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A General Factor of Personality (GFP) from two meta-analyses of the Big Five: Digman (1997) and Mount, Barrick, Scullen, and Rounds (2005)

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ABSTRACT

In two studies, we used structural equation models to test the hypothesis that a General Factor of Personality (GFP) occupies the apex of the hierarchy of personality. In Study 1, we found a GFP that explained 45% of the reliable variance in a model that went from the Big Five to the Big Two to the Big One in the 14 studies of inter-scale correlations ($N = 4496$) assembled by Digman (1997). A higher order factor of Alpha/Stability was defined by Conscientiousness, Emotional Stability, and Agreeableness, with loadings of from 0.61 to 0.70, while Beta/Plasticity was defined by Openness and Extraversion with loadings of 0.55 and 0.77. In turn, the GFP was defined by Alpha and Beta with loadings of 0.67. In Study 2, a GFP explained 44% of the reliable variance in a similar model using data from a published meta-analysis of the Big Five ($N = 4000$) by Mount, Barrick, Scullen, and Rounds (2005). Strong general factors such as these, based on large data sets with good model fits that cross validate perfectly, are unlikely to be due to artifacts and response sets.

1. Introduction

A recent hypothesis has been that a General Factor of Personality (GFP) occupies the apex of the hierarchical structure of personality in the same way that *g*, the general factor of mental ability, occupies the apex in the organization of cognitive abilities. Both empirical and theoretical reasons lead to the GFP. At the empirical level, personality scales are often found to be correlated, i.e., they are not orthogonal. For example, when Digman (1997) assembled 14 studies of inter-scale correlations in the Big Five (Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism), the mean inter-scale correlation was 0.26. Digman obtained two higher order factors: Alpha (Agreeableness, Conscientiousness, Emotional Stability) and Beta (Extraversion, Openness), which he associated with socialization processes and personal growth, respectively. Subsequently, DeYoung (2006) and DeYoung, Peterson, and Higgins (2001) replicated Digman's two-factor solution and re-labeled Alpha as Stability and Beta as Plasticity.

A theoretical reason for expecting a GFP comes from evolutionary life history theory. Thus, Rushton (1985, 1990) proposed that "one basic dimension – *K* – underlies much of the field of personality" (1985, p. 445). He extrapolated to people, Wilson's (1975) *r*–*K* theory of how organisms colonize territories and stabilize populations. Individuals and species genetically inclined to *r*-reproductive strategies produce more offspring but provide less parental care, while those inclined to *K*-reproductive strategies produce fewer offspring but provide greater parental care. Rushton (1985) dubbed his formulation, "differential *K* theory" and predicted that diverse personality traits, maturational speed, brain size, intelligence, attachment styles, longevity, sexuality, and fecundity would correlate together as a suite of characteristics genetically organized to meet the trials of life – survival, growth, and reproduction. Unlike conventional personality psychology, life-history theory predicts hierarchically organized traits, culminating in a single, harmonized super-factor.

Research has confirmed many predictions from differential *K* theory (Bogaert & Rushton, 1989; Figueredo, Vásquez, Brumbach, & Schneider, 2004; Templer, 2008). For example, among university students, Bogaert and Rushton (1989) found correlations between self-reported delinquency, sex guilt, mating effort (sexual permissiveness), general intelligence, and an aggregate of items assessing family size, maturational speed, longevity, altruism, and reproductive effort. The results held when three separate measures of family background were statistically controlled. Although the average correlation between single indices of *K* was low, aggregate measures were predictive of a general factor on which single items loaded an average of +0.31.

It was Musek (2007) who brought the GFP to theoretical center stage. He analyzed data from three samples of differently

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aged subjects across several assessment methods including self-reports and observer ratings. His measures included the Big Five Inventory, the Big Five Observer, the Positive Affect and Negative Affect Schedule, the Satisfaction with Life Scale, the Self-Liking and Competence Scale, and the International Personality Item Pool. Musek's analyses yielded first, Digman's (1997) Big Two, followed by a higher-order factor that explained 60% of the source variance. Individuals high on the GFP were emotionally stable, agreeable, conscientious, extraverted, and intellectually open, with a sense of well-being, satisfaction with life, and self-esteem.

