

**Human Capital and Economic Opportunity:
A Global Working Group**

Working Paper Series

Working Paper No. 2011-025

The Structure of Temperament and Personality Traits: A Developmental Perspective

Rebecca L. Shiner

Colin G. DeYoung

October, 2011

**Human Capital and Economic Opportunity Working Group
Economic Research Center
University of Chicago
1126 E. 59th Street
Chicago IL 60637
humcap@uchicago.edu**

Running Head: PERSONALITY STRUCTURE

**THE STRUCTURE OF TEMPERAMENT AND PERSONALITY TRAITS:
A DEVELOPMENTAL PERSPECTIVE**

Rebecca L. Shiner

Colgate University

Colin G. DeYoung

University of Minnesota

To appear in the *Oxford Handbook of Developmental Psychology*

THE STRUCTURE OF TEMPERAMENT AND PERSONALITY TRAITS: A DEVELOPMENTAL PERSPECTIVE

Introduction

Humans show a panoply of individual differences in their typical behavior, emotions, and thoughts. Beginning in infancy, individuals vary in traits such as energy and activity level, positive emotional engagement with others, feelings of distress and irritability, and persistent attention and interest in absorbing tasks. Older children, adolescents, and adults vary in their typical self-discipline, responsibility, empathy, imagination, and intellect. Traits show some stability across time and situations, but they also change over time and show some degree of situational specificity (McAdams & Pals, 2006). Contemporary research on temperament and personality traits addresses fundamental questions about these individual differences: What are the biological and environmental sources of variation in traits? To what extent and how do traits remain the same and change over time? How do individuals' traits affect their physical and mental health, relationships, work, and well-being?

These questions are best answered when researchers can achieve some consensus about the basic *structure* of traits. A structure or taxonomy of traits articulates which traits covary with which other traits, which traits are the most important, and what form those traits take at various points in the life course. A trait structure thus provides an organizational scheme for the basic units of temperament and personality and identifies how those basic units relate to one another. In the past, students of personality development used a bewildering array of measures and scales to describe individual differences, with the unfortunate consequence that results were difficult to compare from one study to the next. A structure or taxonomy provides a number of benefits in the study of personality development. First, researchers can make greater progress when they use similar language to study the same traits. As with psychiatric diagnoses, communication is aided by a common language for describing the phenomena of interest. Second, a taxonomy of traits enables integration of new findings with previous research. New measures can be related to the known structure of traits. A shared taxonomy can prevent the re-christening of already-recognized individual differences. New findings for each trait can be integrated with existing nomological networks for those traits, and in turn new hypotheses can be generated. Although taxonomies provide structure for research, they can likewise be modified by new findings; taxonomies are organizational systems that evolve over time.

Because children's traits expand so much in number and variety over the early years, it is challenging to develop a clear taxonomy or structure for describing these traits and their patterns of co-occurrence. As children grow from infancy to the school-age years, they develop new capacities, and these capacities greatly increase the number of traits that children can display. Within the first year of life, children already display temperamental differences in positive emotions and pleasure, various negative emotions, and interest and attention (Rothbart & Bates, 2006). As children move out of infancy, the development of more coordinated motor skills enables children to display physical aggression (Tremblay & Nagin, 2005) and to explore more widely. Children change from manifesting only a small number of emotions during infancy—pleasure, distress, and interest—to manifesting an expanded set of emotions by age 3—including joy, sadness, anger, fear, empathy, pride, shame, and guilt (Eisenberg, 2000; Lewis, 2000). Children's capacities for self-regulation likewise develop rapidly, which enables children to display differences in their abilities to regulate their emotions, engage in moral behavior, and pursue tasks (Eisenberg, Hofer, & Vaughan, 2007). In short, children's maturation permits the development and expression of new personality traits. The more narrow range of temperament traits seen in infants expands into a more complex network of traits in the school-age years. During each phase of early development, the structure is likely to be different, as new traits become apparent. Despite these challenges, over the last two decades, substantial progress has been made in identifying the structure of temperament and personality traits during each phase of life from early childhood through adulthood.

One important finding emerging from recent work on temperament and personality structure is that these individual differences are organized hierarchically across the lifespan. Some specific behavioral descriptors tend to co-vary (e.g., talkative, expressive, not shy when meeting new people). The co-variation among those descriptors is explained by lower-order traits that are relatively narrow in focus (e.g., sociability or assertiveness). In turn, some lower-order traits tend to co-vary, and the co-variation among those traits is accounted for by higher-order traits with greater breadth (e.g., Extraversion). Traits manifest a hierarchical structure like this in infancy and early childhood (Rothbart & Bates, 2006), middle childhood and adolescence (Caspi & Shiner, 2006), and adulthood (DeYoung, Quilty, & Peterson, 2007; Digman, 1997; Markon, Krueger, & Watson, 2005). As we discuss in more detail later in the chapter, there is newer evidence that, at an even higher level, these higher-order traits tend to show reliable

patterns of co-variation, forming “metatraits” (DeYoung, 2006; Digman, 1997). Thus, traits demonstrate a hierarchical structure that ranges from lower-order traits to higher-order traits to metatraits.

In this chapter, we articulate a developmental perspective on personality traits from early childhood through adulthood. In the first section, we address two topics that are fundamental in defining the most important traits at each point in the life span: the relationship between temperament and personality and the methods used to ascertain the structure of traits in the temperament and personality research traditions. We argue in this section that temperament and personality are different ways of describing the same basic traits, with temperament research primarily focused on early-emerging individual differences and personality research focused on individual differences that appear later in childhood and continue into adulthood. In the second section, we describe the current status of the most prominent models of temperament, as well as the most widely-accepted personality trait model, the Big Five (John, Naumann, & Soto, 2008). In the third section, we articulate a structural model that integrates contemporary findings on temperament and personality traits from early childhood through adulthood. We use the Big Five trait structure, along with one additional childhood trait, to organize this taxonomy. In the fourth section, we discuss the current research on the psychological and biological processes that underlie individual differences in the Big Five traits in childhood and adulthood. In the final sections, we offer concluding thoughts on the nature of personality trait development and suggestions for future research.

Definitions and Measurement: Temperament and Personality Traits

Although people display individual differences in traits across the lifespan, these traits are described sometimes as “temperament” and other times as “personality”. Before turning to a discussion of the trait structures found in childhood and adulthood, it is important to address two issues that impact the structures obtained for temperament and personality traits: the definitions of temperament and personality and the means used to measure traits and ascertain the structure of traits. Researchers’ definitions of temperament and personality affect which traits or descriptors they choose to include in various models of individual differences, and the traits included in different models in turn affect the resulting structure.

What are temperament and personality?

The concept of temperament has a long history, beginning in ancient times. Notions of temperament date at least from the ancient Greek idea that a person's typical mood and behavior result from the balance of four humors in the body: blood, black bile, yellow bile, and phlegm. In this ancient model, temperament was viewed as deriving from biological and emotional processes, a view consistent with current conceptualizations of temperament (Clark & Watson, 2008; Zuckerman, 1995). In more recent times, the empirical study of temperament in childhood was galvanized by the work of Alexander Thomas and Stella Chess, who started a longitudinal study of children's early-emerging behavioral styles in 1956 (Thomas, Chess, Birch, Hertzig, & Korn, 1963). At the time that Thomas and Chess began their study, most research on personality development was based on the assumption that children's socialization experiences were the most important sources of their individual differences in personality. Thomas and Chess' work helped to convince researchers, practitioners, and parents that children vary biologically from one another from early in life and that these biological differences are important for the course of children's development.

In the years since Thomas and Chess sparked interest in childhood temperament, the amount of research on the topic has grown at a rapid pace. Different models of temperament have been put forth, and these structural models will be discussed in the following section. At present, temperament researchers and practitioners are not yet unanimous in their definition of temperament. Perhaps the most influential contemporary definition of temperament comes from Mary Rothbart. Rothbart and colleagues argue that temperament includes individual differences in affect, activity, attention, and self-regulation (Rothbart & Bates, 2006). Like the ancient Greek model, this model highlights the importance of individual differences in emotional processes, including many different positive and negative emotions; these differences reflect children's reactivity to the environment. Unlike the Greek model, this model equally emphasizes the importance of individual differences in the regulation of reactive tendencies through attention and other aspects of self-regulation. According to this contemporary view, temperamental traits emerge during childhood, are closely linked with biological processes, and are in part shaped by heredity; however, experience also shapes their development. This model captures most of the points of agreement among current temperament models (Zentner & Bates, 2008).

Personality includes a much broader range of individual differences than does temperament. McAdams and Pals (2006) have developed a particularly helpful model for

understanding the purview of personality, which they divide into three broad levels: traits, characteristic adaptations, and personal narratives. First, *traits* describe relatively stable patterns of behavior, motivation, emotion, and cognition (Pytlík Zillig, Hemenover, & Dienstbier, 2002; Wilt & Revelle, 2009) that are not bound to a particular sociocultural context but could be observed in any such context. This is not to say that all traits will be evident to the same extent in all cultures, nor that all traits can be observed in any situation, but rather that any trait can be observed in a subset of situations in any culture, regardless of time and place. Second, *characteristic adaptations* include “a wide range of motivational, social-cognitive, and developmental adaptations” that are specific to a particular time, place, or role (p. 208). For example, youths vary in their goals and their sense of competence and self-efficacy in particular domains of their lives (e.g., academics, friendships) (Shiner, in press). Third, by adolescence youths begin to form *personal narratives* that help them to make sense of their identities and selves over time (McAdams, 2008). These narratives are unique to each person but can be studied empirically in terms of their common features across individuals. This chapter addresses traits, while acknowledging that personality extends well beyond that level, even in childhood (Shiner, in press).

Historically, temperament and personality have been studied as distinct sets of individual differences, with temperament consisting of more narrowly defined consistencies that appear earlier in life and with personality consisting of a broader range of consistencies that emerge later in life. However, if we restrict our consideration of personality to traits rather than characteristic adaptations or narratives, then temperament and personality traits have much in common (see Caspi & Shiner, 2006, Clark & Watson, 2008, McCrae et al., 2000, and Zentner & Bates, 2008 for similar arguments that personality traits in adulthood are, in essence, temperamental traits). First, both sets of individual differences are shaped by heredity and by the environment (Krueger & Johnson, 2008; Saudino, 2005). A common assumption about traits is that they start at birth as largely heritable in origin and gradually come to be more influenced by the environment, as children have more and more life experiences. However, this assumption is incorrect, in part because it overlooks the fact that, before a child’s birth, the intrauterine environment has already influenced the expression of each child’s genetic material (Feldman, 2008). In addition, there is evidence that early traits sometimes become *more* rather than less related to genetics as children grow from infancy to childhood (Knafo & Plomin, in press;

Saudino, 2005). Temperament traits in childhood and personality traits in adulthood both follow another interesting pattern: Stability in individuals' traits seems to derive from genetic influences, whereas changes in traits are influenced by both genetic and environmental factors (Ganiban, Saudino, Ulbricht, Neiderhiser, & Reiss, 2008; Krueger & Johnson, 2008; Saudino, 2005). In short, current behavior genetic research makes clear that temperament and personality traits both arise from the complex interplay of genes and experiences.

Second, animals display individual differences in behavior that mirror most of the major temperament dimensions in childhood and personality trait dimensions in adults (Weinstein, Capitanio, & Gosling, 2008). Temperament and personality traits thus may be more elaborated forms of basic behavioral systems that appear across species. These temperament and personality traits may reflect individual differences in biological systems that have been selected through evolution and are shaped by individuals' life experiences (Nettle, 2006). There are a number of biological systems that are relevant for personality functioning and that are crucial for human survival—for example, systems supporting the detection of rewards and threats, achievement of social dominance, striving after long-term goals, nurturance of the young, aggression, and exploration of new environments. Although such biological systems are part of the human make-up, people vary in the strength and expression of such systems. Individuals' life experiences create further variations in the expression of these systems, which become manifest in traits across the life span.

Third, both temperament traits and personality traits show both stability and change over time (Roberts & Del Vecchio, 2000). Sometimes child psychologists and psychiatrists shy away from using the term “personality” to describe individual differences in children, because of understandable but incorrect assumptions about the nature of personality traits. Although personality is often assumed to be extremely stable across time and situations and essentially unchangeable, more recent work suggests that personality differences, in transaction with environmental circumstances, organize behavior in dynamic ways over time (Caspi & Shiner, 2006). Fourth, a final point of convergence between temperament and personality is their very similar structure and content, as reviewed in detail later in this chapter. Research on the structure of temperament and personality traits proceeded in two distinct traditions; despite this, the two lines of research have converged on two similar sets of traits. Thus, it may be helpful to view temperament and personality not as truly distinct forms of individual differences, but rather as

different ways of describing the same basic traits, with “temperament” typically referring to earlier forms of these traits and “personality” to later forms. Because of the substantial overlap between temperament and personality traits, the two sets of individual differences are discussed together throughout this review.

How is structure established for temperament and personality traits?

Given that temperament and personality traits have often been conceptualized as different constructs, it is not surprising that these two domains of individual differences have been measured differently. As noted, the way that traits are measured has important implications for the way structure is established.

Temperament research is marked by great variety in the ways that temperament traits are measured. This richness of methods is likely due to several underlying factors. The first reason is straightforward: Children cannot easily report on their own traits, because of the limitations of their language development and self-insight. Child psychologists have not had the luxury of simply asking their subjects to describe themselves and have had to employ more complex methods. Second, children’s behavioral tendencies can probably be observed more easily and more naturally than adults’. Infants and very young children are less aware of being observed than adults are, and even preschoolers are likely to be less self-conscious and more spontaneous than adults while being observed in natural contexts or during lab tasks. Third, child psychologists have recognized for many years that children’s behavior varies across context and that different informants have different insights into children’s behaviors (Achenbach, McConaughy, & Howell, 1987).

Consequently, temperament researchers have relied on multiple methods and reporters to assess children’s traits (Caspi & Shiner, 2008; Rothbart & Bates, 2006). As with adults, questionnaires are often used; parents are the most frequent reporters, but teachers, older children, and adolescents can also complete questionnaires. Naturalistic observations are used to code children’s behavioral tendencies. For example, home observation systems have been developed to assess individual differences in preschoolers (e.g., Buckley, Klein, Durbin, Hayden, & Moerk, 2002). Laboratory tasks create specific situations in which children’s behaviors can be observed. Tasks have been developed to assess specific individual differences, such as Effortful Control (Kochanska & Knaack, 2003) and behavioral inhibition (Kagan, Snidman, & Arcus, 1998). A more comprehensive battery of laboratory tasks assessing temperament in children is

available and widely used (Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995). These varied methods have allowed temperament researchers to explore children's individual differences in a more valid fashion than would be possible with reliance on a single method.

