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Intelligence–personality associations reconsidered: The importance of distinguishing between general and narrow dimensions of intelligence

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Abstract

The relationship between intelligence and personality has been of scientific interest for over 100 years. However, most contemporary estimates of these relationships are limited because they do not separate the variance due to general and narrow cognitive abilities. This study demonstrates that this methodological oversight can distort estimates of intelligence–personality associations by masking true effects and falsely showing others. To test this proposition, we examine correlations between several personality and ability scales, and then repeat the analyses using latent modeling techniques where variance due to general intelligence (*g*) and narrow mental abilities is appropriately separated. Our results show that estimates of specific intelligence–personality associations based on observed test scores can be both erroneously inflated or deflated.

Keywords: Intelligence–personality associations; Intelligence; Personality; Cognitive abilities

Although many notable differential psychologists have viewed personality and intelligence as inextricably linked individual characteristics (e.g., Cattell, 1957; Eysenck, 1967; Guilford, 1959), these two core domains are typically treated as independent entities. However, the last decade has been marked by increased efforts to study individual differences as constellations rather than independent domains; most noticeable is the growing interest in intelligence–personality associations (IPA). A number of recent empirical studies (e.g., Ashton, Lee, Vernon, & Jang, 2000; Bates & Shieles, 2003; Harris, 2004), a comprehensive meta-analysis (Ackerman & Heggestad, 1997), several books (e.g., Barratt, 1995; Collis & Messick, 2001; Saklofske & Zeidner, 1995), and a variety of theoretical models of IPA (e.g., Ackerman, 1996; Chamorro-Premuzic & Furnham, 2004; Matthews, 1999) have been published in the last decade.

However, it is our contention that the bulk of the extant research suffers from a methodological problem than can obscure the nature and magnitude of intelligence–personality associations. Specifically, instead of estimating the relations between personality facets and ability constructs (i.e., ability factors), most existing studies simply correlate personality scales with observed test scores (e.g., Bates & Shieles, 2003; Harris, 2004; but see Demetriou, Kyriakides, & Avraamidou,

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2003; Gignac, 2005; Gignac, Stough, & Loukotomis, 2004, for notable exceptions). Given the principle of the indifference of the indicator with respect to *g* (Jensen, 1998; Spearman, 1927), all measures of narrow cognitive abilities include variance due to *g*. Thus, results from studies that report personality–ability correlations based on observed scale scores, such as full-scale IQ, Performance IQ, and Verbal IQ composites (e.g., Harris, 2004) are ambiguous because those observed test scores reflect variance due to both *g* and other narrow abilities. A clear understanding of intelligence–personality associations requires the variance due to *g* to be separated from the variance due to narrow cognitive abilities.[1] As such, the purpose of this study is to test the proposition that estimates of intelligence–personality relations based on observed test scores, even those estimated via meta-analytic methods, can be distorted due to the multiple sources of variance underlying observed performance on ability tests. It should be noted that our goal is not to provide exact estimates of specific ability–personality relations per se, but rather to investigate the plausibility of our proposition.

1. Psychometric models of intelligence and personality

1.1. Intelligence

There is a general (though not unanimous) consensus among intelligence researchers that the construct space of mental abilities is best described as a factor hierarchy with numerous specific abilities and skills occupying the lower levels, a small number of narrow factors at an intermediate level, and a single general factor (i.e., *g*) at the top (Carroll, 1993; Jensen, 1998). Although many researchers have made significant contributions, Carroll's (1993) exhaustive re-analysis of data spanning more than 60 years stands as the definitive tome on this issue. From this endeavor, a three-stratum structure of cognitive abilities was identified in which general mental ability (*g*) subsumes 8 to 10 group factors (i.e., "narrow abilities") located in the second stratum, which in turn subsume a large number of very specific abilities. The similarities between Carroll's three-stratum model and other large-scale efforts, such as the Horn–Cattell *Gf–Gc* model (Horn & Noll, 1997), are readily apparent; especially in terms of the overlap in the narrow abilities included in both models. However, the Horn–Cattell model does not include the general factor, whereas Carroll's model does. McGrew's (1997) synthesized Carroll–Horn–Cattell model is arguably the best reflection of current theorizing regarding the psychometric structure of mental abilities. In addition to the broad *g* factor, McGrew's model includes the following narrow abilities: fluid intelligence (*Gf*), crystallized intelligence (*Gc*), quantitative reasoning (*Gq*), short-term memory (*Gsm*), visual intelligence/processing (*Gv*), auditory intelligence/processing (*Ga*), long-term associative storage and retrieval (*Glr*), cognitive processing speed (*Gs*), decision reaction-time (*Gt*), and reading and writing (*Grw*). The factors from this model that are assessed with the current data set are described in Table 1.

1.2. Personality

The emergence of the five-factor taxonomy of personality (Digman & Inouye, 1986; Goldberg, 1990; Tupes & Christal, 1961/1992), as well as similar models (e.g., Eysenck's three-factor model, Eysenk & Eysenk, 1985; Brand's "Comprehensive Six" model, Brand,

Table 1
Cognitive ability factors from the Carroll–Horn–Cattell model to be assessed in the current study

Stratum II factor name (code)	Description of abilities
Fluid intelligence/ reasoning (*Gf*; *g*)	Eduction of relations and correlates; ability to apply rules and premises to reach a solution; ability to discover underlying characteristics that govern problems (e.g., abstract reasoning, inductive reasoning). Note, *Gf* is indistinguishable from *g*
Quantitative reasoning (*Gq*)	Ability to reason, either inductively or deductively, with mathematical concepts, relations, and properties; general knowledge of mathematical concepts
Crystallized intelligence (*Gc*)	Range of general and domain-specific knowledge, reading comprehension
Visual–spatial perception (*Gvs*)	Ability to mentally manipulate objects or visual patterns such as mentally rotating multidimensional objects in space; ability to quickly discern a meaningful object from partially obscured or vague patterns and stimuli
Cognitive speededness (*Gs*)	Ability to rapidly make simple decisions or perform simple tasks; ability to compare visual symbols; ability to rapidly manipulate and deal with numbers in elementary ways

Note: Definitions were derived largely from Carroll (1993) and McGrew (1997). Factor codes (e.g., *Gs*) are those used by McGrew (1997).

[1] Numerous terms exist to refer to narrower, non-*g* cognitive abilities (e.g., group factors, specific abilities, narrow abilities). The term "narrow abilities" is used throughout this paper to refer to the group of non-*g* ability factors.

