Personality and Intelligence: Gender, the Big Five, Self-Estimated and Psychometric Intelligence

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This paper reports on two studies that investigated the relationship between the Big Five personality traits, self-estimates of intelligence (SEI), and scores on two psychometrically validated intelligence tests. In study 1 a total of 100 participants completed the NEO-PI-R, the Wonderlic Personnel Test and the Baddeley Reasoning Test, and estimated their own intelligence on a normal distribution curve. Multiple regression showed that psychometric intelligence was predicted by Conscientiousness and SEI, while SEI was predicted by gender, Neuroticism (notably anxiety) and Agreeableness (notably modesty). Personality was a better predictor of SEI than of psychometric intelligence itself. Study 2 attempted to explore the relationship between SEI and psychometric intelligence. A total of 130 participants completed the NEO-PI-R, the Baddeley Reasoning Test, and the S & M Spatial intelligence test. In addition, SEI and participants conceptions of intelligence were also examined. In combination with gender and previous IQ test experience, these variables were found to predict about 11% of the variance in SEI. SEI was the only significant predictor of psychometrically measured intelligence. Inconsistencies between results of the two studies, theoretical and applied implications, and limitations of this work are discussed.

Introduction

In the history of research into personality and intelligence most researchers have treated the two constructs as relatively independent although it is known there are modest correlations between test scores (Barratt, 1995; Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000). Despite the tradition of differentiating between personality and intelligence, many researchers attempted to show how they are conceptually and empirically related (Zeidner, 1995; Furnham, Forde, & Cotter, 1998a, b; Chamorro-Premuzic & Furnham, 2004). These attempts have come from two different approaches. The first is the psychometric approach, which focuses predominantly on the measurement and structure of personality and intelligence, and seeks to identify correlations between these phenomena. The second is the cognitive science approach, which looks at biological, cognitive and adaptive processes which contribute to both constructs (Zeidner & Matthews, 2000). This paper is in the tradition of the psychometric approach. We use the term psychometric intelligence to mean scores obtained from validated cognitive ability/intelligence tests.

One difficulty underlying the psychometric approach is that there are several competing theories for the structure of intelligence and (to a lesser extent) personality. Most theories of intelligence, notably Cattell's (1971), are based on hierarchical models, which originated from Spearman (1927), who proposed that intelligence consists of a general (g) factor and a set of specific (s) factors. Based on Spearman, Cattell (1943) distinguished between fluid (gf) and crystallized (gc) intelligence. gf is dependent on the efficient functioning of the central nervous system, while gc is dependent on experience and education within a culture. Other current predominant theories that differentiate between types of intelligence include Sternberg' (1991)

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triarchic theory of intelligence and Gardner's (1999) theory of multiple intelligence.

In the area of personality structure, current researchers (De-Raad, 1996; Digman, 1990; Furnham, 1996, 1997; Busato, Prins, Elshout, & Hamaker, 2000) have agreed on the psychometric advantages of the Big Five Model proposed by McCrae and Costa (1987). Most of the recent literature which deals with the main personality correlates of psychometric intelligence has focused on the relationship between intelligence test scores and the Big Five personality traits (Brand, 1994), although there is an earlier literature looking at other personality traits.

Most studies report low and non-significant correlations between personality traits and psychometric intelligence test scores (Moutafi, Furnham, & Crump, 2003). However, recent research has suggested that personality traits may have more important distal, rather than primal, role effects. Further, there is increasing evidence that personality and intelligence are good predictors for academic performance (Chamorro-Premuzic & Furnham, 2003a, b; 2004; Chamorro-Premuzic, Furnham, & Moutafi, 2004; Furnham, Chamorro-Premuzic, & McDougall, 2003). Thus Furnham (2001a) suggested that personality variables influence test-taking style, which in turn influences intelligence test scores and which therefore may not reflect true latent scores.

This study will focus on another possible intervening variable namely self-estimated intelligence (SEI), currently a topic of considerable research, specifically with respect to a widely replicated pattern for females to give lower self-estimates than males (Furnham, 2001b; Furnham, Shahidi, & Baluch, 2002). Various studies have shown modest but significant (around $r = .30$) correlations between self-estimated and test-measured intelligence (Paulhus, Lysy, & Yik, 1998). More recent research, however, suggests correlations can exceed $r = .40$ (Furnham & Chamorro-Premuzic, 2004; Chamorro-Premuzic, Furnham, & Moutafi, 2004). It is possible that personality influences these self-estimates, which in turn are related to psychometric intelligence. Recent studies have in fact shown this to be the case (Furnham, Kidwai, & Thomas, 2001; Furnham & Thomas, 2004).

Furnham and Thomas (2004) examined parents' personalities with regard to SEI. Openness to experience, Agreeableness and Neuroticism significantly predicted SEI (over and above demographics), and the Big Five in total accounted for 17% of the variance in SEI. Similarly, Furnham, Kidwai, and Thomas (2001) examined the relationship between personality, SEI and psychometric intelligence using the Gordon Personality Profile, and measures of verbal, numerical, and spatial intelligence. SEI correlated significantly with numerical intelligence ($r = .42$) in males, and with verbal ($r = .40$) and spatial intelligence ($r = .55$) in females. Although personality dimensions did not predict psychometric intelligence, they were significantly related to SEI (notably Extraversion, positively). Personality accounted for 17% of the variance in SEI scores, and it was concluded that personality factors may be more powerful predictors of SEI than of psychometric intelligence. This paper extends that research but using more robust and well known measures of both personality and intelligence on a bigger sample in two related studies.

To some extent self-estimates may be self-fulfilling by influencing expectations and the effort put in the test itself. In these studies we shall examine both the direct effects of personality on intelligence scores, but also the effect of personality (and gender) on self-estimates and then the effects of the latter on test scores.

Theoretically it is possible to develop a link between each of the Big Five traits and measures of intelligence (Furnham, Forde, & Cotter, 1998a).