Although these varied methods have been a strength of temperament research, some challenges have made it difficult to establish a clear structure of temperamental differences in childhood. With some of the methods described, the researcher has to begin with a reasoned hypothesis about the crucial temperament traits. For example, in conducting naturalistic observations or creating lab tasks, the researcher must start with some notion of the relevant traits in order to create the coding scheme or to construct the lab task. Empirical means can be used to refine the measurement of those traits, but the basic boundaries of the traits must be defined at the outset; this limits the usefulness of these methods as a means of establishing trait structure. Naturalistic observations and behavioral tasks also share the problem of potentially tapping more than one underlying trait, which makes it difficult to interpret the meaning of any particular task. For example, behavioral observations of inhibition in young children may confound temperamental differences in low levels of positive emotions in response to novelty and high levels of negative emotions in response to novelty (Putnam & Stifter, 2005); children may be inhibited because of either one or both of these tendencies.

Questionnaires may provide an easier means of establishing trait structure, because they can identify which traits tend to co-occur across a much wider range of traits more quickly. However, temperament questionnaires have been constructed with an eye toward measuring specific temperament models. Thus, as with naturalistic observations and lab tasks, researchers begin with reasoned hypotheses about the relevant traits and construct the questionnaires to measure those traits. The researchers' guiding assumptions about the basic nature of temperament also limit the traits sampled. Thus, any particular temperament questionnaire is likely to fail to include all potential traits. Because of the limitations of the methods used for assessment, there remains no general consensus about the structure of temperament in childhood. However, as we hope to demonstrate in our discussion of temperament structure, despite the varied means of measuring temperament, some traits have emerged as important across models and measures.

The fundamental difficulty in investigating trait structure is to create a sufficiently broad and unbiased pool of trait measurements, in which to identify structure. A reasonably

representative sample from the universe of all possible traits must be used to ensure unbiased results in factor analysis, which identifies broad patterns of covariation among variables. The lexical approach, which samples trait-descriptive words from natural language, is the best approximation of this criterion yet developed. Another valuable approximation is to sample traits from a large number of existing questionnaires (e.g., Markon et al., 2005). Neither approach ensures a complete lack of bias in the pool of traits, but they are less biased than other methods that have been used for trait selection.

Research on personality structure in childhood and adulthood provides a striking contrast to temperament research. In adulthood, self-report questionnaires have reigned as the most common method of personality assessment by far. Unlike younger children, adults are assumed to possess insights into their typical thoughts, behaviors, and feelings. Self-report questionnaires are used in part because they are inexpensive and easy to administer, but they have more substantive strengths as well. Questionnaires aggregate information about behavior across a number of situations and over a period of time; they efficiently gather a lot of information about a wide variety of traits; and they can solicit information about relatively rare but important behaviors. Although work on trait structure in adults has tended to rely on individuals' self-reports, the reports of others have been used as well, including spouses and peers (Costa & McCrae, 1992; McCrae, Jang, Livesley, Riemann, & Angleitner, 2001; Riemann, Angleitner, & Strelau, 1997). Many adult personality measures include a large number of person descriptors that sample a very wide range of behaviors. By employing this kind of questionnaire study, in conjunction with factor analysis, over the last several decades, personality researchers have made large strides in identifying the basic structure of personality traits in adults (John et al., 2008). This structure, known as the Five Factor Model or the Big Five, will be described in detail later in the chapter; the Big Five traits include Extraversion, Neuroticism, Conscientiousness, Agreeableness, and Openness/Intellect. The research on personality structure in childhood has been far less extensive than that in adults. As we will describe in the section on personality structure in childhood, personality questionnaires describing children and adolescents yield evidence of a Big Five trait structure for youth, even as early as preschool-age (Caspi & Shiner, 2006).

The methods used to measure temperament and personality and to establish trait structure have offered different strengths to these research traditions. Because personality psychologists

have devoted considerable effort to establishing trait structure through extensive empirical analysis of multiple questionnaires, the field has converged on a generally accepted trait structure. As a consequence of this general agreement about structure, adult personality research has made great strides in exploring the nature of traits—for example, their genetic and biological bases, cross-cultural manifestations, and underlying psychological processes. Because the study of temperament has focused instead on the development of different temperament models, there is less consensus among temperament researchers about the general structure of temperament. The field of temperament has made tremendous progress in recent years. But, even greater progress is likely to occur as temperament researchers empirically test and evaluate competing models of individual differences and arrive at greater consensus about the basic units of temperament.

Still, the multiple methods used to study temperament have been a great strength of this research tradition. Temperament research puts in bold relief the overreliance of personality research on questionnaires, particularly self-report questionnaires. There have been a number of personality studies examining personality through behavioral observations; one of the best examples is the recent German Observational Study of Adult Twins (Borkenau, Riemann, Angleitner, & Spinath, 2001), which has provided important insights into the genetic and environmental sources of variation in adults' observed traits. Nonetheless, such studies remain the exception. Kagan (2003) has been a particularly vocal critic of overreliance on self-report questionnaires, stating, "Conclusions about a child's psychological features based only on questionnaires or interviews have a meaning that is as limited as Ptolemy's conclusions about the cosmos based on the reports of observers staring at the night sky without a telescope" (p. Kagan, 2003). This claim is too strong, given the substantial knowledge accumulated through the use of questionnaires and interviews in both children and adults. Nonetheless, as Kagan (2007) notes, work on individual differences will proceed faster and better as researchers turn to more varied methods. In short, the temperament and personality traditions have much to offer each other in the study of personality development.

Models of Temperament and Personality Structure

In this section, we describe several temperament models and the most widely accepted model of personality. Because temperament researchers have not reached consensus on what model provides the most valid structure, we review the most prominent models of temperament

that have been developed over the last several decades. As noted in the previous section, personality researchers have generally converged on the Big Five model for describing trait structure in adults (John et al., 2008), and there is increasing evidence that this model captures the structure of personality traits in children as well (Caspi & Shiner, 2006). Thus, we present the evidence for this personality model only, rather than reviewing alternative personality models. This brief review of various temperament and personality structural models highlights points of convergence in the traits included in various models.

Thomas and Chess

As noted, Alexander Thomas and Stella Chess galvanized contemporary interest in temperament among both researchers and clinicians. Thomas and Chess (1977) guided the well-known New York Longitudinal Study (NYLS) of temperament, based on their overarching framework for temperament: “We conceptualize temperament as the stylistic component of behavior—that is the *how* of behavior as differentiated from motivation, the *why* of behavior, and abilities, the *what* of behavior” (Goldsmith et al., p. 508). In other words, they wanted to focus on behavioral style—the variations in how children display their behavior. They presumed that such differences would have, in part, an endogenous biological basis, given their emergence early in infancy. Thomas and Chess derived their list of temperament traits based on a content analysis of a small set of interviews with parents in the NYLS study. The list of traits included nine dimensions (Thomas & Chess, 1977; Thomas et al., 1963): (a) activity level; (b) regularity of biological functions, (c) initial approach or withdrawal from new stimuli, (d) adaptability to new situations following the initial response, (e) threshold of sensory responsiveness, (f) intensity of emotional reactions (regardless of quality), (g) general positivity versus negativity of mood, (h) distractibility, or capacity for external stimuli to alter behavior, and (i) attention span or persistence in the face of obstacles. These traits were chosen with an eye toward identifying traits with likely impact on later functioning.

Later work has identified some conceptual and empirical problems with the Thomas and Chess model. Conceptually, it is not truly possible to distinguish children’s style of behavior from the content of and motivation for their behavior; *what* children do cannot be disentangled from *how* they do it, and motivation influences both the content and style of behavior. Empirically, the Thomas and Chess-inspired questionnaires do not yield nine distinct temperament traits (De Pauw, Mervielde, & Van Leeuwen, 2009; Shiner & Caspi, 2003), but

rather a much smaller number of traits. These traits include social inhibition, irritability, attention/persistence, activity level, and sensory sensitivity (Martin, Wisenbaker, & Huttenen, 1994). Despite the problems that have become evident with newer research, the Thomas and Chess model successfully inspired contemporary research on temperament and highlighted aspects of young children's behavior that have long-term clinical implications.

Buss and Plomin

In contrast to Thomas and Chess's focus on traits appearing in infancy, Arnold Buss and Robert Plomin chose to focus their temperament model on childhood traits that were likely to be apparent from infancy through adulthood (Buss & Plomin, 1975, 1984; Goldsmith et al., 1987). They argued that temperament traits should be substantially heritable, apparent in primates, and relatively stable over time, even in childhood. When Buss and Plomin first presented their model, they believed that four traits fit these criteria, and these form the acronym *EASI*: *emotionality* (focused on negative emotions, first undifferentiated distress and later both fear and anger), *activity*, *sociability*, and *impulsivity*. Sociability was later differentiated from shyness, with the former tapping a preference for interaction with others and the latter tapping discomfort interacting with unfamiliar people. Impulsivity was moved out of the model and later added back in as empirical work explored the construct. The EASI model has fallen out of favor in research on childhood temperament, probably because it leaves out some traits that could reasonably be considered temperamental in nature and thus paints too narrow a picture of temperament. Nonetheless, this model pointed researchers to the importance of understanding traits that appear both early and later in life and identified some of the most important traits that appear across models.

Rothbart

Mary Rothbart's theoretical model of temperament was described earlier in this chapter, because it is the model that most often guides current research on temperament. As noted, Rothbart has argued that temperament traits consist of "constitutional differences in reactivity and self-regulation, with 'constitutional' seen as the relatively enduring biological makeup of the organism influenced over time by heredity, maturation, and experience" (Rothbart & Derryberry, 1981, p. 37). Children's reactive traits (such as emotional tendencies) reflect biological arousability, whereas regulatory traits modulate children's reactivity. According to this view, new temperament traits emerge over time as children mature.

In order to capture the expansion and development of temperament traits during each phase of life, Rothbart and colleagues developed questionnaire measures to assess temperament in infancy, early childhood, preschool-age, middle childhood, early adolescence, and adulthood (Putnam, Ellis, & Rothbart, 2001). In order to develop the lower-order scales at each age, Rothbart and colleagues considered other temperament models (including the NYLS and EASI models), adult temperament and personality models, and research on basic emotions (Izard, 1977). These lower-order scales were designed to assess a wide range of differences in reactivity and self-regulation at each age and have been refined empirically, although their basic content was defined rationally. Factor analyses of Rothbart and colleagues' questionnaire measures yield evidence for three overarching traits from infancy through later childhood (Rothbart & Bates, 2006). *Surgency* taps tendencies toward high activity, a rapid approach style, expressions of positive emotions, and pleasure and excitement in social interaction. *Negative Emotionality* taps children's tendencies toward sadness, fear, irritability and frustration, and difficulty with being quieted after high arousal. *Effortful Control* (named *Orienting/regulation* in infancy) includes the ability to sustain attention and inhibit behavior, the ability to persist in tasks, pleasure in low intensity situations, and sensitivity to perceptual experiences. However, when Rothbart's Children's Behavior Questionnaire was factor analyzed together with a broader collection of traits in a large sample of preschool children, low intensity pleasure and perceptual sensitivity formed a separate factor, distinct from Effortful Control (De Pauw et al., 2009). Table 1 presents items assessing the three widely recognized higher-order traits in children ages 3 to 7, as well as items reflecting this additional factor. Rothbart has obtained evidence for a fourth trait, *Affiliativeness*, in adolescence (Rothbart & Bates, 2006) and has developed a temperament model for adults that includes a fifth trait, Orienting Sensitivity, which corresponds to the factor found by De Pauw and colleagues in children (Evans & Rothbart, 2007). The five adult temperament factors correspond closely to the Big Five (Evans & Rothbart, 2007). Rothbart's work has highlighted important higher-order traits that show clear conceptual links with personality traits observed in children and adults.

Kagan

Jerome Kagan's work on temperament stands in contrast to the broader temperament models outlined thus far in that he has tended to argue for a narrower definition of temperament. Specifically, Kagan (2008) has suggested that "a temperamental bias refers to a biologically

based foundation for clusters of feelings and subsequent actions that appear during early childhood . . .” (p. 39) and that “it is assumed, but not yet proven, that the biological foundations for many, but probably not all, human temperaments are heritable neurochemical profiles” (p. 39). Rather than attempting to describe the possible full range of temperament traits, Kagan has adopted a more inductive approach by focusing in-depth on a particular observable tendency—specifically, a predisposition toward high or low reactivity to novel or unfamiliar situations (Kagan, 2008; Kagan & Fox, 2006). This tendency, sometimes termed “inhibition to the unfamiliar”, indexes variations in the tendency to withdraw and express fear in the face of stressful novel situations (Fox, Henderson, Marshall, Nichols, & Ghera, 2005). Kagan and colleagues have obtained evidence for both the biological underpinnings and long-term outcomes of this temperamental trait (Kagan, Snidman, Kahn, & Towsley, 2007).

Cloninger

The models reviewed thus far have originated from attempts to understand temperament in childhood. Like Rothbart, others have considered the manifestations of temperament in adults. The most widely known theory is that of Cloninger (1987; Cloninger, Svrakic, & Przybeck, 1993) who developed a model of personality that distinguishes between four temperament traits (Novelty Seeking, Harm Avoidance, Reward Dependence, and Persistence) and three character traits (Self-Directedness, Cooperativeness, and Self-Transcendence). He hypothesized that the temperament traits would be evident early in ontogeny and strongly genetically determined. In contrast, he hypothesized that the character traits would develop later because they are determined by experience during development rather than primarily by genes. However, empirical work has revealed flaws in Cloninger’s model. First, his distinction between temperament and character appears untenable. The character traits show similar levels of heritability to the temperament traits (Ando et al., 2004; Gillespie, Cloninger, Heath, & Martin, 2003). Second, Cloninger’s seven-factor structure has not proven consistently replicable (Ando et al., 2004; Ball, Tennen, & Kranzler, 1999; Herbst, Zonderman, McCrae, & Costa, 2000). In fact, Cloninger’s Temperament and Character Inventory is best described by the five-factor structure of the Big Five (Markon et al., 2005; Ramanaiyah, 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. And Novelty Seeking 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/Intellect. Cloninger's model has been popular, in part, because he proposed hypotheses for the biological substrates of three of the temperament traits. As biological theories are developed to explain better-validated trait models (e.g., DeYoung & J. R. Gray, 2009), reliance on a poorly validated model becomes less appealing.

