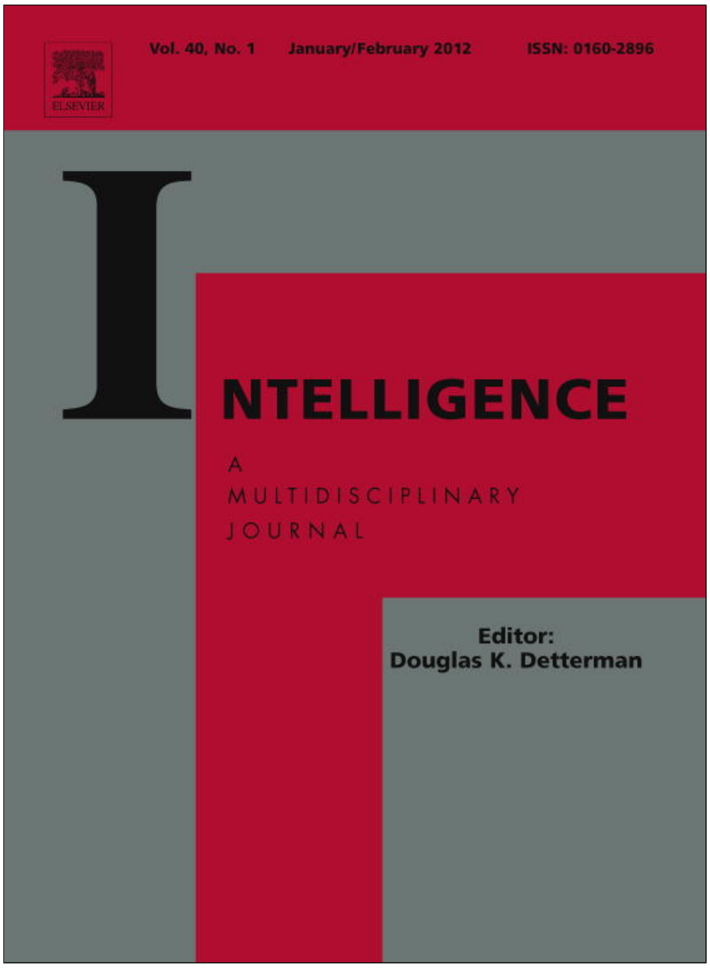

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Are g and the General Factor of Personality (GFP) correlated?

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ABSTRACT

We examined whether the General Factor of Personality (GFP) is related to the *g* factor of cognitive ability using data from the Vietnam Experience Study which randomly sampled 4462 Vietnam War veterans from a total sample of about five million Vietnam era army veterans. Exclusionary criteria included passing a fitness test, achieving a final rank of no higher than sergeant, and scoring above the 10th percentile on a pre-induction general aptitude test, but otherwise the sample is broadly representative of the U.S. male population for the period 1965–1971. A hierarchical confirmatory factor analysis of the Minnesota Multiphasic Personality Inventory (MMPI) and 15 cognitive ability tests yielded three first-order factors from the MMPI (Somatization, Internalization, and Externalization), and four first-order factors from the cognitive ability tests (Memory, Dexterity, Crystallized, and Fluid intelligence). At the apex of both measures was a general factor and we were able to fit a model which integrated both structures. This model provided a close fit to the data (χ^2 = 3114.1, df = 235, RMSEA = .052, SRMR = .047, NNFI = .97), and provided an estimate of −.23 for the correlation between g and the GFP(Abnormal), that is, the higher the *g* score the higher the score on the GFP. One possible reason for the low correlation is restriction of range in the sample. Another is that intelligence and personality are to a degree mutually exclusive strategies, the first aimed at generating resources and the second at maximizing one's share of resources.

1. Introduction

Hierarchical models of individual difference constructs are commonplace. Perhaps the most well researched and least controversial is the Cattell–Horn–Carroll taxonomy of human cognitive abilities. This is best conceived of as an organizing framework in which *g* sits at the apex of the hierarchy of specific cognitive abilities, of which there are probably four strata, and about 16 Stratum II factors (McGrew, 2009). More controversial has been the recent hypothesis that a similar construct, the General Factor of Personality (GFP), sits at the apex of the personality hierarchy (Musek, 2007; Rushton, Bons, & Hur, 2008; Rushton & Irwing, 2011). The current study seeks to explore the relationship between g and the GFP, and to offer a possible explanation of this relationship drawing on recent work in individual differences and behavioral ecology.

One framework for understanding the relationship between *g* and the GFP is Life History (LH) theory, which posits that clusters of correlated traits (e.g. timing of puberty, age at sexual debut and first birth and parental investment strategies) lie on a continuum from slow to fast. In the simplest form of LH, fast strategies are hypothesized to evolve in harsh and unpredictable environments, while the reverse holds for slow strategies. Originally LH was conceived of as a cross species phenomenon, but there is now considerable evidence of within species differences in LH strategies, in particular among humans (Ellis, Figueredo, Brumbach, & Schlomer, 2009). Rushton (1985) showed that the degree to which a person adopts a slow strategy co-selects for a range of characteristics including intelligence, altruism, being law abiding, behaviorally restrained, maturationally delayed and longer lived. Overall he predicted that diverse

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characteristics including personality characteristics would correlate together as a suite of characteristics genetically organized to meet the trials of life: survival, growth and reproduction. Thus LH theory predicts greater intelligence, both within and between species, mediated by brain size (Rushton, 2004). It also predicts a General Factor of Personality (GFP), for which there is substantial psychometric evidence (Rushton & Irwing, 2011).

Rushton et al. (2008) proposed that much like *g*, the GFP has clear positive and negative poles. High scores on the GFP indicate what is meant by someone having a "good" personality; low scores indicate what is meant by a "difficult" personality, i.e., someone who is hard to get along with. Individuals high on the GFP are altruistic, agreeable, relaxed, conscientious, sociable, and open, with high levels of well-being and self-esteem. These characteristics are hypothesized to have co-evolved alongside *g* as part of a slow Life History strategy. Further, Rushton et al. (2008) argue that, like the *g* factor, the GFP arose through evolutionary selection for socially desirable traits that facilitate performance across a wide range of contexts. This follows a proposal by Darwin (1871) that natural selection acted directionally to endow people with more cooperative and less contentious personalities than their archaic ancestors or nearest living relatives, the chimpanzees. Rushton et al. (2008) conjectured that individuals high on the GFP left more progeny, since people prefer as mates, fellow workers, and leaders those who are altruistic, conscientious, and emotionally stable. People able to cooperate in groups were also more likely to win competitions and wars.

There is growing psychometric support for the location of a GFP in a large number of personality inventories (Rushton & Irwing, 2011). The nonclinical inventories include the Big Five and Big Five alternatives, the California Psychological Inventory, the Comrey Personality Scales, the EAS Temperament Scales, the Eysenck Personality Questionnaire, the Guilford-Zimmerman Temperament Survey, the Hexaco Personality Inventory, the Hogan Personality Inventory, the Jackson Personality Inventory, the Multidimensional Personality Questionnaire, the Personality Research Form, the Temperament and Character Inventory, and the Trait Emotional Intelligence Questionnaire (Erdle, Irwing, Rushton, & Park, 2010; Figueredo, Vásquez, Brumbach, & Schneider, 2004; Loehlin & Martin, 2011; Musek, 2007; Rushton & Irwing, 2009a, 2009b, 2009c, 2009d; Rushton et al., 2008; Rushton et al., 2009; Schermer & Vernon, 2010; Veselka, Schermer, Petrides, & Vernon, 2009; Veselka et al., 2009; Zawadzki & Strelau, 2010).

