadings	2.65	1.87	1.49
Proportion Var	0.29	0.21	0.17
Cumulative Var	0.29	0.50	0.67
Proportion Explained	0.44	0.31	0.25
Cumulative Proportion	0.44	0.75	1.00

With factor correlations of

	MR1	MR2	MR3
MR1	1.00	0.59	0.53
MR2	0.59	1.00	0.52
MR3	0.53	0.52	1.00

Mean item complexity = 1.2

Test of the hypothesis that 3 factors are sufficient.

The degrees of freedom for the null model are 36 and the objective function was 5.2 with

Chi Square of 1081.97

The degrees of freedom for the model are 12 and the objective function was 0.01

The root mean square of the residuals (RMSR) is 0.01

The df corrected root mean square of the residuals is 0.01

The harmonic number of observations is 213 with the empirical chi square 0.52 with prob < 1

The total number of observations was 213 with Likelihood Chi Square = 2.98 with prob < 1


```

Tucker Lewis Index of factoring reliability = 1.026
RMSEA index = 0 and the 90 % confidence intervals are 0 0
BIC = -61.36
Fit based upon off diagonal values = 1
Measures of factor score adequacy

                                MR1  MR2  MR3
Correlation of (regression) scores with factors  0.96 0.92 0.90
Multiple R square of scores with factors          0.93 0.85 0.82

Minimum correlation of possible factor scores      0.86 0.71 0.63

```

Reliability

Here we find the reliability of the `msqR` items found in the first example. We select just the time 1 data. We show several different approaches. Because we have just eight items and they represent two subfactors, we find ω_h using a two factor solution.

R code

```

msq.items <- c("anxious" , "at.ease" , "calm" , "confident", "content",
  "jittery", "nervous", "relaxed" , "tense" , "upset" ) #these overlap with the sai
msql <- subset(msqR,msqR$time==1)
alpha(msql[msq.items], check.keys=TRUE)
omega(msql[msq.items], nfactors=2)

```

```
alpha(msql[msq.items], check.keys=TRUE)
```

Reliability analysis

```
Call: alpha(x = msql[msq.items], check.keys = TRUE)
```

```

raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd median_r
      0.83      0.83      0.86      0.33  5 0.0046    2 0.54      0.32

```

```

lower alpha upper      95% confidence boundaries
0.82 0.83 0.84

```

Reliability if an item is dropped:

```

raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
anxious-      0.83      0.83      0.85      0.34 4.7   0.0047 0.026 0.34
at.ease       0.80      0.80      0.83      0.31 4.1   0.0055 0.028 0.32
calm          0.80      0.81      0.84      0.32 4.2   0.0054 0.030 0.32
confident     0.83      0.83      0.85      0.36 5.0   0.0046 0.022 0.32

```

content	0.82	0.82	0.84	0.34	4.6	0.0049	0.025	0.32
jittery-	0.83	0.83	0.85	0.35	4.8	0.0047	0.027	0.33
nervous-	0.82	0.82	0.84	0.33	4.4	0.0049	0.030	0.32
relaxed	0.80	0.81	0.84	0.31	4.1	0.0055	0.030	0.31
tense-	0.81	0.81	0.83	0.32	4.2	0.0051	0.029	0.32
upset-	0.82	0.82	0.85	0.34	4.7	0.0049	0.033	0.35

Item statistics

	n	raw.r	std.r	r.cor	r.drop	mean	sd
anxious-	1871	0.54	0.56	0.51	0.42	2.3	0.86
at.ease	3018	0.77	0.74	0.72	0.67	1.6	0.94
calm	3020	0.74	0.71	0.68	0.63	1.6	0.92
confident	3021	0.54	0.50	0.43	0.38	1.5	0.93
content	3010	0.64	0.59	0.55	0.50	1.4	0.92
jittery-	3026	0.52	0.55	0.48	0.41	2.3	0.83
nervous-	3017	0.59	0.64	0.60	0.52	2.6	0.68
relaxed	3023	0.76	0.73	0.70	0.66	1.6	0.91
tense-	3017	0.67	0.71	0.69	0.60	2.4	0.78
upset-	3019	0.54	0.58	0.50	0.45	2.6	0.68