Neuroticism

In a large meta-analytical study, Ackerman and Heggestad (1997) reported a significant, albeit modest, correlation between intelligence and Neuroticism ($r = -.15$). According to Hembree (1988); Matthews (1986), and Zeidner (1995), at least three Neuroticism facets—i.e., anxiety, angry, hostility, and depression—are related to psychometric intelligence. Anxiety has been found to impair intellectual functioning in a variety of contexts, ranging from intelligence tests to school achievement. Results of Ackerman and Heggestad's (1997) study reported a correlation of $r = -.33$ between g and self-report measures of test anxiety. Research on the effects of anger also revealed that there is a general tendency for low intelligence to be associated with increased aggression and delinquency (Zeidner, 1995). Previous research would suggest that neuroticism would also be associated with lower self-estimated intelligence (Furnham & Thomas, 2004).

Extraversion

In a study of adolescents, Lynn, Hampson, and Magee (1984) found correlations between psychometric intelligence and Extraversion of $r = .21$ for males and $r = .19$ for females. In their meta-analysis, Ackerman and Heggestad (1997) found a smaller, although still significant correlation between g and Extraversion ($r = .08$). Zeidner (1995) proposed that introverts have an advantage in tasks related to superior associative learning ability (verbal tasks), whereas extraverts have an advantage in tasks related to ready acquisition of automatic motor sequences (performance tasks). Revelle, Amaral, and Turriff (1976) noted an interaction between Extraversion and test conditions, which could be explained by the arousal theory (Eysenck & Eysenck, 1985). Extraverts consequently trade accuracy for speed when taking an ability test, thus having slightly different results to introverts, depending on the demands of the test: specifically whether it is timed and how long it takes. Extraverts would seem to have an advantage when

tests are short (2–5 min) and timed. Further, previous research would suggest that the self-confidence associated with Extraversion would mean Extraversion would be positively associated with self-estimated intelligence (Furnham & Thomas, 2004; Furnham, Kidwai, & Thomas, 2001).

Openness to experience

The personality factor which is considered to correlate most strongly with psychometric intelligence is openness to experience (Zeidner & Matthews, 2000). However, researchers have noticed that openness to experience specifically correlates with gc (Brand, 1994). Goff and Ackerman (1992) reported a correlation of $r = .40$ between openness to experience and gc. A possible explanation for this is that individuals who are open to experience are more motivated to engage in intellectual activities. Additional psychometric evidence for this explanation can be found in the high association between gc and typical intellectual engagement, a construct suggested by Ackerman and Goff (1994). When compared with personality measures, typical intellectual engagement showed a significant correlation with openness to experience ($r = .65$), as well as with Conscientiousness ($r = .27$) (Ackerman & Goff, 1994). Studies of authoritarianism-in some sense the opposite of openness to experience—also provide evidence of a link between openness to experience and intelligence. Authoritarianism has been found to be negatively correlated to both openness to experience ($r = -.57$; Trapnell, 1994) and intelligence (up to $r = -.50$; Zeidner & Matthews, 2000). Furnham and Thomas (2004) found openness the strong Big 5 predictor of self-estimated intelligence, which requires replication.

Agreeableness

Among the Big Five personality traits, Agreeableness seems to be the least related to ability. In their meta-analysis, Ackerman and Heggestad (1997) reported a near zero correlation coefficient between g and Agreeableness ($r = .01$). In another meta-analytic study, Kyllonen (1997) also reported very modest correlations between ability measures and Agreeableness. This pattern of results confirms Agreeableness' theoretical independence from g, since none of its primary factor scales, i.e., trust, straightforwardness, altruism, compliance, modesty, tender-mindedness, appear to be theoretically related to mental ability. However, it should be noted that the modesty scale could be linked to intelligence indirectly, through SEI. Indeed Furnham and Thomas (2004) found Agreeableness negatively correlated with self-estimated intelligence.

Conscientiousness

Like Agreeableness, Conscientiousness seems to be only weakly related to ability (Ackerman & Heggestad, 1997; Kyllonen, 1997; Zeidner & Matthews, 2000). However, Conscientiousness more than any other personality trait has been consistently related to performance, both work and academic (Barrick & Mount, 1993; McHenry, Hough, Toquman, Hanson, & Ashworth, 1990; De Raad, 1996; De Raad & Schouwenburg, 1996; Blickle, 1996; Geisler-Brenstein & Schmeck, 1996; Goff & Ackerman, 1992; Rothstein, Paunonen, Rush, & King, 1994; Wiggins, Blackburn, & Hackman, 1969). Studies on the correlation between Conscientiousness and self-estimated intelligence have shown few significant results (Furnham & Thomas, 2004). Moutafi, Furnham, and Paltiel (2004) however found consistent evidence of a negative correlation between psychometric intelligence and Conscientiousness. They argued from their results that this was because of fluid intelligence affecting the development of Conscientiousness in an educated and high need-achieving population such as the one used in these studies.

Although the above-mentioned studies provide psychometric evidence for the relationship between personality and intelligence, and personality and self-estimated intelligence, these relationships are rather modest and, in some cases, contradictory. As Mayer, Caruso, Zigler, and Dreyden (1989) observed, personality traits are, at best, modestly related to intellect and intellectual achievement.

One recent paper looked at the possibility of self-estimated intelligence being a mediating variable between personality and psychometric intelligence (Furnham & Chamorro-Premuzic, 2004). However none was found, although the idea that there are mediating (or moderating) variables is explored in these studies. It focuses specifically on whether gender is a mediating variable between personality and self-estimated intelligence.

Study 1

The aim of this study is to investigate the relationship between personality, gender, SEI, and psychometric intelligence. The NEO-PI-R will be examined with regard to SEI and scores on two short psychometric intelligence tests, i.e., the Wonderlic Personnel Test (a measure of general intelligence) and the Baddeley Reasoning Test (a measure of fluid intelligence). Self-evaluation (SEV) of performance *after* taking the Wonderlic Personnel Test will be also examined as a direct indicator of participants' insight into their intellectual abilities.[1] It is expected to replicate the results of previous researchers (e.g., Ackerman & Heggestad, 1997; Lynn, Hampson, & Magee, 1984; Zeidner, 1995; Furnham, Fong, & Martin, 1999) by finding significant correlations between intelligence test scores and the Big Five personality factors, notably Neuroticism, Extraversion, and openness to experience. Further, SEI/SEV and intelligence test scores are also expected to correlate significantly (around $r = .30$), suggesting that people have

some insight into their intellectual abilities (Chamorro-Premuzic, Furnham, & Moutafi, 2004).