The Big Five Model from Childhood Through Adulthood

One of the great achievements in the study of adult personality over the past two decades is greater clarity about the higher-order structure of personality. As noted earlier in the chapter, the most widespread support has been obtained for a five-factor structure, dubbed the Big Five or the five-factor model (Caspi & Shiner, 2006; John et al., 2008) and including broad traits of Extraversion, Neuroticism, Conscientiousness, Agreeableness, and Openness-to-Experience/Intellect. Table 1 presents items measuring these five traits in both children and adults. Support for this model derives from two main sources of evidence. First, research in the lexical tradition has examined the structure of natural language. According to the lexical hypothesis guiding this research, the personality terms contained in the natural language may provide an extensive, yet finite, set of attributes that people who share that language have found to be important and useful in their interactions with each other. Factor analyses of adjectives drawn from dictionaries in numerous countries have resulted in factors resembling the Big Five traits; strongest support has been found in languages from northern European origins (Caspi & Shiner, 2006). Recently, a six-factor solution has been discovered in lexical research that appears to be more widely replicable across languages than the Big Five (Ashton et al., 2004); however, this model appears to be only a minor variation on the Big Five, splitting Agreeableness into two factors (DeYoung et al., 2007; McCrae & Costa, 2008). Natural languages are likely to include many words describing traits within the Agreeableness domain because Agreeableness describes the quality of social interactions (social salience is one likely biasing factor in variable selection in the lexical approach). Second, factor analyses of questionnaires designed to measure a broad range of individual differences yield the Big Five traits, even when those questionnaires were not designed to assess the Big Five (Caspi & Shiner, 2006; John et al., 2008). A number of studies have jointly analyzed several personality questionnaires at once, rather than focusing on a single

personality model, and these studies have provided converging evidence of this same basic structure for adult personality (e.g., Markon et al., 2005).

There is now convincing evidence that, at least by the school-age years, children's personality traits share the same Big Five structure as adult traits (Caspi & Shiner, 2006; Mervielde, De Clercq, De Fruyt, & Van Leeuwen, 2005; Shiner & Masten, 2008). This five-factor structure of children's traits has been found in studies with both parents and teachers as reporters and in both questionnaire and Q-sort measures (see Caspi & Shiner, 2006 for relevant studies). Although some of the studies obtaining a five-factor structure in childhood have employed measures pre-structured to reflect the Big Five traits, other studies have found similar structures in measures designed simply to tap a broad range of personality traits in childhood (e.g., John, Caspi, Moffitt, Robins, & Stouthamer-Loeber, 1994; Digman & Shmelyov, 1996; Shiner, 2000; Tackett et al., 2008). In fact, one of the most seminal early papers documenting a five-factor personality trait structure included teacher reports on schoolchildren's traits, using a broad, unselected set of descriptors (Digman & Takemoto-Chock, 1981). Parents' reports on their children's traits show structural continuity of the Big Five traits by the time children are school-age (DeFruyt et al., 2006). Remarkably, when children as young as 6-years-old rate their personalities in the context of a interview with puppets, they can provide coherent, differentiated reports on the Big Five traits (Measelle, John, Ablow, Cowan, & Cowan, 2005). A recent study of youths ages 10 to 20 demonstrated that youths' personality self-reports increasingly conform to a Big Five factor structure with age (Soto, John, Gosling, & Potter, 2008). Taken together, these studies suggest that the Big Five model can be used as an overarching taxonomy for both children's and adults' personality traits.

An Integrative Model of Temperament and Personality Trait Structure

In this section, we describe a structural model that integrates existing research on temperament and personality traits from infancy through adulthood. Although work on temperament and personality structure has proceeded using varied models and methods, there is considerable convergence on a core set of traits across the lifespan. We organize this structure using the Big Five trait model, with the addition of one trait, activity level, that does not clearly map onto the Big Five in childhood.

We chose to use the Big Five as an organizing structure, even for childhood traits, for several reasons. First, single childhood personality traits have been studied for decades—

including dominance, shyness, stress reactivity, aggression, delay of gratification, empathy, and achievement striving (Shiner, 1998). The Big Five model encompasses most of these single traits and relates them to each other in a structural system. Second, the Big Five model provides excellent coverage of traits that parents from many countries consider important in describing their children. As part of an international project, parents from the United States, China, Poland, Belgium, Holland, Germany, and Greece were asked to describe their 2- to 13-year old children (Kohnstamm, Halverson, Mervielde, & Havill, 1998). The vast majority of the phrases parents used to characterize their children could be easily classified as fitting into one of the Big Five trait domains.

Third, the Big Five traits appear to encompass the temperament traits that emerge from multiple methods, including questionnaires, observations, and lab tasks. Factor analyses of parent and teacher questionnaires point consistently to a set of core temperament traits; these questionnaires derive from the models described in the previous section and from other models as well (e.g., Goldsmith, 1996; Kochanska, Coy, Tjebkes, & Husarek, 1998; Lemery, Goldsmith, Klinnert, Mrazek, 1999). Particularly helpful are the rare studies that examine questionnaires from multiple temperament models within the same study, because they provide evidence about the joint structure of temperament traits across models (e.g., De Pauw et al., 2009; Lemery et al., 1999). Evidence for the structure of temperament traits also derives from home observational coding systems (Bornstein, Gaughran, & Homel, 1986; Buckley, Klein, Durbin, Hayden, & Moerk, 2002) and from laboratory tasks (Goldsmith et al., 1995; Kochanska & Knaack, 2003; Majdandžić & van den Boom, 2007), which demonstrate which behavioral tendencies cohere as temperament traits. Questionnaire, observational, and lab task studies all yield a set of temperament traits that show conceptual and empirical relationships with many of the Big Five traits (see Caspi & Shiner, 2006, Mervielde & Asendorpf, 2000, and Zentner & Bates, 2008 for similar lists of traits). In these cases, the Big Five traits encompass the essential aspects of the temperament traits and add additional information.

In what follows, we describe in some detail each of the traits as they are manifested from early childhood through adulthood. We begin with one narrower childhood trait—activity level—and then turn to the Big Five traits. In our discussion of the Big Five, we explain what personality research adds to the temperament conception of traits, and we review briefly longitudinal research linking children’s early traits with the later manifestation of those traits. To

illustrate the meaning of the Big Five traits, Table 1 lists items from three measures: the *Children's Behavior Questionnaire* (Rothbart, Ahadi, Hershey, & Fisher, 2001), a parent-report temperament questionnaire for children ages 3 to 7; a teacher-report instrument used to explore the structure of personality in a sample of children ages 8 to 10 (Digman & Shmelyov, 1996); the *Big Five Aspect Scales* (DeYoung et al., 2007), an adult Big Five questionnaire created from the International Personality Item Pool, which is in the public domain (Goldberg, 1999). After describing the various traits, we end this section with a review of metatraits, the higher-order factors that capture the covariance of the Big Five traits.

Activity Level

Activity level is an important component of most childhood temperament models and is typically conceptualized as the vigor and tempo of children's motor movements. Activity level emerges as a separate temperament trait in questionnaire studies from infancy through later in childhood (Caspi & Shiner, 2006; DePauw et al., 2009; Lemery et al., 1999), but it also can be measured reliably across natural and laboratory settings through the use of an actigraph, a mechanical device tracking children's movements (Saudino & Zapfe, 2008). The meaning of children's activity level is likely to change with development. Motor movement in infancy is associated with both anger and positive emotions, whereas motor movement in the toddler years is linked in complex ways with early markers of high Extraversion and low self-control (Eaton, 1994). Most childhood temperament questionnaire measures of activity level skew toward the measurement of poorly regulated, impulsive activity (De Pauw et al., 2009), which is most likely to be associated with low Conscientiousness and low Agreeableness, given that these two traits tap aspects of self-regulation. In contrast, high levels of energy, enthusiasm, and positive engagement are clearly a component of Extraversion in toddlers, older children, and adults (Goldberg, 2001; John et al., 2008; Lamb, Chuang, Wessels, Broberg, & Hwang, 2002), and "Activity," in this sense, has been conceived explicitly as a facet of Extraversion (Costa & McCrae, 1992).

Positive Emotionality/Extraversion

Children display variations in their positive emotions in infancy; as children age, this trait broadens in content to become the trait of Extraversion. From infancy, children vary in their expression of positive emotions, including smiling and laughter, pleasure, and joy and excitement in social interactions (Gartstein & Rothbart, 2003). Both observational and

questionnaire measures demonstrate that the disposition toward positive emotions is already distinct from the disposition toward negative emotions in infancy (Belsky et al., 1996; Kochanska et al., 1998). These expressions of positive emotions are substantially related to children's eagerness to approach potentially rewarding situations (Kochanska, Askan, Penney, & Dobbay, 2007). For example, 4-month-old infants who demonstrate high positive emotions in response to visual and auditory stimuli demonstrate continued high positive emotions and eager approach to novel stimuli later in infancy (Hane, Fox, Henderson, & Marshall, 2008). As children move out of infancy, this dimension of temperament broadens to include other behaviors beyond positive emotions, particularly children's eagerness for social interaction.

From preschool-age onward, children display temperamental variations in a broader Extraversion trait (De Pauw et al., 2009). By preschool-age, this trait includes at least three major components (Olino, Klein, Durbin, Hayden, & Buckley, 2005): children's *positive emotions* such as joy and enthusiasm; their *sociability*, meaning their motivation to engage and interact with others; and their eager *approach* of rewarding situations. Extraversion also includes another component that is not included in most temperament models, namely *assertiveness*. Extraversion in both children and adults includes tendencies toward being more persuasive and directive and toward being stronger, more compelling leaders (DeYoung et al., 2007; Morison & Masten, 1991). Assertiveness is a fundamentally important aspect of youths' social motivations and goals in their relationships with peers (Di Blas, 2007; Markey, Markey, & Tinsley, 2005; Ojanen, Gronroos, & Salmivalli, 2005); thus, childhood Extraversion research includes an important emerging aspect of children's social behavior.

Robust evidence exists for the continuity of markers of Extraversion from early in childhood to later in childhood. Early positive emotions (especially high-intensity positive emotions), sociability, and positive activity level in early childhood all predict later childhood Extraversion (Caspi & Shiner, 2006). A 23-year longitudinal study found that highly confident, friendly, and zealous 3-year-olds exhibited high Extraversion as adults, whereas socially reticent, fearful 3-year-olds exhibited low scores on this trait in adulthood (Caspi et al., 2003). In addition, the various components of Extraversion (positive affect, sociability, positive activity level) all show moderate stability from preschool-age to middle childhood, whether measured through home observations, laboratory tasks, or parent ratings (Durbin, Hayden, Klein, & Olino, 2007). Further, the various components of Extraversion in preschool predict *other* components of

Extraversion in middle childhood as well (Durbin et al., 2007). Thus, Extraversion appears to be an early-emerging trait that shows considerable coherence over time.

Negative Emotionality/Neuroticism

Just as people vary in their predisposition toward positive emotions, they vary in their predisposition toward negative emotions; this trait is typically called *Negative Emotionality* earlier in childhood, but *Neuroticism* is the name used in Big Five research. Early in childhood and continuing into the preschool years, children show individual differences in their experience and expression of a wide variety of negative emotions, including distress, fear, anxiety, sadness, irritability, and frustration (Buss & Plomin, 1984; De Pauw et al., 2009; Mervielde et al., 2008; Rothbart & Bates, 2006). Children high on this trait have difficulty becoming settled after facing stressful or challenging situations. This trait seems to tap children's tendencies toward perceiving the world and their experiences as threatening. Behavior observations of preschoolers provide evidence of an overarching Negative Emotionality trait that includes sadness and depression, anger and irritability, and lability of mood (or emotion regulation deficits) (Buckley et al., 2002).

Although children do show general tendencies toward the experience and expression of negative emotions, temperament researchers often focus on components of Negative Emotionality; *fear* and *irritability/anger* have received especially intensive study. Fear measures children's tendencies to express fear and exhibit withdrawal and avoidance in the face of stressful or novel situations. Irritability/anger taps children's propensities toward outer-directed, hostile emotions such as anger, frustration, and irritation; in children, such hostility is often evoked by limits set by adults. Numerous questionnaire, observational, and lab-based measures have shown that infants and young children show differentiated tendencies toward fear and irritability/anger (Goldsmith & Rothbart, 1991; Kochanska et al., 1998; Lemery et al., 1999; Majdandžić & van den Boom, 2007; Rothbart & Mauro, 1990). These two lower-order traits predict different social outcomes, have different effects on cognitive processing, and require different regulatory strategies (Caspi & Shiner, 2006).

Like the trait of Negative Emotionality measured in younger children, the Big Five trait of *Neuroticism* taps youths' and adults' susceptibility to negative emotions and general distress. Neuroticism shows clear conceptual overlap with the temperamental trait of Negative Emotionality, and the traits are related empirically (De Pauw et al., 2009; Digman & Shmelyov, 1996). Both traits have at their core a wide range of negative emotional traits, including

fearfulness, feelings of distress in the face of challenging situations, sadness over losses, and difficulty with becoming settled after adverse events. Yet, there are two significant differences between the two traits. First, irritability, anger, and hostility often are linked with Agreeableness more so than with Neuroticism in childhood (De Pauw et al., 2009; Digman & Shmelyov, 1996), but these outer-directed negative emotions show associations with Neuroticism and low Conscientiousness as well (Abe, 2005; Goldberg, 2001; Hampson, Andrews, Barckley, & Peterson, 2007; Lamb et al., 2002). Thus, irritability, anger, and hostility show widespread associations with numerous aspects of children's personalities. Second, Neuroticism includes components that only become expressed as people develop greater awareness of themselves and more complex cognitive capacities, such as the ability to think about the future. For example, high Neuroticism entails feeling insecure, vulnerable, jealous, fearful of failing, unable to face uncertainty, sensitive to criticism, and concerned about acceptance. Many of these traits seem to tap an underlying predisposition toward anxiety, which can be experienced when there is no imminent threat. For children to display these characteristics, they need to be cognizant of possibilities in the future and of how they see themselves in relation to others. In contrast, temperament measures of fear emphasize children's behavioral responses to actual exposure to a feared situation. Thus, Neuroticism adds aspects of negative emotionality that may become increasingly important from preschool-age into adolescence.

Neuroticism and its related components (fear, irritability/anger) in childhood are predicted by a number of markers of negative emotions earlier in life (Caspi & Shiner, 2006). For example, in a longitudinal study predicting preschool-age personality, Neuroticism was predicted by high-intensity full-face negative emotions (sadness and anger) in the Strange Situation paradigm at 18-months (Abe & Izard, 1999). Similarly, another study found that Negative Emotionality at ages 5 and 7 was predicted by children's earlier Negative Emotionality, anger, and sadness (Durbin et al., 2007). Fear, sadness, and irritability/anger each show modest to moderate continuity over the childhood years as well (Caspi & Shiner, 2006; Durbin et al., 2007). Sometimes one aspect of Negative Emotionality in early childhood predicts other aspects of Negative Emotionality later in childhood (e.g., irritability/anger sometimes predicts later sadness and vice-versa; Abe, 2005; Caspi & Shiner, 2006; Durbin et al., 2007).

