Intelligence and Personality

Colin G. DeYoung
Department of Psychology
University of Minnesota

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Contact: cdeyoung@umn.edu

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One purpose of this chapter is to explore the conceptual relation of intelligence to personality. Another is to review empirical research on the relation of intelligence to other traits. Personality and intelligence have often been viewed as distinct domains that intersect only to a very limited degree. However, research on both personality and intelligence over the last three decades suggests the possibility that, both conceptually and empirically, intelligence could be integrated with larger models of personality. Such an integration may allow a more unified conception of the structure and sources of individual differences.

Following presentation of working definitions for intelligence and personality, the chapter reviews arguments for and against three of the most common distinctions that are drawn between intelligence and personality. These three dichotomies provide an overview of the major conceptual issues at stake. Given the amount of thought that has been devoted to the conceptual relation of intelligence to personality, this chapter cannot hope to be comprehensive. Additional perspectives can be found in three excellent edited collections (Collis & Messick, 2001; Saklofske & Zeidner, 1995; Sternberg & Ruzgis, 1994). Additionally, the chapter discusses whether intelligence can be located within the Big Five model (John, Naumann, & Soto, 2008). Finally, the Big Five personality dimensions serve to organize a review of empirical associations of intelligence with various personality traits, with a separate section at the end for associations with sociopolitical orientation.

Definition of Intelligence

In 1994, a group of 52 experts in the study of intelligence and related fields endorsed the following definition of intelligence (Gottfredson, 1997a, p. 13):

> Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather it reflects a broader and deeper capability for comprehending our surroundings—"catching on," "making sense" of things, or "figuring out" what to do.

This definition emphasizes that intelligence represents the ability to solve problems (including problems of comprehension) by thinking. Intelligence is widely considered to occupy the apex of a hierarchy of more specific abilities that are all related to each other (Carroll, 1993). Indeed, the concept of a general intelligence, or

"*g*," was first elaborated in psychology because of the so-called "positive manifold," the tendency for performance on all cognitive tests to be positively correlated, regardless of their content (Jensen, 1998; Spearman, 1904). Intelligence is posited as the general ability that accounts for the covariation of the many specific abilities. However, specific abilities covary to different degrees, and *g* cannot account for all of the shared variance among them. Thus, below *g* in the hierarchy are a number of more specific but still fairly general abilities; below these are the many specific abilities, and below these are various different instances or measures of those specific abilities (Carroll, 1993; Johnson & Bouchard, 2005a, 2005b).

The most widely used distinction between abilities, at the level of the hierarchy immediately below *g*, is between *fluid* and *crystallized* intelligence (Horn & Cattell, 1966), though other factors may also be identified at this level (Carroll, 1993). Fluid intelligence describes abilities that are innate and not dependent on prior education or experience (and thus, in theory, cannot be modified by experience), whereas crystallized intelligence describes abilities that rely on knowledge or skill acquired from experience. Traditional measures of fluid and crystallized intelligence are differentially related to various other traits, and this finding has led to the incorporation of these concepts in many theories regarding the relation of intelligence to personality. However, recent evidence from factor analysis suggests that individual differences in ability do not, in fact, covary according to whether they are fluid or crystallized, but rather according to whether they are verbal or nonverbal (Johnson & Bouchard, 2005a, 2005b).[1]

Most tests traditionally considered to measure crystallized intelligence are verbal, whereas most tests traditionally considered to measure fluid intelligence are nonverbal. Thus, most past findings regarding fluid and crystallized intelligence and personality can be translated cleanly into a verbal-nonverbal framework, simply by replacing terms, and this chapter will primarily discuss *verbal* and *nonverbal intelligence* rather than *crystallized* and *fluid intelligence*. "Crystallized" and "fluid" are not good labels for the two commonly used types of test, not only because of the verbal-nonverbal factor structure identified by Johnson and Bouchard (2005a, 2005b), but also because both verbal and nonverbal intelligence are determined by a combination of innate ability and acquired knowledge and skills. Verbal intelligence cannot be entirely crystallized (dependent on experience), given that it is just as heritable (genetically influenced) as nonverbal intelligence, even when controlling for *g* (Johnson & Bouchard, 2007; Johnson et al., 2007). And nonverbal intelligence cannot be

entirely fluid (independent of experience), both because it is influenced by environmental factors in studies of heritability (Johnson & Bouchard, 2007; Johnson et al., 2007) and because it may be improved by schooling (Ceci, 1991) and by training on video games (Feng, Spence, & Pratt, 2007), working memory tasks (Jaeggi, Buschkuehl, Jonides, & Perrig, 2008; but see Moody, 2009), and other mentally stimulating activities (Tranter & Koutstaal, 2008). The fact that, on average, nonverbal intelligence declines with age after the mid-20s, whereas verbal intelligence increases or remains stable until very old age (Berg, 2000), does not provide sufficient evidence to claim that verbal intelligence is exclusively crystallized whereas nonverbal intelligence is exclusively fluid. The underlying brain systems responsible for these two types of intelligence are at least partially distinct (Choi et al., 2008) and may age differently, despite the fact that both incorporate fluid and crystallized processes.

Definition of Personality

Personality is a broader concept than intelligence, as can be seen in the following definition by McAdams and Pals (2006, p. 212):

> Personality is an individual's unique variation on the general evolutionary design for human nature, expressed as a developing pattern of dispositional traits, characteristic adaptations, and integrative life stories, complexly and differentially situated in culture.

This definition highlights three distinct levels at which personality can be described: traits, characteristic adaptations, and life stories. Characteristic adaptations and life stories both describe the individual's adaptation to his or her particular socio-cultural context (e.g., as a lawyer). Traits describe relatively stable patterns of behavior, motivation, emotion, and cognition (Pytlik Zillig, Hemenover, & Dienstbier, 2002; Wilt & Revelle, 2009) that are not bound to a particular socio-cultural context but could be observed in any such context (e.g., argumentativeness). This is not to say that all traits will be evident to the same extent or with identical manifestations 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. Traits will be the primary level of focus in this chapter. For this reason, vocational interests will not be discussed, despite their relevance to intelligence and related personality traits (Ackerman & Heggestad, 1997), as they are more like characteristic adaptations than traits, in their cultural specificity.

A central project in personality psychology has been the development of a comprehensive taxonomy of traits. To develop such a taxonomy, one needs a reasonably comprehensive set of traits to be classified. The *lexical hypothesis* states that natural language (as represented in dictionaries) provides a reasonably comprehensive pool of trait descriptors, which can be used to determine the general factors that underlie the covariation among many specific traits (Saucier & Goldberg, 2001). Another promisingly large and broad pool of traits in which to locate general factors can be found in existing personality questionnaires. Lexical and questionnaire research have both provided evidence for a five factor solution, leading to a taxonomy known as the Five Factor Model or Big Five, which includes the broad trait domains of Extraversion, Neuroticism, Agreeableness, Conscientiousness, and Openness/Intellect (Digman, 1990; Goldberg, 1990; John et al., 2008; Markon, Krueger, & Watson, 2005). The Big Five are strongly genetically influenced (Rieman, Angleitner, & Strelau, 1997), and the genetic factor structure of the Big Five appears to be invariant across European, North American, and East Asian samples, suggesting the biological universality of this model (Yamagata et al., 2006).

Personality traits are hierarchically organized, with more specific traits (e.g., talkativeness, sociability, enthusiasm) varying together, such that one can deduce the presence of broader traits (e.g., Extraversion, for the three traits just mentioned) that account for their covariance. Higher-order traits may exist above the Big Five (DeYoung, 2006; Digman, 1997), but they do not appear to be related to intelligence (DeYoung, Peterson, Séguin, & Tremblay, 2008). For the present purpose, therefore, they are of less interest than levels of trait structure below the Big Five. Each Big Five domain comprises a large number of lower-level traits, called *facets*, with no consensus as to how many facets exist for each domain. Additionally, research suggests the existence of a level of personality structure between the Big Five and their facets. In two samples, two genetic factors were necessary to account for the shared genetic variance among the facets within each of the Big Five (Jang, Livesley, Angleitner, Riemann, & Vernon, 2002). If the Big Five were the next level above the facets, only one genetic factor should have been necessary for each domain. In factor analysis of phenotypic data, using 15 facets for each domain, two factors similar to the genetic factors were found for each of the Big Five (DeYoung, Quilty, & Peterson, 2007). These factors were then characterized empirically by their correlations with over 2000 items from the International Personality Item Pool (Goldberg, 1999). Of particular relevance for intelligence, the two factors in the Openness/Intellect domain clearly differentiated

between Openness to Experience and Intellect, with Openness reflecting aesthetically oriented traits related to engagement in sensation and perception (e.g., "Believe in the importance of art"; "See beauty in things that others might not notice") and Intellect reflecting intellectual interest or engagement (e.g., "Avoid philosophical discussions"–reversed) and perceived intelligence (e.g., "Am quick to understand things").