In addition, significant correlations between SEI/SEV and personality factors are also predicted (Furnham, Kidwai, & Thomas, 2001). Furthermore, these correlations are expected to be higher than those between personality and psychometric intelligence, and personality is expected to be a significant predictor of SEI/SEV. Consistently with nearly all the previous literature (around 20 studies) regarding gender differences in SEI (e.g., Furnham & Rawles, 1995; Furnham, Fong, & Martin, 1999), it is also hypothesized that gender will be significantly correlated with SEI, i.e., males giving higher SEI than females. Likewise, it is also expected to find similar significant gender differences in SEV. Finally, it is hypothesized that gender will not be significantly related to actual intelligence test scores. Although some researchers support the idea that males outperform females on mathematical and spatial intelligence tests, whereas females outperform males on verbal intelligence tests (Maccoby & Jacklin, 1980), there is a general consensus that there are no significant gender differences in g (Loehlin, 2000).

Results from the previous studies seem fairly consistent with gender: gender is consistently related to SEI; but not related to psychometric general intelligence; one trait (Neuroticism) shows a gender difference (females score higher than males). It is possible that gender is a mediating variable between trait neuroticism and self-estimated intelligence and this possibility will be explored.

Method

Participants

Participants were 100 (63 of whom were females) undergraduate students at University College London. Their ages ranged from 17 to 45, with an arithmetic mean of 19.81 (SD = 3.71) years. Out of the 100 participants, 80 were native and 20 non-native (but fluent) English speakers. There were no significant native language differences in any of the measures.

Tests

The Wonderlic Personnel Test (Wonderlic, 1992). This 50-item test can be administered in 12 minutes and measures general intelligence. Scores can range from 0 to 50. Items include word and number comparisons, disarranged sentences, serial analysis of geometric figures and story problems that require mathematical and logical solutions. The test has impressive norms and correlates very highly ($r = .92$) with the WAIS-R. Norms based on 118,549 Americans note that the mode and the median are 21 with a SD = 7.12. Previous studies using this test on British University students indicate that whereas they tend to score about one standard deviation above the mean there is a wide and normal distribution of scores (Furnham & Chamorro-Premuzic, 2004a, b).

The Baddeley Reasoning Test (Baddeley, 1968). This 60-item test can be administered in 3 minutes and measures gf through logical reasoning. Scores can range from 0 to 60. Each item is presented in the form of a grammatical transformation that has to be answered with "true"/"false", e.g.: "A precedes B–AB" (true), or "A does not follow B–BA" (false). The test has been employed previously in several studies (e.g., Furnham, Gunter, & Peterson, 1994; Hammerton, 1969) to obtain a quick and reliable indicator of people's intellectual ability. Scores for populations such as this tend to have a mode of around 26–28 points.

The NEO Personality Inventory-Revised (NEO-PI-R; Costa & McCrae, 1992). This 240-item, non-timed questionnaire, measures 30 primary personality traits and its underlying "Big Five" personality factors, i.e., Neuroticism, Extraversion, openness to experience, Agreeableness, and Conscientiousness. Items involve questions about typical behaviors or reactions which are answered on a five-point Likert scale, ranging from "strongly disagree" to "strongly agree". The manual shows impressive indices of reliability and validity.

Procedure

Participants were tested simultaneously in a large lecture theatre in the presence of five examiners who ensured the tests were appropriately completed. Participants were first requested to report their SEI. In order to standardize SEI, the normal distribution of intelligence scores (the possible range was 0–155), including labels for "retardation", "low average", "average", "high average" and "gifted", was presented to the participants. The bell curve showed standard deviation scores each with the appropriate label. After that, they completed the Wonderlic Personnel Test (WPT), which had a time limit of 12 min. Once the WPT was completed, they were requested to report their SEV on that test (like for SEI, the possible range for SEV was 0–155). Participants then completed the NEO-PI-R, for which there was no time limit. A week later, they were gathered in the same lecture theatre to complete the Baddeley reasoning test (BRT) under similar test conditions. Completion of the BRT took 3 min and was supervised by four examiners.

The testing was part of an undergraduate laboratory study about psychometric testing. Participants were told to be as accurate and honest as possible and that they would receive full feedback on their tests. They were also asked to do their best on the intelligence tests, called Cognitive Ability Tests. There is every reason to suspect that both participants were motivated to do well in the ability tests and that they were honest in their answers in the personality test.

Results

Correlations

Correlations between the Big Five, WPT and BRT scores are presented in Table 1. As it can be observed, the only significant correlation between personality and psychometric intelligence was between Conscientiousness and BRT scores, (i.e., high conscientious participants tended to have lower BRT scores). There was also a modest correlation between Extraversion and BRT scores, but this correlation did not reach significance levels. Big Five traits were not significantly correlated with WPT scores. The highest Big Five correlates of WPT scores were Neuroticism and openness to experience.

Table 1 also presents means and standard deviations for each variable. These are comparable with other studies using university participants (Furnham & Chamorro-Premuzic, 2004) while ability test scores are above population means by about one standard deviation both were relatively normally distributed.

There was a high correlation between SEI and SEV showing that participants who gave higher SEI tended to evaluate their performance on the WPT higher. WPT scores correlated significantly with SEI and with SEV. BRT scores correlated significantly with SEV, but not with SEI. Gender was significantly correlated with both SEI, and SEV (males tended to give higher SEI and SEV than females). Neuroticism correlated significantly with SEI, and SEV, (participants high on Neuroticism tended to give lower SEI and SEV), whereas Agreeableness correlated significantly with SEI, (highly agreeable participants tend to give lower SEI).

Multiple Regressions

In order to investigate more thoroughly the relationship between intelligence tests, personality traits, SEI, and gender, a number of multiple regressions were performed on the following dependant variables:

a) WPT: Model 1 showed that SEI accounted for 7% of the variance in WPT scores. Model 2, which also included the Big Five personality traits as independent variables, and Model 3, in which gender was added as a predictor, did not significantly predict WPT scores. SEI remained the only significant predictor in Models 2.