1994) has fueled a resurgence in interest in the relations between personality and other key human traits (e.g., abilities) as well as personality's impact on social adjustment and workplace behavior (Hough & Oswald, 2000). While there remains some disagreement concerning the *precise* nature of the best taxonomic structure of personality (cf. Block, 1995; Brand, 1994; Pervin, 1994), there does appear to be converging consensus concerning its basic structure.

Specifically, there appears to be general consensus that personality traits can be organized into a hierarchical structure consisting of a small number of broad factors (i.e., 3 to 6) below which reside a larger, but manageable, number of specific facets. Remaining controversies seem to revolve primarily around the appropriate breadth of the major factors (e.g., are there six factors at the highest level, or can these be further collapsed into 2 or 3 higher order factors?) and arguments concerning the exact specification of which lower-order facets fit within each of the three to six larger factors. Despite these remaining issues, most taxonomies of personality include the major factors (in some form) of Extraversion/Surgency, Neuroticism/Emotional Stability, Agreeableness, Conscientiousness, and Openness/Intellectance. Further, it has been noted that most of the recent research on intelligence–personality associations has adopted the Five-Factor model (Chamorro-Premuzic & Furnham, 2005), in particular the specific framework assessed by Costa and McCrae's (1992) NEO-PI-R, and is the dominant model in some applied areas of psychology (e.g., Industrial–Organizational Psychology). Thus, it is the model we use for this study.

2. Theoretical perspectives on intelligence–personality associations[2]

Theoretical conceptualizations of IPA can arguably be divided into three distinct perspectives (Barratt, 1995; Chamorro-Premuzic & Furnham, 2005). First, in what might be called the traditional perspective, complete independence is assumed due to "psychologically insignificant" zero-order correlations. Webb (1915) popularized this view by demonstrating that personality and intelligence load on separate factors and show very little overlap. It has been noted by a number of researchers (e.g., Eysenck, 1971; Furnham, Forde, & Cotter, 1998; Furnham, Moutafi, & Chamorro-Premuzic, 2005) that remnants of Webb's work continue to be seen today as some researchers begin with the assumption that personality and intelligence are independent domains. However, recent theorizing postulates that the lack of sizeable correlations may not provide sufficient evidence for *theoretical* independence. For instance, research into shared biological origins and the possibility that personality variables may serve as meaningful mediators and moderators have inspired many to investigate the possibility of *correlational* independence but *nomological* interdependence.

In this spirit, the second perspective still maintains that personality and intelligence are conceptually independent; however, it suggests that personality influences the *measurement* of intelligence. For example, Chamorro-Premuzic and Furnham (2004) posited that extraversion positively influences test performance through greater assertiveness and response speed, whereas neuroticism negatively influences test performance through anxiety and stress. Likewise, intraverts are predicted to perform better on verbal tasks, whereas extraverts perform better on performance tasks (e.g., Zeidner, 1995), suggesting that personality and the type of ability test interact to influence test performance. Similarly, several researchers from a variety of perspectives have suggested that the negative effects from various facets of neuroticism (e.g., anxiety, worry, anger) likely interfere with test performance (e.g., Leon & Revelle, 1985; see Chamorro-Premuzic & Furnham, 2005, pp. 49–54 for a summary). For example, Dobson (2000) showed that neuroticism scores were negatively associated with numerical ability test performance, but only when the test was completed under demanding circumstances (e.g., important outcomes based on performance). However, it should also be noted that this causal arrow may well go the other direction; that is, poor performance due to low ability may lead to lower self-efficacy, increased test anxiety, etc. (e.g., Chan, Schmitt, Jennings, Clause, & Delbridge, 1998; Muller, 1992).

The third perspective, more developmental in its focus, posits that personality traits influence how and where people apply their intellectual abilities, and intellectual abilities in turn "provide the cognitive background for the formation of interests, preferences, attitudes and orientations to different types of activities that differentiate between personalities" (Demetriou et al., 2003, p. 548). This perspective is perhaps best captured by Cattell's (1971) investment theory, and

[2] A large literature investigating intelligence–personality relations from one of these perspectives has emerged, with a substantial increase in activity over the last 10 years. However, as our purpose is methodological in nature, a comprehensive review of this literature is outside our scope. Readers seeking a more comprehensive review of this literature are encouraged to consider sources such as Collis and Messick (2001), Saklofske and Zeidner, (1995), or Chamorro-Premuzic and Furnham (2005).

more recently by Ackerman's (1996) "PPIK" (i.e., intelligence as process, personality, interest and knowledge) theory of adult intellect. Both of which posit that one's "raw" abilities, personality, and conative dispositions work in concert to form "trait complexes." This perspective not only suggests that intelligence and personality are correlated, but also the way in which they are correlated may have a substantive impact on knowledge acquisition (e.g., Reeve & Hakel, 2000), information processing (Matthews, 1999), environment selection (e.g., Austin & Hanisch, 1990; Reeve & Heggestad, 2004) and overall world view (Lubinski, 2004).

In addition to these "high-level" theories of IPA (exemplified by Cattell, 1971) which regard personality and intelligent behavior as a complex interaction of traits, attitudes, and environmental affordances, "low-level" approaches are concerned with features of the central nervous system responsible for observed differences in intelligence and personality (Brebner & Stough, 1995). For example, Eysenck's (1967) theory of arousal posits that intraverts are more responsive to, and more physiologically affected by, arousing stimuli than are extraverts due to differences in their baseline level of arousal. The implications of this perspective are highly similar to suggestions by Cattell and Lubinski that people tend to select and respond to environments differentially based on the correspondence to their profile of abilities and personality traits. Similarly, Robinson (1986) hypothesized that the reason intraverts perform better on verbal intellectual tasks and extraverts perform better on performance-based intellectual tasks is due to differences in the tonic level of thalamocortical activity. Thus, although similar to Eysenck's theory in its physiological basis, the implications of Robinson's suggestions are consistent with the second perspective on intelligence–personality associations; namely that personality influences the measurement of ability.

