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Higher Order Factors of Personality: Do They Exist?

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Scales that measure the Big Five personality factors are often substantially intercorrelated. These correlations are sometimes interpreted as implying the existence of two higher order factors of personality. The authors show that correlations between measures of broad personality factors do not necessarily imply the existence of higher order factors and might instead be due to variables that represent same-signed blends of orthogonal factors. Therefore, the hypotheses of higher order factors and blended variables can only be tested with data on lower level personality variables that define the personality factors. The authors compared the higher order factor model and the blended variable model in three participant samples using the Big Five Aspect Scales, and found better fit for the latter model. In other analyses using the HEXACO Personality Inventory, they identified mutually uncorrelated markers of six personality factors. The authors conclude that correlations between personality factor scales can be explained without postulating any higher order dimensions of personality.

Keywords: *personality structure; higher order factors; general factor; Big Five; HEXACO*

Research on the topic of personality structure has suggested that a set of several factors can account for the majority of the covariation among personality characteristics. There is not yet a consensus as to the exact number and precise nature of these factors. Many researchers favor the "Big Five" factors that became widely adopted during the 1980s and 1990s (e.g., Goldberg, 1990), but some researchers endorse a set of six dimensions called the HEXACO factors (Ashton & Lee, 2001, 2007). In any case, there is widespread agreement that there exist only a few large personality factors and that these factors can summarize the personality domain reasonably well.

The major dimensions of personality—whether those of the Big Five or those of the HEXACO framework—are generally conceptualized as being independent of each other. But when researchers construct self- or observer report instruments to assess these factors, the resulting scales are generally not mutually uncorrelated. Instead, there are usually substantial correlations among those scales, and the direction of the correlations is fairly consistent across samples and across inventories. For example, in the case of the Big Five factors, one frequently finds positive correlations among measures of Emotional Stability (i.e., low Neuroticism), Conscientiousness, and Agreeableness, and also between measures of Openness to Experience (a.k.a. Intellect/Imagination) and Extraversion (Digman, 1997).

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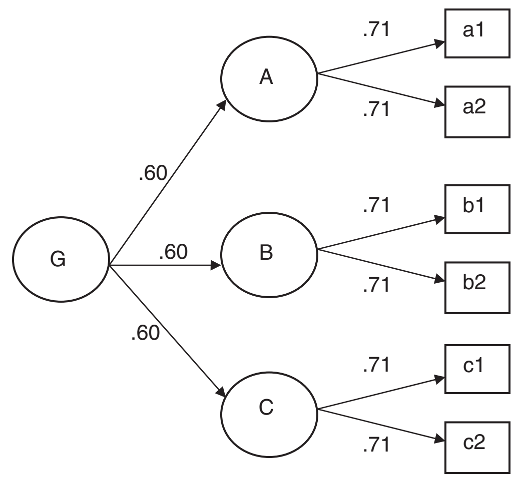
Some researchers have suggested that the substantial correlations among Big Five scales indicate the existence of one or more higher order factors. Digman (1997) proposed an "alpha" factor that accounts for the positive correlations among scales measuring Big Five Agreeableness, Conscientiousness, and Emotional Stability, and a "beta" factor that accounts for the positive correlations between scales measuring Big Five Openness to Experience and Extraversion.[1] Note that alpha and beta are supposed to capture most of the *common* variance that is shared by the Big Five dimensions, not most of the *total* variance of those dimensions; in other words, alpha and beta correspond to common factors, not to principal components.[2]

Digman's proposal of higher order personality factors has generated a substantial volume of research, including investigations of the heritability of those factors (Jang et al., 2006) and their external validity (e.g., Silvia et al., 2008). With regard to the meaning of the alpha and beta factors, Digman interpreted both factors as substantive personality dimensions, suggesting that alpha represented a broad socialization tendency and that beta represented a broad self-actualization tendency. At about the same time, however, Paulhus and John (1998) identified two broad factors of bias in self-evaluation, and the content of those factors closely resembles that of Digman's alpha and beta. Paulhus and John interpreted the former dimension as a moralistic bias (i.e., a tendency to overestimate one's dutifulness and cooperativeness) and the latter dimension as an egoistic bias (i.e., a tendency to overestimate one's social and intellectual status). These findings raise the possibility that the higher order factors identified by Digman might represent artifacts of evaluative bias rather than substantive dimensions of personality.

To test the substance and artifact interpretations, some researchers have examined the relations among measures of the Big Five in cross-observer investigations. The results of these studies have indicated that the correlations among the Big Five as assessed by a single source (whether self-reports or observer reports) are at least partly due to rating biases (e.g., Anusic, Schimmack, Pinkus, & Lockwood, 2009; Biesanz & West, 2004; DeYoung, 2006; McCrae et al., 2008). However, most of these studies (except that of Biesanz and West) have also indicated that the Big Five factors remain somewhat correlated even when these biases are accounted for, and that the alpha and beta factors do emerge as substantive higher order factors.