The genetics and evolution of the GFP were discussed by Rushton, Bons, and Hur (2008) who found it accounted for 56% of the reliable variance in the Big Five factors, the EAS temperament traits of Emotional Stability, Activity, and Sociability, and measures of altruism and prosocial behavior. The results were robust across three samples – 214 university students in Canada, 322 pairs of adult monozygotic (MZ) and dizygotic (DZ) twins from the UK, and 575 pairs of 2- to 9-year-old twins from South Korea. Individuals high on the GFP were altruistic, open to experience, conscientious, sociable, agreeable, and emotionally stable. Analysis of the twin data showed the GFP had emerged by 2- to 3-years of age with 50% of the variance attributable to genetic influence and 50% to non-shared environmental influence.

In the present investigation we provide a complete test of the GFP hypothesis from two published Big Five meta-analyses. In Study 1, we re-analyze Digman's (1997) 14 sets of inter-scale correlations from which he extracted the Big Two of Alpha and Beta. In Study 2, we re-analyze a meta-analysis of inter-scale correlations from Mount et al. (2005).

2. Digman's data

Table 1 provides the 14 sets of inter-scale correlations from Digman's (1997) Appendix B. They are re-arranged here using the OCEAN mnemonic – Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N), the last being reverse-keyed as Emotional Stability (ES). Five are based on teachers' ratings of students, four use self-ratings by adults, two peer ratings, two the revised NEO PI-R, and one an alternative self-report instrument. The Alpha coefficients for the five factors from Costa and McCrae's (1992a) NEO PI-R Form S ($N = 1539$) are: O (0.87), C (0.90), E (0.89), A (0.86), and N (0.92).

We noted many discrepancies between the information Digman (1997) provided on the 14 samples and those reported in his sources. Perhaps Digman only cited the article closest to the data on which he was working. Regardless, Table 1 gives the numbers from Digman's Appendix.

1. Digman 1 (1994). Digman (1997) described this sample as 102 children assessed by teacher ratings with factor scores calculated as weighted components of standardized variables. However, we found no correlations or any sample specifics in the source, which described a re-analysis of two earlier studies by Digman.
2. Digman 2 (1994). Digman (1997) described this sample as 149 children assessed by teacher ratings. We found no correlations or any specific sample described.
3. Digman 3 (1963a). Digman (1997) described this sample as 334 children assessed by teacher ratings using "unpublished raw data," which we were unable to examine.

Table 1
Inter-scale correlations from 14 Studies of the Big Five factors (Adapted from Digman, 1997)

	Digman 1 (1994) ($N = 102$; Mean $r = 0.37$)				Digman 2 (1994) ($N = 149$; Mean $r = 0.33$)				Digman 3 (1963a) ($N = 334$; Mean $r = 0.33$)			
	O	C	E	A	O	C	E	A	O	C	E	A
O	–				–				–			
C	35	–			44	–			33	–		
E	37	−10	–		45	07	–		41	−10	–	
A	00	62	−48	–	−05	39	−30	–	14	65	25	–
ES	41	59	27	41	22	59	09	53	41	37	24	35
	Digman and Takemoto–Chock (1981) ($N = 162$; Mean $r = 0.42$)				Graziano and Ward (1992) ($N = 91$; Mean $r = 0.34$)				Yik and Bond (1993) ($N = 656$; Mean $r = 0.44$)			
O	–				–				–			
C	24	–			22	–			31	–		
E	66	−16	–		53	16	–		59	20	–	
A	−03	65	−26	–	22	64	29	–	38	66	35	–
ES	11	71	01	70	36	27	32	35	31	45	49	57
	John et al. 1 (1984) ($N = 70$; Mean $r = 0.30$)				John et al. 2 (1984) ($N = 70$; Mean $r = 0.27$)				Costa and McCrae 1 (1992c) ($N = 277$; Mean $r = 0.26$)			
O	–				–				–			
C	12	–			16	–			05	–		
E	35	43	–		33	26	–		56	19	–	
A	15	25	13	–	19	36	16	–	24	18	11	–
ES	10	28	37	59	07	26	36	41	12	42	22	44
	Costa and McCrae 2 (1992b) ($N = 227$; Mean $r = 0.44$)				Costa and McCrae 3 (1992b) ($N = 1000$; Mean $r = 0.26$)				Costa et al. (1991) ($N = 227$; Mean $r = 0.23$)			
O	–				–				–			
C	54	–			−02	–			−04	–		
E	46	25	–		40	27	–		43	22	–	
A	44	34	42	–	−02	24	04	–	−06	13	−07	–
ES	42	43	26	69	−02	53	21	25	−05	49	21	25
	Barrick and Mount (1993) ($N = 91$; Mean $r = 0.22$)				Goldberg (1992) ($N = 1040$; Mean $r = 0.13$)				Mean of 14 studies ($N = 4496$; Mean $r = 0.26$)			
O	–				–				–			
C	08	–			−03	–			20	–		
E	28	−03	–		24	04	–		43	12	–	
A	−17	25	−04	–	−09	13	06	–	10	39	05	–
ES	12	41	−03	34	−01	17	16	23	18	43	23	44