Importantly, it should be noted that some of these perspectives posit curvilinear relations in addition to linear relations (e.g., Austin, Deary, & Gibson, 1997; Eysenk & Eysenk, 1985; Robinson, 1989). Arguably, the most obvious example can be derived from the perspective that suggests personality influences the measurement of intelligence. Consistent with the famous Yerkes and Dodson (1908) proposition concerning arousal and performance, it has been suggested that the relation between ability test performance and neuroticism is curvilinear such that performance is lowest for individuals extremely high or extremely low in neuroticism (e.g., Robinson, 1989). For example, Austin et al. (1997) found a significant positive quadratic relationship between neuroticism and intelligence, contradicting the past arguments by showing that higher test performance generally occurs for those with either high or low levels of neuroticism. Similarly, the neuroticism-differentiation hypothesis suggests that cognitive abilities are less differentiated at increased levels of neuroticism, and conversely more differentiated at decreased levels of neuroticism (Eysenck & White, 1964; see also Austin et al., 1997). In other words, *g* should account for more of the total observed variance in a battery of ability tests at high levels of neuroticism than it should at low levels.

3. The importance of separating variance due to general and narrow abilities

Studies of ability–personality associations often rely on the observed subscales of a test (as defined at the discretion of test constructors) as a construct-valid surrogate for narrow ability constructs (e.g., Ashton et al., 2000; Bates & Shieles, 2003). This can cause substantial confusion because, as Lubinski (2004) notes, "indicators based on homogenous content often carry large components of more than one construct. Because of this, when measures of specific abilities are used in isolation in psychological research and generate significant results, inferences about the operative constructs are typically equivocal" (p. 99). Thus, by ignoring the fact that most test sub-scales confound sources of variance due to multiple specific and general abilities, these studies have necessarily failed to obtain reliable and construct-valid assessments of narrow abilities. Because narrow ability factor estimates retain the variance due to *g*, the correlations with other variables reflect both the variance due to *g* as well as the unique variance due to the narrow factor. A clear understanding of the unique relations between any variable and narrow abilities (as well as *g*) requires the contribution of *g* to be removed (Gustafsson, 2002; Gustafsson & Balke, 1993; Reeve, 2004). To their credit, Ackerman and Heggestad (1997) carefully sorted the ability scales in their seminal meta-analysis into meaningful groups based largely on Carroll's (1993) extensive analyses, but this does not remove the variance due to *g* from the correlations between personality scales and observed test scores.

Evidence that the methodological concern we raise has merit can be drawn from recent research indicating that the failure to appropriately differentiate specific *criterion* dimensions can occlude validities for predictors (e.g., Reeve, 2004; Zazanis, Carpenter, & Kilcullen, 2001). Zazanis et al. showed that when observed variance in a specific criterion measure is due to both general and narrow criterion constructs, failing to properly separate the components of criterion variance makes it impossible to accurately assess the relative contribution of each predictor. Likewise, Reeve (2004) demonstrated that predictive validities for narrow abilities could be obscured by the failure to separate variance due to general and narrow criterion factors. Although these studies were concerned with general and narrow variance in criterion factors, the methodological implications are certainly relevant.

Recent evidence from studies investigating the association between intelligence and openness to experience also supports our central premise. It has been suggested that openness correlates more strongly with estimates of *Gc* than it does with *Gf* or *g*. For example, Ashton et al. (2000) predicted and found that openness was more strongly correlated with measures of crystallized than fluid intelligence (measured through the verbal and performance scales of the Multidimensional Ability Battery, respectively). Similarly, Bates and Shieles (2003) found that openness correlated more strongly with measures of crystallized than fluid intelligence (assessed with the vocabulary and comprehension test of the Multidimensional Ability Battery and the Raven's Advanced Progressive Matrices, respectively). Others have also reported associations between openness and various measures of general and/or narrow abilities (e.g., Austin et al., 2002; Chamorro-Premuzic, Moutafi, & Furnham, 2005; Harris, 2004; Moutafi, Furham, & Crump, 2003). However, these studies do not appropriately model cognitive abilities as explained above. Gignac (2005) and Gignac et al. (2004) have also recognized this problem and have attempted to address it by removing the variance due to *g* from his measures of crystallized intelligence. To this end, Gignac et al. used a residualized regression-based approach (Gignac et al., 2004) as well as a nested modeling approach (Gignac, 2005) to assess the variance due uniquely to the narrow factor of crystallized intelligence. In doing so, they found a pattern *opposite* of that typically reported; namely that openness to experience was more strongly correlated with *g* than it was with *Gc*.

Taken as a whole, we believe there is sufficient reason to reconsider existing conclusions regarding the nature and magnitude of intelligence–personality relations. As noted by Schmidt and Hunter (1999), the goal of research is to accurately calibrate scientific quantities and evaluate scientific theories regarding the true relation among various constructs. To do this, researchers must use methods that can distill the many sources of variance underlying observed scores and correct for distortion of measurement error variance.

In the current study, we provide a test of whether and to what degree linear and curvilinear intelligence–personality correlations based on observed ability scores can be obscured due to the multiple sources of variance underlying ability test performance. To do so, we conduct two sets of analyses on the same data set containing multiple ability scales. First, we conduct a traditional correlation analysis using observed ability scores. That is, we sorted the ability scales into categories using the same sorting criteria as Ackerman and Heggestad (1997), and computed the average correlation with each of the personality scales. We then repeated these analyses using latent modeling techniques in which we distill the variance due to the underlying ability factors themselves and correlate these ability estimates with the personality scales. Again, our primary interest is in the differences between the sets of results rather than the precise magnitude of the correlations produced by either analysis.[3]

4. Method

4.1. Sample

We acquired the "primary" sample of senior high school students (the primary sample excludes cases indicated as having learning or reading disabilities) from the Project TALENT (PT) data bank. PT was an intensive, longitudinal study designed to provide a global inventory of the skills, abilities, and aptitudes of a representative sampling of 5% of all U.S. high school students in 1960 (see Tiedeman, 1972, for details). To protect the integrity of the extracted covariance matrix, participants with omitted personality or ability test scores were deleted resulting in a total operational sample of $N=71{,}887$. Just over half the sample was female (52.2%). The average age was 17.23 years.

4.2. Measures

Sophisticated sampling and careful instrument development ensure reliable and valid data (see Tiedeman, 1972 for details), making the PT battery well suited for

[3] The reason we are hesitant to claim our SEM-based results should be taken as optimal estimates of the precise magnitude of relations between abilities and personality is that the personality scales used are sub-optimal with respect to current personality theory and assessment. Likewise, we readily admit that the ability battery does not provide a comprehensive assessment of the domain of abilities. However, because both sets of our analyses are conducted on the same data, the comparison of the two can be quite informative with respect to the methodological question that is the focus of this paper.