Finally, before leaving the trait of Negative Emotionality, it is important to address how the childhood trait of *behavioral inhibition* (or reactivity) relates to Negative

Emotionality/Neuroticism; as noted earlier in the chapter, Kagan's strong emphasis on this trait has inspired considerable research on inhibition (Fox et al., 2005; Kagan, 2008). Inhibition is a broad construct that is typically measured through children's reactions to potentially stressful, novel social and non-social situations. Inhibition shows itself in infancy through motor reactivity and distress and later in childhood through reticent, withdrawn behavior in response to novelty (Kagan, 2008). Despite in-depth research on this trait, it remains unclear how this tendency relates to other measures of fear and Negative Emotionality (Hane et al., 2008). Children's observed behavioral inhibition may not reflect a single underlying trait: Children may show differentiated inhibited responses to social versus nonsocial situations (Majdandžić & van den Boom, 2007), and inhibition may derive from either high Negative Emotionality or low approach/Extraversion (Putnam & Stifter, 2005). More detailed work is needed to clarify the relationship among the constructs of behavioral inhibition, shyness, fear, and Negative Emotionality.

Effortful Control/Conscientiousness

Throughout childhood, children vary in their capacities for self-regulation. Between the 4 and 8-month period, infants vary in their focused attention to various environmental stimuli (Rothbart, Chew, & Gartstein, 2001). By the toddler years, this trait broadens to include the ability to sustain attention over time and to persist in tasks (Martin et al., 1994; Goldsmith, 1996). Among preschoolers, the trait includes more sophisticated self-regulatory abilities, including capacities to plan behavior, inhibit inappropriate responses, and focus and shift attention (Rothbart et al., 2001). Because the trait involves executive, self-directed control, Rothbart and colleagues have termed this trait *Effortful Control*. The trait can likewise be measured through tasks that require children to exert self-control by suppressing dominant responses in favor of subdominant responses (Kochanska & Knaack, 2003; Kochanska, Murray, & Coy, 1997). Children's increasing capacities for effortful self-regulation enable children to modulate their more automatic emotional responses to their experiences; thus, Effortful Control helps children to regulate their tendencies toward approach (positive emotions and Extraversion) and withdrawal (Negative Emotionality) (Rothbart & Bates, 2006).

The broader Big Five trait of *Conscientiousness* reflects individual differences in self-control reflected in the capacities for constraining impulses and striving to meet standards. Conscientiousness is clearly related to Effortful Control conceptually and empirically. Both traits

capture children's capacities for self-control, including their abilities to persist at tasks and to be planful, cautious, deliberate and controlled in their actions. Empirically, Conscientiousness is associated with measures of Effortful Control (Halverson et al., 2003). In a multi-measure study of preschool-age children, Conscientiousness formed a factor along with temperament measures of attention focusing, persistence, and the capacity to inhibit behavior (De Pauw et al., 2009). Temperament models tend to emphasize attention and impulse control, which are individual differences that can be identified in a rudimentary form in infants and toddlers. In contrast, personality measures of Conscientiousness include not only impulse control but also traits that youths do not exhibit until the preschool period, such as orderliness, dependability, and motivation to strive for high standards and to pursue goals over time in a determined manner. These tendencies are likely to become especially salient as children are faced with demands for more sophisticated work in elementary-school.

Although little is known about the antecedents of Conscientiousness as measured in the Big Five research, more is known about the early antecedents of Effortful Control and its components. Childhood markers of self-control are predicted in conceptually coherent ways by several early individual differences, and childhood self-control itself is remarkably stable by the preschool years (Caspi & Shiner, 2006). Early IQ and ability to focus attention both predict later Effortful Control (Kochanska, Murray, & Harlan, 2000; Kochanska & Knaack, 2003). Persistence at tasks (Guerin, Gottfried, Oliver, & Thomas, 2003) and Effortful Control (Kochanska & Knaack, 2003) are both highly stable traits by the preschool years. Interestingly, Effortful Control and Conscientiousness are also *negatively* predicted by intense positive emotions, quick approach, and high anger earlier in childhood (Caspi & Shiner, 2006), suggesting that intense emotions in infancy may either reflect self-regulatory problems or may pose challenges for the development of self-regulation. Generally, childhood markers of self-control are predicted in conceptually coherent ways by several early individual differences, and childhood self-control itself is remarkably stable by the preschool years.

Agreeableness

Human beings are an extremely social species, and Agreeableness encompasses traits associated with empathy and prosocial behavior, the tendency to help and cooperate with others. Like Conscientiousness, *Agreeableness* reflects differences in self-regulation; however, Agreeableness relates more explicitly to self-regulation in service of maintaining positive

relationships with others (Graziano, Habashi, Sheese, & Tobin, 2007). In research on both children and adults, Agreeableness describes individual differences in empathic emotional reactions to others' emotions, concerns, and desires, as well as individual differences in the inhibition of hostile and aggressive impulses. Highly Agreeable individuals are characterized as considerate, empathic, generous, polite, gentle, protective of others, and kind, whereas highly Disagreeable people are characterized as aggressive, rude, spiteful, stubborn, cynical, callous, and manipulative. Agreeableness involves individuals' willingness to consider others' wishes rather than forcing their own desires and intentions on others. Among more Agreeable children, this tendency is seen in more compliant and manageable behavior. In a recent study examining parents' ratings of the temperament and personality traits of their preschool children, an Agreeableness factor clearly emerged, suggesting that this trait can be measured coherently by at least preschool-age (De Pauw et al., 2009); the trait included typical markers of Agreeableness (high altruism and compliance and low egocentrism and willfulness), as well as temperamental measures of inflexibility and angry, irritable reactions to challenging situations. Agreeableness also seems to reflect children's general interpersonal orientation toward affiliation, nurturance, and warmth versus detachment and coldheartedness (Di Blas, 2007; Markey et al., 2005; Ojanen et al., 2005).

Although Agreeableness has emerged robustly and consistently in questionnaire studies that tap a wide range of children's behaviors, the traits encompassed by this factor are not included in most temperament models. Rothbart and colleagues have argued for a biologically-based Affiliativeness system that may underlie children's differences in prosocial and aggressive behaviors (Rothbart & Posner, 2006), but Affiliativeness and Agreeableness are rarely measured as distinct traits in childhood temperament research. Temperament researchers may see the traits encompassed by Agreeableness (e.g., empathy, aggression, considerateness) as being products of socialization in conjunction with other temperamental tendencies. There are good reasons, however, to see Agreeableness as being fundamentally like other temperament traits. Like Extraversion and Neuroticism, traits analogous to Agreeableness can be observed reliably across a wide range of non-human animal species, even though most of these same animals do not exhibit differences in Conscientiousness (Weinstein et al. 2008). Further, the Big Five traits appear to be equally and at least moderately heritable in adults (Krueger & Johnson, 2008); this

is true for both Agreeableness and Openness/Intellect, the two traits typically left out of temperament systems.

Individual differences in Agreeableness-related traits emerge early in life. Children vary in their displays of physical aggression already by the age of 1, and the average levels of such aggression seem to peak by the age of 3 (Tremblay & Nagin, 2005). By the preschool years, children vary in relational aggression as well (Crick, Ostrov, Appleyard, Jansen, & Casas, 2004), and tendencies toward relational and physical aggression tend to co-vary in young children (Cote, Vaillancourt, Barker, Nagin, & Tremblay, 2007). Likewise, children exhibit modestly to moderately stable and situationally-consistent differences in empathy by 14 months (Knafo, Zahn-Waxler, Van Hulle, Robinson, & Rhee, 2008) and moderately stable tendencies toward prosocial behavior by the age of 3 (Knafo & Plomin, 2006). Individual differences in aggression (DiLalla, 2002), empathy (Knafo et al., 2008), and prosocial behavior (Knafo & Plomin, in press) are shaped in part by genetic factors early in childhood, and the relative influence of genes on empathy and prosocial behavior increases during the childhood years. All of this recent evidence suggests that the components of Agreeableness emerge as genetically-influenced dispositions relatively early in childhood.

The early antecedents of Agreeableness provide evidence that this trait involves the regulation of emotions in interpersonal contexts. Agreeableness and its components in childhood are predicted negatively by early differences in high-intensity irritability and frustration and positively by early attention and self-control (Caspi & Shiner, 2006). Good attentional control may be especially important for helping children to shift their focus from negative emotions to positive emotions when they are angry, frustrated, or aroused (Wilson, 2003). In contrast, early fearfulness presages later compliance, higher empathy, and lower aggression (Caspi & Shiner, 2006) and thus may promote greater Agreeableness for some children. As for positive emotions, childhood Agreeableness is predicted by mild, regulated positive emotions (Abe & Izard, 1999); the high-intensity positive emotions seen in childhood Extraversion are distinct from this type of milder positive emotions displayed in close interpersonal contexts (Kochanska et al., 2007). In short, Disagreeableness appears to develop most strongly among those children whose high irritability is not constrained by either good self-regulation or by the inhibiting power of fearfulness, whereas high Agreeableness is promoted by early tendencies toward well-regulated positive emotions in relationships.

Openness-to-Experience/Intellect

The final Big Five trait—*Openness-to-Experience/Intellect*—has more limited support as a trait in childhood than the other Big Five traits (Caspi & Shiner, 2006). However, some evidence indicates that this trait is an important aspect of children's individuality, when it is measured carefully, even as early as preschool age (De Pauw et al., 2009). Further, parents from many countries spontaneously and frequently use words from the Openness/Intellect trait domain when asked to describe their children (Mervielde, De Fruyt, & Jarmuz, 1998). Children and adults who are high on Openness/Intellect are described as quick to learn, knowledgeable, perceptive, imaginative, curious, artistic, and original, whereas individuals who are low on this trait exhibit lower levels of fantasy, creativity, and intellectual interests. Some additional markers of Openness/Intellect in children are enthusiastic involvement in extracurricular activities, eagerness to take on creative and intellectual work, imaginativeness in play, confidence, and adaptability in the face of uncertainty (Abe, 2005; Goldberg, 2001; Shiner & Masten, 2008). This trait appears to index individual differences in the tendency to explore, seek, and attend to internal and external sensory stimulation and abstract information (Caspi & Shiner, 2006). The compound label, "Openness/Intellect," reflects an old debate about how best to characterize the content of this domain, with some researchers favoring "Openness to Experience" and others favoring "Intellect." This debate has been largely resolved by the observation that Openness and Intellect describe distinct but equally central aspects of the trait as a whole, with Openness reflecting perceptual and aesthetic interests and Intellect reflecting intellectual interests (DeYoung et al., 2007, Johnson, 1994; Saucier, 1992).

The developmental precursors of Openness/Intellect are not well understood, but there are three interesting potential antecedents. First, in one study, toddlers' high-intensity positive emotions in the Strange Situation predicted their later Openness/Intellect as preschoolers (Abe & Izard, 1999). Second, curiosity and exploration of new situations in early childhood predict later IQ and academic achievement and thus may similarly predict later Openness/Intellect (Caspi & Shiner, 2006), which is the only Big Five trait consistently positively associated with intelligence (DeYoung, Peterson, & Higgins, 2005). Similar exploratory behaviors are markers of an Openness-like trait in animals (Weinstein et al., 2008). Third, sensory sensitivity (the tendency to be sensitive to internal and external sensory stimulation) is strongly related to Openness in adulthood (Evans & Rothbart, 2007) and thus is a likely childhood precursor of this trait. In

children, sensory sensitivity involves children's tendencies to note and react to subtle changes in the environment or to other sensory experiences. This trait is measured most clearly in Rothbart and colleagues' temperament measures (De Pauw et al., 2009; Gartstein & Rothbart, 2003). Interestingly, this trait goes beyond children's mere awareness of sensory experiences to their thorough enjoyment of a wide variety of tactile, auditory, and visual experiences (De Pauw et al., 2009). Although sensory sensitivity is typically treated as a component of the broader Effortful Control trait in Rothbart and colleagues' studies of childhood temperament (Rothbart & Bates, 2006), it forms a separate trait in childhood when a broad range of measures is used (De Pauw et al., 2009) and in adult temperament research (Evans & Rothbart, 2007). Although the early manifestations of Openness/Intellect are poorly understood, this trait warrants greater attention in childhood research. Openness/Intellect is important for the development of individuals' values and political beliefs and for their academic and creative achievement (Caspi & Shiner, 2006) and thus is worth measuring in childhood; additional work may be needed to measure the trait in a more developmentally appropriate manner.

Metatraits

Despite the original conception of the Big Five as orthogonal and the highest level of generality in personality description, research has demonstrated that the Big Five have two consistent higher-order factors or *metatraits*, which have been labeled "Alpha" or "Stability" and "Beta" or "Plasticity," and which are heritable and appear across different cultures (Digman, 1997; DeYoung, 2006; Jang et al., 2006; McCrae et al., 2008). Stability, comprising the shared variance of Neuroticism (reversed), Agreeableness, and Conscientiousness, appears to reflect the tendency to maintain well-controlled, stable functioning in emotional, social, and motivational domains. Plasticity, comprising the shared variance of Extraversion and Openness/Intellect, appears to reflect a tendency to explore both behaviorally and cognitively, engaging actively with novel information and situations. These higher-order factors were discovered in ratings of both adults and children (Digman, 1997). Some evidence suggests that antecedents of these traits may be seen even in infancy. Abe and Izard (1999) found that 18-month-olds' facial expressions of emotion in the Strange Situation paradigm predicted parents' ratings of the Big Five at 3.5 years, in a manner consistent with the metatraits. Negative emotional expression predicted Neuroticism positively and Agreeableness and Conscientiousness negatively, whereas strong positive emotional expression positively predicted Extraversion and

Openness/Intellect. Less is known about whether similar factors might appear in temperament measures, although one study of the Adult Temperament Questionnaire found two similar, though not identical, factors (Evans & Rothbart, 2009).

Temperament and Personality Traits: Psychological Processes and Neural Underpinnings

This section pursues three goals: to identify the psychological processes that are most likely to unify the traits within each of the Big Five, to explore the biological systems that are likely to instantiate each set of processes, and finally to discuss how these biological systems might contribute to changes in the structure of temperament and personality during development. It is clear that the structure of personality (including temperament) is not radically dissimilar from early childhood to adulthood; thus, there should be much continuity in the psychological and biological mechanisms that produce various traits. Nonetheless, the changes that do take place during development may be informative regarding ways in which the development of neural systems creates different traits and different relations among traits. A recent review of neuroscience research on personality proposed a set of underlying psychological and biological processes involved in each of the Big Five (DeYoung & J. R. Gray, 2009), which we have used to organize the following discussion. Bear in mind that some brain systems appear to influence more than one trait, and this may influence correlations among traits (Zuckerman, 2005). Identifying the functional substrates of trait domains may be particularly useful in studying development because it offers the potential to understand both continuity and change in trait structure. Change may reflect neural development, and continuity may be evident in part because the same neural systems can be seen to drive different age-typical behaviors.