In this article, however, we consider an entirely different sense in which the alpha and beta factors may represent artifacts rather than substantive dimensions of personality. Even though the finding of correlations among measures of the Big Five factors does suggest the possibility of higher order factors, this finding might also be explained much more parsimoniously: If each Big Five scale tends to include some variables that represent same-signed blends of two or more factors, then those scales will tend to be positively intercorrelated, even if the higher order factors do not exist. These competing hypotheses about the nature of the correlations among Big Five scales have not yet been tested, and the purpose of this report is to provide such a test. We begin below by illustrating the two competing models, and we then conduct empirical tests of their ability to explain the structure of personality variable sets.



Correlations among the original variables

	a1	a2	b1	b2	c1	c2
a1	1					
a2	.50	1				
b1	.18	.18	1			
b2	.18	.18	.50	1		
c1	.18	.18	.18	.18	1	
c2	.18	.18	.18	.18	.50	1

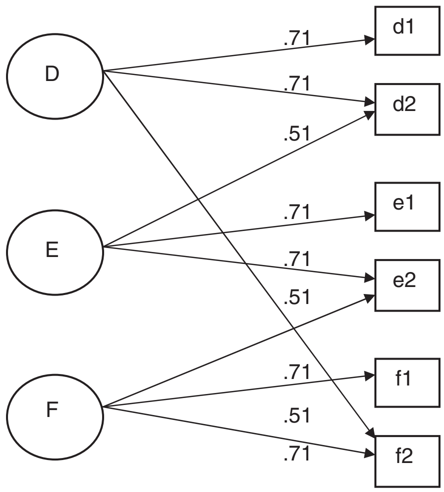
Correlations among the factor-level scales (not latent factors)

	a1 + a2	b1 + b2	c1 + c2
a1 + a2	1		
b1 + b2	.24	1	
c1 + c2	.24	.24	1

Figure 1 A hypothetical higher order factor model.

ILLUSTRATION OF THE HIGHER ORDER FACTOR MODEL AND BLENDED VARIABLE MODEL

In Model 1 (see Figure 1), six standard-scored variables (a1, a2, b1, b2, c1, c2) define three factors (A, B, C), which in turn define a higher order factor (G). As seen in Figure 1, each variable loads .71 on its (lower order) factor, each of which loads .60 on the higher order factor. Model 1 provides a perfect fit to the correlation matrix



Correlations among the original variables

	d1	d2	e1	e2	f1	f2
d1	1					
d2	.50	1				
e1	.00	.36	1			
e2	.00	.36	.50	1		
f1	.00	.00	.00	.36	1	
f2	.36	.36	.00	.36	.50	1

Correlations among the factor-level scales (not latent factors)

	d1 + d2	e1 + e2	f1 + f2
d1 + d2	1		
e1 + e2	.24	1	
f1 + f2	.24	.24	1

Figure 2 A hypothetical blended variable model.

shown in the first table within Figure 1. If a factor scale is computed for each of the three factors (in each case by computing the unit-weighted sum of its two defining variables), then each scale will correlate .24 with each of the other scales (see the second table within Figure 1). If one were to use those factor scales to define a higher order factor, then each scale would load .49 on that factor. (Note also that if one were to extract one common factor from the set of six variables, all variables would define that factor, with each variable having a loading of .50.)

In Model 2 (see Figure 2), there are again six standard-scored variables (d1, d2, e1, e2, f1, f2) that define three factors (D, E, F), and again each variable has a primary loading of .71. But in Model 2, the three factors are orthogonal, and there is no higher order factor; instead, this model incorporates three secondary loadings, such that d2 loads .51 on E, e2 loads .51 on F, and f2 loads .51 on D. Model 2 provides a perfect fit to the correlation matrix shown in the first table within Figure 2. If a factor scale is computed for each of the three factors (in each case by computing the unit-weighted sum of its two defining variables), then each scale will correlate .24 with each of the other scales (see the second table within Figure 2). If one were to use those factor scales to define a higher order factor, then each scale would load .49 on that factor. (Note also that if one were to extract one common factor from the set of six variables, all variables would define that factor, with loadings ranging from .37 to .64.)

The two models above are based on quite different correlation matrices, as comparison of Figures 1 and 2 will make clear. The models themselves describe structures that are profoundly different: In Model 1, there is a higher order factor that accounts for the correlations between what would otherwise be three oblique factors defined by variables a1 to c2. In Model 2, there is no such higher order factor; instead, the three factors defined by variables d1 to f2 are orthogonal, and some variables load on two factors. Yet, despite this fundamental difference between the two structural models, both variable sets produce a set of three factor-level scales that have an identical pattern of intercorrelations. If one were to consider those factor-level scales without reference to the underlying structure of their constituent variables, then one would conclude that the three factors define a higher order factor. However, this conclusion would be consistent with the underlying data only in the first of the two variable sets. In the other case, the higher order factor is spurious, appearing to exist only because the factor-level scales conceal the actual structure of the original variables.