The largest study to find a GFP comprised a sample of 628,640 Internet respondents who completed the Big Five Inventory (Erdle et al., 2010). One study found the GFP was independent of method variance using a multitrait-multimethod analysis of self-, teacher-, and parent-ratings of 391 13- to 14-year-olds on the Big Five Questionnaire—Children (Rushton et al., 2009). Several cross-national twin studies have found 50% of the variance on the GFP is attributable to genetic influence and 50% to nonshared environmental influence, including from 322 pairs of twins in the United Kingdom, 575 pairs of 2- to 9-year-old twins in South Korea, 651 pairs of 14- to 30-year-old twins in Japan, and 386 pairs of 18- to 74-year-old twins in Canada and the United States (Figueredo et al., 2004; Rushton et al., 2009, 2008; Veselka, Schermer, Petrides, Cherkas, et al., 2009; Veselka, Schermer, Petrides, & Vernon, 2009). The South Korean twin data showed that the GFP had emerged by 2- to 3-years of age (Rushton et al., 2008).

Inventories of the personality disorders also yield a GFP. Rushton and Irwing (2009c) found a general factor of maladjustment from the interscale correlations of the Minnesota Multiphasic Personality Inventory-2 ($N=2600$) that explained 49% of the variance in two second-order factors dubbed Internalizing and Externalizing in a model that went from the GFP to two second-order factors, to four higher-order actors, and then to all 10 scales. Rushton and Irwing (2009d) extracted a GFP from the Millon Clinical Multiaxial Inventory-III ($N=998$), which accounted for 41% of the variance in two second-order factors, again identified as Internalizing and Externalizing, 31% of the variance in five first order factors, and 26% of the variance in all 24 scales. Rushton and Irwing (2009d) also found a GFP in a cross-validation study of the Personality Assessment Inventory ($Ns=1246$, 1000) that accounted for 65% of the variance in Internalizing and Externalizing, 47% of the variance in five first-order factors, and 27% of the variance in all 18 scales. Rushton, Irwing, and Booth (2010) found a GFP in three validation samples of the Dimensional Assessment of Personality Pathology—Basic Questionnaire (DAPP-BQ). In a general population sample ($N=942$), the GFP explained 34% of the variance in four first-order factors and 33% of the variance in all 18 scales. In a twin sample ($N=1346$), a GFP explained 35% of the variance in four first-order factors and 34% of the variance in all 18 scales. In a clinical sample ($N=656$), a GFP explained 34% of the variance in four first-order factors and 30% of the variance in all 18 scales.

Despite the growing body of psychometric replications supporting the GFP, a number of criticisms have been raised within the literature. For example, the GFP has been variably argued to represent social desirability, halo or evaluation (Anusic, Schimmack, Pinkus, & Lockwood, 2009; Bäckström, 2007; Bäckström, Björklund, & Larsson, 2009; Saucier & Goldberg, 2001). Further, the predictive power of the GFP over and above the broad traits of the Five Factor Model has also been questioned (de Vries, 2011).

Much emphasis has also been placed on the results of multitrait-multimethod studies (MTMM) in establishing the substantive nature of the GFP. One of the underlying assumptions of MTMM is that correlations between traits on a single method can be biased by artifacts or method bias, whereas correlations across methods will be less susceptible to such effects (Eid, Lischetzke, Nussbeck, & Trierweiler, 2003). Therefore, if higher order factors of personality are the result of method bias and/or artifacts, theoretically they should not emerge from cross method correlation matrices. To date, five MTMM studies have provided evidence against the GFP (Anusic et al., 2009; Biesanz & West, 2004; DeYoung, 2006; McCrae et al., 2008; Riemann & Kandler, 2010), and two MTMM studies have reported positive support for a GFP (Rushton et al., 2009; Zawadzki & Strelau, 2010). Thus the evidence from MTMM studies of a GFP is somewhat inconclusive. Moreover, while it is generally concluded that failures of the GFP to emerge across raters are because it constitutes an artifact, there are other possible reasons. For example, there is considerable evidence for the situational specificity of human behavior (Bandura, 1997; Mischel & Shoda, 1995), and that these effects are strong (Malloy, Albright, Kenny, Agatstein, & Winquist, 1997). Paunonen and O'Neill (2010) argued on this basis for the superiority of self-report over peer ratings. It may be particularly important for the GFP, which is domain general, to view a person's behavior over a representative range of situations in order to remove the effects of context specificity. In consequence, in adult populations, in which we tend to view people whom we know in only a few situations, we propose that the biggest component of other ratings is situational specificity. In this situation, it is perhaps not surprising that a cross-rater GFP does not emerge. This is probably exacerbated by measurement problems in many personality measures (e.g. Hopwood & Donnellan, 2010; Vassend & Skrondal, 2011).

A number of critiques will be specifically addressed within the current paper. Firstly, Revelle and Wilt (2009) have argued from varying estimates of general factor saturation that the GFP, unlike *g*, is indeterminate, and thus not a substantive trait. Secondly, Ferguson, Chamorro-Premuzic, Pickering, and Weiss (2011) argue that the relationships between the GFP, *g* and fitness outcomes are not consistent, and thus thirdly, that the argument from LHT that the GFP and *g* coevolved as general fitness factors is inconsistent.

Revelle and Wilt (2009) have argued from the psychometric evidence that the GFP is not a substantive construct in the same sense as other general factors such as *g*. The authors evaluated two psychometric properties of the GFP and *g* as general factors in structural models, namely estimates of general factor saturation (omega hierarchical ($\acute{\omega}_{h}$)) and total variance explained by the general factor (r^2). Revelle and Wilt (2009) report that the average $\acute{\omega}_h$ estimate for published GFP studies is .38, compared to .73 for studies of cognitive abilities. Further, they report that the average r^2 for the GFP is .40, whereas for ability measures it is .75. The crucial issue here is that factors accounting for less than 50% of the variance in any given data set are indeterminate, and thus, Revelle and Wilt maintain that the GFP is indeterminate, whereas *g* is not. Based on previous research (Revelle & Zinbarg, 2009) the authors argue that statements about the suitability of general factors should primarily be based on estimates of McDonald's omega hierarchical ($\acute{\omega}_h$).

To some degree, comparing such estimates of *g* and the GFP is not comparing like with like. Firstly, general factors should be measured by the entire range of lower order constructs. Whereas within many studies and measures of cognitive abilities, *g* is comprised of many sub-factors representing a wide range of cognitive skills, the GFP is located in personality measures which are designed to measure either normal or clinical range personality traits in isolation. There is now a growing body of research evidence which suggests that normal and clinical personality should be measured on a single continuum (e.g. Markon, Krueger, & Watson, 2005; Samuel, Simms, Clark, Livesley, & Widiger, 2010). As such, personality, and thus the GFP are not being assessed across the entire range of the theoretical sphere between the extremes of normal and abnormal. Secondly, in order to make reasonable comparisons of saturation and variance explained, it would be preferable to derive *g* and the GFP from the same, population representative sample. Such estimates are provided in the current study.