Importantly, traits are probabilistic entities. Each of the Big Five encompasses many subtraits, and a high score on a Big Five trait indicates an increased likelihood of high scores on its various subtraits but is not deterministic. This entails that people scoring high in Intellect will, on average, score higher in Openness than people scoring low in Intellect. However, the correlation between Openness and Intellect is far from perfect, which means that some people will score high in Intellect but only moderate or low in Openness, and vice versa. One must remember, when interpreting correlations among traits, that a significant correlation does not indicate a pattern of necessary co-occurrence in every individual, but rather a general trend in the population. The fact that Openness and Intellect are two subtraits within a single Big Five dimension suggests that they share some of their sources, but the fact that they are separable indicates that each additionally has unique sources that differentiates it from the other.

The Conceptual Relation of Intelligence to Personality

Given a broad definition of personality, like the one presented above, the possibility of describing intelligence as a personality trait seems clear. Indeed, some early theorists considered personality to include intelligence (Cattell, 1950; Guilford, 1959). However, most theorists have not considered intelligence to be part of personality, instead asserting either that intelligence (as defined above) is unrelated to personality (e.g., Eysenck, 1994) or that intelligence and personality are related but nonetheless categorically distinct (e.g., Chamorro-Premuzic & Furnham, 2005a). The large body of empirical evidence reviewed in the latter half of this chapter rules out the possibility that intelligence is unrelated to personality. A number of personality traits show consistent and meaningful relations to intelligence. Thus, the important contrast is between the view that intelligence is a personality trait and the more common view that intelligence is fundamentally different from personality traits.

Three dichotomies seem to be largely responsible for the view that intelligence and personality may be related but must be considered categorically distinct. (Because many researchers have advanced similar dichotomies, with slight variations, what follows

represents a distillation of many viewpoints.) First, a distinction is often made between cognitive and noncognitive traits, with intelligence considered to be cognitive and personality considered to be noncognitive. Second, intelligence and personality differ in their typical methods of measurement: Intelligence is usually assessed using ability tests, whereas personality is usually assessed by questionnaire. Third, the difference in typical measurement corresponds to a conceptual distinction in which intelligence is often considered to reflect "maximal performance" (i.e., performance when individuals are trying their hardest), whereas personality is considered to reflect "typical behavior" (Cronbach, 1949). The following section reviews arguments for and against the validity of these dichotomies.

The cognitive/noncognitive dichotomy is widely used, but the evidence against it is strong enough that even some psychologists who utilize it acknowledge that it is flawed and a "misnomer" (Duckworth, 2009, p. 279). The distinction between cognitive and noncognitive fails because almost all traits have cognitive attributes, though these are more prominent in some traits than others. In a study of common Big Five questionnaires, items describing cognitive traits were found in all five domains, with Openness/Intellect containing the most such items and Extraversion and Neuroticism containing the fewest (Pytlik Zillig, Hemenover, & Dienstbier, 2002). Examples of cognitive attributes are easily provided, even for traits that might be considered relatively less cognitive: Neuroticism is associated with rumination, compulsive thinking about possible threats (Nolan, Roberts, & Gotlib, 1998); Agreeableness is associated with "social-cognitive theory of mind," understanding and considering the mental states of others (Nettle & Liddle, 2008). Personality includes stable patterns of cognition, in addition to behavior, motivation, and emotion. Duckworth (2009) suggests that psychologists may continue to employ this problematic dichotomy because "cognitive" is a convenient shorthand for "cognitive ability." "Noncognitive," therefore, is used as shorthand to indicate all variables other than cognitive ability or intelligence, even though many of those other variables have cognitive attributes. Thus, the existence of the cognitive/noncognitive dichotomy may reflect imprecise use of language rather than a strong theoretical assertion that intelligence is categorically distinct from personality.

The second dichotomy involves methods of measurement. Historically, research on intelligence has been separated from research on personality by the fact that personality has typically been assessed by questionnaire, whereas intelligence has typically been

assessed by ability tests. These two research traditions thus represent two *paradigms*, in Kuhn's (1970) original sense, separated from each other by differing sets of conventional scientific practices. Nonetheless, most psychologists would not assert that different methods of measurement, in and of themselves, justifiy a categorical distinction between the constructs that have been measured. (Whether the differences in measurement are necessary because of an underlying conceptual distinction is a separate question and the focus of the third dichotomy, discussed below.) Psychometricians warn against confusing constructs with measures (Jensen, 1998; Loevinger, 1957). Personality traits are not identical to scores on personality questionnaires, just as intelligence is not identical to an IQ score. In both cases, the measures merely provide estimates of what researchers typically want to investigate—namely, latent traits, actual patterns of human functioning that persist over time—and these cannot be measured without error. (Some researchers may be interested exclusively in the manner in which people represent or describe personality traits, without reference to actual patterns of functioning, but they are in the minority.) Multiple methods can be used to measure a single latent trait; each method may incorporate different sources of error or bias, and one method may be better than another for the purposes intended, but nonetheless each can be said to measure the same trait. For example, given our working definition of intelligence as "a general mental capability," one should expect it to be best measured by ability tests, but one could also measure it, albeit less accurately, using questionnaires that require self-, peer, or observer ratings of subjects' mental ability (this approach is discussed in more detail below). Differences in typical methods of measurement, therefore, would not usually be seen as sufficient to rule out the possibility that intelligence is part of personality.

What makes the issue of measurement more complicated, however, is the possibility that the different types of measures typically used for intelligence and personality correspond to a valid dichotomy between maximal performance and typical behavior. If intelligence really involves only maximal performance, and if personality really involves only typical behavior, then one would be forced to conclude that intelligence and personality are categorically distinct. The working definition of intelligence above can be read to imply that maximal performance is what matters. However, some theorists have questioned the sharpness of the distinction between maximal performance and typical behavior (e.g., Ackerman, 1996). This distinction is blurred by the fact that ability can affect typical behavior, as illustrated by the fact that IQ scores are good predictors of outcomes

that depend on typical behavior—including job success, academic performance, and health (Gottfredson, 2002; Gottfredson & Deary, 2004). If being intelligent did not typically entail that one often used one's intelligence, IQ would be unlikely to predict real-world outcomes. Because the complexity of the world always outstrips our simplified mental models (Peterson & Flanders, 2002), intelligence will often be expressed in typical behavior (Gottfredson, 1997b). Even idle thoughts seem likely to be different for those high as opposed to low in intelligence. Any ability for which there is frequent demand or possibility for application will influence typical behavior, and tests of that ability will provide indices of both maximal performance and typical behavior. This is not to say that maximal performance is identical to typical behavior—underachievers who fail to make the best use of their abilities are a clear counterexample—but a case can be made that intelligence, as a trait, entails typical behavior as well as maximal performance.

The idea that personality involves only typical behavior has also been contested. The personality research framework provided by the lexical hypothesis has generally not excluded abilities. Traits that describe ability have been included in all selections of personality descriptors from natural languages (though more in some than others; John Naumann, & Soto, 2008), and these have not fallen exclusively within the Openness/Intellect domain in factor analysis. For example, empathy is a component of Agreeableness that involves the ability to detect the mental states of others. Many components of Conscientiousness, such as self-discipline and patience, can be considered abilities (Mischel, Shoda, & Rodriguez, 1989). For example, large differences in outcome may be evident when people are trying their hardest to be patient, rather than not attempting to restrain themselves, and some people may be more successful in the attempt than others. Abilities thus appear to be relatively common within the Big Five.

One complement to the observation that numerous personality traits involve abilities is the idea that ability tests could be used to measure traits other than intelligence (Ackerman, 2009; Cattell & Birkett, 1980; Cattell & Warburton, 1967; Wallace, 1966; Willerman, Turner, & Peterson, 1976). For example, tests of the ability to detect and understand others' mental and emotional states might be good measures of Agreeableness (Nettle et al., 2008). Tests of the ability to delay gratification or resist distraction might be good measures of Conscientiousness (Mischel et al., 1989). And tests of the ability to remain calm under stress might be good measures of Neuroticism. Personality includes many abilities that could potentially be measured by tests of maximal performance. Past attempts

at ability tests for traits other than intelligence have not been very successful (Kline, 1995). However, better progress may be made if such tests are designed to reflect theories regarding the key underlying processes involved in different personality traits (DeYoung & Gray, 2009; Van Egeren, 2009) and if the field recognizes that, because of the differences in method, correlations between questionnaires and tests measuring the same trait are unlikely to be very high, even if the tests are valid (correcting correlations for attenuation due to unreliability and using multiple measures with latent variable models are important strategies for dealing with this problem).