The metatraits, Stability and Plasticity, are a useful place to begin discussion of the biological substrates of personality and temperament because they are likely to represent very broadly acting biological factors that affect many lower-level traits. Based on review of genetic and pharmacological studies, serotonin and dopamine have been identified as likely biological sources of Stability and Plasticity, respectively (DeYoung, 2006; DeYoung, Peterson, & Higgins, 2002; DeYoung & Gray, 2009). These two neurotransmitters modulate neural activity in a wide array of brain systems, and their extensive influence is consistent with a role in the broadest level of personality structure. Serotonin facilitates the regulation of motivation and emotion and the inhibition of aggressive and impulsive responses, whereas dopamine facilitates exploration,

approach behavior, and flexible cognitive functioning (Ashby, Isen, & Turken, 1999; Braver & Barch, 2002; Carver & Miller, 2006; Depue & Collins, 1999; Panksepp, 1998; Spont, 1992).

As likely biological substrates of Stability and Plasticity, serotonin and dopamine are hypothesized to influence multiple traits from the Big Five. Other biological systems have been identified that may differentiate the Big Five. Of the five, Extraversion/Positive Emotionality and Neuroticism/Negative Emotionality have accumulated the most evidence and the most straightforward theories regarding the mechanisms that produce them. Extraversion and Neuroticism appear to reflect the various manifestations in personality of sensitivity to reward and punishment, respectively, and a great deal is known about the neural systems that respond to reward and punishment. These are fundamental and evolutionarily ancient capacities of the organism and, as such, appear very early in development. Abilities to react to punishment and seek reward are present from birth, despite the infant's limited behavioral repertoire. Positive emotions are responses to the anticipation or acquisition of reward, whereas negative emotions are responses to anticipation or receipt of punishment (including failure to receive an anticipated reward). Even in infancy, obvious trait differences exist in these responses.

Extraversion

Evidence supports the theory that Extraversion is related to the psychological processes and brain systems involved in sensitivity to reward. Of particular importance is the concept of the behavioral approach (or activation) system (BAS), originally developed by J. A. Gray (1982; Pickering & Gray, 1999). The BAS responds to incentive reward cues – that is, signals of the possibility of reward – by activating approach and exploratory behaviors intended to locate and/or acquire the reward in question. Most of the traits grouped within Extraversion are examples of approach or exploratory behavior, including activity, sociability, talkativeness, and assertiveness. (Social interactions designed to achieve rewards should be considered “approach behavior” even if they involve speech rather than locomotion, and human beings find a variety of social outcomes rewarding.) Key brain regions involved in the BAS and empirically linked to Extraversion include orbitofrontal cortex and nucleus accumbens, regions strongly influenced by dopamine (DeYoung & Gray, 2009). Dopamine appears to be the primary neurotransmitter involved in the BAS, and several studies have linked Extraversion to individual differences in dopaminergic function (Depue & Collins, 1999; Wacker, Chavanon, & Stemmler, 2006). Another neurotransmitter system involved in reward and linked to Extraversion, but not central

to the BAS, is the opioid system, which is associated with the pleasure experienced after acquiring rewards generally and with social bonding specifically (Depue & Morrone-Strupinsky, 2005). This system is primarily involved in the experience of receiving reward, rather than in responding to incentive reward cues. Depue and Morrone-Strupinsky (2005) provided evidence that the opioid system is involved in the affiliative subtraits of Extraversion, specifically demonstrating that individual differences in Social Closeness predicted opiate response following exposure to affiliative stimuli.

Both theoretically and empirically, Extraversion has been divided into two aspects, one reflecting assertiveness and drive, the other reflecting sociability and positive emotions (Depue & Collins, 1999; DeYoung et al., 2007). This division is likely to reflect the distinction between dopamine- and opiate-mediated reward functioning, which has been described as a difference between “wanting” and “liking” – desiring reward versus enjoying reward (Peciña, Smith, & Berridge, 2006). Although separable, these processes are obviously related, as enjoying a reward is likely to increase desire for it.

Neuroticism

Considerable evidence supports the theory that Neuroticism reflects sensitivity to threat and punishment. Neuroticism has been linked to two additional constructs from Gray’s (1982, Gray & McNaughton, 2000) “conceptual nervous system,” the behavioral inhibition system (BIS) and the fight-flight-freeze system (FFFS). The FFFS responds when a stimulus is immediately threatening, punishing, or frustrating, and one’s only motivation is to avoid imminent or further punishment. The output of the FFFS is active avoidance (panic and flight) or anger and reactive aggression (fight). The BIS, in contrast, responds to stimuli that one needs or desires to approach but that also contain threat (creating an approach-avoidance conflict). The output of the BIS is vigilance, rumination, and passive avoidance, which Gray and McNaughton (2000) described as symptoms of anxiety, and which may also be linked to depression. Approach-approach or avoidance-avoidance conflicts are less common but can also activate the BIS, which responds to any conflict between goals. Novel stimuli also trigger the BIS because of their inherent potential to be either rewarding or threatening, prior to exploration and categorization. Gray and McNaughton (2000) suggested that Neuroticism reflects a general sensitivity to threat determined by the joint sensitivity of FFFS and BIS.

Neuroanatomically, the FFFS involves amygdala and lower regions of the brain including the hypothalamus (a key component of the hypothalamic-pituitary-adrenal, or HPA, axis) and the periaqueductal gray region of midbrain. The BIS also involves amygdala but additionally is strongly associated with the septo-hippocampal system, which Gray has argued detects mismatches between desired and actual outcomes, in the context of goal-directed behavior. The differentiation between BIS and FFFS may explain why, as children develop, those who were irritable as infants are more likely to become inhibited, anxious, and timid as young children (Kagan & Fox, 2006). Irritability suggests the action of FFFS in response to discomfort or threat, whereas timidity suggests the action of BIS. The primary effector of sensitivity to threat may change with age, such that children who experienced frequent FFFS activation may later experience frequent BIS activation, as the inhibitory circuits associated with the BIS mature later than those related to the FFFS (Gray & McNaughton, 2000). This distinction may be similarly reflected in the two related but separable aspects of Neuroticism that have been found in adults (DeYoung et al., 2007), one labeled Withdrawal and the other Volatility. Withdrawal encompasses anxiety, depression, and self-consciousness – negative emotions likely to be associated with the BIS, whereas volatility encompasses irritability, anger, and the tendency to get upset or panicky, which seem more likely to be associated with FFFS.

Conscientiousness

The core of Conscientiousness appears to be the predisposition to constrain impulses, in order to follow rules or pursue non-immediate goals. Human beings are unique in their ability to plan for the future and to organize their behavior according to abstract systems, and the capacity for Conscientiousness is likely to be an evolutionarily recent development. In comparative studies, only our nearest evolutionary neighbor, the chimpanzee, has been found to possess a trait directly analogous to Conscientiousness (Weinstein et al., 2008). The primary neurobiological substrate of Conscientiousness is likely to be the lateral prefrontal cortex (PFC), which is responsible for much of the human ability to plan and follow complex rules (Bunge & Zelazo, 2006; Miller & Cohen, 2001). Functional and structural neuroimaging studies have linked Conscientiousness and its polar opposite, impulsivity, to both dorsal and ventral regions of lateral PFC (Asahi, Okamoto, Akado, Yamawaki, & Yokota, 2004; Brown, Manuck, Flory, & Hariri, 2006; DeYoung et al., 2009).

Neurobiological research on Conscientiousness in adults is consistent with research on Effortful Control in children. Posner and Rothbart (2007; Rothbart & Posner, 2006) have argued that biological development of attention networks underlies the development of individual differences in Effortful Control. In infancy and early childhood, children show alerting attention, which involves being alert or sensitive to incoming sensory stimuli, and orienting attention, which entails the selection of information from the available sensory stimuli. From the age of 2 and continuing into later in childhood, executive attention shapes children's self-regulation, as they note and resolve various conflicts among their experiences. More generally, by early in the preschool years children vary in their overall levels of executive control, including their abilities to pursue goals, solve novel problems, inhibit more automatic tendencies, direct attention, and maintain information in memory (Garon, Bryson, & Smith, 2008; Wiebe, Espy, & Charak, 2008). These executive skills are supported by PFC (Miller & Cohen, 2001) and seem likely to be related to children's emerging Effortful Control (e.g., Simonds, Kieras, Rueda, & Rothbart, 2007). Effortful Control is also likely to include the ability to assess the current costs and benefits of various behaviors and to make effective choices, taking those costs and benefits into account (MacDonald, 2008).

Agreeableness

Agreeableness appears to identify the collection of traits related to altruism. Not surprisingly, therefore, it has been linked to psychological mechanisms that allow understanding and concern for others' emotions, intentions, and mental states, including empathy, theory of mind, and attentional biases toward social stimuli (Graziano et al., 2007; Nettle & Liddle, 2008; Wilkowski, Robinson, & Meier, 2006). Multiple fMRI studies of observation and imitation of others have reported that trait measures of empathy are associated with activity in brain regions known to process social information, including medial PFC, inferior frontal gyrus, and superior temporal sulcus (Chakrabarti, Bullmore, & Baron-Cohen, 2007; Kaplan & Iacoboni, 2006; Schulte-Rüther, Markowitsch, Fink, & Piefke, 2007). Specific neurotransmitters likely to be involved in Agreeableness are the sociosexual neuropeptides oxytocin and vasopressin and the sex hormones testosterone and estrogen. Administration of oxytocin in human males has been found to improve their ability to identify others' emotional states from facial expressions (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007). Testosterone is linked to aggression, and evidence suggests that higher exposure to testosterone is linked to reduced Agreeableness. The

ratio of the length of the second finger to the fourth (2D:4D) is an index of prenatal exposure to testosterone (McIntyre, 2006). Variation in 2D:4D has been found to predict both aggression and Agreeableness (Luxen & Buunke, 2005; McIntyre et al., 2007). The biological systems involved in affiliative bonding are also likely to be involved in Agreeableness (Depue & Morrone-Strupinsky, 2005), and opioid systems may contribute to Agreeableness as well as to Extraversion, which could explain why the aspect of Agreeableness that reflects compassion and empathy is positively associated with the aspect of Extraversion reflecting sociability and positive emotions (DeYoung et al., 2007). From an evolutionary perspective, Agreeableness may have arisen from biological systems that promote parental investment in offspring, pair-bonding between mates, and altruistic behavior toward kin. Additionally, human beings are unique in the strength of their tendency to cooperate with unrelated members of their social groups, and Agreeableness may represent a necessary capacity for such a social species (Nettle, 2006).

Openness/Intellect

Openness/Intellect has much in common with sensory sensitivity and, at its core, appears to reflect a predisposition to detect, explore, utilize, and enjoy abstract and perceptual information. It is likely to involve the PFC and functionally related regions, particularly those involved in working memory, abstract reasoning, and the control of attention (DeYoung et al., 2005, in press). Openness/Intellect is the only one of the Big Five to be consistently positively associated with performance on tests of intelligence (Ackerman & Heggestad, 1997; DeYoung et al., 2005), which appears to be governed by brain systems strongly overlapping with those that control working memory (Gray & Thompson, 2004). More is known about traits related to specifically to the Intellect aspect of the domain than about traits related specifically to Openness, which include artistic and aesthetic sensitivity and interests (DeYoung et al., 2007). Those aspects of attention that are related to alerting and orienting, rather than executive control, might be associated with Openness rather than Intellect.

Developmental Changes

Although personality and temperament structure appears to be relatively stable across development, such that the Big Five are an effective organizing framework beginning in early childhood, it is not completely unchanging. Consideration of the processes that underlie the Big Five and their lower-level traits may provide insight into changes in the prominence of different traits and in the associations between various traits, throughout development.

The distinction between Assertiveness and Enthusiasm or Sociability as two aspects of Extraversion may help to explain the status of Activity as a trait. In adults, Activity loads on the Assertiveness aspect of Extraversion (DeYoung et al., 2007). Activity level is likely to be a more prominent component of Extraversion in early childhood, prior to the appearance of behavior that could be described in terms of assertiveness, whereas assertiveness is more prominent than activity in Extraversion in adulthood. This shift might be seen as a developmental change in the mode through which approach behavior is expressed. As children age, they gain increased control over their motor output, increased verbal skill, and an increasingly abstract set of social guidelines and desires; these changes seem likely to result in a drive toward reward that is more often verbally mediated, rather than motorically mediated. The hormone testosterone is involved in both activity and assertiveness (as well as aggression) and is therefore likely to influence Extraversion (DeYoung & Gray, 2009); testosterone levels change dramatically over the course of development, particularly at puberty, and these changes are likely to be reflected in personality.

The distinction between Withdrawal and Volatility within Neuroticism in adults (DeYoung et al., 2007), which may correspond to the distinction between fearfulness and irritability/anger in children, could help to illuminate the difficulty posed by the fact that, in both the child and adult literatures on trait structure, irritability and anger-proneness are related to both Neuroticism/Negative Emotionality and Agreeableness. In the Big Five, irritability and anger have their primary loadings on Neuroticism, which makes theoretical sense if one considers them to be responses to threat or punishment. However, they have considerable secondary loadings on Agreeableness, and in young children they may even be primarily associated with Agreeableness (De Pauw et al., 2009). A number of studies suggest that Agreeableness reflects the tendency to inhibit aggressive or hostile impulses toward others (Caspi & Shiner, 2006; Robinson, 2007), and people prone to irritability and anger are likely to have such impulses more frequently. In early childhood, disagreeable behavior may be more strongly determined by children's tendency to anger than by their ability to empathise with others or to control aggressive impulses, because the brain systems involved in the latter abilities are probably not yet fully operational.

Indeed, many of the changes that are evident in personality over the course of development seem likely to reflect the development of cortical neural mechanisms involved in

top-down control and complex cognitive operations. During cortical development, basic sensorimotor cortex matures first, followed by parietal and temporal association cortices, with PFC maturing later than any other brain region (Casey, Tottenham, Liston, & Durston, 2005). Whereas Extraversion and Neuroticism appear to be strongly influenced by limbic and midbrain structures (though they involve some cortical regions as well), Agreeableness, Conscientiousness, and Openness/Intellect all appear related to later-developing cortical circuits involved in more complex cognitive mechanisms.

Conscientiousness and Openness/Intellect, especially, may have related substrates, as evidence suggests that both are associated with lateral PFC. These two traits may reflect two distinct functions of lateral PFC, one (associated with Conscientiousness) to ensure the stable execution of plans and rules, the other (associated with Openness/Intellect) to manipulate abstract information in order to explore alternative possibilities (DeYoung & Gray, 2009; DeYoung et al., in press). In adolescence and adulthood, Openness/Intellect and Conscientiousness are clearly discriminable factors. In early childhood, however, some traits related to Intellect (e.g., creativity and intellect; De Pauw et al., 2009) often covary with Conscientiousness or Effortful Control, whereas others, such as perceptual sensitivity and enjoyment of low intensity sensations, form a separate factor most analogous to Openness. It appears that Intellect tends to covary with Conscientiousness or Effortful Control more strongly in early childhood, whereas later in development it coheres more clearly with Openness (though, even in adulthood, Intellect maintains a secondary association with Conscientiousness (Costa & McCrae, 1992; DeYoung et al., 2007)). This change in structure could be due to the relatively slow development of PFC. Early in development, differences between same-age children in their level of PFC maturity may produce covariation of traits dependent on PFC (such as those related to Conscientiousness and those related to Intellect), whereas, after sufficient PFC development, the functional similarity of Intellect and Openness as forms of exploratory cognition may ensure that the strongest association of Intellect is with Openness.