The situation described above has obvious and serious implications for the idea of higher order factors of personality. In previous investigations, the alpha and beta factors have been derived from scores on broad factor-level scales assessing the Big Five, without examination of the actual structure of the narrower personality traits that constitute the Big Five scales. But, as shown in the analyses above, the existence of correlations among factor-level scales does not necessarily imply the existence of any higher order factor. This leaves open the possibility that the alpha and beta factors are artifacts, emerging only because analyses of the broad Big Five scales can conceal an underlying structure in which there are no higher order factors. If those broader scales each contain some variables that have substantial secondary loadings—thereby representing blends of two or more Big Five factors—then the correlations among the Big Five scales could be explained without invoking any higher order factors.

WHY ARE SOME BLENDS MORE COMMON THAN OTHERS?

The suggestion that the correlations among Big Five scales are attributable to "blended" variables raises an important question. If broad measures of the Big Five tend to incorporate some blended variables, then why is there not a rough balance between same-signed and opposite-signed blends, such that the overall Big Five scales would be approximately orthogonal to each other? First, it should be noted that some combinations of Big Five factors do indeed exhibit a rough balance between same-signed and opposite-signed blends (Hofstee, de Raad, & Goldberg, 1992). For example, many traits combine high levels (vs. low levels) of Big Five Extraversion and Big Five Agreeableness (e.g., friendly, warm vs. cold, impersonal), and many other traits combine high levels of one with low levels of the other (e.g., dominant, forceful vs. submissive, unaggressive). It is presumable that this balance reflects the roughly equal salience in person description of the two bisectors of Extraversion and Agreeableness: To know whether someone is warm or cold is about as important as it is to know whether someone is dominant or submissive.

For other sets of Big Five factors, however, there is a strong preponderance of same-signed blends over opposite-signed blends. Perhaps the most striking example involves the Big Five Agreeableness, Conscientiousness, and Emotional Stability factors. In lexical studies of personality structure, many adjectives show appreciable loadings of the same sign on all three factors. These adjectives tend to describe the extent to which an individual is well socialized as opposed to badly behaved: consider traits such as responsibility, politeness, and maturity versus their opposites (e.g., Ashton, Lee, & Goldberg, 2004). These characteristics, which are obviously of critical importance in person description, are much more prominent in the lexicon (and in personality inventories) than are traits that represent contrasts between these factors. The latter traits would generally be of roughly neutral social desirability—consider, for example, a blend of high Agreeableness with low Conscientiousness, or vice versa—and do not describe any socially crucial contrast between good and bad behavior.

Another set of factors for which there is a preponderance of same-signed blends over opposite-signed blends is that of Extraversion and Openness to Experience. For example, traits of originality, enthusiasm, or leadership generally fall within the high-Extraversion, high-Openness quadrant. In person description, these traits address the important issue of whether or not an individual has a high (vs. low) "social stimulus value," that is, the extent to which an individual can capture and keep the attention of others. In contrast, traits that involve opposite-signed blends of Extraversion and Openness to Experience—traits such as introspectiveness or meditativeness versus their opposites—do not answer such a critical question and are less salient in person description.

The arguments described above can provide some plausible reasons to expect that the correlations among Big Five scales might not be due to the influence of any hypothesized higher order factors such as alpha and beta. Instead, those correlations might reflect the special importance in person description of certain blends of orthogonal factors.[3] Because there are so many variables that represent those socially important same-signed blends, most scales developed to assess the Big Five will also tend to include some variables that represent such blends. As a result, those scales will generally be intercorrelated, unless great and unusual care is taken either to select univocal variables or to include a sufficient proportion of variables that represent opposite-signed blends (Saucier, 2002).

EMPIRICAL COMPARISON OF THE HIGHER ORDER FACTOR AND BLENDED VARIABLE MODELS

Our test of the higher order factor model and the blended variable model used the Big Five Aspect Scales (BFAS; DeYoung, Quilty, & Peterson, 2007). The BFAS was developed on the basis of a series of factor analyses of facet-level personality scales within each of the Big Five factors. Each of those analyses included six facet-level scales from the NEO Personality Inventory–Revised (NEO-PI-R; Costa & McCrae, 1992) and nine facet-level scales from the International Personality Item Pool Abridged Big Five Circumplex (IPIP-AB5C; Goldberg, 1999), using scores from Goldberg's Eugene-Springfield (Oregon) mixed-sex sample of community adults. In each of the five analyses, two factors were extracted and rotated. DeYoung et al. (2007) then selected IPIP items to assess each of the two subfactors or "aspects" obtained within each Big Five factor, and the resulting scales were then cross-validated in a second mixed-sex sample of Ontario university students.

Because the BFAS variables were derived from analyses of a wide range of facet-level variables within each Big Five factor, the two BFAS aspects from each Big Five domain are clearly distinct from each other, both conceptually and empirically. Moreover, the inclusion of only two scales within each Big Five domain is useful for this investigation, because this small variable set allows the specification of blended variable models in which relatively few secondary loadings are required. If instead each Big Five factor were defined by, say, 20 variables, then many secondary loadings would (obviously) be needed, even though the conceptual parsimony of the blended variable model would be unchanged. This would then complicate the interpretation of comparisons between the two models, because the blended variable model would have fewer degrees of freedom than would the higher order factor model.