(b) BRT: Model 1 showed that SEI accounted for only 2% of the variance in BRT scores. Despite the small value, however, the model approached significance levels. Model 2, which also included the Big Five traits as independent variables, was not significant. However, Conscientiousness on its own was found to be a significant predictor of BRT scores. Model 3 added gender as an independent variable but was not a significant predictor of BRT scores. Conscientiousness was again the only significant predictor in the model.

(c) SEI: Model 1 showed that the Big Five personality traits significantly predicted SEI, accounting for 7% of the variance in SEI. Two out of five personality traits, i.e., Neuroticism and Agreeableness, were significant predictors of SEI. In order to investigate this further, the facets of Neuroticism and Agreeableness were entered, with gender, into two different additional multiple regressions that used SEI as a dependent variable. Neuroticism facets and gender accounted for 18% of the variance in SEI. However, only anxiety and gender were significant predictors of SEI. In another regression, Agreeableness facets and gender were found to predict 22% of the variance in SEI. Among Agreeableness facets, modesty was the most powerful predictor of SEI. In Model 2 gender and the Big Five accounted for nearly 17% of the variance in SEI. Gender was the most powerful (and only significant) variable in the model, accounting for nearly 10% of the variance in SEI.

Table 1. Correlations between gender, personality, SEI, psychometric intelligence, and SEV

	X	SD	SEI	BRT	WPT	SEV
Gender			.42**	.03	.11	.37**
Personality (NEO-PI-R)						
Neuroticism	102.82	21.77	−.24*	−.08	−.12	−.25*
Extraversion	116.76	20.29	.06	.14	.09	.06
Openness to experience	130.78	17.40	.12	.09	.11	.19
Agreeableness	112.95	18.80	−.23*	−.05	.02	−.17
Conscientiousness	105.84	18.18	−.03	−.21*	.01	−.06
SEI	109.60	12.49	–	.19	.27**	.77**
Psychometric Intelligence						
BRT	30.09	11.42	.19	–	.53**	.25*
WPT	27.79	5.46	.27**	.53**	–	.51**

**$p < .01$, *$p < .05$, N, 100. SEI, self-estimates of intelligence; BRT, Baddeley reasoning test; NEO-PI-R, NEO personality inventory-revised; WPT, wonderlic personnel test.

(d) SEV: In Model 1, the Big Five significantly accounted for 7% of the variance in SEV. Neuroticism was the most powerful predictor in the model, followed by openness to experience, which approached significance levels. In Model 2, gender was added as a predictor and accounted for an additional 7% of the variance in SEV. Gender was also the most powerful (and only significant) predictor in the model.

These results are presented in Table 2. It can be observed that the Adjusted R^2 for the WPT decrease in the second and in the third regression models. Detailed exploration of the data showed that this is because the variables added as predictors (the Big 5 and gender) do not make any significant contribution to the accountable variation of the WPT scores, and not because any of the variables act as suppressors.

It is interesting to note from Table 2 that when gender is added to personality in the regressions concerning SEI and SEV neuroticism ceases to become significant. This may mean as others have noted that neuroticism may be acting as a surrogate for gender.

Moderator/Mediator Variable

Following the distinguition of moderator/mediator variable and the method of calculating these as set out in Baron and Kenny (1986) various analyses were run to determine if either SEI or gender mediated between personality and intelligence.

As noted by Baron and Kenny (1986), mediational models are three-variable models that require statistically significant relationships between the outcome variable (psychometric intelligence) and *both* the independent variable (psychometric personality) and the mediator (self-estimated intelligence), as well as between the independent variable and the mediator. Although there were significant relationships between psychometric personality and self-estimated intelligence, there were no significant relationships between psychometric personality and psychometric intelligence.

In the second attempt with gender as a mediating variable indeed the regressional results suggest that gender did mediate between neuroticism and self-estimated IQ ($F(2.94) = 11.52$, Adj $R^2 = 18$). This may be interpreted thus: Females had higher neuroticism scores and lower self-estimated IQ which are standard results. The mediation variable approach tests whether a female's under-estimations are because of the fact that they are neurotic. This was not the case. It seems that modesty, rather than neuroticism, accounts for females lower scores.

Discussion

This study aimed to investigate the relationship between personality, gender, SEI/SEV, and psychometric intelli-

Table 2. Standardized β coefficients for predictors of WPT, BRT, SEI, and SEV after multiple regressions

	WPT		BRT		SEI		SEV	
	β	t	β	t	β	t	β	t
SEI	.28	2.81**	.19	1.78				
Regression Model	F (1,96) = 7.90**		F (1,88) = 3.17					
R^2	.07		.02					
SEI	.28	2.65**	.18	1.54				
Neuroticism	−.02	−.18	−.01	−.05	−.28	−2.43*	−.31	−2.60*
Extraversion	.07	.55	.12	.87	−.14	−1.18	−.20	−1.56
Openness	.05	.44	−.02	−.16	.11	1.00	.21	1.89
Agreeableness	.10	.92	.01	.08	−.22	−2.22*	−.15	−1.50
Conscientiousness	.03	.27	−.22	−1.99	−.05	−.49	−.07	−7.23
Regression Model	F (6,96) = 1.60		F (6,88) = 1.42		F (5,96) = 2.46*		F (5,96) = 2.49*	
R^2	.04		.03		.07		.07	
SEI	.28	2.46*	.21	1.74				
Neuroticism	−.02	−.16	−.04	−.32	−.15	−1.27	−.20	−1.67
Extraversion	.07	.55	.09	.62	−.03	−.28	−.10	−.78
Openness	.05	.42	−.01	−.07	.06	.59	.18	1.69
Agreeableness	.10	.91	−.01	−.09	−.15	−1.52	−.08	−.83
Conscientiousness	.03	.28	−.23	−2.12*	.01	.14	−.02	−.19
Gender	−.01	−.08	.11	.89	−.35	−3.40**	−.30	−2.87**
Regression Model	F (7,96) = 1.36		F (7,88) = 1.32		F (6,96) = 4.21**		F (6,96) = 3.62**	
R^2	.03		.03		.17		.14	

*$p < .05$, **$p < .01$. SEI, self-estimates of intelligence; BRT, Baddeley reasoning test; WPT, wonderlic personnel test.

gence. Specifically, it attempted to explore whether psychometric intelligence and SEI/SEV correlate with personality and gender, and whether SEI/SEV correlate with psychometric intelligence.