Decimal points omitted. Note. O = Openness; C = Conscientiousness; E = Extraversion; A = Agreeableness; ES = Emotional Stability.

4. Digman and Takemoto-Chock (1981). Digman (1997) described this sample as 162 children assessed by teacher ratings using factor correlations with an "oblique solution by promax." However, we found no correlation matrices in the source, which described eight samples, two by Digman using teacher ratings of children but with *N*s = 1723.
5. Graziano and Ward (1992). Digman (1997) described this sample as 91 adolescents assessed by teacher ratings. We found a different set of inter-scale values than Digman reported for this sample of 91, 11- to 14-year-olds (67% female, 35% African American), all rated on 40, 9-point adjective scales, with five factors extracted.
6. Yik and Bond (1993). Digman (1997) described this Hong Kong sample as 656 young adults assessed using self-ratings from which he selected variables to form Big Five composites. We found no inter-scale correlations in the three studies reported: one with 389 grade 12 students using US adjectives with five factors extracted; another with 284 secondary school students using "indigenous" adjectives with six factors extracted; and a third with 414 grade 12 students using the 83 adjectives common to Studies 1 and 2, with eight factors extracted.
7. John et al. 1 (1984). Digman (1997) described this sample as 70 young adults assessed using self-ratings. We found the inter-scale correlations were from the English version of a set of adjective ratings given to "highly verbal bilinguals" (32 Americans, 38 Germans) who completed them in both English and German.
8. John et al. 2 (1984). These data are from the same 70 young adults described in Sample 7, with the inter-scale correlations from the German version.
9. Costa and McCrae 1 (1992c). Digman (1997) described this sample as 277 mature adults assessed using peer-ratings based on the NEO PI-R. We found no inter-scale correlations in this book chapter which reported several analyses including two peer rating studies, but with *N*s of 142 and 91.
10. Costa and McCrae 2 (1992b). Digman (1997) described this sample as 227 mature adults assessed using peer ratings. We found no inter-scale correlations in the paper, which reported factor analyses of three sets of measures with one from Costa, McCrae, and Dye (1991) having *N* = 227 from peer ratings using the NEO PI-R. This latter citation is the same as for Sample 12.
11. Costa and McCrae 3 (1992b). Digman (1997) described this sample as 1000 mature adults assessed by self-report from the NEO PI-R. We found no inter-scale correlation in this source, which is the same as Sample 10 providing three data sets, but none with an *N* of 1000.
12. Costa et al. (1991). Digman (1997) described this sample as 227 mature adults by self-reports on the NEO PI-R. We found a table with Digman's inter-scale correlations but with *N* = 394.
13. Barrick and Mount (1993). Digman (1997) described this sample as 91 mature adults assessed by a self-report inventory. We found a different set of values for the inter-scale correlations and the source described 146 managers in a training program (68% male, mean = 43 years) who completed the Personal Characteristics Inventory, which did measure the Big Five.
14. Goldberg (1992). Digman described this sample as 1040 mature adults assessed using self-ratings. We were unable to examine these "raw data."

3. Mount et al.'s data

Mount et al. (2005) provided a meta-analysis of inter-scale correlations from four inventories assessing the Big Five: the NEO PI-R (Costa & McCrae, 1992a); the Hogan Personality Inventory (HPI; Hogan & Hogan, 1995); the Personal Characteristics Inventory (PCI; Mount, Barrick, & Callans, 1999); and the International Personality Item Pool (IPIP; Goldberg, 1999). The data for the NEO PI-R came from the test's normative sample of 1000 adults based on three subsamples: (a) a group of 405 men and women in the Augmented Baltimore Longitudinal Study of Aging (ABLSA) who completed the instrument in 1989 and 1990; (b) 329 ABLSA participants who completed the NEO PI-R by computer administration between 1989 and 1991; and (c) 1539 employees from a national study of job performance. The normative sample of 500 men and 500 women were selected from these groups and matched to the US Census projections for 1995.