Ferguson et al. (2011) note the inconsistent nature of the evidence linking the GFP to *g* and to important fitness outcomes. If *g* and the GFP coevolved under uni-directional evolutionary pressures, as is suggested within the LHT explanation of the GFP, positive and consistent correlations would be expected between *g* and the adaptive poles of personality traits. As such, it would also be expected that the GFP, which is located within the positive manifold of personality trait correlations, should, according to their interpretation also have a large and significant correlation with *g*. However, current research evidence shows little support for such relationships.

The modern consensus based on the Five Factor Model (FFM: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism/Emotional Stability) is that while Openness and its facets typically show low to moderate correlations (.2 to .5) with g, the correlations with the remaining FFM dimensions are typically low and inconsistent (rs = −.1 to +.3). This remains the case whether personality is measured at the broad factor or at the facet level (e.g., von Stumm, Chamorro-Premuzic, & Ackerman, 2011; Zimprich, Allemand, & Dellenbach, 2009). Evidence at the level of the GFP is a little more consistent. Although Rushton et al. (2009) found no significant correlations between the GFP and *g*, Schermer and Vernon (2010) found correlations of .256 and .279 between the GFP derived from the Personality Research Form and *g* from the Multidimensional Aptitude Battery in two samples ($N = 254$, and $N = 253$). Moreover, Loehlin (2011) found a correlation of .284 between a GFP derived from the California Personality Inventory and *g* from the National Merit twin sample ($N = 490$ monozygotic twins and 317 dizygotic twins). The correlation was partitioned into genetic, and shared and unshared environmental sources: approximately 39%, 50% and 11%, respectively, offering some support to a theory that may reflect evolutionary trends.

According to the Ferguson et al. (2011) interpretation, the low correlation between *g* and the GFP, and personality traits more generally, is inconsistent with LH theory. However, theirs is a rather particular version of LH theory. Certainly, LH theory predicts that both *g* and the GFP are under directional selection, and that to a degree this may be common to both. However, we take the view that evolved adaptations are the result of multiple selective pressures, and that there are many candidate mechanisms (e.g. Ellis et al., 2009; MacDonald, 1995; Nettle, 2006; Penke, Denissen, & Miller, 2007). There appears to be a broad consensus that personality is subject to selection pressures due to environmental unpredictability and heterogeneity across both space and time. In this view personality variation may be shaped by a range of selection mechanisms. We suggest that plausible candidate mechanisms include: (1) niche-splitting; (2) bet hedging strategies; (3) developmental plasticity; (4) behavioral flexibility; (5) stabilizing selection; and (6) genetic diversification, among others. In broad terms these multiple selection pressures combined with directional selection may well explain the small observed correlation between *g* and the GFP. More particularly, we suggest that the niche spaces of *g* and the GFP are to a degree different and mutually exclusive.

This contention is supported by research evidence from different fields. For example, *g* is known to be the best predictor of work performance (Schmidt & Hunter, 1998), yet the average correlation within societies between intelligence and earnings is approximately .30 (Zagorsky, 2007). Therefore, individual organizational success, if measured by earnings, has only a weak direct linear relationship to *g*, despite the consensus noted earlier that *g* is the best single predictor of performance. Further, a generalization of Price's law would contend that 50% of organizational output is generated by the square root of the total number of employees in an organization.

Although Price's law is known to be inaccurate (Nicholls, 1988), nevertheless, simple calculation using data from the Integrated Postsecondary Education Data System of the U.S. Department of Education, plus publication data from Nicholls (1988, p. 473), suggests that about 7.26% of employees in U.S. universities which awarded 4-year degrees in 2009, were responsible for 50% of published papers. Put simply, organizational wealth is created by a few, but distributed to many.

It therefore seems that there may be alternative strategies which are used to secure resources within societies. Commonly *g* is hypothesized to have evolutionary advantage in the *generation of resources* (Buss, 2004). We suggest here that personality and the GFP may represent an alternative strategy of maximizing one's share of resources via the commonly observed tactic of “getting along to get ahead”. It has recently been suggested that the GFP may be better characterized as a dimension of social effectiveness (Rushton & Irwing, 2011). To the extent that this is true, the GFP may represent a collection of traits centered on social effectiveness as a means of “getting ahead”.

This conceptualization fits well with some of the special features of human LH that have been identified by Kaplan and Lancaster (2003:179), in particular: (1) an extended period of juvenile dependence, resulting in families with multiple dependent children of different ages, (2) multi-generational resource flows and support of reproduction by older post reproductive individuals, (3) male support of reproduction through the provisioning of females and their offspring, and (4) that the brain and its functional abilities are also extreme among humans. The implication of this is that humans spend much of their lives in a dependent relationship in which they share resources generated by others. It is perhaps unsurprising that they have evolved somewhat separate psychological abilities in order to achieve each of these ends.

In sum, the current paper seeks to investigate the relationship between *g* and the GFP in a large population representative sample. In doing so, it will address three of the fundamental challenges to GFP research suggested by Revelle and Wilt (2009) and Ferguson et al. (2011). Firstly, a reliable estimate of the correlation between *g* and the GFP will be provided in a large population representative sample using confirmatory factor analysis. Secondly, estimates of general factor saturation derived from the same large sample will be calculated in order to compare the levels of indeterminacy present in both *g* and the GFP. Finally, an integrative evolutionary explanation of the observed relationships will be presented.

2. Method

2.1. Sample

The Centers for Disease Control (1988) provided an archival data set on 4462 males, randomly sampled from a total sample of about five million soldiers, who had served in the United States Armed Forces. Approximately half of the sample had served in the Vietnam War. This sample completed the MMPI and numerous recognized measures of cognitive ability.

The original purpose in obtaining these data was to assess the long-term effects of the veteran's military service some 17 years after induction in the military. The total sample is fairly representative of the U.S. male population with respect to race, education, income, and occupation (see Table 1). However, it should be noted that a mandate of the U.S. Congress prohibits all persons who score below the 10th percentile on a pre-induction general aptitude test from serving in the military. Additional exclusionary criteria included passing a fitness test, and achieving a final rank of no higher than sergeant.

2.2. Measures

The Minnesota Multiphasic Personality Inventory (MMPI) is extensively described elsewhere (e.g. Graham, 1987). The current analysis confined itself to a factor analysis of the 10 clinical scales. Because the MMPI assesses a variety clinical conditions (e.g. Depression, Paranoia), a high score on the GFP extracted from it corresponds to the presence of psychopathology. That is, its meaning corresponds to the exact reverse of the GFP extracted from measures of normal personality. In order to avoid confusion, this general factor will consequently be described as the GFP(Abnormal).

Alongside the MMPI, the following tests of cognitive ability were administered to the current sample: the Rey–Osterrieth Complex Figure Drawing (copy, immediate and delayed recall scores); the Grooved Pegboard Test (scores for the right and left hand); the Army Classification Battery (Verbal and Arithmetical Reasoning Tests); the WAIS-R (Information and Block Design Tests); the California Verbal Learning Test; the Word List Generation Test, the Wide Range Achievement Test (Reading); the Wisconsin Card Sort Test; the Paced Auditory Serial Addition Test; and the Pattern Analysis Test. Some of the IQ data have been published previously (Nyborg & Jensen, 2000). The correlations between these measures are shown in Table 2.

Table 1
Selected demographic characteristics of sample.