Having reviewed arguments for and against the three dichotomies commonly used to separate intelligence from personality, one can conclude that viewing intelligence as a personality trait is a viable, if relatively uncommon, conceptual strategy. Many personality traits appear to involve both cognitive processes and abilities, which have sometimes been considered exclusive to intelligence. One might argue that maximal performance (relative to typical behavior) is more important in intelligence than in other traits, but this could suggest a difference of degree between intelligence and other traits, rather than a qualitative or categorical difference. The question of whether intelligence should be considered a personality trait remains open.

Intelligence in the Big Five

The previous section raised the question of whether intelligence can be considered part of personality. Given the potential viability of an affirmative answer, another important question is whether intelligence can be integrated with models of personality, like the Big Five, that are derived from trait descriptors and attempt to provide comprehensive taxonomies of traits. Any trait model that would claim comprehensiveness should presumably include intelligence. In considering evidence related to this question, method is an important consideration: One must differentiate between descriptors of intelligence (as in lexical and questionnaire research) and ability tests of intelligence.

Based on lexical and questionnaire studies, a natural home for descriptors of intelligence, in the Big Five taxonomy, appears to be within the Intellect aspect of the Openness/Intellect domain. The compound label “Openness/Intellect” reflects a history of debate about how best to characterize the content of this domain, with some researchers preferring “Openness to Experience” (e.g., Costa & McCrae, 1992a) and others “Intellect” (e.g., Goldberg, 1990). This debate was largely resolved conceptually by the observation that “Openness” and “Intellect” describe two central aspects of the larger domain (DeYoung

et al., 2007; Johnson, 1994; Saucier, 1992). Lexical studies made it clear that both aspects are represented in natural language and appear within a single Big Five factor (e.g., Goldberg, 1990; Saucier, 1992). Many words describe Intellect—*intellectual, intelligent, philosophical, erudite, clever*—and many words describe Openness—*artistic, perceptive, poetic, fantasy-prone*. Additionally, many words could characterize people high in Intellect or Openness or both—*imaginative, original, innovative*. In fact, Saucier (1992, 1994) proposed that "Imagination" might be a better single label for the domain as a whole, given the existence of both intellectual and aesthetic forms of imagination. This broad sense of "imagination" is appropriate for a trait domain that has, as its central characteristic, the disposition to detect, explore, and utilize abstract and sensory information (DeYoung, Peterson, & Higgins, 2005; DeYoung et al., 2009). Importantly, general measures of Openness/Intellect (such as the Revised NEO Personality Inventory; NEO PI-R; Costa & McCrae, 1992b; the Trait Descriptive Adjectives; Goldberg, 1992; or the Big Five Inventory; John et al., 2008) contain content reflecting both Openness and Intellect, and they predict other variables very similarly, no matter which label their authors prefer (DeYoung et al., 2005).

In studies of the Big Five in languages other than English, less agreement about the nature of the factor corresponding to Openness/Intellect has emerged, relative to the other four factors. In a Dutch study, for example, this factor was most strongly characterized by descriptors of unconventionality (Hofstee, Kiers, De Raad, & Goldberg, 1997). (Content related to unconventionality also appears in the English Openness/Intellect factor, but less centrally.) However, these differences between languages appear to be related primarily to criteria for variable selection. In Dutch and Italian lexical studies, for example, descriptors related to abilities were undersampled, leading to the exclusion of many terms that might reflect intellectual ability (John, Naumann, & Soto, 2008). Additionally, in a six-factor lexical solution that has been proposed as a slight modification of the Big Five (dividing Agreeableness into two factors), the content of Openness/Intellect was more consistent across all languages (Ashton et al., 2004). Thus, the relative lack of consensus about the content of Openness/Intellect appears to have been due to methodological issues. The current state of lexical research suggests that Openness/Intellect encompasses a range of trait descriptors related to intellectual and aesthetic curiosity, imagination, and ability—including descriptors of intelligence.

As measured by questionnaires, therefore, intelligence can be located within the Big Five. Despite this semantic fit, objections have been raised because intelligence tests do not behave quite like descriptors of intelligence. If multiple intelligence tests are factor analyzed with personality questionnaires, they tend to form a sixth factor, rather than grouping with questionnaire variables reflecting Openness/Intellect (McCrae & Costa, 1997). However, this result may be due to one or two method artifacts, the first of which is the presence of two distinct sources of method variance in these factor analyses. In addition to substantive trait variance, all of the ability tests share method variance that they do not share with any questionnaire variables, and vice versa. This shared variance inflates the intercorrelations within each type of measure, relative to their correlations with the other type, and inclines the two types of measure to form separate factors, regardless of what they share substantively.

A second possible artifact resembles what Cattell (1978) called a "bloated specific factor," which could result from the inclusion of many intelligence tests in factor analysis of broad personality questionnaires. A bloated specific factor appears when measures of a single lower-level trait are over-represented in the pool of variables to be factor analyzed. Their large number will tend to cause them to form a separate factor, even when the other factors recovered are at a higher level of the trait hierarchy and one of them should subsume the lower-level trait in question. As an analogy, consider what would happen if one included 10 scales measuring different types of anxiety in a factor analysis with the 30 facets of the Big Five measured by the NEO PI-R. One would be likely to find a sixth factor for anxiety, in addition to the usual Neuroticism factor encompassing traits like depression, vulnerability, and self-consciousness. This would be considered a bloated specific factor because the location of anxiety as a lower-level trait within Neuroticism is well established (John et al., 2008, Markon et al., 2005).

The existence of distinct method variance for intelligence tests and questionnaires, plus the possibility of bloated specific factors, makes interpretation ambiguous for results of joint factor analyses of tests and questionnaires. The factor-analytic results summarized by McCrae and Costa (1997) can be taken to indicate that intelligence falls outside of the Big Five (which would imply that descriptors of intelligence do not measure intelligence as much as they measure some other construct), or they can be challenged by the argument that an adequate factor analysis would need to model method variance explicitly and test a

model in which the intelligence tests marked a lower-level factor below Openness/Intellect. The question of whether intelligence can be located within the Big Five thus remains open.

The idea that intelligence could be a lower-level trait in the personality hierarchy might strike some as odd, given the obvious importance of intelligence in human functioning and the number of cognitive abilities that make up the hierarchy below *g*. Nonetheless, the location of descriptors of intelligence within the Big Five seems clear. As noted above, the existence of Openness and Intellect as two correlated but separable aspects of Openness/Intellect was supported by factor analysis of 15 facet scales in this domain, and empirical characterization of the Intellect factor by correlations with thousands of personality items indicated that it includes at least two facets, intellectual engagement and perceived intelligence (DeYoung et al., 2007). In the Big Five personality hierarchy, therefore, intelligence appears to be at a relatively low level: one facet out of at least two within Intellect, which is itself one of two aspects of the broader Openness/Intellect domain (see Figure 1). This structural finding highlights the great complexity of the personality hierarchy, in terms of how many different patterns of emotion, motivation, cognition, and behavior it encompasses. Intelligence is by no means unique in being an extremely important and multi-faceted construct that is, nonetheless, relatively narrow when compared to traits like the Big Five that represent very broad regularities in personality. Anxiety, for example, appears to be one facet of the Withdrawal aspect of Neuroticism (DeYoung et al., 2007) and thus exists at the same level of the personality hierarchy as intelligence. The relative breadth of a trait places no limitation on its importance to human beings and seems to place little limitation on the extent to which it may be further subdivided.

[Insert Figure 1 about here.]

Having located intelligence within the personality hierarchy conceptually, we can turn to the question of how it relates empirically to the Big Five and their lower-order traits. Its putative position within Intellect suggests that it should be most strongly related to other measures of Intellect and to general measures of the Openness/Intellect domain, but less strongly to specific measures of Openness and to other Big Five domains. Having suggested above that ability tests are likely to be better measures of intelligence than questionnaires, this chapter will continue to focus on these tests, and when "intelligence" is discussed below, in relation to empirical work, it has been measured by ability tests, unless otherwise noted.