CFA MODELS OF THE HIGHER ORDER FACTOR AND BLENDED VARIABLE HYPOTHESES

We compared the fit of the higher order factor and blended variable models to the two BFAS data sets reported by DeYoung et al. (2007) and to a third BFAS data set obtained for the purpose of this article. The first data set consisted of 481 adults of the Eugene-Springfield (Oregon) community sample, and the second consisted of 480 university students in Ontario (see DeYoung et al., 2007, for details of these participant samples). The third data set consisted of 230 university students in Alberta (68% women, median age 20 years). Appendix A shows the correlations and descriptive statistics for the BFAS variables in the Alberta sample.

Before comparing the higher order factor and blended variable models, we began with a baseline model in which all five factors were constrained to be orthogonal and in which each factor was defined only by its two constituent aspect scales, which were constrained to have equal loadings. To define the higher order factor model, we modified the original model to include two correlated higher order factors, alpha and beta, that influence the lower order factors. Specifically, we allowed the Emotional Stability (i.e., low Neuroticism), Agreeableness, and Conscientiousness factors to load on a higher order alpha factor. We also allowed the Extraversion and Openness to Experience factors to load on a higher order beta factor, with the loadings on beta constrained to be equal. We allowed the alpha and beta factors to correlate.

To define the blended variable model, we modified the baseline model to allow five secondary loadings on the basis of modification indices obtained from the Oregon sample. Specifically, we selected the first path with the largest modification index obtained from the baseline model and then selected the second path with the largest modification index obtained from the model with the first secondary path added. This procedure continued until five secondary loadings had been added to the original model. As a result, we allowed five secondary loadings of BFAS variables as follows: (low) Withdrawal, Industriousness, and Intellect on Extraversion, Enthusiasm on Agreeableness, and Politeness on Conscientiousness. The model with these secondary loadings was evaluated in the Ontario and Alberta samples as well as in the Oregon sample, which served as the derivation sample.

We should note that our aim in these analyses was to compare the relative levels of fit for the competing

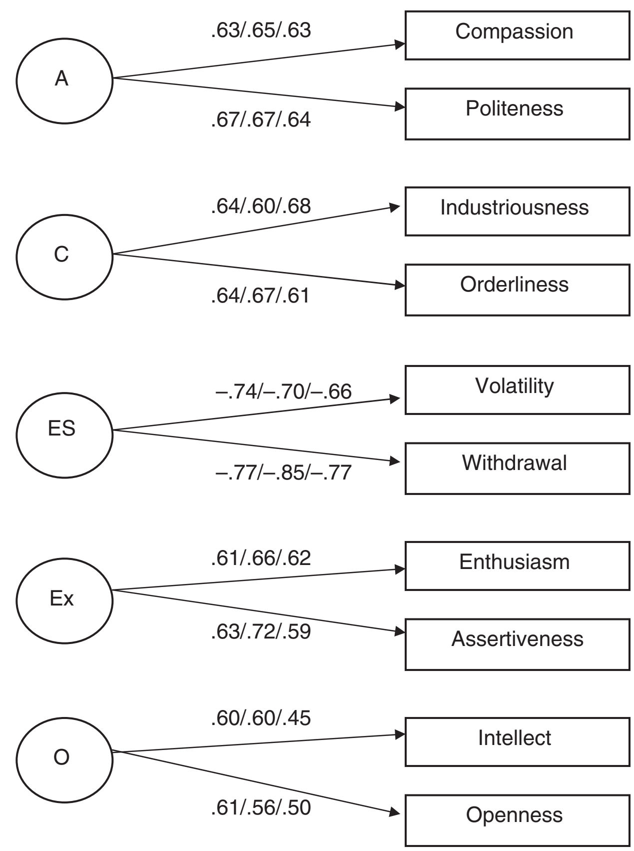


Figure 3 Original model applied to 10 Big Five Aspect Scales.
NOTE: See Appendix A for factor abbreviations. Values are standardized factor loadings (Oregon/Ontario/Alberta).
Oregon: $\chi^2(40) = 950.5$, SRMR = .195, CFI = .375, RMSEA = .218 (.206–.230).
Ontario: $\chi^2(40) = 957.0$, SRMR = .207, CFI = .391, RMSEA = .219 (.207–.231).
Alberta: $\chi^2(40) = 475.5$, SRMR = .196, CFI = .306, RMSEA = .218 (.201–.236).

models, and not simply to produce more complex models that will have particularly high absolute levels of fit. Absolute levels of fit are expected to be rather poor, for two reasons. First, because the personality domain is not characterized by true simple structure, most of the facet-level variables would show appreciable secondary loadings on one or more factors. Also, some pairs of aspects from different Big Five factors might reflect some areas of similar (or opposite) content not accounted for by the five large factors, with the result that there will be some residual correlations among those facets. But because our aim in this article is simply to compare the levels of fit for the higher order factor and blended variable models, we did not attempt to incorporate these various additional sources of covariance within the models below.