Variables	N	*P*
Age		
30–34 years	420	9.4
35–39 years	2974	66.6
40–48 years	1068	29.9
Education		
0–11 years	540	12.1
12–15 years	2958	66.3
16–18 years	964	21.6
Income		
<$10,000	437	9.8
$10,000–$29,999	2024	45.4
$30,000–$49,999	1431	32.1
>$50,000	485	10.9
Missing	85	1.9
Occupation		
Managerial/professional	1419	31.8
Administrative/clerical	349	7.8
Service	523	11.7
Skilled	1078	12.2
Semi-skilled	691	15.5
Unemployed	402	9.0
Race		
White	3654	81.9
Black	525	11.8
Other	283	6.4

Table 2
Correlations between the scales of the Minnesota Multiphasic Personality Inventory and cognitive abilities.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Hypochondria	1.0																							
2. Depression	.54	1.0																						
3. Hysteria	.76	.44	1.0																					
4. Psychopathy	.44	.44	.48	1.0																				
5. Paranoia	.38	.43	.41	.52	1.0																			
6. Obsessive–compulsive	.57	.72	.49	.56	.60	1.0																		
7. Schizophrenia	.60	.60	.50	.64	.66	.82	1.0																	
8. Hypomania	.20	−.04	.14	.34	.29	.22	.41	1.0																
9. Social introversion	.19	.59	−.03	.08	.22	.47	.34	−.24	1.0															
10. CVLT	−.13	−.17	−.04	−.04	−.08	−.14	−.16	−.05	−.14	1.0														
11. WAIS-R Information	−.18	−.17	−.01	−.04	−.02	−.15	−.13	−.09	−.17	.38	1.0													
12. WAIS-R Block Design	−.10	−.13	.01	−.06	−.01	−.12	−.12	−.10	−.10	.31	.45	1.0												
13. Rey–Osterrieth copying	−.12	−.12	−.04	−.06	−.04	−.10	−.11	−.08	−.05	.24	.28	.40	1.0											
14. Immediate memory	−.10	−.14	−.02	−.07	−.02	−.11	−.10	−.06	−.08	.33	.34	.49	.47	1.0										
15. Delayed memory	−.10	−.13	−.01	−.07	−.02	−.10	−.09	−.06	−.07	.34	.35	.49	.48	.92	1.0									
16. Word generation	−.10	−.13	.04	.05	.01	−.08	−.06	.05	−.21	.33	.41	.28	.18	.21	.22	1.0								
17. Wisconsin Card Sort Test	−.15	−.12	−.05	−.08	−.08	−.12	−.15	−.12	−.08	.23	.33	.36	.29	.27	.27	.21	1.0							
18. PASAT	−.12	−.15	−.01	−.04	−.03	−.11	−.14	−.09	−.13	.34	.37	.39	.25	.28	.28	.36	.29	1.0						
19. Pegboard right	−.11	−.11	−.05	−.07	−.06	−.10	−.14	−.08	−.07	.14	.17	.30	.23	.20	.20	.17	.19	.23	1.0					
20. Pegboard left	−.14	−.14	−.06	−.09	−.08	−.13	−.17	−.09	−.08	.16	.18	.31	.23	.23	.23	.16	.20	.22	.64	1.0				
21. Wide range achievement	−.16	−.13	.03	.02	.02	−.09	−.08	−.06	−.15	.34	.65	.38	.27	.27	.27	.50	.29	.42	.20	.21	1.0			
22. Army verbal	−.20	−.15	.00	−.04	−.04	−.15	−.16	−.13	−.16	.37	.72	.44	.29	.31	.30	.44	.33	.41	.20	.20	.75	1.0		
23. Army arithmetic	−.18	−.16	−.02	−.09	−.05	−.16	−.19	−.17	−.13	.39	.64	.50	.33	.34	.34	.37	.36	.52	.19	.21	.59	.70	1.0	
24. Pattern analysis	−.11	−.11	.02	−.07	−.01	−.12	−.12	−.11	−.09	.30	.48	.64	.38	.46	.45	.29	.33	.37	.25	.26	.41	.52	.58	1.0
Mean	56.5	61.4	57.7	60.7	56.9	59.2	58.8	57.7	54.6	46.2	10.1	10.5	32.7	20.1	20.3	35.1	0.8	108.8	−73.7	−77.4	61.2	107.1	104.4	104.2
Standard deviation	12.5	14.1	9.5	11.6	10.6	12.6	15.0	11.1	10.9	8.8	2.8	2.6	3.3	6.8	6.3	10.9	0.2	50.8	11.9	13.8	14.7	22.3	22.0	22.7

Note: PASAT = Paced Auditory Serial Addditon Test; CVLT = California Verbal Learning Test.

2.3. Missing data

Prior to the completion of the substantive analyses, we conducted an evaluation of missing data using Schafer's NORM package. NORM indicated that .23% of the data were missing. The Expectation-Maximization (EM) algorithm was used to create starting values for data augmentation (DA). DA is usually used within NORM to create multiple imputations. In the current analysis, given the exceptionally low amount of missing data, DA was used to assess the iteration (k) by which the auto-correlation between the imputed values was minimized. At this point, it can be assumed that the imputed values are no longer correlated with the imputed values from the previous set of imputations. A single imputation was then made from one of the imputed data sets, larger than k. In this instance, a single imputation was made for iteration 4500 of the data augmentation series.

2.4. Analysis

Hierarchical models of cognitive ability, and personality were developed individually using the procedure outlined subsequently. Once suitable individual models had been established, they were combined in order to assess the relationship between *g* and the GFP(Abnormal).

As a first step, exploratory factor analyses were conducted on the fifteen individual measures of cognitive ability, and the ten primary scales of the MMPI. Analyses were conducted in MPlus using maximum likelihood extraction and Promax oblique rotation. In order to establish the number of factors to extract from the MPlus analyses, we utilised Velicer's (1976) Minimum Average Partial (MAP) procedure in combination with Parallel Analysis (Horn, 1965).

The MAP procedure involves extracting a single principal component, the variance of which is then partialed out from the correlation matrix between the indicator variables. The average squared coefficient of the off-diagonal elements of the matrix is then computed. This process is repeated extracting sequentially more components, until $k-1$ components are extracted, where k is the number of variables. The average squared coefficients are then compared, with the lowest value indicating the appropriate number of factors to extract. Parallel analysis involves the comparison of the eigenvalues generated by the actual data, here taken from MPlus, with eigenvalues generated from a series of random data sets containing the same number of variables and observations. Current best practice suggests comparing the eigenvalues of the 95th percentile of the distribution of random data eigenvalues, with those derived from the actual data (Glorfeld, 1995; O'Connor, 2000). Factors are retained if the eigenvalue from the actual data is larger than the eigenvalue of the random data for the corresponding factor.

Both methods were implemented in SPSS using the syntax codes provided by O'Connor (2000). O'Connor (2000; p.398) states that the MAP can on occasion provide an underestimate, whilst parallel analysis provides an over-estimate, of the correct number of factors to extract. We thus took the evidence from these two tests as providing a plausible range for the correct number of factors, and assessed each factor solution within this range for substantive meaning. The resulting exploratory solutions were then tested within a confirmatory factor analysis.