Openness/Intellect

Several thorough reviews of associations between intelligence and personality have been published (Ackerman, 2009; Chamorro-Premuzic & Furnham, 2005a; Eysenck, 1994; Zeidner & Matthews, 2000), but only one has been meta-analytic (Ackerman & Heggestad, 1997). This meta-analysis included only three studies reporting the correlation of Openness/Intellect with *g*, and they indicated a correlation of .33. (Other Big Five traits showed correlations of around .1 or lower.) The last decade has seen a surge of research on this topic, especially research utilizing the Big Five, which consistently replicates the finding that, of the Big Five, Openness/Intellect shows by far the strongest association with intelligence. A comprehensive meta-analysis is beyond the scope of this chapter, but the *N*-weighted average of correlations from 9 studies (N = 2220) not included in Ackerman and Heggestad's meta-analysis was r = .30 (range = .06 to .42; Ashton, Lee, Vernon, & Jang, 2000; Austin, Deary, & Gibson, 1997; Austin et al., 2002; Chamorro-Premuzic & Furnham, 2008; DeYoung et al., 2005, 2009; Furnham & Chamorro-Premuzic, 2004; Holland, Dollinger, Holland, & MacDonald, 1995).[2] In these studies, mean weighted correlations of intelligence with the other Big Five traits were all very close to those reported by Ackerman and Heggestad, with the exception of Conscientiousness, which showed a correlation of -.12, whereas Ackerman and Heggestad reported .02 (across 3 studies). Although the correlation of about .3 between intelligence and Openness/Intellect is moderate (though tending toward large for variables that do not share method; Hemphill, 2003), it is consistent with the possibility of including intelligence as a facet of Openness/Intellect, given the lack of shared method. Note that the average correlation between facets of Openness/Intellect in the NEO PI-R is only .28 (Costa & McCrae, 1992b).

In studies that have examined verbal and nonverbal intelligence separately, Openness/Intellect consistently shows a stronger correlation with verbal than nonverbal intelligence (Ackerman & Heggestad, 1997; Ashton et al., 2000; Austin et al., 1997; Baker & Bichsel, 2006; Bates & Shieles, 2003; Beauducel1, Liepmann, Felfe, Nettelnstroth, 2007; DeYoung et al., 2005; Holland et al., 1995), which has led many researchers to hypothesize that Openness/Intellect causes increased crystallized intelligence through increased motivation to learn (e.g., Chamorro-Premuzic & Furnham, 2005a). The problem with this interpretation is that, as discussed above, verbal intelligence cannot be equated conceptually to crystallized intelligence (Johnson & Bouchard, 2005a, 2005b). Because both verbal and nonverbal intelligence are influenced by a mix of genetic and environmental

forces, their differential associations with Openness/Intellect are uninformative regarding the causal relation between Openness/Intellect and intelligence.

Although a great deal of speculation has gone into the question of how Openness/Intellect might influence the development of intelligence, thus far little evidence has been provided that is not correlational and cross-sectional (i.e., assessing people of different ages at one point in time). Longitudinal studies are necessary to make any strong claims about causal influence. One such study found no support for the idea that Openness/Intellect is related to change in intelligence over time, using IQ at ages 11 and 79 years (Gow, Whiteman, Pattie, & Deary, 2005). Although Openness/Intellect, assessed at 79, was correlated with IQ at both ages (r = .32 at age 11 and .22 at age 79), it ceased to predict IQ at age 79 after controlling for IQ at age 11. Consistent with the argument of this chapter that intelligence is a facet of Openness/Intellect, Gow and colleagues concluded that the variance shared between Openness/Intellect and intelligence simply reflects the same stable trait of intelligence across the lifespan. In addition to developing models positing effects of Openness/Intellect on intelligence, or vice versa, it may be that researchers should be looking for shared psychological and biological substrates (DeYoung et al., 2005, 2009).

Thus far, this section has considered total Openness/Intellect scores. Considering Intellect and Openness separately is additionally informative. No instrument other than the Big Five Aspect Scales (BFAS; DeYoung et al., 2007) has been explicitly designed to measure Intellect and Openness as distinct constructs using single scales. However, many older questionnaires tap core components of these two traits. Most measures of Intellect can be categorized according to whether they measure intellectual engagement or perceived intelligence. Commonly used scales measuring intellectual engagement include Typical Intellectual Engagement (TIE; Goff & Ackerman, 1992), Need for Cognition (NFC; Cacioppo, Petty, Feinstein, & Jarvis, 1996), and the Ideas facet of the NEO PI-R (Costa & McCrae, 1992b). The Ideas facet is much more strongly correlated with TIE (r = .77; Ackerman & Goff, 1994) and NFC (r = .78; Cacioppo et al., 1996) than with any of the other NEO PI-R facets (Costa & McCrae, 1992b). Like Ideas, TIE and NFC have been found to be associated with intelligence (Ackerman & Heggestad, 1997; Cacioppo et al., 1996; Espejo, Day, & Scott, 2005; Frederick, 2005; Gow et al., 2005).

Whereas Ideas is the only NEO PI-R facet that is a good marker of Intellect (DeYoung et al., 2007), four NEO PI-R facets are good markers of Openness; listed from largest to smallest loading, they are Aesthetics, Fantasy, Feelings, and Actions.[3] (The sixth

Openness/Intellect facet, Values, does not mark either Openness or Intellect strongly and is discussed below in the section on sociopolitical orientation.) In studies that consider the NEO PI-R facets individually, Ideas typically predicts intelligence (whether general, verbal, or nonverbal) more strongly than do the four Openness facets (DeYoung et al., 1995; 2009; Furnham, Dissou, Sloan, & Chamorro-Premuzic, 2007; Holland et al., 1995; McCrae, 1993; Moutafi, Furnham, & Crump, 2003, 2006).

From the few studies that not only examined the NEO PI-R facets but also separated verbal and nonverbal intelligence, it appears that the stronger association of Intellect (Ideas) than Openness with intelligence may be especially pronounced for nonverbal intelligence (DeYoung et al., 2005; McCrae, 1993; Moutafi et al., 2006; but see Holland et al., 1995). The Openness facets appear more likely to be associated with verbal intelligence than with nonverbal intelligence, whereas Ideas is often associated with both forms of intelligence about equally. This pattern suggests one reason why total Openness/Intellect scores might be associated more strongly with verbal than nonverbal intelligence: Intellect may be associated with both verbal and nonverbal intelligence, whereas Openness may be associated primarily with verbal intelligence. This possibility requires more investigation, as does the more general question of which cognitive abilities are and are not associated with Openness, as opposed to Intellect. Studies of these questions should distinguish unique variance in Openness from variance shared with Intellect, using partial correlations or structural equation modeling.

Measures of perceived intelligence (or *subjectively assessed intelligence*; Chamorro-Premuzic & Furnham, 2005a, 2005b) are not as widely used or standardized as measures of intellectual engagement. Furthermore, items reflecting perceived intelligence rather than intellectual engagement are rarely incorporated into standard Big Five questionnaires (with the important exception of questionnaires derived from the International Personality Item Pool; DeYoung et al., 2007; Goldberg, 1999). Nonetheless, enough studies have assessed perceived intelligence to conclude (1) that perceived intelligence is correlated with Ideas more strongly than with the four Openness facets of the NEO PI-R (Chamorro-Premuzic, Moutafi, & Furnham, 2005; DeYoung et al., 2007), and (2) that correlations of self-reported intelligence with tested intelligence are similar in magnitude to correlations discussed above for Openness/Intellect and intellectual engagement—typically in the range of .20 to .35 (Chamorro-Premuzic & Furnham, 2005a, 2005b; Chamorro-Premuzic et al., 2005; Paulhus et al., 1998). These effect sizes are consistent with the location of intelligence

within the personality hierarchy but imply that self-reported intelligence should not be used as a proxy for tested intelligence (Paulhus et al., 1998). Other-ratings of intelligence fare somewhat better, though they have been less well studied. Teacher-ratings of intelligence strongly predict student IQ, with correlations ranging from about .45 all the way up to .80 (Alvidrez & Weinstein, 1999; Brickenkamp, 1975, cited in Ostendorf & Angleitner, 1994; Pedulla, Airasian, & Madaus, 1980). Additional research is necessary on how well intelligence can be rated by others who are not teachers, such as friends or family members.