The hypothesis of a significant correlation between various Big Five personality traits and intelligence test scores was only partially supported. Only Conscientiousness was significantly related to psychometric intelligence, correlating with BRT scores. It is worth noting that the correlation was negative, indicating that higher conscientious participants tended to have lower gf. This confirms the work of Moutafi, Furnham, and Paltiel (2004). One possible explanation is that people (especially university students) with lower gf try to cope or compensate with this by becoming more organized, thorough, determined, persistent and methodological, all of which are characteristics of Conscientiousness. Conscientiousness could be positively associated with gc and negatively with gf. Even though these two types of intelligence are related through g, lack of gf could lead to increased gc and vice versa. This assumption may also explain why openness to experience seems to relate to gc, but not to gf. Moutafi, Furnham, and Paltiel (2004) indeed have some evidence to support this assumption. However, previous research has failed to find consistent evidence for the relationship between intelligence and Conscientiousness (Zeidner & Matthews, 2000).

On the other hand, Big Five traits were not significantly related to WPT scores. These results do not support previous investigations, which reported significant, albeit modest correlations between personality and intelligence (Zeidner, 1995; Furnham, Fong, & Martin, 1999; Lynn, Hampson, & Magee, 1984). However, comparing the present results with the meta-analysis performed by Ackerman and Heggestad (1997), it can be seen that the r values in both studies are similar. Neuroticism, $-.12$ (present study), vs. $-.15$ (Ackerman & Heggestad, 1997), Extraversion, .09 (present study), vs. .08 (Ackerman & Heggestad, 1997), Agreeableness, .02 (present study), vs. .01 (Ackerman & Heggestad, 1997), Conscientiousness, .01 (present study), vs. .02 (Ackerman & Heggestad, 1997). These similarities are particularly impressive given the size of the sample in this study. It could therefore be inferred that a larger sample may have replicated the significant correlations in Ackerman and Heggestad's (1997) study. It is however more certain to support the idea that personality and psychometric intelligence are essentially unrelated constructs (Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000).

The hypothesis that there would be no gender differences in psychometric intelligence was also supported. Gender was tested as a predictor for both the WPT and BRT and in both cases was not significant. Further, there were no significant correlations between gender and WPT/BRT scores. This is in line with the general consensus that there are no major gender differences in general intelligence as measured by standard intelligence tests (Loehlin, 2000). However, as the mediating variable analysis showed gender did mediate between trait neuroticism and self-estimated, rather than, psychometric intelligence.

The hypothesis that SEI and psychometric intelligence would be significantly correlated was supported (only) by WPT scores. In the present study, the correlation between WPT scores and SEI ($r = .27$) is consistent with previous research, ($r = .30$) (Furnham, 2001b), and suggests that people have some insight into their intellectual abilities. Furthermore, participants' SEV (made immediately after they had completion of the WPT) were highly associated with psychometric intelligence, suggesting that people's insight is more accurate when they are more aware of the abilities they are requested to estimate. The highly significant correlation between SEI and SEV indicates that SEI is far more related to SEV than to actual test scores. This could suggest that people's conceptions of their own intellectual abilities are quite robust and to some extent unaffected by test performance or expert's judgment (psychometric intelligence).

As hypothesized, SEI/SEV were significantly related to personality and gender. Two Big Five significant correlates of SEI, namely Agreeableness (notably the modesty facet) and Neuroticism (notably the anxiety facet), which also correlated significantly with SEV, confirmed this hypothesis. Modest and anxious participants tended to give lower SEI, even though they did not differ in their actual psychometric intelligence scores. However, this contradicts Ackerman and Heggestad (1997) who found significant negative correlations between actual psychometric intelligence scores and Neuroticism. A high score on the anxiety facet represents anxious, fearful and pessimistic individuals, with a lack of confidence, while modesty is typical of non-assertive and unconfident individuals. This suggests that both modesty and anxiety tend to impair the accuracy in people's insight (or report) of their intellectual abilities, as well, on occasion, on their tests performance so becoming self-fulfilling. Yet this is correlational data and no cause should be inferred. Correlations show differences in traits affects and estimates of intellectual ability not which estimates are indeed accurate.

However, only gender was a significant predictor of SEI/SEV. Males gave significantly higher SEI/SEV than females, albeit not differing from them in actual intelligence scores. Thus, the present results replicate the robustness of the effect of gender in SEI (Hogan, 1978; Furnham & Rawles, 1995; Furnham, Fong, & Martin, 1999; Furnham, 2000). The fact that there are gender differences in SEI, but not in psychometric intelligence was explained by Furnham (2000), who proposed that SEI are based on specific abilities which are male normative, like mathematical and spatial intelligence. These abilities would lead to males giving higher SEI than females. What the mediator variable analysis did show however was that females lower self-estimates are because of their higher neuroticism. In this

sense it is more likely that what Beloff (1992) called female "modesty training" accounts for this consistent finding. Indeed in an internet-based study Furnham and Buchanan (2005) also tested the idea that personality (especially neuroticism) mediated between gender and self-estimated intelligence. They too found little evidence for this hypothesis.

Study 2

Consistently with the previous literature (Paulhus, Lysy, & Yik, 1998; Furnham & Rawles, 1995; Furnham, 2001a), study 1 suggested that people have some insight into their intellectual abilities (SEI) and, furthermore, that this insight is a better predictor of psychometric intelligence than gender and/or personality. Results also indicated that SEI was only a moderate predictor of psychometric intelligence. This suggests that people's insight (or at least estimation) of their intellectual abilities is limited: that is, people are only partially aware of their own intellectual capability. On the other hand, personality and gender were related to SEI, rather than psychometric intelligence. To explore this further, people's SEI will be examined in relation to two measures of gf (spatial ability and logical reasoning tests), whereas both gf and SEI will be examined in relation to people's conceptions of intelligence (CI), the Big Five, gender, and previous IQ test experience.