Shifts in trait structure related to Agreeableness, Conscientiousness, and Openness/Intellect, which seem likely to reflect the development of cortical circuits involved in top-down control and more abstract information processing, raise an interesting question regarding the metatraits above the Big Five—namely whether they are observable in childhood. As mentioned above, their emotional antecedents appear to be visible as early as 18 months, and

these predict the Big Five in the expected manner at 3.5 years (Abe & Izard, 1999). However, the fact that some traits associated with Openness/Intellect in older children and adults appear more closely related to Effortful Control and Conscientiousness in early childhood suggests that a later realignment may produce the final shape of the metatraits, and we would encourage researchers to investigate higher-order factor structure of the Big Five, or their equivalents, in early childhood.

Conclusion: An Integrative Model of Personality Trait Development

In this chapter, we have offered a model for the structure of personality traits from early childhood through adulthood. Over the last several decades, researchers have explored the structure of temperament and personality traits in order to determine what form traits take during different points in life and what traits are most important. Children's temperament traits have been studied through varied means, including questionnaire studies (with multiple reporters), lab tasks, and observational studies. This research has offered a rich understanding of processes underlying temperament traits. The structure of adults and youths' personality traits has been explored through the use of questionnaires tapping an extensive range of traits across cultures, and the result has been increasing consensus about the basic dimensions of personality. Despite variations in the guiding assumptions and methods used, the temperament and personality research traditions have converged on a key set of findings regarding the nature of trait development over the life course.

Temperament traits in early childhood and personality traits in later childhood and adulthood appear to be variations on the same basic dimensions, in light of current findings on the features shared between the two. Both sets of traits manifest stability and change over time and are influenced by individuals' variations in genes and experiences. Non-human animals display individual differences in behaviors that parallel child and adult traits. Temperament and personality traits evince a similar structure, with personality including a more expansive set of behavioral tendencies. Similar processes appear to underlie the expression of comparable temperament and personality traits; in other words, the same basic biological and psychological processes reveal themselves in age-specific behaviors at different points in the life course. These empirical findings require an updated model for how traits develop. A common metaphor for thinking about personality development has been that at birth children display genetically influenced temperament traits and that life experiences "layer" personality onto the early

“biological” temperament. More recent work in behavior genetics and neuroscience suggests instead that genetic and environmental influences interact in the shaping of temperament traits in childhood and personality traits later in life and that traits do not become any less heritable as people encounter new life experiences.

Because of biological development, the units of personality become increasingly differentiated from infancy through later childhood and adolescence and into adulthood. In infancy, children display a more narrow range of traits, including differences in typical positive and negative emotions and early self-regulation. With new brain development, children acquire new skills in motor movement, cognition, language, emotion, and social interaction. Children’s expanding repertoire of behavior enables them to display new traits, such as differences in task persistence, empathy, aggression, and imagination. In addition, children’s environments typically broaden, as they encounter new contexts (school, peer groups, neighborhoods) and have new experiences. These new experiences also enable the expression of new traits. For example, individual differences in assertiveness and intellect become more apparent as children interact with more peers and encounter more advanced academic work. Thus, temperament traits that appear during early childhood (positive and negative emotionality, attention and self-regulation) expand to include a wider variety of more complex behaviors over time, and new traits become apparent as new biologically-based systems come on-line.

The Big Five personality model provides a useful structure for describing individual differences in both childhood and adulthood and can incorporate the temperament traits that have emerged in numerous lines of research. *Extraversion* is already evident in infancy in the form of positive emotions and then expands to include positive energy and activity, sociability, and later assertiveness. *Neuroticism* is another emotion-based trait that appears in infancy and early childhood in the form of fearfulness, irritability, sadness, and negative emotional responses to challenging situations. By the preschool years, the trait comes to include anxiety, insecurity, and sensitivity to signs of failure. Subcomponents of the trait—including at least fearfulness and withdrawal, irritability, and sadness—can be identified early life, and, although they show some common features, they have distinctive developmental pathways as well. Aspects of *Conscientiousness* appears early in life in children’s individual differences in self-regulation, specifically in attention and persistence in infancy and, additionally, in more self-controlled, planful behavior in toddlerhood. By the preschool years, the trait expands further to include

orderliness, dependability, and achievement motivation. *Agreeableness* reflects tendencies toward empathy and the consideration of others and the inhibition of hostile and aggressive impulses. Although this trait is not typically included in child temperament models, other developmental research has demonstrated that individual differences in empathy, prosocial behavior, and aggression arise in the toddler years. The final trait—*Openness/Intellect*—may emerge later than the other traits and may be difficult to identify before the preschool years, though it may be reflected in individual differences in sensory sensitivity. In preschool, children vary in imagination, curiosity, and intellectual engagement; by adolescence, the trait expands to include a wider range of interests.

Increasingly, the Big Five traits are being mapped onto their biological substrates, and we therefore reviewed much of what is known in this young field. Although the Big Five began as a purely descriptive model, reflecting the patterns of covariation that emerged in factor analysis, the trend toward research in personality neuroscience has enabled the development of explanatory, neurobiological theories for the Big Five traits (DeYoung & Gray, 2009). Temperament research has had a head start on personality research, in this regard, as temperament researchers have always focused on the underlying biological processes that are responsible for individual differences. Integrating results from these two research traditions is a boon to both, given that temperament and personality traits appear to reflect the same core processes. Their integration also begins to address the crucial question of how change in trait structure over the course of development reflects change in the underlying biological systems.

Future Directions

In light of the current findings on trait structure, we offer the following recommendations for future work on this topic.

First, child temperament and adult personality research could each benefit from drawing on the complementary strengths of the other research tradition. Personality research has benefitted from rigorous empirical analysis of competing models for personality structure and from the open exploration of structure in questionnaires using very expansive sets of descriptors; research on temperament structure would proceed more efficiently if these methods were adopted. In contrast, temperament research has demonstrated the benefits of using multiple methods and reporters to assess individual differences. Although personality research increasingly includes methods beyond self-report questionnaires to assess personality traits,

greater progress would be made by using multiple methods and reporters in the same study. Temperament researchers tend to focus on describing the underlying processes that drive phenotypic traits, whereas personality researchers tend to focus on describing the phenotypic traits as broadly as possible. Both goals are reasonable and hopefully can be integrated fruitfully, such that temperament models help to provide an explanatory framework for personality and personality models help to broaden the scope of phenomena that are seen as relevant to temperament.

Second, more detailed work is needed to trace the structure of traits during the childhood years. Although temperament research has clarified the broad outlines of important traits in childhood, this work has been hampered by the use of competing models of temperament. The various temperament models do share many traits in common; however, each one still adds valuable, non-overlapping information on children's temperaments (DePauw et al., 2009). Thus, future measures could incorporate constructs from various temperament models in order to measure temperament more thoroughly. In addition, in light of the arguments and data offered in this chapter, childhood traits could be measured more completely by integrating trait dimensions from both the temperament and personality traditions. Rather than excluding some behaviors a priori from childhood trait measures because they are assumed not to be "temperamental" in nature, it would be better to begin by including as broad a range of behaviors as possible to ascertain trait structure at various ages. In constructing such measures, it would be helpful to look to the literature on adult traits and consider including likely childhood manifestations of the adult traits.

Third, much could be learned from studying how traits become re-organized in different periods of life. In many domains, development proceeds through the simultaneous differentiation and hierarchical integration of biological and behavioral systems (Cicchetti & Tucker, 1994; Ford, 1987). As personality traits become increasingly differentiated, the patterning of how traits co-vary may shift over time as well. Although traits show a replicable higher-order structure in adolescence and adulthood (the overarching Stability and Plasticity dimensions), traits may relate to each other differently earlier in childhood. For example, as we noted, Conscientiousness and Intellect often co-vary in childhood, whereas they separate clearly by adolescence. These changes in the higher-order structure of traits may reflect changes in the underlying mechanisms

and may therefore provide interesting clues about the biological and psychological processes underlying the traits.

Fourth, increased attention should be given to the biological systems that are related to the structure of traits and their development. Traits represent relatively stable patterns of emotion, cognition, motivation, and behavior, and understanding the structure of traits fully requires understanding the brain systems that influence those patterns. Biological research may help us to understand why certain traits vary together. Importantly, this is not a one-way street from biological to personality research; research on trait structure may provide clues about which biological systems are involved in which traits. An integrated approach should be adopted that combines biological theorizing and research with research on trait structure. Such an integrated approach has long been embraced by temperament theorists and should be more widely applied to personality. Adding the temperament perspective to personality research will be useful for studying the neurobiological correlates of changes in trait structure.

Fifth, as we noted in the beginning of this chapter, personality includes much more than just personality traits. Youths and adults vary in their goals, coping strategies for handling different challenges, values, schemas for interpreting particular kinds of situations, identities, and life narratives (McAdams & Olson, in press; Shiner, in press). Although these other aspects of personality are distinct from traits, their development is likely to be influenced by individuals' traits, given that traits shape the ways that people interpret, engage with, and create their experiences. Longitudinal research could examine the role of youths' traits in the emergence of these other aspects of personality.

This is an exciting time in the study of personality in part because of the marked progress in uncovering the basic structure of traits. We hope that even greater progress will be made as personality research spans the life course and crosses multiple levels of analysis.

Related Chapters

Gene and environment interactions in personality development

Stress reactivity

Temperamental inhibition

Emotional processing

Personality and emotional development

References

- Abe, J. A. (2005). The predictive validity of the Five-Factor model of personality with preschool-age children: A nine year follow-up study. *Journal of Research in Personality, 39*, 423-442.
- Abe, J. A. & Izard, C. E. (1999). A longitudinal study of emotion expression and personality relations in early development. *Journal of Personality and Social Psychology, 77*, 566-577.
- Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin, 101*, 213-232.
- Ackerman, P. L. & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin, 121*, 219-245.
- Ando, J., Suzuki, A., Yamagata, S., Kijima, N., Maekawa, H., Ono, Y., & Jang, K. L. (2004). Genetic and environmental structure of Cloninger's temperament and character dimensions. *Journal of Personality Disorders, 18*, 379-393.
- Asahi, S., Okamoto, Y., Akado, G., Yamawaki, S., & Yokota, N. (2004) Negative correlation between right prefrontal activity during response inhibition and impulsiveness: A fMRI study. *European Archive of Psychiatry and Clinical Neuroscience, 254*, 245-251.
- Ashby, F. G., Isen, A. M., & Turken, A.U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review, 106*, 529-550.
- Ashton, M. C., Lee, K., Perugini, M., Szarota, P., de Vries, R. E., Blas, L. D., Boies, K., & De Raad, B. (2004). A six-factor structure of personality descriptive adjectives: Solutions from psycholexical studies in seven languages. *Journal of Personality and Social Psychology, 86*, 356-366.
- Ball, S. A., Tennen, H., & Kranzler, H. R. (1999). Factor replicability and validity of the Temperament and Character Inventory in substance-dependent patients. *Psychological Assessment, 11*, 514-524.
- Belsky, J., Hsieh, K., & Crnic, K. (1996). Infant positive and negative emotionality: One dimension or two? *Developmental Psychology, 32*, 289-298.

- Borkenau, P., Riemann, R., Angleitner, A., & Spinath, F. M. (2001). Genetic and environmental influences on observed personality: Evidence from the German Observational Study of Adult Twins. *Journal of Personality and Social Psychology, 80*, 655-668.
- Bornstein, M. H., Gaughran, J. M., & Homel, P. (1986). Infant temperament: Theory, tradition, critique, and new assessments. In C.E. Izard & P. B. Read (Eds.), *Measuring emotions in infants and children* (pp. 172-199). New York: Cambridge University Press.
- Braver, T. S., & Barch, D. M. (2002). A theory of cognitive control, aging cognition, and neuromodulation. *Neuroscience & Biobehavioral Review, 26*, 809-817.
- Brown, S. M., Manuck, S. B., Flory, J. D. & Hariri, A. R. (2006). Neural basis of individual differences in impulsivity: Contributions of corticolimbic circuits for behavioral arousal and control. *Emotion, 6*, 239-245.
- Buckley, M. E., Klein, D. N., Durbin, E., Hayden, E. P., & Moerk, K. C. (2002). Development and validation of a Q-sort procedure to assess temperament and behavior in preschool-age children. *Journal of Clinical Child and Adolescent Psychology, 31*, 525-539.
- Bunge, S. A. & Zelazo, P. D. (2006). A brain-based account of the development of rule use in childhood. *Current Directions in Psychological Science, 15*, 118-121.
- Buss, A. H. & Plomin, R. (1984). *Temperament: Early developing personality traits*. Hillsdale, NJ: Erlbaum.
- Buss, D. M. & Plomin, R. (1975). *A temperament theory on personality development*. New York: Wiley.
- Carver, C. S., & Miller, C. J. (2006). Relations of serotonin function to personality: Current views and a key methodological issue. *Psychiatry Research, 144*, 1-15.
- Casey, B.J., Tottenham, N., Liston, C., & Durston, S. (2005). Imaging the developing brain: what have we learned about cognitive development? *Trends in Cognitive Sciences, 9*, 104-110.
- Caspi, A., Harrington, H., Milne, B., Amell, J. W., Theodore, R. F., & Moffitt, T. E. (2003). Children's behavioral styles at age 3 are linked to their adult personality traits at age 26. *Journal of Personality, 71*, 495-513.
- Caspi, A., & Shiner, R. L. (2006). Personality development. In W. Damon & R. Lerner (Series Eds.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology, Vol. 3. Social, emotional, and personality development* (6th ed., pp. 300-365). New York: Wiley.