Table 2
Descriptive statistics and intercorrelations for Project TALENT ability and personality scales

Indicators	*M*	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
(1) Abstract reas.	9.47	2.95	0.66																					
(2) Quantitative reas.	9.29	3.60	0.53	0.77																				
(3) Math problems	11.40	5.35	0.51	0.68	na																			
(4) Reading comp.	33.59	9.95	0.58	0.62	0.58	0.86[a]																		
(5) Literary know.	14.26	4.67	0.44	0.52	0.56	0.70	0.77																	
(6) Soc. sci. know.	15.94	4.95	0.46	0.59	0.60	0.68	0.71	0.83																
(7) Bio. sci. know.	6.28	2.33	0.38	0.47	0.48	0.53	0.55	0.59	0.57															
(8) Mech. reas.	11.05	4.47	0.51	0.50	0.50	0.45	0.35	0.46	0.49	0.78														
(9) 2D visual.	13.19	5.79	0.41	0.34	0.34	0.32	0.23	0.28	0.27	0.51	0.81[a]													
(10) 3D visual.	9.10	3.35	0.54	0.46	0.45	0.44	0.33	0.39	0.38	0.61	0.50	0.72												
(11) Object insp.	24.18	7.22	0.23	0.08	0.09	0.15	0.10	0.07	0.06	0.18	0.29	0.24	na											
(12) Table read.	14.41	8.62	0.10	0.05	0.07	0.07	0.04	0.03	−0.01	0.08	0.19	0.09	0.45	na										
(13) Clerical check.	39.92	14.27	0.07	0.00	0.04	0.06	0.04	−0.01	−0.05	−0.02	0.16	0.03	0.44	0.50	na									
(14) Culture (O)	5.62	2.37	0.05	0.03	0.05	0.11	0.14	0.04	0.01	−0.13	−0.03	−0.03	0.08	0.05	0.13	na								
(15) Tidiness (C)	6.10	2.83	0.02	0.00	0.01	0.04	0.02	−0.03	−0.06	−0.12	−0.01	−0.04	0.09	0.08	0.13	0.56	na							
(16) Maturity (C)	12.30	5.27	0.11	0.17	0.20	0.17	0.16	0.14	0.11	0.04	0.06	0.08	0.08	0.09	0.14	0.54	0.57	na						
(17) Impulsiv. (E)	2.05	1.70	0.00	0.03	0.02	0.07	0.10	0.07	0.06	0.04	0.03	0.02	0.06	0.05	0.08	0.13	0.02	0.12	na					
(18) Sociability (E)	6.97	2.92	−0.01	−0.03	−0.03	−0.01	−0.02	−0.06	−0.08	−0.08	−0.01	−0.07	0.08	0.09	0.13	0.38	0.34	0.34	0.20	na				
(19) Vigor (E)	3.81	2.16	0.06	0.07	0.10	0.09	0.08	0.09	0.08	0.08	0.08	0.04	0.09	0.08	0.11	0.37	0.34	0.48	0.22	0.47	na			
(20) Leadership (E)	1.42	1.44	0.05	0.08	0.13	0.08	0.10	0.09	0.07	0.03	0.04	0.03	0.08	0.07	0.13	0.39	0.28	0.47	0.21	0.34	0.41	na		
(21) Social sens. (A)	5.12	2.34	0.06	0.05	0.05	0.14	0.13	0.04	0.02	−0.09	−0.03	−0.03	0.07	0.04	0.11	0.59	0.47	0.52	0.16	0.47	0.36	0.37	na	
(22) Calmness (ES)	4.81	2.56	0.10	0.12	0.14	0.14	0.13	0.12	0.10	0.07	0.07	0.07	0.08	0.07	0.10	0.48	0.47	0.56	0.08	0.37	0.39	0.36	0.53	na
(23) Self-conf. (ES)	5.47	2.58	0.09	0.12	0.14	0.14	0.13	0.12	0.11	0.09	0.08	0.07	0.08	0.07	0.10	0.28	0.23	0.39	0.11	0.36	0.32	0.34	0.26	0.42

Note: Values shown are based on male and female data combined. Reliability estimates, shown on diagonal, obtained from Flanagan et al. (1964). Estimates are based on Kuder–Richardson Formula 21 (Gulliksen, 1950, p. 125) unless otherwise indicated. All values are lower-bound estimates. The Big 5 factor to which each personality facet is linked is shown in parentheses; O = openness to experience; C = conscientiousness; E = extraversion; A = agreeableness; ES = emotional stability.

[a] Estimate based on split-half reliability.

this study, as well as others in the past (e.g., Austin & Hanisch, 1990; Reeve & Hakel, 2000). Descriptive statistics and intercorrelations for the ability and personality scales are shown in Table 2 (for space considerations, descriptive statistics shown are based on the full sample; tables with the data separated by gender are available from the first author).

4.3. Cognitive abilities

Thirteen scales from the PT battery of cognitive aptitude measures were used for the current study. Scales were selected based on prior analyses (e.g., Carroll, 1993) and our own evaluation of their content (the first author has a specimen set of the actual materials used during the 1960 assessment) which showed them to be highly similar to and consistent with more modern scales commonly used to assess abilities. As item-level data for most tests are not available, reliability estimates are those reported by Flanagan et al. (1964). Following Gustafsson and Balke's (1993) suggestion, ability data were fit to a nested-factor measurement model, in which the general and narrow factors are directly estimated as orthogonalized, rather than using higher-order models. Analyses were conducted using AMOS (Arbuckle & Wothke, 1996) with maximum-likelihood estimation.

For both types of analyses, we needed to sort the scales into the appropriate ability classifications. That is, for the traditional analysis, we needed to group the scales in a fashion similar to Ackerman and Heggestad (1997). For the latent variable analysis, an a priori measurement model needed to be formulated. To do this, the PT test descriptions and example items for each aptitude scale were evaluated for content and matched to the appropriate narrow factor based on classifications reported by Carroll (1993) and that used by Ackerman and Heggestad. By using the same classification for both analyses, comparisons between the two sets of results can be made directly. The resultant classifications and measurement model are shown in Fig. 1. The only primary difference between the categories created for the traditional analysis and the latent variable analysis is that the abstract reasoning test was the only test placed in the "general intelligence" category

Fig. 1. Cognitive ability measurement model fit to the Project TALENT ability scales.

for the traditional analysis, whereas all tests load on the *g*-factor in the structural equation modeling (SEM) measurement model (by definition).