According to the previous literature, it is predicted that gender will be significantly related to spatial intelligence, but not to gf. Many gender differences have been reported for performance in particular spatial ability tests (e.g., Linn & Petersen, 1985; Loehlin, 2000; Voyer, Voyer, & Bryden, 1995). Studies using spatial visualization tests (this type of task will be employed in the present study) consistently report male superiority (Sanders, Soares, & D'Aquila, 1982). Masters and Sanders' (1993) meta-analysis estimated males to score an average of nearly 1 SD higher than females. Thus, gender is expected to relate to spatial intelligence. However, there is a vast literature against the notion of significant gender differences in g (Brody, 1992; Halpern, 1992; Jensen, 1998), and it is therefore hypothesized that gender will not be significantly correlated with gf.

Previous IQ experience (i.e., having taken a test and got feedback from it) is expected to relate to gf. It has been established that, since anxiety affects performance on intelligence tests, and since past experience should reduce anxiety, people who have already taken an intelligence test will perform better (Zeidner, 1995).

Despite the vast recent literature linking personality to psychometric intelligence (e.g., Harris, Vernon, Olson, & Jang, 1999; Furnham, Forde, & Cotter, 1999; Staudinger, Lopez, & Baltes, 1997; Xiao-Li, 1995), personality and intelligence are still considered independent constructs (Zeidner & Matthews, 2000), and only partial relationships have been reported. For instance, personality and intelligence were related (indirectly) through secondary factors, i.e., performance, test taking style, or (directly) through some of its components, notably gc and openness to experience. However, empirical and theoretical evidence appears to have failed in providing a direct link between the main personality factors (the Big Five) and g (particularly gf). It is therefore hypothesized that the main personality factors will not relate to gf.

However, it is expected to find significant personality correlates of SEI. Unlike psychometric intelligence, SEI seems to relate to personality factors more clearly (Chamorro-Premuzic, Furnham, & Moutafi, 2004). As such, SEI may be regarded as a non-objective (i.e., personality polluted) report of one's own abilities. For this reason, SEI is also expected to relate to participant's conceptions of intelligence (as measured by a brief inventory which assesses attitudes toward intelligence), and gender.

Finally, following study 1, SEI is predicted to be the most significant predictor of gf. This hypothesis depends, to great extent, on the confirmation of the previous hypotheses. That is, since only previous IQ test experience is expected to relate to gf, and since SEI have been repeatedly reported to be a significant predictor of psychometrical intelligence, SEI is expected to predict gf over and above all other variables included in the present design.

Method

Participants

A total of 131 (78 females and 53 males) British and American undergraduate economics students participated in this study. Their age ranged from 18 to 26, with an arithmetic mean of 20.22 (SD = 1.05) years. Out of all the participants, 109 were native English speakers, while 21 were non-native (but fluent) English speakers. There were no significant native language differences in any of the measures. Participants were all volunteers and received individual feedback on personality and intelligence measures.

Tests

S & M Test of Mental Rotation Ability. (Phillips & Rawles, 1979). This is a quick measure of mental rotation based upon Shepard and Metzler's (1971) visual-spatial ability test. The S & M test is a timed version of Vanderberg & Kuse's (1978) mental rotation test and can be administered in 2 min. This is generally considered a measure of gf not gc.

Conceptions of intelligence. This brief inventory was designed to address people's conceptions of intelligence (CI). The inventory consisted of 6-items, 5 of which loaded on one factor which has labelled "positive attitudes toward IQ". Participants' total scores on this factor were calculated by simply adding the scores for each item (i.e., "IQ test should be used more often in companies", "IQ tests are very

useful", "IQ tests do not really measure intelligence", (reversed), "I'm interested in knowing what my IQ is", and "Intelligence can be measured by IQ tests"). Participants indicated the extent to which they agreed or disagreed with each item on a five-point Likert scale (1 = "completely disagree", 5 = "completely agree"). The other item, i.e., "have you ever tested your intelligence before" (which was responded by "yes" or "no"), did not load onto the "positive attitudes toward IQ" factor and was analysed separately as "previous IQ experience" (see results section).

The BRT Reasoning Test (Baddeley, 1968). As in study 1.

The NEO Personality Inventory Revised (NEO-PI-R; Costa & McCrae, 1992). As in study 1.

Procedure

Participants were given the NEO-PI-R at the end of a lecture and completed it by the following week. After that, they were tested simultaneously in a very large lecture theatre. As in study 1, following a brief explanation of intelligence scores and their distribution (e.g., average, retardation, low, and above average levels), participants were asked to report their SEI on the back of one of the tests. In addition, participants' CI was assessed via a brief inventory (described above). Demographic data (i.e., names, native language, age, and gender) was also collected. Following this, participants were given instructions on the S & M test, and completed this test in exactly 2 minutes time. Because of the large number of participants, four examiners were present during this task to ensure test-administration was appropriate. After completing the S & M test, participants were given instructions on the BRT test, which they completed in 3 minutes time. Again, examiners were present to ensure that participants attended to the time limit of this task and completed the test properly. There was once again no reason to assume that any specific participants or groups would either systematically respond dishonestly or not try to maximise their intelligence test scores.

Results

Although the correlation between S & M and BRT was modest, gf was obtained by calculating the average standardized score in both intelligence measures, i.e., gf = [(BRT/64*100)+(S&M/20*100)]/2. Since participants had been asked to estimate their "intelligence", rather than their spatial or reasoning abilities, it was considered that gf would be more representative of "intelligence" than a single spatial or logical reasoning score. An ANOVA showed no significant gender differences in gf, (F (1,100) = 1.83, p = .18, Partial η^2 = .02). When performance differences in gender were examined in both intelligence measures separately, the ANOVA showed that males scored significantly higher than females in spatial intelligence, (F (1,101) = 5.13, p = .03, Partial η^2 = .05).