- Caspi, A., & Shiner, R. L. (2008). Temperament and personality. In M. Rutter, D. Bishop, D. Pine, S. Scott, J. Stevenson, E. Taylor, & A. Thapar (Eds.), *Rutter's child and adolescent psychiatry* (5th ed., pp. 182-199). London: Blackwell.
- Chakrabarti, B., Bullmore, E., & Baron-Cohen, S. (2007). Empathizing with basic emotions: Common and discrete neural substrates. *Social Neuroscience, 1*, 364-384.
- Cicchetti, D., & Tucker, D. (1994). Development and self-regulatory structures of the mind. *Development and Psychopathology, 6*, 533-549.
- Clark, L. A., & Watson, D. (2008). Temperament: An organizing paradigm for trait psychology. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and Research* (pp. 265-286).
- Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants. *Archives of General Psychiatry, 44*, 573-588.
- Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*, 975-990.
- Costa, P. T. & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences, 13*, 653-665.
- Cote, S. M., Vaillancourt, T., Barker, T., Nagin, D., & Tremblay, R. E. (2007). The joint development of physical and indirect aggression: Predictors of continuity and change during childhood. *Development and Psychopathology, 19*, 37-55.
- Crick, N. R., Ostrov, J. M., Appleyard, K., Jansen, E. A., & Casas, J. F. (2004). Relational aggression in early childhood: 'You can't come to my birthday party unless . . .'. In M. Putallaz & K. L. Bierman (Eds.), *Aggression, antisocial behavior and violence among girls: A developmental perspective* (pp. 71-89). New York: Guilford.
- DeFruyt, F., Bartels, M., Van Leeuwen, K. G., De Clercq, B., Decuyper, M., & Mervielde, I. (2006). Five types of personality continuity in childhood and adolescence. *Journal of Personality and Social Psychology, 91*, 538-552.
- De Pauw, S. S. W., Mervielde, I., & Van Leeuwen, K. G. (2009). How are traits related to problem behavior in preschool children? Similarities and contrasts between temperament and personality. *Journal of Abnormal Child Psychology, 37*, 309-325.

- Depue, R. A. & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, 22, 491-569.
- Depue, R. A. & Morrone-Strupinsky, J. V. (2005). A neurobehavioral model of affiliative bonding: Implications for conceptualizing a human trait of affiliation. *Behavioral and Brain Sciences*, 28, 313-350.
- DeYoung, C. G. (2006). Higher-order factors of the Big Five in a multi-informant sample. *Journal of Personality and Social Psychology*, 91, 1138-1151.
- DeYoung, C. G., & Gray, J. R. (2009). Personality neuroscience: Explaining individual differences in affect, behavior, and cognition. In P. J. Corr & G. Matthews (Eds.), *The Cambridge handbook of personality psychology*. New York: Cambridge University Press.
- DeYoung, C. G., Hirsh, J. B., Shane, M. S., Papademetris, X., Rajeevan, N., & Gray, J. R. (2009). Testing predictions from personality neuroscience: Brain structure and the Big Five. Manuscript submitted for publication.
- DeYoung, C. G., Peterson, J. B., & Higgins, D. M. (2002). Higher-order factors of the Big Five predict conformity: Are there neuroses of health? *Personality and Individual Differences*, 33, 533-552.
- DeYoung, C. G., Peterson, J. B., & Higgins, D. M. (2005). Sources of Openness/Intellect: Cognitive and neuropsychological correlates of the fifth factor of personality. *Journal of Personality*, 73, 825-858.
- DeYoung, C. G., Quilty, L. C., & Peterson, J. B. (2007). Between facets and domains: 10 aspects of the Big Five. *Journal of Personality and Social Psychology*, 93, 880-896.
- DeYoung, C. G., Shamosh, N. A., Green, A. E., Braver, T. S., & Gray, J. R. (in press). Intellect as distinct from Openness: Differences revealed by fMRI of working memory. *Journal of Personality and Social Psychology*.
- Di Blas, L. (2007). A circumplex model of interpersonal attributes in middle childhood. *Journal of Personality*, 75, 863-897.
- Digman, J. M. (1997). Higher-order factors of the Big Five. *Journal of Personality and Social Psychology*, 73, 1246-1256.
- Digman, J. M. & Shmelyov, A. G. (1996). The structure of temperament and personality in Russian children. *Journal of Personality and Social Psychology*, 71, 341-351.

- Digman, J. M. & Takemoto-Chock, N. K. (1981). Factors in the natural language of personality: Re-analysis, comparison, and interpretation of six major studies. *Multivariate Behavioral Research, 16*, 49-170.
- DiLalla, L. F. (2002). Behavior genetics of aggression in children: Review and future directions. *Developmental Review, 22*, 593-622.
- Domes, G., Heinrichs, M., Michel, A., Berger, C., & Herpertz, S. C. (2007). Oxytocin improves “mind-reading” in humans. *Biological Psychiatry, 61*, 731-733.
- Durbin, C. E., Hayden, E. P., Klein, D. N., & Olino, T. M. (2007). Stability of laboratory-assessed temperamental emotionality traits from ages 3 to 7. *Emotion, 7*, 388-399.
- Eaton, W. O. (1994). Temperament, development, and the Five-Factor Model: Lessons from activity level. In C.F.Halverson, G. A. Kohnstamm, & R. P. Martin (Eds.), *The developing structure of temperament and personality from infancy to adulthood* (pp. 173-187). Hillsdale, NJ: Erlbaum.
- Eisenberg, N. (2000). Emotion, regulation, and moral development. *Annual Review of Psychology, 51*, 665-697.
- Eisenberg, N., Hofer, C., & Vaughan, J. (2007). Effortful control and its socioemotional consequences. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 287-306). New York: Guilford.
- Evans, D. E., & Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality, 41*, 868-888.
- Evans, D. E., & Rothbart, M. K. (2009). A two-factor model of temperament. *Personality and Individual Differences, 47*, 565-570.
- Feldman, R. (2008). The intrauterine environment, temperament, and development: Including the biological foundations of individual differences in the study of psychopathology and wellness. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*, 233-235.
- Ford, D. H. (1987). *Humans as self-constructing living systems: A developmental perspective on behavior and personality*. Hillsdale, NJ: Erlbaum.
- Fox, N. A., Henderson, H. A., Marshall, P. J., Nichols, K. E., & Ghera, M. M. (2005). Behavioral inhibition: Linking biology and behavior within a developmental framework. *Annual Review of Psychology, 56*, 235-262.

- Ganiban, J. M., Saudino, K. J., Ulbricht, J., Neiderhiser, J. M., & Reiss, D. (2008). Stability and change in temperament during adolescence. *Journal of Personality and Social Psychology, 95*, 222-236.
- Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134*, 31-60.
- Gartstein, M. A. & Rothbart, M. K. (2003). Studying infant temperament via the Revised Infant Behavior Questionnaire. *Infant Behavior and Development, 26*, 64-86.
- Gillespie, N. A., Cloninger, C. R., Heath, A. C., Martin, N. G. (2003). The genetic and environmental relationship between Cloninger's dimensions of temperament and character. *Personality and Individual Differences, 35*, 1931-1946.
- Goldberg, L. R. (2001). Analyses of Digman's child-personality data: Derivation of Big Five factor scores from each of six samples. *Journal of Personality, 69*, 709-743.
- Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. J. Deary, F. De Fruyt & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7-28). Tilburg, The Netherlands: Tilburg University Press.
- Goldsmith, H. H. (1996). Studying temperament via construction of the Toddler Temperament Behavior Assessment Questionnaire. *Child Development, 67*, 218-235.
- Goldsmith, H. H., Reilly, J., Lemery, K. S., Longley, S., & Prescott, A. (1995). *Preliminary manual for the Preschool Laboratory Temperament Assessment Battery*. Department of Psychology, University of Wisconsin, Madison.
- Goldsmith, H. H. & Rothbart, M. K. (1991). Contemporary instruments for assessing early temperament by questionnaire and in the laboratory. In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement* (pp. 249-272). New York: Plenum Press.
- Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. New York: Oxford University Press.
- Gray, J. A. & McNaughton, N. (2000). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system (Second edition)*. New York: Oxford University Press.

- Gray, J. R. & Thompson, P. M. (2004). Neurobiology of intelligence: Science and ethics. *Nature Reviews Neuroscience*, 5, 471-482.
- Graziano, W. G., Habashi, M. M., Sheese, B. E., & Tobin, R. M. (2007). Agreeableness, empathy, and helping: A person x situation perspective. *Journal of Personality and Social Psychology*, 93, 583-599.
- Guerin, D. W., Gottfried, A. W., Oliver, P. H., & Thomas, C. W. (2003). *Temperament: Infancy through adolescence*. New York: Kluwer.
- Halverson, C. F., Havill, V. L., Deal, J., Baker, S. R., Victor, J. B., Pavlopoulos, V. et al. (2003). Personality structure as derived from parental ratings of free descriptions of children: The Inventory of Child Individual Differences. *Journal of Personality*, 71, 995-1026.
- Hampson, S. E., Andrews, J. A., Barckley, M., & Peterson, M. (2007). Trait stability and continuity in childhood: Relating sociability and hostility to the Five-Factor model of personality. *Journal of Research in Personality*, 41, 507-523.
- Hane, A. A., Fox, N. A., Henderson, H. A., & Marshall, P. J. (2008). Behavioral reactivity and approach-withdrawal bias in infancy. *Developmental Psychology*, 44, 1491-1496.
- Herbst, J. H., Zonderman, A. B., McCrae, R. R., & Costa, P. T. (2000). Do the dimensions of the Temperament and Character Inventory map a simple genetic architecture? Evidence from molecular genetics and factor analysis. *American Journal of Psychiatry*, 157, 1285-1290.
- Izard, C. E. (1977). *Human emotions*. New York: Plenum Press.
- Jang, K. L., Livesley, W. J., Ando, J., Yamagata, S., Suzuki, A., Angleitner, A., et al. (2006). Behavioral genetics of the higher-order factors of the Big Five. *Personality and Individual Differences*, 41, 261-272.
- John, O. P., Caspi, A., Robins, R. W., Moffitt, T. E., & Stouthamer-Loeber, M. (1994). The "Little Five": Exploring the five-factor model of personality in adolescent boys. *Child Development*, 65, 160-178.
- John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History: measurement, and conceptual issue. In O. P. John, R. W. Robins, & L. A. Pervin (Eds). *Handbook of personality: Theory and research* (pp. 114-158). New York: Guilford Press.
- Johnson, J. A. (1994). Clarification of factor five with the help of the AB5C model. *European Journal of Personality*, 8, 311-334.

- Kagan, J. (2008). The biological contributions to temperaments and emotions. *European Journal of Developmental Science*, 2, 38-51.
- Kagan, J. (2007). A trio of concerns. *Perspectives on Psychological Science*, 2, 361-376.
- Kagan, J. (2003). Biology, context, and developmental inquiry. *Annual Review of Psychology*, 54, 1-23.
- Kagan, J., & Fox, N. A. (2006). Biology, culture, and temperamental biases. In N. Eisenberg (Ed.), *Handbook of child psychology, Vol. 3* (pp. 167-225). Hoboken, New Jersey: John Wiley & Sons, Inc.
- Kagan, J., Snidman, N., & Arcus, D. (1998). Childhood derivatives of high and low reactivity in infancy. Kagan, J., Snidman, N., Kahn, V., & Towsley, S. (2007). The preservation of two infant temperaments into adolescence. *Monographs of the Society for Research in Child Development*, 72, 1-75.
- Kaplan, J. T., & Iacoboni, M. (2006). Getting a grip on other minds: Mirror neurons, intention understanding and cognitive empathy. *Social Neuroscience*, 1, 175-183.
- Kochanska, G., Aksan, N., Penney, S. J., & Doobay, A. F. (2007). Early positive emotionality as a heterogeneous trait: Implications for children's self-regulation. *Journal of Personality and Social Psychology*, 93, 1054-1066.
- Kochanska, G., Coy, K. C., Tjebkes, T. L., & Husarek, S. J. (1998). Individual differences in emotionality in infancy. *Child Development*, 64, 375-390.
- Kochanska, G. & Knaack, A. (2003). Effortful control as a personality characteristic of young children: Antecedents, correlates, and consequences. *Journal of Personality*, 71, 1087-1112.
- Kochanska, G., Murray, K. T., & Coy, K. C. (1997). Inhibitory control as a contributor to conscience in childhood: From toddler to early school age. *Child Development*, 68, 263-277.
- Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36, 220-232.
- Kohnstamm, G. A., Halverson, C. F., Mervielde, I., & Havill, V. L. (1998). *Parental descriptions of child personality: Developmental antecedents of the Big Five?* Mahwah, NJ: Erlbaum.

- Knafo, A., & Plomin, R. (in press). Prosocial behavior from early to middle childhood: Genetic and environmental influences on stability and change. *Developmental Psychology*.
- Knafo, A., & Plomin, R. (2006). Parental discipline and affection and children's prosocial behavior: Genetic and environmental links. *Journal of Personality and Social Psychology, 90*, 147-164.
- Knafo, A., Zahn-Waxler, C., Van Hulle, C., Robinson, J. L., & Rhee, S. H. (2008). The developmental origins of a disposition toward empathy: Genetic and environmental contributions. *Emotion, 8*, 737-752.
- Krueger, R. F., & Johnson, W. (2008). Behavioral genetics and personality: A new look at the integration of nature and nurture. In O. P. John, R. W. Robins, & Pervin, L. A. (Eds.), *Handbook of personality: Theory and research, 3rd Ed.* (pp. 387-287). New York: Guilford.
- Lamb, M. E., Chuang, S. S., Wessels, H., Broberg, A. G., & Hwang, C. P. (2002). Emergence and construct validations of the Big Five factors in early childhood: A longitudinal analysis of their ontogeny in Sweden. *Child Development, 73*, 1517-1524.
- Lemery, K. S., Goldsmith, H. H., Klinnert, M. D., & Mrazek, D. A. (1999). Developmental models of infant and childhood temperament. *Developmental Psychology, 35*, 189-204.
- Lewis, M. (2000). The emergence of human emotions. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions, 2nd ed.* New York: Guilford.
- Luxen, M. F. & Buunk, B. P. (2005). Second-to-fourth digit ratio related to verbal and numerical intelligence and the Big Five. *Personality and Individual Differences, 39*, 959-966.
- MacDonald, K. B. (2008). Effortful control, explicit processing, and the regulation of human evolved predispositions. *Psychological Review, 115*, 1012-1031.
- Majdandžić, M., & van den Boom, D. C. (2007). Multimethod longitudinal assessment of temperament in early childhood. *Journal of Personality, 75*, 121-167.
- Markey, P. M., Markey, C. N., & Tinsley, B. (2005). Applying the interpersonal circumplex to children's behavior: Parent-child interactions and risk behaviors. *Personality and Social Psychology Bulletin, 31*, 549-559.
- Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology, 88*, 139-157.