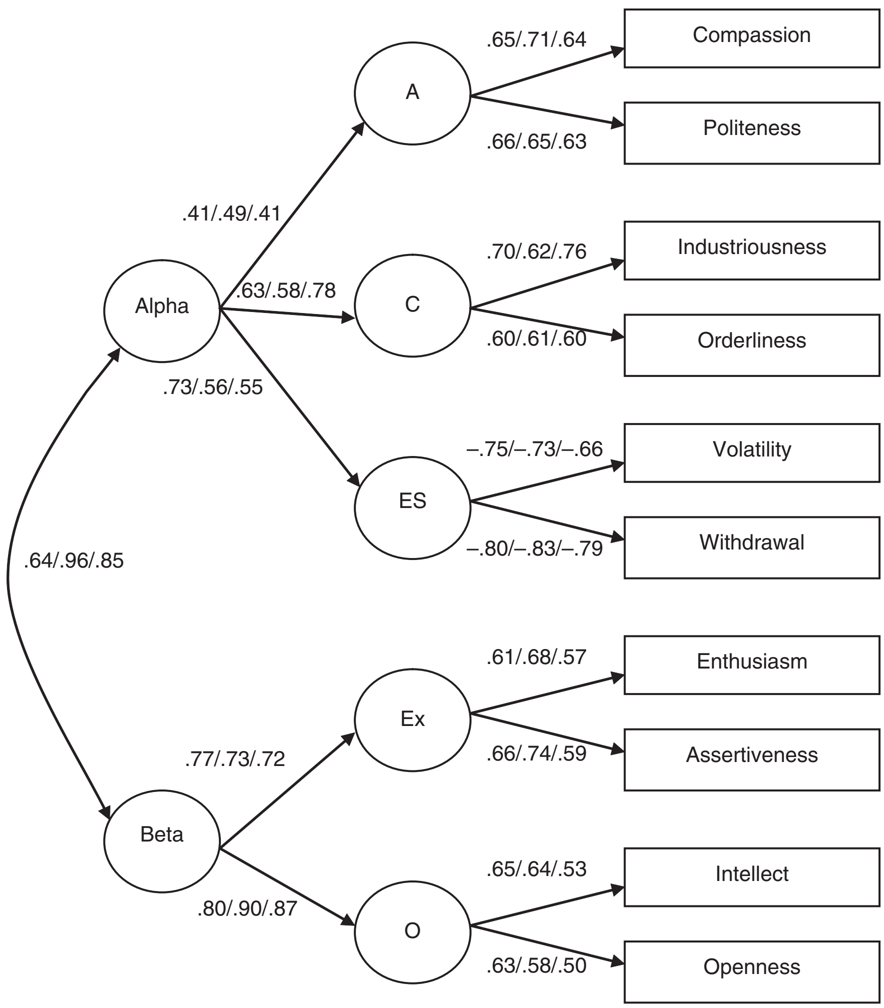


Figure 4 Higher order factor model applied to 10 Big Five Aspect Scales.
NOTE: See Appendix A for factor abbreviations. Values are standardized factor loadings (Oregon/Ontario/Alberta).
Oregon: $\chi^2(35)$ = 785.1, SRMR = .150, CFI = .485, RMSEA = .211 (.199–.224).
Ontario: $\chi^2(35)$ = 724.3, SRMR = .138, CFI = .542, RMSEA = .203 (.190–.216).
Alberta: $\chi^2(35)$ = 395.2, SRMR = .155, CFI = .426, RMSEA = .212 (.193–.231).

We conducted confirmatory factor analyses using AMOS 7.0 and maximum likelihood estimation, and we evaluated model fit in terms of the standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA) indices (Hu & Bentler, 1998). Figures 3, 4, and 5 show the results for the baseline model and the two competing models as applied to the BFAS in the three participant samples. In all three samples, the fit of the baseline model (i.e., orthogonal factors, no secondary loadings) was exceeded by that of the higher order factor model (ΔSRMR = .05, .07, and .04, and ΔRMSEA = .01, .02, and .01, for the Oregon, Ontario, and Alberta samples, respectively) and by that of the blended variable model (ΔSRMR = .08, .08, and .07, and ΔRMSEA = .06, .05, and .05, for the Oregon, Ontario, and Alberta samples, respectively). With regard to the differences between the higher order and blended models, all fit indices favored the blended variable model over the higher order factor model (ΔSRMR = .03, .01, and .03, and ΔRMSEA = .06, .04, and .05, for the Oregon, Ontario, and Alberta samples, respectively). Moreover, all three samples showed no overlap in the 90% confidence intervals for the RMSEA values. We should note that the superior fit for the blended model was observed not only in the Oregon sample (i.e., the derivation sample) but also in the Ontario and Alberta samples (i.e., the validation samples). These results indicate that the higher order factor model clearly has no advantage over the blended variable model in approximating the correlations among the 10 BFAS variables. On the contrary, the blended variable model provided a substantially better approximation than did the higher order factor model.[4]