The measurement model was first fit to the data from each gender separately. Results suggested the model fit well for both males ($\chi^2=9146.55$, $df=53$, $p<0.01$; NFI = 0.99; TLI = 0.99; CFI = 0.99; RMSEA = 0.07) and females ($\chi^2=8366.90$, $df=53$, $p<0.01$; NFI = 0.99; TLI = 0.99; CFI = 0.99; RMSEA = 0.06). Thus, we refit the model using simultaneous multi-group confirmatory factor analysis (SMCFA) procedures and constrained the model in accordance with the assumptions of metric invariance. The SMCFA results show that the hypothesized nested model fit the data well confirming the assumption of metric (and thus configural) invariance across gender groups ($\chi^2=18{,}714.58$, $df=123$, $p<0.01$; NFI = 0.99; TLI = 0.99; CFI = 0.99; RMSEA = 0.05). The standardized factor solution from the SMCFA is shown in Table 3.

4.3.2. Personality scales

Following Schneider, Hough, and Dunnette's (1996) suggestion that constructs of interest should be matched in terms of their specificity, it is most appropriate to assess personality at the facet level when assessing relations with narrow cognitive abilities. Ten personality scales were available from the PT data bank. However, as they were created in 1960, they were not constructed

Table 3
Standardized factor solution for the cognitive ability model

Indicators	*g*	*Gq*	*Gc*	*Gvs*	*Gs*
Abstract reasoning	0.75				
Quantitative reasoning	0.77	0.46			
Math problems	0.73	0.31			
Reading comp.	0.80		0.31		
Biological science knowledge	0.59		0.31		
Social science knowledge	0.69		0.49		
Literature knowledge	0.66		0.57		
3D visualization	0.60			0.50	
2D visualization	0.44			0.47	
Mechanical reasoning	0.67			0.42	
Object inspection	0.19			0.29	0.60
Clerical checking	0.07				0.73
Table reading	0.09				0.69

Note: *g* = general mental ability; *Gq* = quantitative reasoning; *Gc* = crystallized intelligence; *Gvs* = visual–spatial perception; *Gs* = cognitive speededness. Solution shown is from the multi-group analysis specifying metric invariance.

Table 4
Results of subject matter experts content-based matching of PT scales to NEO-PI-R scales

PT scale	Example PT items	NEO-PI-R scale	% Agree
Culture	I enjoy beautiful things I think culture is more important than wealth	Artistic interest (O)	100
Tidiness	I am never sloppy in my personal appearance My work suffers from lack of neatness (r)	Orderliness (C)	100
Maturity	It bothers me to leave a task half done I do things the best I know how, even if no one checks up on me	Achievement Striving (C)	66
Leadership	I am influential I like to make decisions	Assertiveness (E)	100
Impulsiveness	It takes me quite a while to come to a decision (r) I usually act on the first plan that comes to mind	Cautiousness* (C)	100
Vigor	I am full of pep and energy I am energetic	Activity level (E)	100
Sociability	I like to spend a good deal of time by myself (r) I'd rather be with a group of friends than at home by myself	Gregariousness (E)	100
Social sensitivity	I seem to know how other people will feel about things I sympathize with my friends and encourage them when they have problems	Sympathy (A)	100
Self-confidence	People seem to think I am easily discouraged when criticized (r) I am often self-conscious (r)	Self-consciousness* (ES)	66
Calmness	I often lose my temper (r) I can usually keep my wits about me even in difficult situations	Anger* (ES)	100

Note: Corresponding Big 5 factor in parentheses. % Agreement based on agreement among 3 raters. *Indicates the NEO scale and label is reversed relative to the PT scale (i.e., they are scored to reflect the opposite poles of the same trait).

in accordance with any commonly accepted model. Therefore, to link them to a contemporary model, we conducted two types of analyses. First, the three authors independently analyzed each scale's item content and compared it to the item content of the NEO-PI-R facets. Raters were instructed to only count it as a match if the bulk of the PT scale's content clearly matched the bulk of the NEO scale. For 8 of the 10 scales, there was complete agreement regarding which NEO facet the PT scale matched. For the two scales where there was two-thirds agreement; however, the dissenting rater listed the same NEO facet (as the other two raters) as the second most similar scale. Consensus was reached after further discussion. The results of this analysis are shown in Table 4, along with the corresponding Big Five factor associated with the NEO-PI facet.

Second, we conducted our own pilot study using the original PT items along with the IPIP short form (Goldberg, 1999). Both sets of scales were administered to a sample of 219 college students. Descriptive statistics and scale intercorrelations from this pilot study are shown in Table 5. The internal consistency estimates for all PT scales are either close to or exceed the reliability level that is traditionally considered adequate (i.e., greater than 0.70). Next, we submitted the 10 PT scales and the 5 IPIP scales to an exploratory factor analysis. Five eigenvalues greater than 1.0 were produced, accounting for 67.04% of the reliable variance. Examination of the rotated factor solution (χ^2=126.33, df=40; χ^2/df=3.16) revealed a relatively clean pattern of factor loadings consistent with the five-factor framework. The solution was consistent with our content analysis with one exception (see Table 6). Whereas the content analysis had linked impulsiveness to conscientiousness (reverse scored) which is consistent with Costa and McCrae (1992), the empirical results show it to be related to Extraversion which is consistent with Eysenck (1967). Taken as a whole, we believe these two analyses

Table 6
Results of factor analysis of PT and IPIP personality scales based on pilot study data

	A	E	ES	C	O
Agreeableness	0.90				
Social sensitivity	0.81				
Extraversion		0.93			
Sociability	0.38	0.69			
Leadership		0.51			0.41
Impulsiveness		0.42			
Vigor		0.43			
Self-confidence		0.60	0.60		
Emotional stability			0.93		
Calmness			0.69		
Conscientiousness				0.98	
Tidiness				0.79	
Maturity	0.35			0.63	
Openness					0.71
Culture	0.44				0.51

Note: Only salient factor loadings (i.e., $\lambda \geq 0.35$) shown. IPIP scales shown in boldface. A=agreeableness; E=Extraversion; ES=emotional stability; C=conscientiousness; O=openness.