The relative lack of accuracy for self-ratings of intelligence suggests the utility of studying discrepancies between self-rated and tested intelligence (Ackerman, Beier, & Bown, 2002; Paulhus & John, 1998). Self-reported intelligence may reflect a combination of actual intelligence and inaccurate self-perception that could be due to over- or under-confidence. Indeed, self-esteem predicts the tendency to rate one's intelligence more highly than is warranted by one's tested intelligence (Gabriel, Critelli, & Ee, 1994). It is also possible that, when individuals rate their own intelligence, they are taking into account abilities that are not strongly tested by typical intelligence tests (such as divergent or creative thinking). This supposition is supported by the observation that the accuracy of self-ratings in predicting ability tests appears to be higher when individuals are tested and rate themselves on more specific abilities, below *g* in the intelligence hierarchy, such as verbal, mathematical, or spatial ability (Ackerman et al., 2002). Asking individuals to rate their own general intelligence may make it harder for people to form accurate self-perceptions (because they are required to consider a large and poorly specified range of their own experience) and may also make it easier for them to base their responses on wishful thinking or insecurity or on conceptions of intelligence that differ from the one operationalized in most intelligence tests (Saucier, 2009). Note that the last point raises a possibility that should be further explored empirically: In relation to abilities that are not well tested by typical intelligence tests, self-reports might be more accurate reflections of ability than the typical tests.

The link between intelligence and Openness/Intellect is reinforced by studies of working memory and brain function. Intelligence is very strongly associated with working memory, the ability to maintain and manipulate information in short term memory, despite distraction (Conway, Kane, & Engle, 2003). Further, the brain systems in the prefrontal cortex (PFC) and parietal cortex that support both working memory and intelligence

overlap substantially, indicating that working memory may be one of the primary cognitive substrates of intelligence (Gray & Thompson, 2004). Openness/Intellect, and especially its Intellect aspect, are also associated with working memory (DeYoung et al., 2005, 2009), and a recent study investigated associations of Intellect, Openness, and intelligence with brain activity during a difficult working memory task (N = 104; DeYoung et al., 2009). Intellect was measured using the Ideas scale, which was the only facet of Openness/Intellect that was associated with working memory-related brain activity. In the left frontal pole of prefrontal cortex, Ideas was associated with brain activity that predicted better working memory performance; however, this association was attenuated when controlling for intelligence, suggesting that this brain region is a shared substrate of both intelligence and intellectual engagement. The brain's frontal pole is particularly involved in the abstract integration of multiple cognitive operations and in drawing abstract analogies (Gilbert et al., 2006; Green, Fugelsang, Kraemer, Shamosh, & Dunbar, 2006; Ramnani & Owen, 2004). Ideas was also associated with working memory-related brain activity in a posterior region of medial frontal cortex, which is known to be involved in monitoring goal-directed performance and detecting likelihood of error (Brown & Braver, 2005; Ridderinkhof, Ullsperger, Crone, & Nieuwenhuis, 2004). In this region, Ideas remained significantly related to neural activity even after controlling for intelligence, suggesting that this region and its functions may be involved in intellectual engagement, independently of intelligence. Intellectual engagement suggests a motivation to succeed at cognitive tasks, which is plausibly associated with greater monitoring of cognitive performance. Intelligence and intellectual engagement are conceptually distinct facets of Intellect (though each seems likely to support the other), and this study is relevant to the important question of the extent to which their sources are shared versus distinct.

Another trait that falls within Openness/Intellect in lexical studies is creativity (Saucier, 1992), and both Openness/Intellect and intelligence are consistently associated with creativity, whether the latter is measured by trait-descriptive questionnaires, by real-world achievement, or by measures of creative production in the laboratory, such as divergent thinking (Carson, Peterson, & Higgins, 2005; Feist, 1998; McCrae, 1987). Another chapter provides in-depth review of the association of intelligence with creativity (J.C. Kaufman & Plucker, this volume). Creativity has often been considered a personality trait, and some other mental capacities could also potentially be considered personality traits. Psychologists have studied a variety of individual differences in the ways that people

reason—for example, through logic, heuristics, and intuition (e.g., Stanovich & West, 2000). If these were considered personality traits, they too might fall within Openness/Intellect in the Big Five hierarchy.

Extraversion

Extraversion comprises a set of lower-level traits related to approach behavior and positive affect, including assertiveness, talkativeness, sociability, and positive emotionality. Extraversion appears to represent the manifestation in personality of sensitivity to rewards, both anticipated and received (Depue & Collins, 1999; DeYoung & Gray, 2009). Across 35 studies, Ackerman and Heggestad (1997) reported a very small, but statistically significant, positive correlation of Extraversion with *g*, $r = .08$. An updated meta-analysis for Extraversion (Wolf & Ackerman, 2005), including 50 new studies, found a similar effect size overall, $r = .05$, but noted that different measures of Extraversion and different subtraits within Extraversion yielded significantly different, though all weak, effects (an example of moderation), and that in studies published since 2000 the correlation was, in fact, significantly negative, $r = -.04$. In any case, any weak positive association of intelligence with Extraversion might be artifactual, simply reflecting Extraversion's positive correlation with Openness/Intellect (DeYoung, 2006; Digman, 1997) rather than a real association with intelligence specifically. Studies assessing the association of Extraversion and intelligence while controlling for Openness/Intellect could help to resolve this question.

Another possibility is that weak associations of Extraversion with intelligence reflect individual differences in low-level cognitive processes. For example, Extraversion has been found to predict better short term memory (Zeidner & Matthews, 2000), although it does not typically predict working memory, in which information in short term memory must be manipulated or maintained despite distraction (DeYoung et al., 2005, 2009). Extraversion may be related to some aspects of intelligence test-taking, rather than to actual intelligence. Faster speed of test taking and a lack of persistence during tests have been associated with Extraversion, but results are equivocal (Chamorro-Premuzic, & Furnham, 2005a). In general, the cognitive correlates of Extraversion are moderated by contextual factors, such as sensory stimulation and incentives (Eysenck, 1994; Zeidner & Matthews, 2000). Perhaps because it primarily reflects basic positive emotional and motivational tendencies, Extraversion appears to be related to the stylistic ways in which people solve problems that require intelligence, while affecting their ability to solve them correctly only slightly, if at all.

Neuroticism

Neuroticism encompasses a variety of traits reflecting the tendency to experience negative emotion, including anxiety, depression, irritability, and insecurity. It appears to reflect the primary manifestation in personality of sensitivity to threat and punishment (DeYoung & Gray, 2009; Gray & McNaughton, 2000). Neuroticism exhibits a small but reliable negative correlation with intelligence, r = -.15 across 30 studies (Ackerman & Heggestad, 1997). This correlation is likely to be due to the facts that negative emotion typically interferes with higher cognition, in part by interrupting the functions of PFC (Fales et al., 2008; Keightley et al., 2003), and that neurotic individuals are more likely to experience anxiety under the pressures of testing situations (Ackerman & Heggestad, 1997). Measures specifically designed to assess test anxiety are negatively correlated with intelligence, r = -.33 (Ackerman & Heggestad, 1997). The most likely reason that this correlation is considerably stronger than the correlation of intelligence with Neuroticism is that trait and state anxiety are not identical. Individuals who are high in Neuroticism and generally anxious may nonetheless be non-anxious while taking tests because of their particular histories and characteristic adaptations. (Similarly, individuals scoring low in Neuroticism, who are not generally anxious, may nonetheless be anxious about taking tests for reasons related to their personal histories.) Neuroticism is not inevitably associated with test anxiety, but the substantial correlation between the two ($r \approx .5$; Ackerman & Heggestad, 1997) means that high levels of Neuroticism increase the probability of anxiety during tests, which presumably leads to the small negative correlation between Neuroticism and intelligence.

That the association of Neuroticism with intelligence is mediated by test anxiety (Moutafi, Furnham, & Tsaousis, 2006) raises the question of whether this association should be considered substantive. Is Neuroticism really associated with intelligence, or is it merely associated with performance on intelligence tests? One's answer to this question will depend on one's view regarding the distinction between maximal performance and typical behavior. If one limits intelligence to maximal performance, then presumably test performance is diagnostic of intelligence only to the extent that test anxiety has not impaired performance. If, however, one takes seriously the argument, presented above, that intelligence entails typical behavior as well as maximal performance, then the situation becomes more complicated. Intelligence involves solving problems, and problems are often a source of stress in daily life. Thus, given the likelihood that a neurotic person's mental

function will be impaired by anxiety precisely when intelligence would be most useful, perhaps the association between Neuroticism and intelligence should indeed be considered substantive. Additional evidence for the possibility of a substantive nature of this association comes from a longitudinal study that found a small negative correlation (r = -.18) of Neuroticism with change in IQ over 68 years (Gow et al., 2005), suggesting either that Neuroticism influences the development of intelligence or that it influences age-related declines in intelligence. Investigations of how Neuroticism and negative emotion influence the development and ongoing function of cognitive processes and brain systems involved in intelligence may usefully expand our understanding of the way intelligence is integrated with the rest of an individual's personality.