- Martin, R. P., Wisenbaker, J., & Huttunen, M. (1994). Review of factor analytic studies of temperament measures based on the Thomas-Chess structural model: Implications for the Big Five. In D. Halveson & R. P. Martin (Eds.), *The developing structure of temperament and personality from infancy to adulthood* (pp. 157-172). Hillsdale, NJ: Erlbaum.
- McAdams, D. P. (2008). Personal narratives and the life story. In O. P. John, R. W. Robins, & Pervin, L. A. (Eds.), *Handbook of personality: Theory and research, 3rd Ed.* (pp. 242-262). New York: Guilford.
- McAdams, D. P., & Olson, B. D. (in press). Personality development: Continuity and change over the life course. *Annual Review of Psychology*.
- McAdams, D. P., & Pals, J. L. (2006). A new Big Five: Fundamental principles for an integrative science of personality. *American Psychologist, 61*, 204-217.
- McCrae, R. R., & Costa, P. T., Jr. (2008). The five factor theory of personality. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 159–181). New York: Guilford Press.
- McCrae, R. R., Costa, P. T., Ostendorf, F., Angleitner, A., Hrebickova, H., Avia, M. D. et al. (2000). Nature over nurture: Temperament, personality, and life span development. *Journal of Personality and Social Psychology, 78*, 173-186.
- McCrae, R. R., Jang, K. L., Ando, J., Ono, Y., Yamagata, S., Riemann, R., et al. (2008). Substance and artifact in the higher-order factors of the big five. *Journal of Personality and Social Psychology, 95*, 442–455.
- McCrae, R. R., Jang, K. L., Livesley, W. J., Riemann, R., & Angleitner, A. (2001). Sources of structure: genetic, environmental, and artifactual influences on the covariation of personality traits. *Journal of Personality, 69*, 511-535.
- McIntyre, M. H. (2006). The use of digit ratios as markers for perinatal androgen action. *Reproductive Biology and Endocrinology, 2*, 10.
- McIntyre, M. H., Barrett, E. S., McDermott, R., Johnson, D. D. P., Cowden, J., & Rosen, S. P. (2007). Finger length ratio (2D:4D) and sex differences in aggression during a simulated war game. *Personality and Individual Differences, 42*, 755-764.
- Measelle, J., John, O. P., Ablow, J., Cowan, P. A., & Cowan, C. P. (2005). Can children provide coherent, stable, and valid self-reports on the Big Five dimensions? *Journal of Personality and Social Psychology, 89*, 90-106.

- Mervielde, I., & Asendorpf, J. B. (2000). Variable-centered versus person-centered approaches to childhood personality. In S. E. Hampson (Ed.), *Advances in personality psychology vol. 1* (pp. 37-76). Philadelphia: Taylor & Francies.
- Mervielde, I., De Clerq, B., De Fruyt, F., & Van Leeuwen, K. (2005). Temperament, personality and developmental psychopathology as childhood antecedents of personality disorders. *Journal of Personality Disorders, 19*, 171-201.
- Mervielde, I., De Fruyt, F., & Jarmuz, S. (1998). Linking openness and intellect in childhood and adulthood. In C.S.Kohnstamm, C. F. Halverson, I. Mervielde, & V. L. Havill (Eds.), *Parental descriptions of child personality: Developmental antecedents of the Big Five?* (pp. 105-142). Mahwah, NJ: Erlbaum.
- Mervielde, I., De Pauw, S. & Van Leeuwen, K. (2008, October). The structure of temperament and personality from infancy to childhood. Paper presented at the Occasional Temperament Conference, San Rafael, CA.
- Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167-202.
- Morison, P. & Masten, A. S. (1991). Peer reputation in middle childhood as a predictor of adaptation in adolescence: A seven-year follow-up. *Child Development, 62*, 991-1007.
- Nettle, D. (2006). The evolution of personality variation in humans and other animals. *American Psychologist, 61*, 622-631.
- Nettle, D., & Liddle, B. (2008). Agreeableness is related to social-cognitive, but not social-perceptual, theory of mind. *European Journal of Personality, 22*, 323-335.
- Ojanen, T., Gronroos, M., & Salmivalli, C. (2005). An interpersonal circumplex model of children's social goals: Links with peer-reported behavior and sociometric status. *Developmental Psychology, 41*, 699-710.
- Olino, T. M., Klein, D. N., Durbin, C. E., Hayden, E. P., & Buckley, M. E. (2005). The structure of extraversion in preschool aged children. *Personality and Individual Differences, 39*, 481-492.
- Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotion*. New York: Oxford University Press.
- Peciña, S., Smith, K. S., & Berridge, K. C. (2006). Hedonic hot spots in the brain. *The Neuroscientist, 12*, 500-511.

- Pickering, A. D. & Gray, J. A. (1999). The neuroscience of personality. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research (Second Edition)* (pp. 277–299). New York: Guilford Press.
- Posner, M. I., & Rothbart, M. K. (2007). *Educating the human brain*. Washington, DC: American Psychological Association.
- Putnam, S. P., Ellis, L. K., & Rothbart, M. K. (2001). The structure of temperament from infancy through adolescence. In A. Elias & A. Angleneiter (Eds.), *Advances in research on temperament* (pp. 165-182). Miami, FL: Pabst Science Publishers.
- Putnam, S. P., & Stifter, C. A. (2005). Behavioral approach-inhibition in toddlers: Prediction from infancy, positive and negative affective components, and relations with behavior problems. *Child Development, 76*, 212-226.
- Pytlik Zillig, L. M., Hemenover, S. H., & Dienstbier, R. A. (2002). What do we assess when we assess a Big 5 trait? A content analysis of the affective, behavioral and cognitive processes represented in the Big 5 personality inventories. *Personality & Social Psychology Bulletin, 28*, 847-858.
- Ramanaiah, N.V., Rielage, J.K., & Cheng, Y. (2002). Cloninger's temperament and character inventory and the NEO Five-Factor Inventory. *Psychological Reports, 90*, 59–63.
- Riemann, R., Angleitner, A., & Strelau, J. (1997). Genetic and environmental influences on personality: A study of twins reared together using the self- and peer report NEO-FFI scales. *Journal of Personality, 65*, 449-476.
- Robinson, M. D. (2007). Personality, affective processing, and self-regulation: Toward process-based views of extraversion, neuroticism, and agreeableness. *Social and Personality Psychology Compass, 1*, 223-235.
- Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001a). Investigation of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development, 72*, 1394-1408.
- Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon & R. Lerner (Series Eds.), & N. Eisenberg (Vol. Ed.), *Handbook of child psychology, Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99-166). New York: Wiley.

- Rothbart, M. K., Chew, K. H., & Gartstein, M. A. (2001). Assessment of temperament in early development. In L. T. Singer & P. S. Zeskind (Eds.), *Biobehavioral assessment of the infant* (pp. 190-208). New York: Guilford.
- Rothbart, M. K., & Derryberry, D. (1981). Development of individual differences in temperament. In M. E. Lamb & A. L. Brown (Eds.), *Advances in developmental psychology, Vol. 1* (pp. 37-86). Hillsdale, NJ: Erlbaum.
- Rothbart, M. K. & Mauro, J. A. (1990). Questionnaire approaches to the study of infant temperament. In J.W.Fagen & J. Colombo (Eds.), *Individual differences in infancy: Reliability, stability, and prediction* (pp. 411-429). Hillsdale, NJ: Erlbaum.
- Rothbart, M. K., & Posner, M. I. (2006). Temperament, attention, and developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental Psychopathology. Vol. 2. Developmental Neuroscience* (2nd ed., pp. 465-450). Hoboken, NJ: Wiley.
- Saucier, G. (1992). Openness versus intellect: Much ado about nothing? *European Journal of Personality*, 6, 381-386.
- Saudino, K. J. (2005). Behavioral genetics and child temperament. *Journal of Developmental and Behavioral Pediatrics*, 26, 214-223.
- Saudino, K. J., & Zapfe, J. A. (2008). Genetic influences on activity level in early childhood: Do situations matter? *Child Development*, 79, 930-994.
- Schulte-Rüther, M., Markowitsch, H. J., Fink, G. R., & Piefke, M. (2007). Mirror neuron and theory of mind mechanisms involved in face-to-face interactions: A functional magnetic resonance imaging approach to empathy. *Journal of Cognitive Neuroscience*, 19, 1354-1372.
- Shiner, R. L. (in press). Mapping the landscape of personality in childhood and adolescence. *Social Psychology and Personality Compass*.
- Shiner, R. (2000). Linking childhood personality with adaptation: evidence for continuity and change across time into late adolescence. *Journal of Personality and Social Psychology*, 78, 310-325.
- Shiner, R. (1998). How shall we speak of children's personalities in middle childhood? A preliminary taxonomy. *Psychological Bulletin*, 124, 308-332.

- Shiner, R. L. & Caspi, A. (2003). Personality differences in childhood and adolescence: Measurement, development, and consequences. *Journal of Child Psychology and Psychiatry*, *44*, 2-32.
- Shiner, R. L., & Masten, A. S. (2008). Personality in childhood: A bridge from early temperament to adult outcomes. *European Journal for Developmental Science*, *2*, 158-175. Special Issue: Current Trends in the Study of Child Temperament.
- Simonds, J., Kieras, J. E., Rueda, M. R., & Rothbart, M. K. (2007). Effortful control, executive attention, and emotional regulation in 7-10-year-old children. *Cognitive Development*, *22*, 474-488.
- Soto, C. J., John, O. P., Gosling, S. D., & Potter, J. (2008). The developmental psychometrics of Big Five self-reports: Acquiescence, factor structure, coherence, and differentiation from ages 10 to 20. *Journal of Personality and Social Psychology*, *94*, 718-737.
- Spoont, M. R. (1992). Modulatory role of serotonin in neural information processing: Implications for human psychopathology. *Psychological Bulletin*, *112*, 330-350.
- Tackett, J. L., Krueger, R. F., Iacono, W. G., & McGue, M. (2008). Personality in middle childhood: A hierarchical structure and longitudinal connections with personality in late adolescence. *Journal of Research in Personality*, *42*, 1456-1462.
- Thomas, A., & Chess, S. (1977). *Temperament and development*. Oxford, England: Brunner/Mazel.
- Thomas, A., Chess, S., Birch, H., Hertzig, M., & Korn, S. (1963). *Behavioral individuality in early childhood*. New York: New York University Press.
- Tremblay, R. E., & Nagin, D. S. (2005). The developmental origins of physical aggression in humans. In R. E. Tremblay, W. W. Hartup, & J. Archer (Eds.), *Developmental origins of aggression* (pp. 83-106). New York: Guilford.
- Wacker, J., Chavanon, M.-L., & Stemmler, G. (2006). Investigating the dopaminergic basis of Extraversion in humans: A multilevel approach. *Journal of Personality and Social Psychology*, *91*, 171-187.
- Weinstein, T. A. R., Capitano, J. P. & Gosling, S. D. (2008). Personality in animals. In O. P. John, R. W. Robins, & Pervin, L. A. (Eds.), *Handbook of personality: Theory and research*, 3rd Ed. (pp. 328-348). New York: Guilford.

- Wiebe, S. A., Espy, K. A., & Charak, D. (2008). Using confirmatory factor analysis to understand executive control in preschool children: I. Latent structure. *Developmental Psychology, 44*, 575-587.
- Wilkowski, B. M., Robinson, M. D., & Meier, B. P. (2006). Agreeableness and the prolonged spatial processing of antisocial and prosocial information. *Journal of Research in Personality, 40*, 1152-1168.
- Wilson, B. J. (2003). The role of attentional processes in children's prosocial behavior with peers: Attention shifting and emotion. *Development and Psychopathology, 15*, 313-329.
- Wilt, J. and Revelle, W. (2009) Extraversion. In M. Leary & R. Hoyle (Eds.) *Handbook of Individual Differences in Social Behavior*. New York: Guilford. 27-45.
- Zentner, M., & Bates, J. E. (2008). Child temperament. *European Journal of Developmental Science, 2*, 2-37.
- Zuckerman, M. (1995). Good and bad humors: Biochemical bases of personality and its disorders. *Psychological Science, 6*, 325-332.
- Zuckerman, M. (2005). *Psychobiology of personality (Second edition, revised and updated)*. New York: Cambridge University Press.

Table 1. Examples of Items Defining the Big Five Traits in Children and Adults Across Three Measures

Personality Trait	Sample Items		
	Children's Behavior Questionnaire ^a	Trait Descriptors ^b	Big Five Aspect Scales (Adults) ^c
Extraversion/ Positive Emotionality	Seems to be at ease with almost any person.	Gregarious	Make friends easily.
	Seems always in a hurry to get from one place to another.	Cheerful	Show my feelings when I'm happy.
	Takes a long time in approaching new situations (rev).	Energetic	See myself as a good leader.
	Likes rough and rowdy games.	Withdrawn (rev)	Hold back my opinions (rev).
Neuroticism/ Negative Emotionality	Gets quite frustrated when prevented from doing something s/he wants to do.	Afraid	Feel threatened easily.
	Is very difficult to soothe when s/he has become upset.	Touchy	Worry about things.
	Tends to become sad if the family's plans don't work out.	Tearful	Change my mood a lot.
	Is quite upset by a little cut or bruise.	Steady (rev)	Get upset easily.
Conscientiousness/ Constraint	When drawing or coloring in a book, shows strong concentration.	Diligent	Carry out my plans.
	Is good at following instructions.	Planful	Am easily distracted (rev).
	Prepares for trips and outings by planning things s/he will need.	Careful	Want every detail taken care of.
	Approaches places s/he has been told are dangerous slowly and cautiously.	Focused	Like order.
Agreeableness	Not applicable.	Considerate Trusting Spiteful (rev) Rude (rev)	Feel others' emotions. Don't have a soft side (rev). Avoid imposing my will on others.

			Seek conflict (rev).
Openness/Intellect	(Enjoys looking at picture books. Notices the smoothness or roughness of objects s/he touches.) ^d	Original	Like to solve complex problems.
		Perceptive	Am quick to understand things.
		Knowledgeable	Need a creative outlet.
		Curious	See beauty in things that others might not notice.

Note. rev = Item is scored in the reversed direction.

^a Children's Behavior Questionnaire items defining the factor in several studies of children aged 3-7 (Rothbart et al., 2001). Items are from the *Children's Behavior Questionnaire* by M. K. Rothbart, 1996, unpublished manuscript, University of Oregon. Copyright © 1996 by the author. Reprinted with permission.

^b Items defining the Big Five trait in a study of 480 Russian children aged 8 to 10 whose teachers rated them (presented in "The structure of temperament and personality in Russian children," by J. M. Digman and A. G. Shmelyov, 1996, *Journal of Personality and Social Psychology*, 71, 341-351. Copyright © 1996 by the American Psychological Association. Adapted with permission).

^c Big Five Aspect Scales items defining the Big Five trait across two samples: (a) 481 community adults, and (b) 480 undergraduates (presented in "Between facets and domains: 10 aspects of the Big Five," by C. G. DeYoung, L. C. Quilty, and J. B. Peterson, 2007, *Journal of Personality and Social Psychology*, 93, 880-896, Table 4, pp. 887-888; items are in the public domain).

^d These items are tentatively located within Openness/Intellect, despite traditionally being assigned to Effortful Control, because they belong to scales of low intensity pleasure and perceptual sensitivity that loaded on a factor separate from Effortful Control in an analysis of multiple inventories in preschool children (De Pauw et al., 2009). In adulthood, similar items mark a factor of orienting sensitivity, which is strongly related to Openness/Intellect (Evans & Rothbart, 2007)