Table 5
Descriptive statistics and intercorrelations from the personality assessment pilot study

Scales	*M*	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IPIP scales																	
(1) Agreeableness	4.15	0.56	0.84														
(2) Conscientiousness	3.45	0.60	0.23	0.80													
(3) Extraversion	3.53	0.75	0.34	−0.01	0.89												
(4) Emot. stability	3.13	0.71	0.11	0.07	0.25	0.87											
(5) Openness	3.72	0.56	0.26	0.14	0.16	0.18	0.79										
PT scales																	
(6) Sociability	3.80	0.57	0.50	0.06	0.69	0.24	0.06	0.83									
(7) Social Sensitivity	4.06	0.51	0.79	0.25	0.16	0.11	0.33	0.28	0.79								
(8) Impulsiveness	3.05	0.53	−0.01	−0.27	0.36	0.13	0.13	0.20	−0.10	0.69							
(9) Vigor	3.65	0.65	0.41	0.27	0.45	0.27	0.27	0.46	0.35	0.12	0.76						
(10) Calmness	3.76	0.59	0.29	0.28	0.07	0.64	0.33	0.19	0.39	−0.17	0.26	0.81					
(11) Tidiness	3.39	0.70	0.18	0.79	0.00	−0.04	0.07	0.09	0.21	−0.22	0.23	0.22	0.85				
(12) Culture	3.76	0.47	0.51	0.29	0.20	0.09	0.51	0.18	0.55	−0.02	0.39	0.30	0.30	0.69			
(13) Leadership	3.26	0.66	0.23	0.15	0.50	0.26	0.38	0.39	0.23	0.34	0.44	0.24	0.15	0.28	0.65		
(14) Self-confidence	3.29	0.55	0.12	0.06	0.60	0.69	0.26	0.38	0.08	0.30	0.35	0.42	−0.03	0.21	0.45	0.79	
(15) Maturity	3.84	0.49	0.49	0.70	0.17	0.24	0.37	0.22	0.49	−0.11	0.51	0.41	0.47	0.40	0.36	0.29	0.90

Note: N=219. Correlations larger than |0.17| are significant at the 0.01 level. Internal consistency estimates shown on diagonal.

Table 7
Comparison of linear correlations based on observed and latent ability measures: male data

Personality	Average correlations based on observed test scores					SEM-based correlations				
	General intelligence	Math-numerical	Crystallized intelligence	Visual perception	Cognitive speed	*g*	*Gq*	*Gc*	*Gvs*	*Gs*
Culture (O)	0.04	0.07	0.08	0.00	0.10	0.06	0.01	0.12	−0.07	**0.16**
Maturity (C)	0.11	**0.19**	0.14	0.09	0.11	**0.18**	0.12	0.03	−0.04	0.14
Tidiness (C)	0.05	0.07	0.04	0.02	0.11	0.08	0.01	0.00	−0.08	**0.17**
Sociability (E)	0.00	0.01	0.00	−0.02	0.11	0.01	0.00	−0.01	−0.08	**0.18**
Impulsiveness (E)	−0.04	0.00	0.05	0.01	0.08	−0.04	0.07	**0.16**	0.08	0.12
Vigor (E)	0.07	0.10	0.10	0.05	0.10	0.11	0.01	0.05	−0.07	**0.16**
Leadership (E)	0.06	0.14	0.12	0.02	0.11	0.11	0.10	0.09	−0.09	**0.19**
Social Sensitivity (A)	0.08	0.11	0.14	0.03	0.07	0.14	−0.01	0.10	−0.10	0.11
Calmness (ES)	0.12	**0.19**	**0.17**	0.12	0.10	**0.20**	0.08	0.08	0.02	0.12
Self-confidence (ES)	0.10	**0.16**	**0.16**	0.10	0.10	**0.17**	0.05	0.10	−0.01	0.12

Note: Due to extreme sample size, all correlations larger than |0.01| are statistically significant. Correlations are corrected for unreliability in the personality scales. Correlations equal to or larger than |0.15| shown in boldface. *The Big 5 factor to which each PT facet is linked is shown in parentheses.

provide sufficient construct validity evidence to make the focal analysis viable.

5. Results[4]

The primary analyses consist of (a) computing average correlations between each personality scale and the set of observed ability scales in each group (i.e., one could think of this as a miniature meta-analysis), and (b) computing correlations between the personality scales and the latent ability factors. Because of known mean gender differences in both abilities (Halpern, 1992; Jensen, 1998) and personality (Lippa, 1998), we investigated these relations for males and females separately. Otherwise, systematic mean differences could severely bias observed correlations.

Linear correlations (corrected for unreliability of the personality scales) were computed with both the observed ability scales and the latent ability factors. The results of these two analyses are shown in Table 7 (for males) and Table 8 (for females). Note, due to the extreme sample size, all correlations larger than |0.01| are statistically significant; however, this does not suggest they are meaningful. Thus, to help with visual inspection of the tables and interpretation, we chose a value of |0.15| in magnitude as a critical value for interpreting a correlation as psychologically meaningful. While this value is admittedly arbitrary, it seemed a reasonable lower limit based on past intelligence–personality association research (e.g., this value is consistent with the lowest value indicated as significant in the results reported by Austin et al., 2002); these correlations are shown in boldface font.

As expected, none of the correlations based on either type of analysis are large in magnitude, which is consistent with previous research and theory on IPA. However, of particular relevance to the current study is the observation of several discrepancies between the two types of analyses. The results show that the traditional method, which uses observed test scores as a proxy for the targeted ability, both over- and under-estimates correlations. For example, the traditional analysis based on observed ability scales suggests that both "quantitative ability" and "crystallized intelligence" are meaningfully related to emotional stability, and are more highly related to it than is general intelligence. However, when the variance due to *g* is removed from these observed scores (and a more appropriate estimate of *g* is gained in the process) the results show the opposite to be the case. That is, neither the actual factor of quantitative ability nor crystallized intelligence is meaningfully related to emotional stability, but *g* does show meaningful relations with both facets of emotional stability that were assessed. This pattern is more apparent for the male sample, but can be seen in both genders. Similarly, the correlation between quantitative ability and culture (i.e., artistic interest) appears to have been over-estimated by the traditional analysis, at least for females.

To provide a quantitative test of our central premise, we counted the number of correlations that increased or decreased substantially when going from the traditional analysis to the latent construct analysis. Given the large sample size, small changes (e.g., |0.02|) were statistically significant but arguably not psychologically meaningful. Thus, to be more conservative we selected a higher difference value of |0.05|. This value seemed

[4] To be precise in the reporting of our analyses, we rely on the PT labels in this section. However, to aid readers who are unfamiliar with the PT scales we will report both the NEO and the PT labels.