The matrix for the Hogan Personality Inventory (HPI) consisted of a normative sample of 11,000 adults tested between 1984 and 1992. The HPI assesses seven rather than five personality dimensions, with Extraversion divided into two factors, Sociability and Ambition. In addition, there is a School Success scale. Mount et al. (2005) did not use this latter scale and they took the average of the correlation between Sociability and Ambition with each of the five factors from the other inventories to represent the correlations with Extraversion.

The matrix for Mount et al.'s (2005) Personal Characteristics Inventory (PCI) consisted of a normative sample of 4140 adults (Mount et al., 1999). The matrix for Goldberg's (1999) IPIP measure consisted of 486 adults assessed on the lexically derived Big Five (Saucier & Goldberg, 1998). Raters completed each item on a 5-point scale ranging from 1 = *very inaccurate* to 5 = *very accurate*.

Table 2 presents the results of Mount et al.'s (2005) meta-analysis. Across inventories the sample sizes differed from approximately 400–11,000, so each inventory was weighted as having the equivalent of a sample of 1000, thus avoiding the potentially biasing effects associated with any one inventory being larger than the others. The average of the observed correlations was obtained as well as the standard deviation (SD_r) for this value. Each observed correlation was corrected for measurement error in both variables using the artifact distribution based on the reliabilities reported by the test authors.

4. Strategy of analysis

In the current study we provide a close approximation to the ideal strategy outlined by Jöreskog (1993) for model testing. It is

Table 2
Mount et al.'s (2005) meta-analytic results for Big Five intercorrelations

Correlation	ρ	SD_ρ	90% CV	% Var.
Stability–Extraversion	0.24	0.02	(.22, .27)	72.0
Stability–Openness	0.19	0.12	(−.03, .34)	7.9
Stability–Conscientiousness	0.52	0.19	(.27, .73)	2.9
Stability–Agreeableness	0.42	0.13	(.26, .58)	7.8
Extraversion–Openness	0.45	0.00	(.45, .45)	368.1
Extraversion–Conscientiousness	0.17	0.11	(.04, .31)	10.5
Extraversion–Agreeableness	0.26	0.15	(.07, .44)	6.14
Openness–Conscientiousness	0.09	0.12	(−.06, .23)	8.1
Openness–Agreeableness	0.17	0.11	(.04, .31)	11.4
Conscientiousness–Agreeableness	0.39	0.14	(.21, .56)	7.6

Note. Number of samples in the analysis = 4; Total number of respondents across the samples = 4000; ρ = estimated true score correlation (corrected for sampling error and unreliability); SD_ρ = estimated true standard deviation for the correlation; 90% CV = estimated 90% credibility value for true score correlation;% Var. = percent variance in correlations accounted for by statistical artifacts.

one designated "strictly confirmatory" and is only rarely approximated. In this situation, prior theory and research point to the correctness of a single model, which is then tested in a representative sample and either accepted or rejected. In a second, cross-validation step, the same model is examined in another representative sample. If confirmed, it can be concluded that the model is generalizable. For the calibration sample we conducted a meta-analysis of Digman's (1997) 14 studies and for the validation sample we used Mount et al.'s (2005) meta-analysis.

5. Results

Table 1 provides the inter-scale correlations across Digman's 14 studies together with the unweighted mean of these ($r = 0.26$; $r = 0.29$ corrected for reliability). We performed a separate meta-analysis on each of the 10 sets of inter-scale correlations weighted by its inverse variance. As Table 3 indicates, only a small proportion of the variance in correlations was due to sampling error, suggesting considerable heterogeneity among the studies, a point reinforced by the large values for all 10 Q statistics. When effect size distributions are extremely heterogeneous, one strategy is to estimate the weighted mean of the correlations using a random effects model. In this instance, we estimated the median of the effect sizes instead, which prevents any undue weighting for size. We then used the estimates of the weighted means to provide a sensitivity analysis. In the event the medians and weighted means were highly similar (see Table 3).