Non missing response frequency for each item

	0	1	2	3	miss
anxious	0.53	0.29	0.13	0.04	0.38
at.ease	0.14	0.33	0.35	0.18	0.00
calm	0.14	0.34	0.36	0.17	0.00
confident	0.16	0.33	0.37	0.14	0.00
content	0.17	0.35	0.35	0.13	0.01
jittery	0.54	0.31	0.12	0.04	0.00
nervous	0.70	0.22	0.06	0.02	0.00
relaxed	0.12	0.30	0.40	0.18	0.00
tense	0.59	0.28	0.10	0.03	0.00
upset	0.74	0.18	0.05	0.02	0.00

Warning message:

```
In alpha(msql[msq.items], check.keys = TRUE) :
```

Some items were negatively correlated with total scale and were automatically reversed.

This is indicated by a negative sign for the variable name.

```
> omega(msql[msq.items], nfactors=2)
```

Three factors are required for identification -- general factor loadings set to be equal.

Proceed with caution.

Think about redoing the analysis with alternative values of the 'option' setting.

Omega

```
Call: omega(m = msql[msq.items], nfactors = 2)
```

```
Alpha:                0.83
G.6:                  0.86
Omega Hierarchical:    0.45
Omega H asymptotic:    0.51
Omega Total            0.87
```

Schmid Leiman Factor loadings greater than 0.2

	g	F1*	F2*	h2	u2	p2
anxious-	0.36		-0.57	0.46	0.54	0.28
at.ease	0.52	0.59		0.64	0.36	0.43
calm	0.49	0.47	-0.21	0.51	0.49	0.48
confident	0.31	0.58		0.46	0.54	0.21
content	0.40	0.65		0.59	0.41	0.26
jittery-	0.35		-0.52	0.40	0.60	0.31
nervous-	0.43		-0.57	0.51	0.49	0.36
relaxed	0.51	0.48	-0.22	0.53	0.47	0.48
tense-	0.50		-0.62	0.63	0.37	0.39
upset-	0.35		-0.29	0.25	0.75	0.50

With eigenvalues of:

```
g F1* F2*
1.8 1.6 1.5
```

general/max 1.13 max/min = 1.05
 mean percent general = 0.37 with sd = 0.1 and cv of 0.28
 Explained Common Variance of the general factor = 0.37

The degrees of freedom are 26 and the fit is 0.24
 The number of observations was 3032 with Chi Square = 721.36 with prob < 2.4e-135
 The root mean square of the residuals is 0.04
 The df corrected root mean square of the residuals is 0.05
 RMSEA index = 0.094 and the 10 % confidence intervals are 0.088 0.1
 BIC = 512.92

Compare this with the adequacy of just a general factor and no group factors
 The degrees of freedom for just the general factor are 35 and the fit is 1.67
 The number of observations was 3032 with Chi Square = 5055.64 with prob < 0
 The root mean square of the residuals is 0.21
 The df corrected root mean square of the residuals is 0.24
 RMSEA index = 0.218 and the 10 % confidence intervals are 0.213 0.223
 BIC = 4775.04

Measures of factor score adequacy

	g	F1*	F2*
Correlation of scores with factors	0.67	0.77	0.76
Multiple R square of scores with factors	0.45	0.60	0.59
Minimum correlation of factor score estimates	-0.09	0.19	0.17

Total, General and Subset omega for each subset

	g	F1*	F2*
Omega total for total scores and subscales	0.87	0.84	0.79
Omega general for total scores and subscales	0.45	0.33	0.30
Omega group for total scores and subscales	0.36	0.51	0.49

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