Table 8
Comparison of linear correlations based on observed and latent ability measures: female data

Personality	Average correlations based on observed test scores					SEM-based correlations				
	General intelligence	Math-numerical	Crystallized intelligence	Visual perception	Cognitive speed	*g*	*Gq*	*Gc*	*Gvs*	*Gs*
Culture (O)	0.12	**0.17**	**0.19**	0.07	0.10	**0.18**	0.06	**0.18**	−0.06	0.13
Maturity (C)	0.14	**0.23**	**0.19**	0.11	0.11	**0.22**	**0.20**	0.08	−0.06	**0.15**
Tidiness (C)	0.02	0.02	0.00	−0.01	0.09	0.03	0.01	−0.04	−0.09	**0.15**
Sociability (E)	−0.01	−0.03	−0.05	−0.03	0.10	−0.02	−0.02	−0.08	−0.08	**0.16**
Impulsiveness (E)	0.04	0.07	0.13	0.07	0.07	0.07	0.01	**0.22**	0.08	0.08
Vigor (E)	0.08	0.08	0.08	0.08	0.11	0.10	0.01	0.03	0.03	0.14
Leadership (E)	0.06	0.12	0.11	0.05	0.11	0.10	0.14	0.09	−0.01	**0.16**
Social sensitivity (A)	0.09	0.10	0.14	0.05	0.08	**0.15**	−0.02	0.09	−0.10	0.11
Calmness (ES)	0.10	0.14	0.13	0.09	0.09	**0.16**	0.08	0.06	−0.01	0.11
Self-confidence (ES)	0.09	0.14	0.12	0.09	0.09	**0.15**	0.08	0.07	0.00	0.12

Note: Due to extreme sample size, all correlations larger than |0.01| are statistically significant. Correlations are corrected for unreliability in the personality scales. Correlations equal to or larger than |0.15| shown in boldface. The Big 5 factor to which each PT facet is linked is shown in parentheses.

reasonably large relative to the magnitude of the typical relations reported between abilities and personality traits (e.g., Ackerman & Heggestad, 1997). Using this criterion, half of the relations (5 of 10) increased substantively when going from observed scores of "general intelligence" to an estimate of the *g* factor for both males and females. When switching from observed math-numerical test scores to a *g*-free estimate of quantitative ability (*Gq*) 8 of the 10 relations changed for males with 7 of these being decreases; and 6 of 10 changed (all decreases) for females. For crystallized intelligence, half of the correlations changed for males (4 of which were decreases) when going to a *g*-free estimate of crystallized intelligence (*Gc*), and 8 of 10 changed for females (7 of which were decreases). For visual-perception, all 10 correlations changed substantively for males (nine of which were decreases) when going to a *g*-free estimate of visual–spatial ability (*Gvs*), and 9 of 10 decreased for females. For cognitive speed, half of the 10 relations increased substantive for males when going to a *g*-free estimate of cognitive speededness (*Gs*), and 3 of 10 increased substantively for females (however, note that all 10 increased to some degree). In total, 35 of the 50 estimated relations changed substantively for males, and 31 of 50 changed substantively for females. These results support our central premise.

In terms of the nature of the changes, the traditional analyses consistently under-estimated associations of personality with *g* and cognitive speededness. Whereas the traditional analysis suggests none of the correlations with general ability or cognitive speededness exceeds our cut-value of |0.15|, the latent variable analysis reveals that approximately half of the correlations do in fact exceed 0.15 for both *g* and *Gs*. Moreover, with the exception of relations with Impulsiveness, our analysis shows that anywhere from half to nine-tenths of the correlations between personality traits and the other three narrow abilities were substantively over-estimated.

To examine curvilinear relationships, we used the method outlined by Rosenthal and Rosnow (1991) in which one variable (in this case, the personality scores) is converted to "extremeness" scores (i.e., $|X - \text{Mean}_x|$). Positive curvilinear correlations indicate a U-shaped relationship whereas negative correlations reflect an inverted-U relationship. These correlations were not corrected for unreliability as the reliability of the extremeness score is unknown (though, if the literature on difference scores is any guidance, the reliabilities should be lower than the raw score, see Edwards, 1995). In neither the male nor female sample did any of the curvilinear correlation reach |0.15| (these results are not shown in the interest of page space; tables of the correlations are available from the first author). Taken as a whole, these results suggest there is little to be gained by considering the impact of the methodological limitation on the examination of nonlinear relations. Whether this is suggestive of the lack of nonlinear relations between ability and personality constructs, or simply a function of the specific personality scales used in the current study, cannot be determined.

Although our primary focus is on the results just reported, it is worth noting the nature of some of the specific relations observed. We chose to interpret the results based on the latent variable analysis given our belief that these are more appropriate. First, the results suggest that *g* is positively related to the achievement-striving component of conscientiousness (reflected by the PT Maturity scale), and emotional stability, and perhaps the social sensitivity facet of agreeableness. Among females, *g* is also positively related to the artistic interest facet of openness (reflected by the PT Culture scale). In contrast, there appears to be essentially no relation between *g* and the sociability and impulsiveness facets of extraversion or the tidiness facet of conscientiousness.

There are few meaningful relations between personality and the narrow ability factors of *Gvs* and *Gq*. In fact, the only meaningful relation seen is between *Gq* and the achievement-striving component of conscientiousness (PT Maturity) among females. One potential explanation is that this finding could be a function of the time-period in which this data was collected (e.g., perhaps only females with very strong achievement-striving personalities were able to break social barriers necessary for the development of their mathematical aptitudes). *Gc* (crystallized intelligence) appears to be related to impulsiveness and the artistic interest facet of openness (reflected by the PT Culture scale). This is also where we see the other salient gender difference. The Artistic Interest facet of Openness appears to be equally related to *g* and *Gc* among females, but is essentially unrelated to *g* among males. A post-hoc *t*-test does show that the males in our sample score substantially lower on this personality scale than do females, but there was still adequate variance (i.e., this pattern of results does not appear to be due to restricted variance in the male sample). Finally, across both genders, cognitive speededness (*Gs*) is most related to the conscientiousness facet of tidiness, and the extraversion facets of sociability and leadership. Interestingly, it is also the only ability factor to be positively related to all personality scales at a level of at least 0.10 (except for the Extraversion Impulsiveness scale among the female sample).

6. Discussion

Psychological researchers are ultimately interested in understanding the relationships among theoretical constructs, but have traditionally relied on inferring those relationships from simple bivariate associations between observed measures. Consistent with our general proposition, the current study reveals that the relations between intelligence and personality may be misestimated (either over-estimated or under-estimated) by correlations based on observed ability scores. For example, results based on the traditional analyses showed that both quantitative ability and crystallized intelligence were meaningfully related to emotional stability, and that general intelligence was not. However, when the variance due to *g* was removed from these factors, and a more appropriate estimate of *g* was gained from the factor analysis, the results show the opposite to be the case. That is, neither the variance due uniquely to quantitative ability nor crystallized intelligence was meaningfully related to emotional stability, but the variance due to *g* does show meaningful relations with both of the assessed facets of emotional stability.