Correlations

There were no significant correlations between Big Five traits and gf (see Table 3). Only two sub-facets of the Big Five, namely impulsiveness (Neuroticism), i.e. impulsive participants had higher intelligence scores, and modesty (Agreeableness), modest participants had lower intelligence scores, correlated significantly with gf. SEI correlated significantly with Extraversion, (extraverts tend to report higher SEI), Conscientiousness, (conscientious participants reported higher SEI), CI, (positive conceptions of intelli-

Table 3. Correlations between gender, personality, SEI, BRT, S & M, gf, and CI

	X	SD	SEI	BRT	S & M	gf	CI
Gender			.17	−.03	.22*	.13	.17
Personality (NEO-PI-R)							
Neuroticism	93.51	19.36	−.03	.04	−.06	.01	−.13
Extraversion	123.14	15.38	.24*	.08	−.12	−.03	−.02
Openness to experience	122.16	15.01	.02	.07	.06	.09	−.05
Agreeableness	110.92	16.10	−.15	−.11	.03	−.05	−.19
Conscientiousness	112.07	19.97	.21*	−.11	−.06	−.12	−.07
SEI	116.29	16.40	–	.27**	.25*	.35**	.35**
Psychometric intelligence							
BRT	35.24	14.02	.27**	–	.20*	.75**	.02
S&M	8.46	4.80	.25*	.27**	–	.80**	.12*
Previous IQ experience			.18	.16	.13	.19	.02

**p < .01, *p < .05, N = 130. NEO-PI-R, NEO personality inventory-revised; SEI, self-estimates of intelligence; BRT, Baddeley reasoning test; CI, conceptions of intelligence.

gence where associated with higher SEI), and gf, (high intelligence test scores were related to high SEI).

Multiple Regressions

Several multiple regressions were performed on the data in order to examine whether gf, SEI, and CI, could be predicted from personality and gender. Table 4 shows standardised β scores for the predictors of each dependent variable.

a) gf: In Model 1 SEI and CI accounted for 11% of the variance in gf. SEI was the only significant predictor of gf. Model 2, in which the Big Five were added to the predictors, only accounted for 7% of the variance in gf and was not significant. Model 3 also included gender and previous IQ experience, accounted for 7% of the variance in gf, and was not significant.

(b) SEI: In Model 1 Big Five traits significantly accounted for 9% of the variance in SEI. Extraversion was the most powerful predictor of the model, followed by Agreeableness and Conscientiousness. Model 2 also included gender and previous IQ test experience. These two predictors were shown to account for an additional 2% in the variance of SEI. Extraversion was the most powerful predictor in the model, followed by Gender.

Moderator/Mediating Variables

The same analyses as done in the first study were carried out. Hence gender was not correlated with any of the five personality traits. Thus neither gender nor SEI were found to be mediating variable.

Discussion

As hypothesised, the results of the present study showed that gender is significantly related to spatial ability, but not to gf. Males outperformed females in the S & M test. The difference found in the present sample is consistent with the one reported by the authors of the test, that is, around 20% of women scoring above the median score of men. The present study therefore confirms that "male superiority on tasks requiring [spatial] abilities is among the most persistent of individual differences in all the abilities

Table 4. Standardized β coefficients for predictors of CI, SEI, and gf after multiple regressions

	gf		SEI	
	β	t	β	t
CI	.04	.35		
SEI	.34	3.28**		
Regression Model	F (2,94) = 6.67**			
R^2	.11			
CI	.05	.40		
SEI	.35	2.86**		
Neuroticism	.05	.44	.01	−.15
Extraversion	−.10	−.86	.26	2.11*
Openness	.12	.98	.07	.49
Agreeableness	.02	.20	−.25	−2.11*
Conscientiousness	−.12	−1.03	.23	2.10*
Regression Model	F (7,77) = 1.88		F (5,80) = 2.64*	
R^2	.07		.09	
CI	.06	.48		
SEI	.30	2.37*		
Neuroticism	.05	.41	.01	.05
Extraversion	−.10	−.80	.26	2.34*
Openness	.11	.93	.07	.57
Agreeableness	.06	.44	−.11	−.91
Conscientiousness	−.12	−1.09	.10	.90
Gender	.09	.78	−.24	2.16*
Previous IQ Test	−.14	−1.28	−.19	−1.76
Regression Model	F (9,74) = 1.70		F (7,76) = 2.45**	
R^2	.07		.11	

*$p < .05$, **$p < .01$. SEI, self-estimates of intelligence; CI, conceptions of intelligence.

literature" (McGee, 1979, p. 41). The fact that significant gender differences were only found in spatial ability, but not in gf, also seems to confirm that, whereas the conception of multiple abilities may identify gender differences for a particular ability or intelligence, the conception of general intelligence neglects them.

As expected, Big Five personality traits were not significantly related to gf. Only two of the Big Five personality facets, i.e., impulsiveness (Neuroticism), and modesty (Agreeableness), were significantly related to gf. Thus the results of the present study are not consistent with those of studies suggesting that personality and psychometric intelligence are not independent constructs. Rather, the present results seem to suggest that psychometric intelligence may only relate to certain primary rather than super-traits of personality.

Unlike gf, SEI was expected to relate to personality factors (study 1, Furnham, Tang, Lester, O'Connor, & Montgomery, 2002). Significant correlations between Big Five traits and SEI confirmed the hypothesis of a relationship between personality and SEI. Extraverts and high conscientious participants gave higher SEI. Results of the multiple regression showed that the Big Five significantly predicted SEI. Since personality did not relate to gf, the results indicate that part of the variance in SEI can be explained by personality. Accordingly, it is possible to suggest that personality affects the judgment (report) of people's own intellectual abilities, regardless of people's actual abilities (gf). The same can be implied for gender. Gender interestingly was not the most significant predictor of SEI (males gave significantly higher SEI than females): in the correlational analysis it did not reach significance while in the regressions it was marginally less significant than extraversion. However, analyses showed that neither gender nor SEI mediated between personality and intelligence.