Another possibility to consider is that intelligence may influence the effects of Neuroticism, as suggested by studies of interactions between Neuroticism and intelligence in predicting various outcomes. One such study found that leadership performance was predicted by the interaction of Neuroticism and intelligence (Perkins & Corr, 2006). For individuals high in Neuroticism, intelligence was positively associated with performance, whereas for those low in Neuroticism, intelligence was unrelated to performance. Another study found a similar effect for the interaction of Neuroticism and intelligence, among military conscripts, in predicting performance, physical health, and adjustment to military life (Leikas, Mäkinen, Lönnqvist, & Verkasalo, 2009). Those high in Neuroticism showed poor performance, health, and adjustment only if they were low in intelligence. Intelligence, therefore, may act as a buffer for neurotic individuals, allowing them to cope with stressors despite heightened sensitivity to negative affect.

Agreeableness (versus Aggression)

Agreeableness reflects traits related to altruism (DeYoung & Gray, 2009; Nettle, 2006), contrasting empathy, politeness, and cooperation with callousness, rudeness, and aggression. Ackerman and Heggestad's (1997) meta-analysis, and the subsequent studies mentioned above, indicate that Agreeableness is not associated with intelligence. However, aggression is negatively associated with intelligence, on average, with correlations around -.20 (Ackerman & Heggestad, 1997; DeYoung et al., 2008; Huesmann, Eron, & Yarmel, 1987; Seguin, Boulerice, Harden, Tremblay, & Pihl, 1999), and aggression clearly marks the negative pole of Agreeableness (Markon et al., 2005). What might explain this paradox? One likely explanation is that measures of Agreeableness rarely include direct assessment of the tendency toward aggression, often assessing rudeness and callousness but stopping short of

outright aggression and other extreme antisocial behaviors. Aggression typically has a skewed distribution, with high levels being relatively rare in the general population. Low levels of aggression might indicate moderate but not necessarily high levels of Agreeableness. An association of intelligence with aggression, in the absence of any association with Agreeableness as typically measured, suggests the possibility that the association between Agreeableness and intelligence may be non-linear, remaining relatively flat until the lower range of Agreeableness. The possibility of non-linear relations between intelligence and other traits has rarely been investigated (but see Austin et al., 1997, 2002). One study failed to find any non-linear association between Agreeableness and intelligence (Austin et al., 2002), but this may reflect that their measure of Agreeableness did not cover the full range of the Agreeableness dimension.

As well as with aggression, intelligence is also negatively associated with the broader trait of externalizing behavior (DeYoung et al., 2008; Seguin et al., 1999), which includes antisocial behavior, impulsivity, and drug abuse, in addition to aggression (Krueger et al., 2002, 2007). Among the Big Five, Agreeableness and Conscientiousness show the strongest (negative) correlations with externalizing behavior (Miller & Lynam, 2001). Behavioral and molecular genetic studies indicate that the association between externalizing behavior and intelligence is genetically based (Koenen, Caspi, Moffitt, Rijsdijk, & Taylor, 2006) and moderated by variation in a gene that produces a receptor for the neurotransmitter dopamine (DeYoung et al., 2006). Such studies may begin to shed light on the question of the causal relation of intelligence and externalizing behavior. Past theories have highlighted the possibility that unintelligent people may experience more frustration, leading to aggression and other externalizing behavior, or that intelligent people may be better able to understand the consequences of their actions, disinclining them from such behavior (e.g., Lynam, Moffitt, & Stouthamer-Loeber, 1993). It is also possible that externalizing behavior and intelligence are both influenced by a shared biological substrate (DeYoung et al., 2006).

Aggression and antisocial behavior may not be the only components of Agreeableness that are associated with intelligence. When components of Agreeableness such as detecting the emotional states of others or facilitating harmonious social relations are measured by ability tests rather than questionnaires, they are correlated with intelligence (Mayer, Salovey, & Caruso, 2004; Mayer, Roberts, & Barsade, 2008; Roberts, Schulze, & MacCann, 2008). This finding has emerged primarily from work on emotional

intelligence, which has been defined as "the ability to engage in sophisticated information processing about one's own and others' emotions and the ability to use this information as a guide to thinking and behavior" (Mayer, Salovey, & Caruso, 2008, p. 503). Many questionnaires have been developed to assess emotional intelligence, but they reflect a diverse and rather incoherent collection of different conceptualizations of the construct (Mayer, Salovey, & Caruso, 2008; Roberts et al., 2008). Of more interest are ability tests that have been developed to assess emotional intelligence, most prominently the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT), which comprises a battery of subtests that involve tasks like identifying emotions in facial expressions or judging how best to manage others' emotions in social situations. Despite psychometric limitations (Barchard, 2003; Brody, 2004), the MSCEIT can be considered an encouraging example of the assessment of personality using ability tests rather than questionnaires. Scores on the MSCEIT are consistently associated with intelligence, with a correlation of about .3 (Mayer et al., 2004; Roberts et al., 2008). Like Openness/Intellect, the MSCEIT appears to be more strongly associated with verbal intelligence than with nonverbal intelligence (Mayer et al., 2004; Roberts et al., 2008).

Despite the fact that the MSCEIT is at least moderately related to intelligence, the term "emotional ability" is currently preferable to the term "emotional intelligence" for two reasons. First, use of the word "intelligence" implies that emotional intelligence is on par with constructs like verbal and nonverbal intelligence, in the hierarchy below *g*. This possibility appears remote, but cannot yet be ruled out; latent structural modeling, using extensive batteries of emotional ability tests in conjunction with standard intelligence tests would be necessary to test it properly. Second, in relation to the Big Five, the emotional abilities tested by the MSCEIT have their primary association with Agreeableness, whereas intelligence, both as tested and as perceived, has its primary association with Openness/Intellect.

Across a number of studies, scores on the MSCEIT have been found to be correlated with Agreeableness in the range of .20 to .30 (Mayer et al., 2008; Roberts et al., 2008). They are also correlated with Openness/Intellect, but more weakly, in the range of .10 to .20. Correlations with Extraversion, Neuroticism, and Conscientiousness are lower still (Mayer et al., 2004, 2008; Roberts et al., 2008). Thus, emotional ability shows roughly the same magnitude of relation to Agreeableness that intelligence shows to Openness/Intellect and self-reported intelligence. The ability to recognize and manage emotions effectively in social

situations can be considered an important component of Agreeableness (cf. Ode, Robinson, & Wilkowski, 2008), and one that appears to be positively associated with intelligence.

If the emotional abilities measured by the MSCEIT can be considered features of Agreeableness, how might one understand the contribution made to them by intelligence? Understanding emotions and their uses certainly constitutes a potential problem for the individual, but to what extent can this problem be solved by thinking? One study found that the combination of intelligence, Agreeableness, and gender predicted MSCEIT scores with a multiple correlation of .81 (corrected for unreliability), with each predictor contributing independently (Schulte, Ree, & Carretta, 2004). Emotional intelligence tests may simply measure the conjunction of two independent traits, the ability to empathize (a component of Agreeableness) and the ability to solve problems by thinking (intelligence), or it is possible that individual differences in empathy are substantively associated with intelligence (despite the fact that Agreeableness questionnaires are not). Many questions remain regarding the relation of Agreeableness and its various components to intelligence.

Conscientiousness (versus Impulsivity)

Conscientiousness contrasts traits like self-discipline, industriousness, and orderliness with carelessness, distractibility, and disorganization. It appears to reflect the ability and tendency to constrain immediate impulses and to exert effort, in order to pursue non-immediate goals or follow rules. The association of Conscientiousness with intelligence is as complicated and uncertain as that of Agreeableness. Ackerman and Heggestad's (1997) meta-analysis and the subsequent studies reviewed above suggest either no correlation or a weak negative correlation between Conscientiousness and intelligence. Chamorro-Premuzic and Furnham (2005a) have hypothesized that higher Conscientiousness in those with lower intelligence might be a compensatory mechanism. People who are unintelligent may be more orderly, in order to avoid complexity that they find difficult to manage because of their low intelligence. Similarly, they may tend to work extra hard, so as to accomplish tasks that could be performed more quickly or easily by someone more intelligent. Conscientiousness and intelligence are the two best trait predictors of academic and occupational performance, and they predict performance independently (Barchard, 2003; Higgins, Peterson, Pihl, & Lee, 2007; Mount, Barrick, & Strauss, 1999). Thus, increasing one might indeed compensate for a deficiency in the other.