We used maximum likelihood estimation procedures from LISREL 8.72 to test several models, with the median of Digman's 14 studies providing the calibration sample, Mount et al.'s (2005) meta-analysis the cross validation sample (Table 4), and the weighted mean of Digman's studies, a sensitivity analysis.

Table 3
Meta-analytic results for Digman's 14 studies of Big Five intercorrelations

Correlation	ρ	SD_ρ	90% CI	Q	% Var.	*Mdn*
Openness–Conscientiousness	.208	.0595	.094–.317	166.99*	9.18	.19
Extraversion–Openness	.413	.0562	.317–.500	147.68*	9.67	.42
Extraversion–Conscientiousness	.122	.0439	.037–.205	87.38*	16.05	.175
Agreeableness–Openness	.114	.0608	–.004–.230	174.40*	8.61	.07
Agreeableness–Conscientiousness	.413	.0817	.273–.537	322.23*	5.33	.35
Agreeableness–Extraversion	.051	.0621	-.070–.171	182.57*	8.20	.085
Emotional Stability–Openness	.188	.0554	.081–.290	143.48*	10.36	.12
Emotional Stability–Conscientiousness	.442	.0619	.340–.535	153.04*	8.77	.425
Emotional Stability–Extraversion	.231	.0436	.149–.310	86.25*	17.78	.23
Emotional Stability–Agreeableness	.438	.0566	.344–.523	150.21*	11.70	.41

Note. Total number of respondents = 4496; ρ = uncorrected estimate of the population correlation; 90% CI = 905 confidence interval; Q = heterogeneity statistic; % Var. = percentage variance in correlations due to sampling error.
* $p < .00001$.

With regard to fit indices, we followed the advice of Schermelleh-Engel, Moosbrugger, and Muller (2003) and utilized the root-mean-square error of approximation (RMSEA) with a cut-off close to .06, the non-normed fit index (NNFI) with a cut-off $\geqslant$.95, and the standardized root-mean-square-residual (SRMSR) with a cut-off close to .05. In order to provide an estimate of parsimony, we used the Consistent Akaike Information Criterion.

The two models with the best fits are presented in Fig. 1 and Table 4. First we estimated Model 2, which represented a strict version of Digman's two-factor model in which only Agreeableness, Conscientiousness and Emotional Stability were specified to load on Alpha, and only Extraversion and Openness on Beta. This model provided an adequate fit in the calibration and validation samples, but was slightly outside our cut-off criteria for close fit. The best fit was Model 1, a slightly less restrictive model, which permitted a small loading of Agreeableness on Beta. It was inferred from inspecting the modification indices for Model 2. Only the RMSEA fit index is slightly higher than ideal, and the SRMSR, which is particularly sensitive to miss-specified factors, met the criterion in both samples (see Table 4). So Model 1 is our preferred representation of the data.

In order to provide an unequivocal test of the existence of a general factor, we tested three further models in which no general factor was allowed and Digman's Alpha and Beta factors were specified to be uncorrelated. Model 3 was identical to our preferred

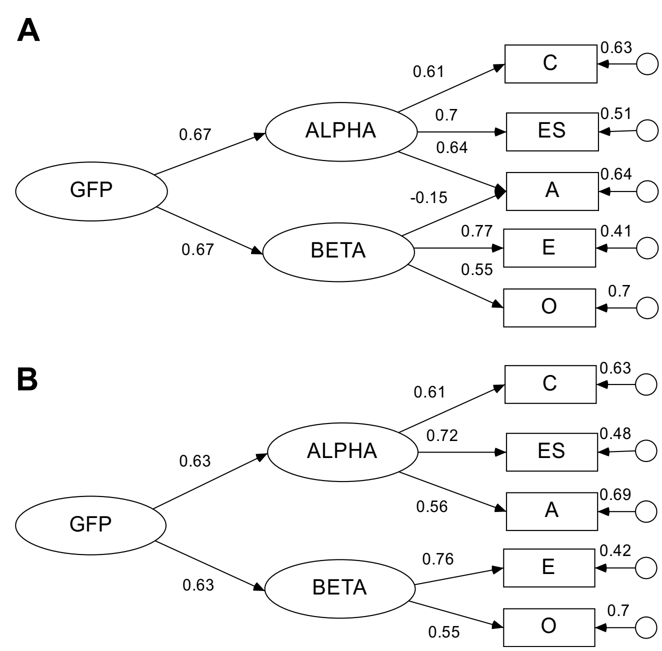

Fig. 1. (A) Preferred model of the structural hierarchy of personality from the Big Five through the Big Two to the GFP (Model 1); (B) Simple structure hierarchical model of personality (Model 2). Note. All reported estimates in the figure are based on medians derived from Digman's (1997) 14 samples.