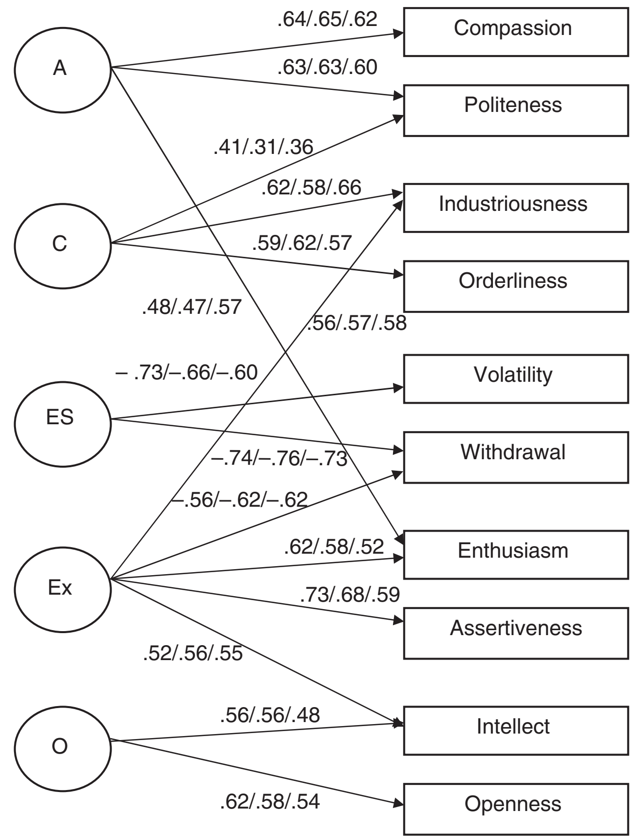


Figure 5 Blended variable model applied to 10 Big Five Aspect Scales.

NOTE: See Appendix A for factor abbreviations. Values are standardized factor loadings (Oregon/Ontario/Alberta).
Oregon: $\chi^2(35) = 437.32$, SRMR = .118, CFI = .724, RMSEA = .155 (.142–.168).
Ontario: $\chi^2(35) = 496.23$, SRMR = .127, CFI = .694, RMSEA = .166 (.153–.179).
Alberta: $\chi^2(35) = 252.10$, SRMR = .122, CFI = .654, RMSEA = .165 (.146–.184).

ON THE PARSIMONY OF BLENDED VARIABLE AND HIGHER ORDER FACTOR MODELS

As described above, our blended variable model of the BFAS had very few secondary loadings. This model was just as parsimonious, in terms of model degrees of freedom, as the higher order factor model. But we should note that the blended variable model in fact possesses vastly greater conceptual parsimony. On one hand, the blended variable model of Figure 5 merely postulated that some variables are influenced by two of the Big Five factors. On the other hand, the higher order factor model of Figure 4 actually postulated the existence of two additional causal factors, beyond the original five. (Recall that, because alpha and beta are hypothesized to represent higher order factors accounting for common variance of the Big Five, each of those constructs does indeed represent an additional causal entity.) From the perspective of understanding the relations among personality variables, the addition even of several secondary loadings is far more conservative than is the addition of the two entirely new causal entities that the higher order factors represent. Given this much greater conceptual parsimony of the blended variable model, it is striking that the inclusion of a few secondary loadings produced a greater improvement in model fit than did the inclusion of two correlated higher order factors.

MUTUALLY ORTHOGONAL MARKER VARIABLES: CFA OF 12 HEXACO-PI FACET SCALES

Our analyses of the BFAS variable set showed better fit for the blended variable model than for the higher order factor model. But, even the blended variable model showed only a mediocre level of fit, and this result reflects the fact that the BFAS does not contain any set of five mutually uncorrelated variables. This fact in turn raises the question of whether or not there exist any personality variable sets that correspond to the ideal blended variable model of Figure 2. If there do exist any sets of mutually uncorrelated markers of the major factors of personality—variables corresponding to d1, e1, and f1 of Figure 2—then this fact alone would gravely undermine the hypothesis of higher order factors. Consider the proposed alpha factor, which is defined by three of the Big Five factors. The influence of the alpha factor should produce positive correlations among all marker variables of those three Big Five factors. But if instead there exist three mutually uncorrelated marker variables of the three alpha-related factors, then each of those three variables must have negative residual correlations with *both* of the other two; that is, the three positive correlations implied by a higher order factor must be balanced by three negative residual correlations. Thus, the higher order factor model requires a very unparsimonious explanation of a simple fact: the existence of mutually orthogonal markers of the alpha-related factors.[5]

In the following section, we analyze a variable set that does contain mutually orthogonal markers of the major factors of personality.[6] This variable set consists of 12 facet-level scales from the short HEXACO Personality Inventory (HEXACO-PI; Lee & Ashton, 2004), in which each facet scale contains four items. Because the HEXACO-PI assesses six broad factors of personality, this instrument is especially interesting for these analyses: Not only does it contain the two factors within the space of the proposed higher order beta factor (i.e., Extraversion and Openness to Experience), but it also contains four—not just three—factors within the space of the proposed higher order alpha factor