However, although the idea of Conscientiousness as a compensation for low intelligence is plausible, a number of reasons exist to hypothesize that Conscientiousness

should be positively associated with intelligence instead. As noted above, externalizing behavior is negatively correlated with both intelligence and Conscientiousness, and impulsivity is an important component of externalizing behavior. Impulsivity marks the negative pole of Conscientiousness[4] (Markon et al., 2005) and has been found to correlate negatively with intelligence (Kuntsi, et al., 2004; Lynam et al., 1993; Vigil-Colet & Morales-Vives, 2005).

Conceptually, Conscientiousness is clearly linked to the tendency to forgo immediate rewards, in favor of longer-term goals. Normatively, people discount rewards that are delayed (Frederick, Loewenstein, & O'Donoghue, 2002), but the strength of this *delay discounting* shows considerable variability and has the characteristics of a stable personality trait (Kirby, 2009). Delay discounting is typically measured through a series of choices between smaller, more immediate rewards and larger, delayed rewards, with similar outcomes obtained whether these choices are hypothetical or actually result in reward (Shamosh & Gray, 2008). A large literature demonstrates that delay discounting is negatively associated with intelligence, with a meta-analysis of 24 studies indicating a correlation of -.23 (Shamosh & Gray, 2008). In one study, this association was partially mediated by working memory capacity and by neural activity in the same fronto-polar brain region discussed above in relation to Intellect (Shamosh et al., 2008). Delay discounting is positively correlated with questionnaire measures of impulsivity (Hinson, Jameson, & Whitney, 2003; Ostaszewski, 1996; Richards, Zhang, Mitchell, & de Wit, 1999; Swann, Bjork, Moeller, & Dougherty, 2002), but whether it is correlated with standard questionnaire measures of Conscientiousness is not yet clear.

Finally, in both childhood and adulthood, descriptions of intelligence and Intellect in questionnaires are related positively to descriptions of Conscientiousness (Costa & McCrae, 1992a; DeYoung et al., 2007). In adults, this association does not prevent Intellect descriptors from loading primarily on a broader Openness/Intellect factor. In preschool-age children, however, this association appears to be strong enough that traits reflecting Intellect may group with Conscientiousness in factor analysis, rather than with traits that reflect Openness (De Pauw, Mervielde, & Van Leeuwen, 2009; Shiner & DeYoung, in press).

A link between Intellect and Conscientiousness may reflect their related biological substrates in the PFC (Shamosh et al., 2008). The lateral PFC is responsible for carrying out plans and inhibiting impulsive responses (Bunge & Zelazo, 2006), functions associated with Conscientiousness, but it is also responsible for manipulating information in working

memory and forming abstract analogies, functions associated with Intellect and intelligence (DeYoung et al., 2005, 2009). These two classes of PFC function, one more stabilizing and the other more exploratory, may be in tension, though both have been described as "executive function." As the PFC is developing rapidly in young children, differences in overall state of development might cause Intellect and Conscientiousness to co-vary (Shiner & DeYoung, in press). After the PFC is more fully developed, however, the functional similarity of Intellect and Openness, as forms of exploratory cognition, may link Intellect more strongly with Openness than with Conscientiousness. At biological, behavioral, and psychometric levels of analysis, the relation of intelligence to Conscientiousness and related traits is a pressing topic for investigation in personality psychology.

Sociopolitical Orientation

Although culturally specific social and political attitudes are clearly characteristic adaptations rather than traits, a general tendency toward conservativism versus liberalism is a trait that might be found in any culture and that has been studied along with related traits like right-wing authoritarianism (Bouchard et al., 2003; Koenig & Bouchard, 2006). Sociopolitical orientation receives a separate section here because it cannot easily be categorized within any one of the Big Five. Conservativism and authoritarianism are associated negatively with Openness/Intellect but also positively with Conscientiousness (Carney, Jost, Gosling, & Potter, 2008; Hirsh, DeYoung, Xu, & Peterson, in press; Goldberg & Rosolack, 1994). Additionally, conservativism is associated negatively with the aspect of Agreeableness labeled *Compassion*, which includes empathy, but it is associated positively with the other aspect of Agreeableness, *Politeness* (Hirsh et al., in press). Sociopolitical orientation thus appears to reflect a complex blend of multiple basic traits, and this blend is consistent with the characterization of the core of conservativism as dislike of change and uncertainty, plus tolerance of inequality, and the core of liberalism as openness to change, plus egalitarianism (Jost et al., 2007).

In keeping with their negative association with Openness/Intellect, conservativism and authoritarianism are negatively associated with intelligence, with correlations in the range of -.20 to -.35 (Block & Block, 2006; Bouchard et al., 2003; Deary, Batty, & Gale, 2008; Koenig & Bouchard, 2006). In the NEO PI-R, the Values facet of Openness/Intellect assesses liberal versus conservative sociopolitical attitudes, and an alternative measure of this facet has been labeled "Liberalism" (Goldberg, 1999). The Values facet seems to behave most like the Ideas facet in its association with intelligence, often showing stronger correlations than

the four Openness facets (DeYoung et al., 2005, 2009; Chamorro-Premuzic et al., 2005). However, Values does not clearly mark either the Intellect or Openness aspect of Openness/Intellect, presumably because it represents a compound of Openness/Intellect with Conscientiousness (DeYoung et al., 2007). In the study of brain function discussed above (DeYoung et al., 2009), Values, like Ideas, was associated with intelligence and working memory, but it was not associated with neural activity, suggesting a less clear link between sociopolitical orientation and brain function than that which exists for Intellect (but see Amodio, Jost, Master, & Yee, 2007).

Liberalism is characterized by appreciation of diverse points of view and embrace of change, which may be facilitated by intelligence and working memory in part because change and consideration of diverse perspectives produce higher levels of complexity in one's ongoing experience. Such complexity may be difficult to manage for those of lesser intelligence (note the similarity of this argument to the one described above regarding the possible negative correlation between Conscientiousness and intelligence; Chamorro-Premuzic & Furnham, 2005a).

Conclusions and Future Directions

Intelligence can be viewed either as a construct that is categorically distinct from personality or as one construct within the larger domain of personality. Neither viewpoint is supported by incontrovertible evidence. However, I believe that psychology would benefit from the conceptual integration of intelligence and personality. The mandate of personality psychology is to understand the whole person as a coherent entity (McAdams & Pals, 2006), and this goal can be furthered by consideration of intelligence as a personality trait. In discussing the relation of intelligence to Openness/Intellect, Saucier (1994, p. 294) wrote, "Intelligence is prone to suck in, or perturb the orbit of, any construct that comes near it." This assertion evokes an image of personality traits as small planets orbiting a massive sun of intelligence. Framed grandiosely, one purpose of this chapter is to propose a Copernican revolution, whereby intelligence is now simply one trait among many, orbiting the central concept of personality. (As mentioned above, this proposal is not entirely novel, but similar proposals in the past have not been much heeded.) Our understanding of personality generally and intelligence specifically will be enriched by considering how the psychological functions and biological systems that underlie intelligence are related to and interact with those that underlie other personality traits.

The major conceptual barrier to integrating intelligence and personality is the old distinction between maximal performance and typical behavior. I suggested above that this dichotomy, although intuitively appealing, may ultimately fail, both because individual differences in intelligence entail individual differences in typical behavior and because many personality traits encompass abilities other than intelligence. Broad personality traits reflect pervasive regularities in human functioning, and such regularities are likely to reflect types of challenge that are common in everyday life (Nettle, 2006, Van Egeren, 2009). Any such challenge provides an opportunity, or even a demand, for the application of relevant ability, ensuring that ability will be intimately tied to typical behavior.

A full integration of intelligence with personality would require locating intelligence within hierarchical trait taxonomies, like the Big Five model. In the Big Five, descriptors of intelligence are located within the Intellect aspect of the broader domain of Openness/Intellect. As reviewed above, this location is reasonably consistent with the patterns of correlation of intelligence tests with trait questionnaires. Having located intelligence within Intellect one can address what is perhaps a more interesting question: Are there personality traits *other* than Intellect that are associated with intelligence, and if so, why? Utilizing the Big Five framework, this chapter reviewed what is known about these associations and highlighted a number of empirical questions that should be addressed in future research.