All confirmatory models were estimated in LISREL 8.8 using maximum likelihood estimation. The suitability of each model was assessed by firstly examining each of the modeled parameters, and secondly, by assessing model fit. The use of absolute fit indices in model evaluation has recently been questioned (Chen, Curran, Bollen, Kirby, & Paxton, 2008), and there is no consensus on which indices should be used. We rely partly on the simulations of Hu and Bentler (1998, 1999), which suggest the utility of the standardized root mean square residual (SRMSR), the root mean square error of approximation (RMSEA), and the non-normed fit index (NNFI). We adopted cut-off points of $\leq$.05 for the SRMSR (Spence, 1997), about .06 for the RMSEA (Browne & Cudeck, 1993), and $\geq$.95 for the NNFI and CFI, which conform to recent recommendations based on Monte Carlo simulation (Hu & Bentler, 1998, 1999). In order to make direct comparisons between plausible models, we adopt the Akaike Information Criterion (AIC; Akaike, 1974). The AIC can be used to compare two models containing different numbers of parameters, with the lower values indicating the better model (Kuha, 2004).

3. Results

3.1. Cognitive ability

Parallel analysis indicated that three factors should be extracted from the cognitive ability data, whilst the MAP suggested two factors. The RMSEAs for the two and three factor solutions in MPlus were .116 and .095 respectively, suggesting that these solutions may not be optimal. However, the RMSEA for the four factor solution (.059) suggested that this model may be superior. Thus, two, three and four factor models were initially tested within CFA.

The initial CFA analyses of the two and three factor solutions showed poor to moderate fit to the data (2 factors: RMSEA = .12; CFI = .92; 3 factors: RMSEA = .11; CFI = .94). Conversely, the initial four factor model demonstrated good model fit (Model 1, Table 3). The four factor solution and their facets were: *Memory* (Rey–Osterrieth Complex Figure Drawing: copy, immediate and delayed recall), *Dexterity* (right and left hand Grooved Pegboard Test), *Crystallized Intelligence* (Army Classification Battery Verbal, WAIS-R Information, California Verbal Learning Test, Word List Generation Test, Wide Range Achievement Test: Reading); and *Fluid Intelligence* (WAIS Block Design), Wisconsin Card Sort Test, Paced Auditory Serial Addition Test, Army Classification Battery: Arithmetical Reasoning, Pattern Analysis Test).

Four modifications were made to this model based on the information from the modification indices (MI). The Army Classification Battery Arithmetic and Rey–Osterich Copy scores were loaded onto *Fluid Intelligence* (MI = 743.62; MI = 284.74 respectively). Further, the California Verbal Learning Test was loaded onto Memory (MI = 205.51). Lastly, a single correlated error was included between the Army Classification Battery Arithmetic score and the Paced Auditory Serial Addition Test (MI = 161.54). Both of these scores are specifically related to numerical ability, a skill which is not reflected in any of the other cognitive ability tests. This model (Model 2, Table 3) showed excellent fit to the data according to all fit indices.

Table 3
Model fit indices for the first and second order models of cognitive abilities and personality.

	χ^2	df	RMSEA	SRMSR	AIC	CFI	NNFI
Model 1: 1st order 'g' model.	2704.34	84	.084	.063	2776.34	.96	.95
Model 2: 1st order 'g' model—modified.	1304.99	80	.059	.036	1384.99	.98	.98
Model 3: higher-order 'g' model.	1357.53	83	.059	.038	1431.53	.98	.98
Model 4: 1st order GFP model.	2160.28	22	.15	.075	2206.28	.94	.90
Model 5: 1st order GFP model—modified.	483.74	18	.076	.026	537.74	.99	.97
Model 6: higher-order GFP model.	522.56	24	.068	.026	584.56	.99	.98
Model 7: combined 'g'–GFP model	3114.08	235	.052	.047	3244.08	.98	.97

As a final step, a second order 'g' factor was modeled above the four first order cognitive ability factors. This factor was primarily defined by the loading of *Fluid Intelligence*. This model still showed excellent fit to the data (Model 3, Table 3).

3.2. General Factor of Personality

Parallel analysis of the MMPI scale scores suggested that 3 factors should be extracted, whilst the MAP indicated that a single factor was required. In a series of initial CFA's, the Masculinity/Femininity scale displayed low loadings in all solutions, and was associated with large modification indices[1]. Given these findings, this scale was removed and the exploratory analyses were re-run. This yielded a clear interpretable three factor solution; however the model displayed only moderate fit (Model 4, Table 3).

The three factors were labeled *Somatization* (Hypochondria, Hysteria); *Internalization* (Depression, Obsessive-Compulsion, negatively loaded Hypomania, Social Introversion); and *Externalization* (Psychopathic Deviate, Paranoia, Obsessive-Compulsion, Schizophrenia, Hypomania). Based on the modification indices, four modifications were made to this model. Firstly, a negative loading was allowed for the Social Introversion scale on factor 1: Somatization (MI = 495.95). Secondly, correlated errors were added between Social Introversion and Hysteria (MI = 733.00), Psychopathic Deviate and Hysteria (MI = 256.60) and Social Introversion and Psychopathic Deviate (MI = 141.88). The resultant model (Model 5, Table 3) showed excellent fit to the data.

As a final step, a single second order factor, a GFP(Abnormal), was modeled above the Somatization, Internalizing and Externalizing factors. As can be seen from Table 3 (Model 6), this model also showed excellent fit to the data. All parameter estimates can be seen in the bottom half of Fig. 1.

3.3. g–GFP(Abnormal) model

In the final analysis, the *g* and GFP models were combined. As can be seen from the model fit statistics in Table 3, this combined model (Model 7), shown in Fig. 1, demonstrates very good fit to the data. The correlation between *g* and the GFP(Abnormal) was −.23 ($p<.001$).

[1] This result conforms to the findings of Rushton and Irwing (2009c). In the final model presented in this paper (Fig. 2, p.440), Masculinity/Femininity has a loading of .27 on a first order factor labeled Gamma.

3.4. General factor saturation

In order to ascertain the factor saturation of both *g* and the GFP(Abnormal), we calculated Fornell and Larcker's (1981) ρ_{vc}, and McDonald's $\acute{\omega}_h$ (Zinbarg, Revelle, Yovel, & Li, 2005), with the estimates derived from Model 7. As can be seen from the estimates in Table 4, the GFP(Abnormal) both explained more average variance in its lower order factors than *g*, and had a higher reliability.

4. Discussion

The results of the current study show a correlation between *g* and the GFP(Abnormal) of −.23. Those with higher scores on *g* had lower scores on the MMPI, which, as a measure of personality disorder means that those with higher intelligence had fewer personality problems. The size of this correlation is consistent with previous estimates reported by Schermer and Vernon (2010) and Loehlin (2011). This estimate can be considered fairly definitive as it is derived from a large representative sample and from robust statistical analyses, though it may be subject to a small degree of range restriction, and is thus probably a slight underestimate. Additionally, some might question whether the correlation differs across sex, but current evidence does not suggest this. Although this correlation does provide partial support for a small degree of co-evolution between *g* and the GFP, and therefore the influence of directional selection, this figure is somewhat lower than might be expected from Life History explanations of the GFP, according to the interpretation of Ferguson et al. (2011).

Contrary to the critique of Revelle and Wilt (2009), according to both Fornell and Larcker's (1981) ρ_{vc}, and McDonald's $\acute{\omega}_h$, in the current data, factor indeterminacy is greater in *g* than it is in the GFP(Abnormal). Indeed, if we consider Fornell and Larcker's ρ_{vc}, in the current sample we would conclude that it is *g*, not the GFP(Abnormal) which is indeterminate. However, some caution is required. A well know problem with the MMPI is that very substantial item overlap biases the correlations between its scales (Helmes & Reddon, 1993). There is no definitive assessment of the extent of this bias, but judged by the eigenvalues of the first principal component extracted from spurious and corrected correlations as estimated by Budescu and Rodgers (1981, p. 495), the spurious correlations inflate estimated eigenvalues by about 10%. A 10% correction in either Larcker's ρ_{vc} or McDonald's $\acute{\omega}_h$, in the current case, leaves the conclusions essentially unchanged.