Our results show that the traditional analytic method relying on observed ability test scores systematically under-estimated the magnitude of the personality relations with *g* and *Gs*, and tended to over-estimate those with the other narrow abilities we examined. Admittedly, in many cases neither analysis suggested the existence of large correlations; however, about half of the correlations increased substantively (i.e., at least 0.05) for *g* and *Gs*, whereas they shrank substantively (i.e., −0.05) for *Gq*, *Gc*, and *Gvs*. Again, we are not suggesting that our data necessarily provide the best estimates of the actual magnitudes of intelligence–personality relations; rather it is the consistent pattern of discrepancies between the two sets of results that is of interest.

We acknowledge that it is possible to find specific occurrences of similarities between our results and those of Ackerman and Heggestad (1997). For example, Ackerman and Heggestad report a meta-analytic correlation of −0.15 between neuroticism and general intelligence. This is similar to our correlations between the *g*-factor and the two facets of emotional stability which average about 0.17 across genders. While at first one might be tempted to interpret this as evidence against our contention that analyses that examine IPA when the variance due to general and narrow cognitive abilities has not been accurately separated are inadequate, we would caution that (a) many other specific comparisons would reveal highly discrepant findings, and (b) the most useful comparison is to our analyses using the traditional method. With respect to the latter point, one would have to make a host of untenable assumptions concerning the equivalency of the psychometric properties of our facet measures of emotional stability to the psychometric properties of the set of measures constituting Ackerman and Heggestad's emotional stability category to make a direct comparison. On the other hand, given that both of our analyses used the exact same data, the equivalency of the correlations can be interpreted directly. Thus, it is the lack of consistency across our two analyses which supports our general contention concerning the methodological limitation of existing estimates of intelligence–personality relations.

Although not the central purpose of our research, inspection of the specific relations between abilities and personality scales would suggest that individual differences in *g* tend to be positively associated with personality traits such as the achievement-striving component of conscientiousness (assessed by the PT Maturity scale), the self-consciousness and (lack of) Anger facets of emotional stability (PT Self-Confidence and Calmness), and the sympathy facet of agreeableness (PT Social Sensitivity). Although admittedly small, they are theoretically meaningful when thought about in terms of trait complexes (Ackerman, 1996) and are consistent with other recent research showing that *g* is positively associated with what are generally considered positive personality traits and negatively associated with what would be generally considered negative or maladaptive traits (e.g., Austin et al., 2002). Results such as these may shed further light on why *g* is such a ubiquitous predictor. That is, in many social, academic, and occupational settings, being smart, achievement oriented, and emotionally stable is arguably an ideal combination for obtaining positive outcomes. Thought about from a trait complex perspective, it is likely that predictive validities based on ability measures with a strong *g*-saturation reflect some of the variance due to this general trait complex. An alternative possibility is that these associations reflect a cascade effect. That is, being high in *g* may afford a person the personal resources (e.g., meta-cognitive resources) necessary to develop and display these socially adaptive traits. Presumably other viable hypotheses could be made as well; however, sorting out the exact reason these traits are associated is obviously beyond the scope of the current paper. In addition, despite several hypotheses and some suggestive evidence in the literature (e.g., Austin et al., 1997; Brand, Egan, & Deary, 1994; Eysenck & White, 1964), no evidence for curvilinear relationships was found.

It is important to note that, although our results may have somewhat negative implications for conclusions based on some prior research, we believe they also have theoretical implications that complement prior work on trait associations. For example, we believe our findings are important with respect to emerging models of the development of adult intellect (e.g., Ackerman, 1996) and trait complexes (e.g., Ackerman & Heggestad, 1997). By clarifying the nature of trait complexes and integrating such findings into the study of personal and social adjustment, the source for such associations are likely to be better understood. In addition, our demonstration that the failure to appropriately distill the variance due to underlying ability factors can potentially both hide and falsely identify intelligence–personality relations may help explain the variety of discrepant and inconsistent findings in this literature. Finally, we want to stress that our intention is not to be critical of the Ackerman and Heggestad meta-analysis. Quite to the contrary, we believe it is a valuable resource that competently summarizes the state of the literature at the time it was published. However, it necessarily suffers from a methodological limitation inherent in all meta-analyses: its results are only as strong as the methodology of the primary studies on which it was based. Our purpose is merely to demonstrate the potential deleterious effects of a common methodological limitation in the extant literature, and to stress the need for future research to accurately model the variance due to various cognitive abilities.

Although this study demonstrates the importance of considering a key methodological limitation in the existing literature, it too has important limitations of its own. For example, the PT measures of personality are neither psychometrically optimal nor comprehensive. While this clearly implies that the absolute magnitudes of the relations reported here need to be interpreted with caution, it is unlikely that such considerations produced the *pattern of differences* in results across the two primary analyses. Additionally, it is worth noting that the reliability estimates of some of the criteria used in the current study are similar to the estimated reliability of performance ratings commonly used as criteria in the organizational sciences (Viswesvaran, Ones, & Schmidt, 1996). Likewise, the ability battery used certainly did not assess the entire domain of abilities. Although it is not necessarily required that one assess the entire domain of abilities to gain an accurate estimate of just a few abilities, this may be of concern to the extent that our estimate of *g* does not reflect the real *g*-factor. However, whether this is a legitimate concern may be questionable given (a) the breadth of types of ability measures used, (b) their similarity to scales used in contemporary ability batteries, and (c) the evidence showing that the *g* factor is remarkably invariant across different test batteries (Johnson & Bouchard, 2005; Ree & Earles, 1991; Thorndike, 1987) and the method of factor extraction (Jensen, 1998; Jensen & Weng, 1994).

Despite these limitations, we believe the current study is important because it exemplifies the need for additional research that uses appropriate analytical methods to estimate relations with general and narrow ability constructs. Thus, we concur with others who have recently called for additional research to better understand the nature of trait complexes (e.g., Ackerman & Heggestad, 1997; Chamorro-Premuzic & Furnham, 2004; Lubinski, 2004). We add to this by calling for more appropriate assessment of the ability constructs so as to more accurately uncover intelligence–personality associations.

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