One set of questions to be addressed in the future surrounds the differential relations of intelligence tests to different subtraits within Openness/Intellect. Intellect, not surprisingly, appears to relate more strongly than Openness to general intelligence. But do verbal and nonverbal intelligence show different patterns of relation to Openness? Can this explain why Openness/Intellect, as a whole, is more strongly related to verbal than nonverbal intelligence? Given that individual differences in the intelligence hierarchy below *g* appear to group according to whether they involve verbal or nonverbal operations, rather than according to whether they are crystallized or fluid (Johnson & Bouchard, 2005a, 2005b), new causal theories regarding the causal and developmental links between Openness, imagination, intellectual engagement, and intelligence probably need to be developed. Clearly, innate versus experience-dependent aspects of intelligence are still of interest, but investigating them will be more challenging now that one cannot simply assume that verbal tests assess crystallized intelligence while nonverbal tests assess fluid intelligence. One promising approach to experience-dependent abilities is to investigate

domain-specific knowledge, while controlling for verbal and nonverbal intelligence (e.g., Ackerman, 2000).

Another set of questions involves the mystery of the relations of Agreeableness and Conscientiousness to intelligence. As typically measured in Big Five questionnaires, they show little or no association. However, some of their components and related measures do show significant associations with intelligence. Agreeableness reflects the mechanisms by which we are able to cooperate with others, and Conscientiousness reflects the mechanisms by which we are able to follow rules and work toward distant goals; understanding exactly how intelligence relates to these sophisticated psychological functions is of paramount importance for understanding personality as a coherent system.

A biological layer can be added to all of the questions raised in this chapter. In each case, we know relatively little about how the biological systems that underlie intelligence relate to the biological systems that underlie other personality traits. Pinpointing specific genetic and neurobiological mechanisms involved in the association of intelligence with other traits is an important project that has barely begun.

In pursuing research on intelligence and personality, one methodological advance should be adopted as often as possible, namely, the use of large samples and structural equation modeling to perform analyses of latent, rather than observed, variables. Failure to analyze latent variables ensures that most of the effect sizes reviewed above are likely to be underestimated. Almost none of them were based on latent modeling, and most were not corrected for unreliability. When error variance is removed, by modeling latent variables, the relations between questionnaire measures and ability tests may reach more impressive magnitudes (e.g., Deary et al., 2008; DeYoung et al., 2005, 2008). Another methodological advance would be to diversify the kinds of association that are investigated between intelligence and other traits. Very few studies have examined non-linear relations or interactions. Many factors may moderate the association of intelligence with other personality traits.

Research on intelligence and personality has hopefully reached a point of critical mass, at which we know a sufficient amount to locate intelligence within larger theories of personality but still know little enough that a great number of questions cry out to be researched. This chapter has raised some of those questions, but, perhaps more importantly, it has also attempted to provide a sound basis for integrative theory. Although the Big Five model began as a purely descriptive taxonomy, theories are being developed to

explain the sources and functions of the Big Five (DeYoung & Gray, 2009; Nettle, 2006; Van Egeren, 2009). Van Egeren (2009) has proposed a functional role for each of the Big Five that unifies them within the psychological system by which individuals pursue their goals. The function of Openness/Intellect he described as "perceiving dynamic possibilities of the environment" through imaginative exploration of its causal structure (Van Egeren, 2009, p. 101). With this in mind, one can understand intelligence—a "capability for comprehending our surroundings" (Gottfredson, 1997a, p. 13)—as one important mechanism for analysis of structure and perception of possibilities, one that is complemented by intellectual engagement and by the aesthetic interests and abilities encompassed by Openness.

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Footnotes

1. Johnson and Bouchard (2005a, 2005b) distinguished between "verbal" and "perceptual" abilities, but nonverbal memory and reasoning tasks were encompassed by the perceptual factor, and "nonverbal" seems a more adequately inclusive label. They also identified a small, third factor representing the ability to rotate images mentally.

2. Two large studies (N = 1507) were excluded from this calculation because they were collected in business and military recruiting and assessment contexts, which are likely to induce impression management strategies that reduce the validity of self-report questionnaires (Moutafi, Furnham, & Crump, 2003; Perkins & Corr, 2006). As one would expect, they found that Openness/Intellect was the only Big Five trait significantly positively associated with intelligence, but with attenuated correlations relative to most other studies (r = .15 and .12).

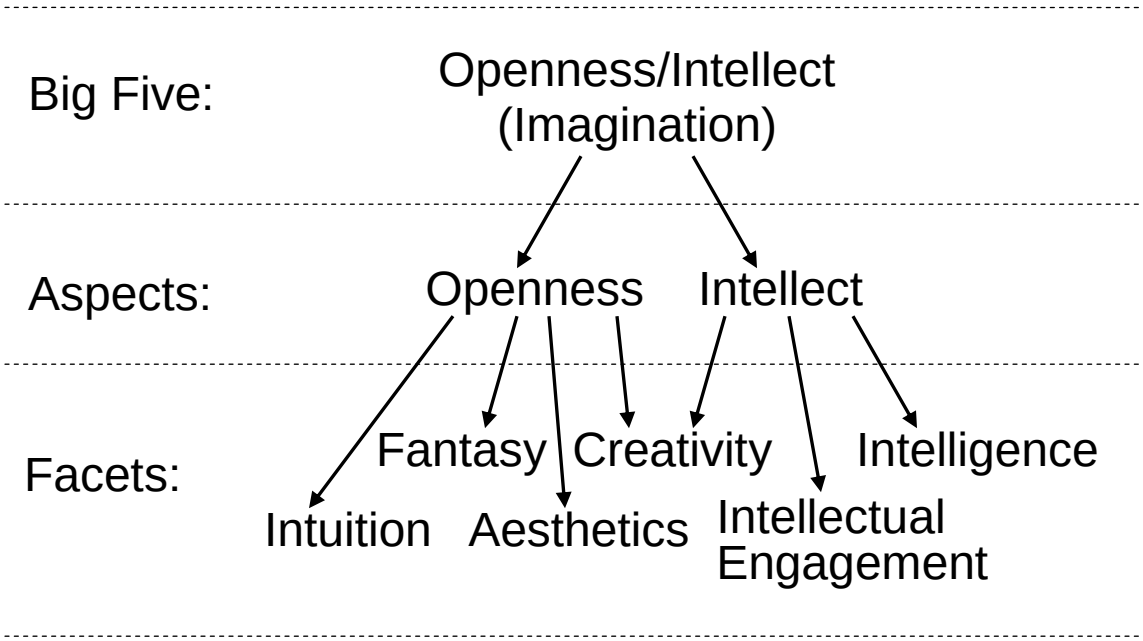
3. That the NEO PI-R contains only one Intellect facet and four Openness facets is an idiosyncracy of that instrument and does not constitute evidence that Intellect is not central to the larger Openness/Intellect domain. The facets of the NEO PI-R were derived rationally, rather than empirically, and its authors have often argued against Intellect as a valid interpretation of content in this domain (Costa & McCrae, 1992a; McCrae & Costa, 1997). As noted above, however, considerable evidence in both lexical and questionnaire research indicates that Intellect is just as central to the larger domain as Openness.

4. Some forms of impulsivity may be more strongly associated with Neuroticism or Extraversion than with Conscientiousness (Whiteside & Lynam, 2001), and impulsivity might best be conceived as a compound trait that reflects variation in multiple, more basic traits (Depue & Collins, 1999). However, low Conscientiousness is a key element of any such compound. Nonetheless, different forms of impulsivity may be differently associated with intelligence.

Figure Captions

Figure 1. Hierarchical structure of personality descriptions within the Openness/Intellect dimension of the Big Five ("Imagination" is an alternative label for this dimension; Saucier, 1992, 1994). Levels of the hierarchy are labeled at left. Note that the number and identity of facets remains speculative. However, item analysis suggests that both intelligence and intellectual engagement are subsumed by Intellect (DeYoung et al., 2007). Creativity receives arrows from both Openness and Intellect to suggest that it is likely to be jointly influenced by both traits.

Figure 1


Big Five:
Openness/Intellect
(Imagination)
Aspects:
Openness
Intellect
Facets:
Fantasy
Creativity
Intelligence
Intuition
Aesthetics
Intellectual
Engagement