Why then are the estimates here so different from those reported by Revelle and Wilt (2009)? Firstly, the purpose of the original analyses which Revelle and Wilt subsequently

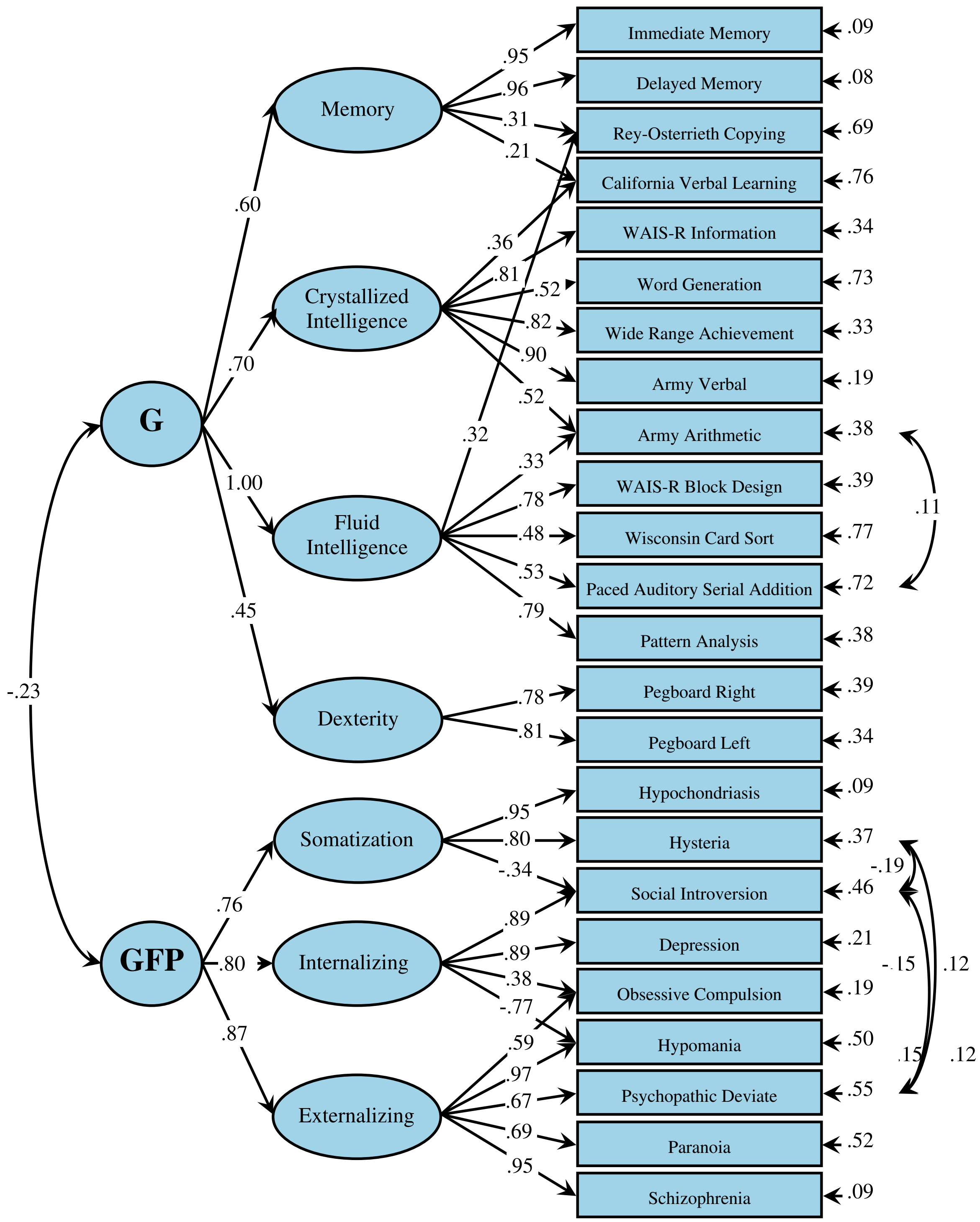

Fig. 1. Model showing four second-order cognitive factors arising from 15 first-order cognitive tasks and three second-order personality factors arising from 20 first-order MMPI scales, with both second-order sets then yielding their respective general factors (*g* and the GFP), which are correlated −.23.

reanalyzed in order to estimate the factor saturation of the GFP, was to demonstrate the plausibility of a GFP, by showing that it could be found across most recognized measures of personality.

Table 4
Variance estimates for *g* and GFP from alternative procedures.

Factor	Fornell & Larcker's ρ_{vc}	McDonald's ω_h
G	.404	.545
GFP	.567	.746

It was not intended to provide an estimate of the factor saturation of the GFP. However, we do not consider that measures of normal personality represent an appropriate way to estimate the GFP. Rather we consider that personality should be measured across the full range of personality from normal to abnormal as is suggested by the work of O'Connor (2002), Markon et al. (2005) and Samuel et al. (2010). Although the MMPI clearly does not achieve this, we nevertheless consider it to be a better approximation to the ideal than is proffered by measures of normal personality. Secondly, measures of factor saturation will be dependent on sample characteristics. Arguably, the most meaningful estimates of factor saturation are obtained from population representative samples. In any case, for a fair comparison of the factor saturations of *g* and the GFP, both should be estimated in the same sample. Here, our estimates represent an improvement on those of Revelle and Wilt (2009) in that we both have a reasonable approximation to a population representative sample, and we meet the criterion of assessing the factor saturations of *g* and the GFP in the same sample.

The correlation between *g* and the GFP(Abnormal) is not fully consistent with the evolutionary explanation for the GFP, according to the reading of Life History theory adopted by Ferguson et al. (2011). Here we propose an alternative which suggests: Firstly, that personality is multiply determined by a range of selection mechanisms; and secondly, that cognitive abilities and personality represent core individual differences in two largely mutually exclusive niches. We follow Ellis et al. (2009) in suggesting that *g*, and cognitive abilities, primarily promote survival, growth and hence reproduction through the *generation of resources*, and in agreement with Penke et al. (2007), we argue that personality as a whole relates more closely to social niches. We extend this to argue that specific combinations of personality traits ensure that individuals can *maximize resource acquisition* within group/societal environments.

How then does this suggestion provide a framework for understanding the low correlation between *g* and the GFP? As is suggested by Life History theory, individuals do not have an infinite amount of bio-resources to put towards growth of the body and brain. Research into brain dimorphisms in humans and primates clearly show differences between individuals in the development of social and problem solving regions of the brain (Goldstein et al., 2001; Larsen, 2003; Lindenfors, 2005; Lindenfors, Nunn, & Barton, 2007; Yamasue et al., 2008). We propose here that to be an extreme within either the resource generation or acquisition maximization niche, one must sacrifice development in the other niche. We offer these suggestions in the same spirit as has been adopted by many previous authors, that is not as definitive, but rather intended to stimulate both theorizing and empirical work.