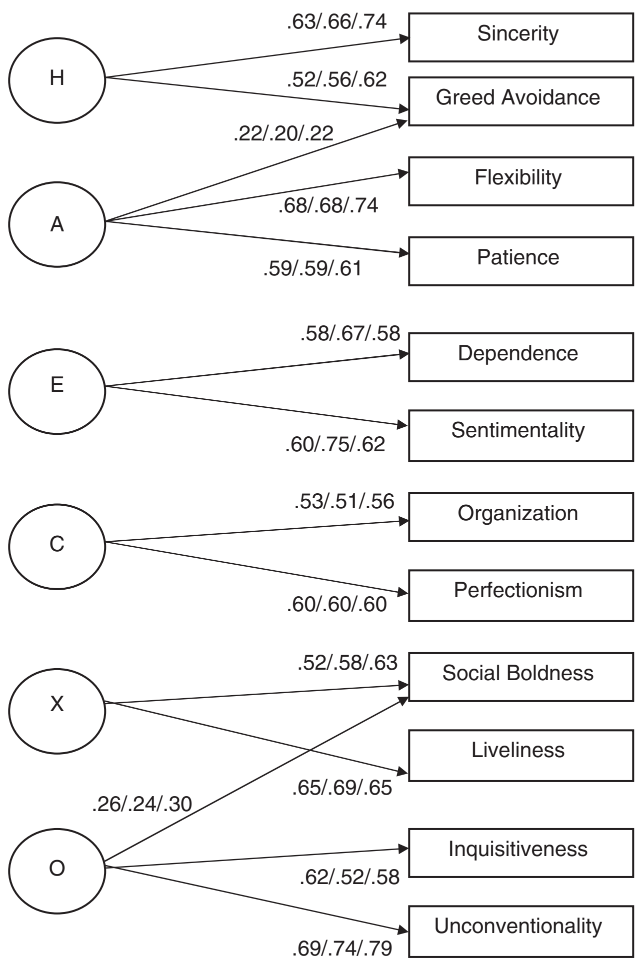


Figure 6 Blended variable model applied to 12 HEXACO Personality Inventory (HEXACO-PI)

NOTE: See Appendix B for factor abbreviations. Values are standardized factor loadings (Oregon/Canada/Netherlands).
Oregon: $\chi^2(58) = 295.76$, SRMR = .069, CFI = .744, RMSEA = .075 (.066–.083).
Canada: $\chi^2(58) = 638.03$, SRMR = .071, CFI = .757, RMSEA = .079 (.073–.084).
Netherlands: $\chi^2(58) = 168.00$, SRMR = .078, CFI = .794, RMSEA = .074 (.061–.087).

(i.e., Conscientiousness, Agreeableness vs. Anger, Emotionality, and Honesty-Humility).

We used data from the Oregon community sample (56% women, median age 48 years) to select 12 of the 24 HEXACO-PI facet scales, with the aim of obtaining a set of relatively pure markers of the factors. We then tested a blended variable model using this sample as well as two cross-validation samples, one consisting of 349 Dutch university students (82% women, median age 19 years) and the other consisting of 1,618 Canadian university students (70% women, median age 19 years).[7]

Correlations among the 12 variables in each of the three samples are shown in Appendix B, along with descriptive statistics. Notice that the correlations between facets of the same factor are all substantial and that facets representing different factors tend to be very weakly intercorrelated: for example, the six facets of Sincerity, Dependence, Liveliness, Flexibility, Perfectionism, and Unconventionality are all nearly mutually orthogonal. In the blended variable model (see Figure 6), we allowed each HEXACO-PI facet to define its intended factor, with the loadings of the two facets of each factor constrained to be equal. In addition, we specified the following two secondary loadings: Greed Avoidance on Agreeableness, Social Boldness on Openness to Experience.

The blended model provided a reasonably good fit to the data across all three samples (SRMR = .069, .071, and .078, and RMSEA = .075, .079, and .074, for the Oregon, Canadian, and Dutch samples, respectively). When we removed the constraint of orthogonality among the factors, the 15 observed correlations were generally small: Averaged across the three samples, no pair of factors showed an absolute average correlation reaching .20. When we attempted to fit higher order factor models—both the alpha/beta model and a general factor model—to the HEXACO-PI variable sets, those models either were unidentified or produced one or more negative variances (i.e., Heywood cases).[8]

The results reported above are extremely difficult to reconcile with the existence of a higher order alpha factor. Of special significance is the fact that there exist four essentially uncorrelated marker variables of factors within the space of the proposed alpha factor. If the alpha factor has any substantial influence on the lower order factors, then this suggests some appreciable positive correlations between the markers of different factors. The existence of four mutually uncorrelated marker variables must then be explained: Each of those four variables would need to have negative residual correlations with *all* of the other three; that is, the six positive correlations suggested by a higher order factor must be balanced by six negative residual correlations. Thus, the higher order factor model requires a wildly unparsimonious explanation of the near-zero correlations among these variables.[9]

COMPARISONS OF HIGHER ORDER FACTORS IN THE DOMAINS OF PERSONALITY AND MENTAL ABILITY

The results reported in this article have indicated that the blended variable model outperformed the higher order factor model in explaining the relations among personality traits making up the major factors of personality. But in contrast to this situation, there do exist other domains of individual differences whose structure is better summarized by a higher order factor model than by a blended variable model.