Table 4
Fit indices for alternative models across different estimates of the population correlation matrix for the Big Five

Model		Digman –Medians					Mount et al. – Means					Digman – Weighted Means				
	df	χ^2	NNFI	RMSEA	SRMSR	CAIC	χ^2	NNFI	RMSEA	SRMSR	CAIC	χ^2	NNFI	RMSEA	SRMSR	CAIC
1. Preferred – GFP	3	61.6	.95	.066	.029	173.9	60.4	.95	.068	.050	170.8	80.6	.94	.076	.023	193.8
2. Simple – GFP	4	109.1	.93	.076	.036	212.5	108.8	.94	.081	.055	210.4	153.0	.91	.091	.039	255.3
3. Preferred – orthogonal	5	359.7	.80	.120	.100	443.3	295.7	.86	.120	.100	379.0	395.5	.80	.130	.110	477.1
4. Digman – Young	4	196.3	.86	.100	.066	296.9	313.5	.75	.160	.098	413.6	88.4	.93	..079	.044	200.7
5. Digman – Adult	3	91.5	.92	.081	.037	204.0	303.6	.76	.160	.093	404.4	113.4	.91	.090	.043	225.4

Model 2, but with the general factor excluded, while Models 4 and 5 corresponded exactly to Digman's confirmatory factor models for the youth and adult samples respectively. It is notable that all three models provided a poor fit to the data in both the calibration and validation samples. The poor fit of all three models provides strong evidence that there is no plausible alternative model, without a general factor, which provides an equivalent fit to the data as good as Model 1 (see Tomarken & Waller, 2003).

The final estimates of the correlation matrix based on a weighted mean of Digman's studies tests the sensitivity of our findings to different methods of analysis. Essentially the fit indices for these data provide exactly the same rank order of model fit. Hence, our conclusions were unaffected by different methods of estimating the Big Five matrix.

In our preferred Model 1 (Fig. 1A) the general factor of personality explains 44.9% of the variance in Digman's factor Alpha and Beta, i.e., 44.9% of the reliable variance. However, because there is substantial error in most of the indicators, this only translates into 19.4% of the scale level variance. The GFP accounted for a very similar 43.6% of the reliable variance in the Mount et al. (2005) data.

6. Discussion

The two studies reported here confirm the hypothesis that a General Factor of Personality (GFP) occupies the apex of the hierarchical structure of personality. Study 1 found the GFP in a re-analysis of the 14 sets of inter-scale correlations assembled by Digman (1997). Study 2 found the GFP in a re-analysis of the Big Five inter-scale correlations aggregated by Mount et al. (2005). Both studies also confirmed a second level that consists of the Big Two factors of Alpha (Emotional Stability, Conscientiousness, Agreeableness) and Beta (Extraversion, Openness), with the Big Five at the third level. We also found that models without a general factor, including both models specified by Digman (1997), simply do not fit either data set. Model fits such as those we have provided, based on large data sets with strong general factors that cross validate perfectly, are unlikely to be due to artifacts and response sets, which are typically not that consistent across respondents.

The existence of a higher-order GFP does not invalidate the clinical, vocational, or theoretical importance of lower-order factors. It is an empirical and practical question as to which level provides the best predictor for a given criterion. Since the personality facets that exist *below* the Big Five factors lie closest to the behavior expressed, they are often more diagnostic or better predictors than higher order traits (Sackett & Lievens, 2008). In other instances, however, aggregation across traits can enhance predictive power since it distills what they have in common and eliminates "noise" (Rushton, Brainerd, & Pressley, 1983). The principle of aggregation also applies to individual results. As Table 1 shows, any particular inter-scale correlation can be significantly negative and the mean in any one study very low. There were sink-holes, whirlpools, and possibly suppressor variables all over the place. However, by aggregating across correlations a stable picture of reality emerged.

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