Throughout, we have discussed some of the limitations of the Vietnam Experience data, but it is perhaps appropriate to revisit two main issues. We noted earlier that item overlap will have biased correlations between the MMPI scales. According to the best estimate available this bias is about 10%, however this estimate is not precise. Consequently there is a degree of uncertainty surrounding our estimates of factor saturation. Secondly, although there is a growing body of work which suggests that normal and abnormal personality represent different points on the same continua, the precise nature of this relationship requires considerably more research. To this extent, correlations between *g* and the GFP(Abnormal) may not generalize to correlations between *g* and the GFP(Normal). However, our estimate of this correlation using the MMPI, a measure of abnormal personality, is close to estimates obtained with the Personality Research Form and the California Personality Inventory, which are measures of normal personality, so current data does suggest a high degree of equivalence between the two different estimates.

In sum, the current paper provides further tentative support for the GFP hypothesis by providing a robust estimate of the correlation between the GFP(Abnormal) and *g*, and by demonstrating that estimates of general factor saturation and variance explained are comparable for *g* and the GFP(Abnormal). Further, we present an argument for a largely mutually exclusive evolutionary process for cognitive abilities and personality based on more recent research into behavioral ecology, niche splitting and bet hedging. Though this hypothesis is not directly tested within the current paper, such an explanation is consistent with the evidence presented.

References

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transaction on Automatic Control*, *AC-19*, 716–723.

Anusic, I., Schimmack, U., Pinkus, R. T., & Lockwood, P. (2009). The nature and structure of correlations among Big Five ratings: The halo-alpha-beta model. *Journal of Personality and Social Psychology*, *97*, 1142–1156.

Bäckström, M. (2007). Higher-order factors in a five-factor personality inventory and its relation to social desirability. *European Journal of Psychological Assessment*, *23*, 63–70.

Bäckström, M., Björklund, F., & Larsson, M. R. (2009). Five-factor inventories have a major general factor related to social desirability which can be reduced by framing items neutrally. *Journal of Research in Personality*, *43*, 335–344.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Biesanz, J. C., & West, S. G. (2004). Towards understanding assessments of the Big Five: Multitrait-multimethod analyses of convergent and discriminant validity across measurement occasion and type of observer. *Journal of Personality*, *72*, 845–876.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing Structural Equation Models* (pp. 136–162). Beverly Hills, CA: Sage.

Budescu, D. V., & Rodgers, J. L. (1981). Correcting for spurious influences on correlations between MMPI Scales. *Multivariate Behavioral Research*, *16*, 483–497.

Buss, D. M. (2004). *Evolutionary psychology: The new science of the mind*. Boston, MA: Pearson Education Inc.

Centers for Disease Control (1988). Health status of Vietnam veterans. *Journal of the American Medical Association*, *259*, 2701–2719.

Chen, F., Curran, P. J., Bollen, K. A., Kirby, J., & Paxton, P. (2008). An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models. *Sociological Methods and Research*, *36*, 462–494.

Darwin, C. (1871). *The descent of man*. London: Murray.

de Vries, R. E. (2011). No support for a general factor of personality in a reanalysis of Van der Linden et al. (2010). *Personality and Individual Differences*, *50*, 512–516.

DeYoung, C. G. (2006). Higher-order factors of the Big Five in a multi-informant sample. *Journal of Personality and Social Psychology*, *91*, 1138–1151.

Eid, M., Lischetzke, T., Nussbeck, F. W., & Trierweiler, L. I. (2003). Separating trait effects from trait-specific method effects in multitrait-multimethod models: A multiple indicator CT-C(M-1) model. *Psychological Methods*, *8*, 38–60.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature*, *20*, 204–268.

Erdle, S., Irwing, P., Rushton, J. P., & Park, J. (2010). The general factor of personality and its relation to self-esteem in 628,640 Internet respondents. *Personality and Individual Differences*, *48*, 343–346.

Ferguson, E., Chamorro-Premuzic, T., Pickering, A., & Weiss, A. (2011). Five into one doesn't go: A critique of the General Factor of Personality. In T. Chamorro-Premuzic, S. von Stumm, & A. Furnham (Eds.), *The Wiley-Blackwell handbook of individual differences*. London: Blackwell.

Figueredo, A. J., Vásquez, G., Brumbach, B. H., & Schneider, S. M. R. (2004). The heritability of life history strategy: The *K*-factor, covitality, and personality. *Social Biology*, *51*, 121–143.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*, 39–50.

Glorfeld, L. W. (1995). An improvement on Horn's parallel analysis methodology for selecting the correct number of factors to retain. *Educational and Psychological Measurement*, *55*, 377–393.

Goldstein, J. M., Seidman, L. J., Horton, N. J., Makris, N., Kennedy, D. N., Caviness, V. S., et al. (2001). Normal sexual dimorphism of the adult human brain assessed by *in vivo* magnetic resonance imaging. *Cerebral Cortex*, *11*, 490–497.

Graham, J. R. (1987). *The MMPI: A practical guide* (2nd ed). New York: Oxford University Press.

Helmes, E., & Reddon, J. R. (1993). A perspective on developments in assessing psychopathology: A critical review of the MMPI and MMPI-2. *Psychological Bulletin*, *113*, 453–471.

Hopwood, C. J., & Donnellan, M. B. (2010). How should the internal structure of personality inventories be evaluated? *Personality and Social Psychology Review*, *14*, 332–346.

Horn, J. L. (1965). A rationale and a test for the number of factors in factor analysis. *Psychometrika*, *30*, 179–185.

Hu, L. -T., & Bentler, P. M. (1998). Fit indices in covariance structural modeling: Sensitivity to underparametrized model misspecification. *Psychological Methods*, *3*, 424–453.

Hu, L. -T., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure modeling: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

Kaplan, H. S., & Lancaster, J. B. (2003). An evolutionary and ecological analysis of human fertility, mating patterns and parental investment. In K. W. Wachter, & R. A. Bulatao (Eds.), *Offspring: Human fertility behavior in biodemographic perspective* (pp. 170–223). Washington, DC: National Academies.

Kuha, J. (2004). AIC and BIC: Comparisons of assumptions and performance. *Sociological Methods & Research*, *33*, 188–229.

Larsen, C. S. (2003). Equality for the sexes in human evolution? Early hominid sexual dimorphism and implications for mating systems and social behaviour. *Proceedings of the National Academy of Sciences*, *100*, 9103–9104.

Lindenfors, P. (2005). Neocortex evolution in primates: The 'social brain' is for females. *Biology Letters*, *1*, 407–410.

Lindenfors, P., Nunn, C. L., & Barton, R. A. (2007). Primate brain architecture and selection in relation to sex. *BMC Biology*, 5.

Loehlin, J. C. (2011). Correlation between general factors for personality and cognitive skills in the National Merit twin sample. *Journal of Research in Personality*, *45*, 504–507.

Loehlin, J. C., & Martin, N. G. (2011). A general factor of personality: Questions and elaborations. *Journal of Research in Personality*, *45*, 44–49 (See also Corrigendum, 45, 258).

MacDonald, K. (1995). Evolution, the five-factor model, and levels of personality. *Journal of Personality*, *63*, 525–567.

Malloy, T. E., Albright, L., Kenny, D. A., Agatstein, F., & Winquist, L. (1997). Interpersonal perception and metaperception in nonoverlapping social groups. *Journal of Personality and Social Psychology*, *72* 390–308.

Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology*, *88*, 139–157.

McCrae, R. R., Yamagata, S., Jang, K. L., Riemann, R., Ando, J., Ono, Y., et al. (2008). Substance and artifact in the higher-order factors of the Big Five. *Journal of Personality and Social Psychology*, *95*, 442–455.

McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence*, *37*, 1–10.

Mischel, W., & Shoda, Y. (1995). A cognitive-affective system theory of personality: Reconceptualizing situations, dispositions, dynamics, and invariance in personality structure. *Psychological Review*, *102*, 246–268.

Musek, J. (2007). A general factor of personality: Evidence for the Big One in the five-factor model. *Journal of Research in Personality*, *41*, 1213–1233.

Nettle, D. (2006). The evolution of personality variation in humans and other animals. *American Psychologist*, *61*, 622–631.

Nicholls, P. M. (1988). Price's square root law: Empirical validity and relation to Lotka's law. *Information Processing & Management*, *24*, 469–477.

Nyborg, H., & Jensen, A. R. (2000). The Black–White differences on various psychometric tests: Spearman's hypothesis tested on American armed services veterans. *Personality and Individual Differences*, *28*, 593–599.

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments and Computers*, *32*, 396–402.

O'Connor, B. P. (2002). The search for dimensional structure differences between normality and abnormality: A statistical review of published data on personality and psychopathology. *Journal of Personality and Social Psychology*, *83*, 962–982.

Paunonen, S. V., & O'Neill, T. A. (2010). Self-reports, peer ratings and construct validity. *European Journal of Personality*, *24*, 189–206.

Penke, L., Denissen, J. J. A., & Miller, G. F. (2007). The evolutionary genetics of personality. *European Journal of Personality*, *21*, 549–587.

Revelle, W., & Wilt, J. (2009). *How important is the general factor of personality? A general critique.* Evanston, IL: Department of Psychology, Northwestern University Retrieved January 15th, 2011 from. http://personalityproject.org/revelle/syllabi/454/gfp.pdf

Revelle, W., & Zinbarg, R. E. (2009). Coefficients alpha, beta, omega and the glb: comments on Sijtsma. *Psychometrika.*, *74*, 145–154.

Riemann, R., & Kandler, C. (2010). Construct validation using multitrait-multimethod-twin data: The case of a general factor of personality. *European Journal of Personality*, *24*, 258–277.

Rushton, J. P. (1985). Differential *K* theory: The sociobiology of individual and group differences. *Personality and Individual Differences*, *6*, 441–452.

Rushton, J. P. (2004). Placing intelligence into an evolutionary framework or how *g* fits into the *r*–*K* matrix of life history traits including longevity. *Intelligence*, *32*, 321–328.

Rushton, J. P., Bons, T. A., Ando, J., Hur, Y. -M., Irwing, P., Vernon, P. A., et al. (2009). A general factor of personality from multitrait-multimethod data and cross-national twins. *Twin Research and Human Genetics*, *12*, 356–365.

Rushton, J. P., Bons, T. A., & Hur, Y. -M. (2008). The genetics and evolution of a general factor of personality. *Journal of Research in Personality*, *42*, 1173–1185.

Rushton, J. P., & Irwing, P. (2009). A general factor of personality (GFP) from the Multidimensional Personality Questionnaire. *Personality and Individual Differences*, *47*, 571–576.

Rushton, J. P., & Irwing, P. (2009). A general factor of personality in 16 sets of the Big Five, the Guilford–Zimmerman Temperament Survey, the California Psychological Inventory, and the Temperament and Character Inventory. *Personality and Individual Differences*, *47*, 558–564.

Rushton, J. P., & Irwing, P. (2009). A general factor of personality in the Comrey Personality Scales, the Minnesota Multiphasic Personality Inventory-2, and the Multicultural Personality Questionnaire. *Personality and Individual Differences*, *46*, 437–442.

Rushton, J. P., & Irwing, P. (2009). A general factor of personality in the Millon Clinical Multiaxial Inventory-III, the Dimensional Assessment of Personality Pathology, and the Personality Assessment Inventory. *Journal of Research in Personality*, *43*, 1091–1095.

Rushton, J. P., & Irwing, P. (2011). The general factor of personality: Normal and abnormal. In T. Chamorro-Premuzic, S. von Stumm, & A. Furnham (Eds.), *The Wiley-Blackwell handbook of individual differences* (pp. 132–161). London: Wiley-Blackwell.

Rushton, J. P., Irwing, P., & Booth, T. (2010). A General Factor of Personality (GFP) in the personality disorders: Three studies of the Dimensional Assessment of Personality Pathology—Basic Questionnaire (DAPP-BQ). *Twin Research and Human Genetics*, *13*, 301–311.

Samuel, D. B., Simms, L. J., Clark, L. A., Livesley, W. J., & Widiger, T. A. (2010). An item response theory integration of normal and abnormal personality scales. *Personality Disorder: Theory, Research, and Treatment*, *1*, 5–21.

Saucier, G., & Goldberg, L. R. (2001). Lexical studies of indigenous personality factors: Premises, products, and prospects. *Journal of Personality*, *69*, 843–879.

Schermer, J. A., & Vernon, P. A. (2010). The correlation between general intelligence (*g*), a general factor of personality (GFP), and social desirability. *Personality and Individual Differences*, *48*, 187–189.

Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin*, *124*, 262–274.

Spence, S. H. (1997). Structure of anxiety symptoms among children: A confirmatory factor-analytic study. *Journal of Abnormal Psychology*, *106*, 280–297.

Vassend, O., & Skrondal, A. (2011). The NEO personality inventory revised (NEO-PI-R): Exploring the measurement structure and variants of the five-factor model. *Personality and Individual Differences*, *50*, 1300–1304.

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, *31*, 321–327.

Veselka, L., Schermer, J. A., Petrides, K. V., Cherkas, L. F., Spence, T. D., & Vernon, P. A. (2009). A general factor of personality: Evidence from the HEXACO model and a measure of trait emotional intelligence. *Twin Research and Human Genetics*, *12*, 420–424.

Veselka, L., Schermer, J. A., Petrides, K. V., & Vernon, P. A. (2009). Evidence for a heritable general factor of personality in two studies. *Twin Research and Human Genetics*, *12*, 254–260.

von Stumm, S., Chamorro-Premuzic, T., & Ackerman, P. L. (2011). Re-visiting intelligence–personality associations: Vindicating intellectual investment. In T. Chamorro-Premuzic, S. von Stumm, & A. Furnham (Eds.), *The Wiley-Blackwell handbook of individual differences*. London: Blackwell.

Yamasue, H., Abe, O., Suga, M., Yamada, H., Rogers, M. A., Aoki, S., et al. (2008). Sex-linked neuroanatomical basis of human altruistic cooperativeness. *Cerebral Cortex*, *18*, 2331–2340.

Zagorsky, J. L. (2007). Do you have to be smart to be rich? The impact of IQ on wealth, income and financial distress. *Intelligence*, *35*, 489–501.

Zawadzki, B., & Strelau, J. (2010). Structure of personality: The search for a general factor viewed from a temperament perspective. *Personality and Individual Differences*, *49*, 77–82.

Zimprich, D., Allemand, M., & Dellenbach, M. (2009). Openness to experience, fluid intelligence, and crystallized intelligence in middle-aged and old adults. *Journal of Research in Personality*, *43*, 444–454.

Zinbarg, R. E., Revelle, W., Yovel, I., & Li, W. (2005). Cronbach's α, Revelle's β, and Mcdonald's ω_H: Their relations with each other and two alternative conceptualizations of reliability. *Psychometrika*, *70*, 123–133.