These results partly confirm the findings reported in the previous literature (Hogan, 1978; Furnham & Rawles, 1995; Furnham, Fong, & Martin, 1999; Furnham, 2000; see also study 1), but also suggest that gender affects people's estimates of their intellectual abilities, regardless of their actual intellectual abilities. Likewise, CI (positive attitudes toward intelligence), which were significantly correlated with SEI, may affect people's estimations of their intelligence. However, as it commonly happens when it comes to interpret significant correlation, it is necessary to be careful and distinguish between a mere relationship and the causal direction in that relationship. Do people think they are clever because they have positive attitudes toward intelligence, or do people have positive attitudes toward intelligence because they think they are very clever? This is difficult to answer but, in any case, it is possible to conclude that CI, gender, and personality are all related to SEI. Furthermore, the prediction that SEI would predict gf, over and above all other variables, was confirmed by the results of the regressions. This can be interpreted as new evidence for people's insight into their intellectual abilities, and suggests that, although people's SEI may not be "objective", people are still able to estimate their intellectual abilities quite accurately.

General Discussion

The present findings have contributed to the psychometric investigation of individual differences in intellectual ability and personality, as well as the relationship between both constructs. Among several variables analysed, SEI was the most relevant to the purposes of understanding the relationship between personality and intelligence. This has been shown in other studies (Chamorro-Premuzic & Furnham, 2004; Chamorro-Premuzic, Furnham, & Moutafi, 2004). More precisely, the results of the present studies seem to suggest that personality and intelligence measures are mainly related through SEI and not directly associated with each other. Only 7% of the correlations between personality and psychometric intelligence variables were significant. However 50% of the correlations between personality and SEI and 75% correlations between psychometric intelligence and SEI were significant. Further explorations into people's CI would be necessary to understand in what sense personality (and gender) may affect SEI. As suggested by Furnham (2000), it could be the case that the relationship between gender and SEI is mediated by CI.

It should be acknowledged that there were indeed inconsistencies in the results from the two studies which were in many ways replications of each other. In Study 1, Neuroticism and Agreeableness are negatively correlated with SEI while in Study 2 it is Extraversion and Conscientiousness are positively correlated with SEI. Thus while personality traits are predictive of SEI in both cases it is different traits that are significant. In study 1 SEI was not significantly correlated with BRT whereas in study 2 it was. More importantly perhaps gender was not significantly correlated with SEI in study 1 but it was in study 2. Yet Furnham and Chamorro-Premuzic (2004) found results almost identical to the first study as did Chamorro-Premuzic, Furnham, and Moutafi (2004).

There may be at least explanations for these inconsistencies. The first is a sampling issue. While both studies used undergraduates it is apparent when comparing personality and intelligence mean scores on Table 1 and Table 3 that students in study 1 were less intelligent (BRT: 30.90 vs 35.24), more neurotic (N: 102.82 vs 93.51) and more introverted (E: 116.76 vs 123.14) than those in Study 2. The students in study 1 also gave lower self-estimates than those in study 2 (SEI: 109.60 vs 116.29). The second, less probable explanation, was that because study 2 had a more heterogeneous student sample, with around 35 per cent visiting American students, there may have been motivational differences in the way students approached

both types of tests. The third possible explanation is sampling error. Given that the size of the correlations between personality and intelligence have never been shown to be very high or robust sampling errors can have considerable difference on the pattern of significant findings.

One issue not explored in this study was the possibility that the true latent psychometric intelligence score is somewhat different from the observed performance score because of the various factors like time-of-day of testing, specific time pressure stress felt by some students and the menstrual cycle. Ideally in any future studies it would be desirable to get a better measure of the participants true latent intelligence score it would be desirable to have a good test (like the WAIS) that has multiple measures of abilities. Further it would be desirable to sample scores over a longer time frame to show longitudinal stability of scores. Any research of this kind would be improved not only by better measures of intelligence but also the examination of personality correlates at the primary as well as super factor level. Thus as Furnham and Chamorro-Premuzic (2004) showed when examined at the primary trait level it is apparent that there are considerable within trait differences in correlations with intelligence. However, it should be pointed out that although this was not done there is good reason to believe the main results of both studies are robust and as similar studies have shown comparable results (Chamorro-Premuzic & Furnham, 2004; Chamorro-Premuzic, Furnham, & Moutafi, 2004).

There are various theoretical and applied implications of this study, specifically related to the assessment of intelligence. First as Paulhus, Lysy, and Yik (1998) have shown self-estimates of intelligence however honestly recorded cannot be used as a proxy for using psychometrically valid tests in selection and assessment. Second the relationship between personality traits and intelligence is very weak although it is possible the former have an effect on test taking style (Moutafi, Furnham, & Crump, 2003). More importantly despite the fact that personality predicted self-estimated intelligence, these estimates did not mediate between personality and intelligence although it does seem that self-beliefs about intelligence are important. Dweck (2000) has in fact developed a cognitive-motivational theory concerning self-theories of intelligence. The theory focuses on specifically beliefs about malleability vs. fixedness of intelligence as well as its level. She has shown that these theories are powerfully and logically related to achievement, coping and motivation. While this study focused on self-estimated level of intelligence only it is possible that beliefs about the malleability and changeability of intelligence are important mediators between personality and gender and intelligence. Recent research by Furnham, Chamorro-Premuzic, and McDougall (2003) provides support for this idea.

Results of this paper suggest the importance of simultaneously examining people's SEI in relation to intellectual (e.g., g, IQ, gf) and extra-intellectual (personality, CI, gender) variables. This would not only improve our understanding of individual differences in both personality and intelligence, but also self-esteem and performance. The study of SEI has thus clinical, educational, and organizational relevance: knowing how intelligent people think they are, and why, and whether they can become more so should not be considered less important than knowing how intelligent people actually are. The findings attest to the possible value of giving people feedback on both their intelligence and personality traits scores along with population norms. However, this would probably be of greater personal advantage to high rather than low scorers, but this also depends on their beliefs about the possible change to their actual intelligence. It is possible that SEI has a self-fulfilling nature about it, like other self-theories. Thus believing, correctly or not that one has comparatively low intelligence leads one to shun test taking which may lead to embarrassment. It may also lead to more anxiety and less effort in test taking itself and hence lower scores. In this sense it is self-fulfilling, yet it is also relatively easy to change and correct as Dweck (2000) has shown.

Note

1. Following Stankov and Crawford (1996, p. 971), SEV and self-confidence are components of meta-cognition, i.e., "higher order knowledge or a "super program" that regulates performance on a cognitive task".

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