The most famous example of a higher order factor in any domain of individual differences is the *g* factor of general intelligence. Consider, for example, the highly diverse variable set that is represented by the Wechsler Intelligence Scale for Children–IV (WISC-IV; Wechsler, 2003). The 10 core subtests of this instrument are intended to define four index factors, which can in turn define a higher order factor (e.g., Watkins, 2006). By examining the data of the WISC-IV normative sample (N = 2,200), allowing those 10 subtests to define the four index factors, we can compare the fit obtained by introducing a higher order g factor with that obtained by introducing many secondary loadings. When we tested a blended variable model having 20 secondary loadings (i.e., 5 secondary loadings per factor), the fit of that model (SRMR = .126, RMSEA = .116) was far inferior to the fit of the higher order (i.e., g) factor model (SRMR = .024, RMSEA = .045). The relatively poor fit of the blended variable model—despite its many secondary loadings—reflects, in part, the fact that the four index factors are not defined by any set of four mutually uncorrelated subtests; instead, all of the correlations among these 10 WISC-IV subtests exceeded .20 in this normative sample.

The above result is typical of findings obtained when batteries of mental ability tests are administered to large and representative samples of participants. The apparent impossibility of constructing a set of several mutually uncorrelated markers of various factors of mental ability suggests that a g factor must be invoked to explain the structure of mental abilities.[10] This fact contrasts sharply with the situation in the domain of personality, where mutually orthogonal markers do exist, and where higher order factors are apparently not required.[11, 12]

ABOUT THE SOURCES OF PERSONALITY REPORTS

The analyses of this study, like those of most investigations of the correlations among factor-level personality scales, were based only on self-report data. One potential problem with the exclusive use of self-report data in such investigations is that even if higher order factors are obtained, one cannot determine whether those factors represent substantive trait covariation or merely artifacts due to biases in self-reports. This problem has little relevance for the present investigation: Our aim was to determine whether or not the higher order factor model would outperform the blended variable model in explaining the relations among variables that define the personality factors, regardless of the relative contribution of self-report biases to those relations. If the higher order factor model had shown superior fit in our analyses, then this would have raised the issue of rater biases in interpreting the meaning of alpha and beta. But, because the blended variable model outperformed the higher order factor model, this question is moot.

ABOUT “HIERARCHICAL” REPRESENTATIONS OF PERSONALITY

We should correct one common misunderstanding about the nature of higher order factors and of hierarchical representations of personality structure more generally. Although it is commonly observed that “personality structure is hierarchical,” it is important to distinguish between two entirely different senses in which personality structure is “hierarchical.” On one hand, one can describe a hierarchy of personality factor *solutions*, whereby one analyzes narrow personality variables (e.g., facet-level scales or even single items or adjectives), examining rotated solutions involving one factor, two factors, and so on in sequence (Goldberg, 2006). In Goldberg’s method, the correlations between orthogonal factor scores at adjacent levels (i.e., solutions) are depicted as path coefficients in a hierarchical diagram (e.g., Markon, Krueger, & Watson, 2005). On the other hand, one can describe a hierarchy of personality *constructs*, in which the lowest level involves single items (or adjectives), which define a higher level of narrow personality traits (e.g., facet-level scales), which in turn define broad personality factors such as the Big Five or HEXACO dimensions.

When researchers examine a hierarchy of factor solutions in analyses of narrow personality variables, it is sometimes observed that the two-factor solution includes (a) a broad factor defined by the variables that load on one or more of the Agreeableness, Conscientiousness, and Emotional Stability factors of five-factor solutions, and (b) another broad factor defined by the variables that load on one or more of the Extraversion and Openness to Experience of five-factor solutions. This result is sometimes taken as further support for the existence of two higher order factors (e.g., DeYoung, 2006). However, this finding is equally consistent with the possibility that there are no higher order factors at all: If there is a preponderance of certain same-signed blends of the Big Five factors, then the nature of the two largest factors will be determined accordingly. (An analogous situation is shown in the hypothetical data sets described earlier in this report: A large first factor was derived from variables d1 to f2 (see Figure 2) even though there was no higher order factor underlying those variables.) Thus, even if the level of five or six broad factors is the highest level of the *hierarchy of personality constructs*—such that there is no set of higher order factors above those five or six—one could easily observe an interpretable two-factor solution in a *hierarchy of personality factor solutions*. It is important to recall that the two largest factors derived from narrow personality variables are not higher order factors; a higher order factor is derived only from analyses of correlated lower order factors that are in turn obtained from analyses of narrower variables.

IMPLICATIONS FOR PERSONALITY ASSESSMENT

Our results have shown that there do exist mutually orthogonal marker variables of the major personality factors. However, scales measuring those factors tend to include many variables that are not orthogonal markers but rather same-signed blends of the factors. This situation raises the question of whether self-report (and observer report) personality inventories ought to be simple-structured instruments that exclude blended variables and instead include only factor-pure variables.

In our opinion, it would be unwise to insist that personality inventories should possess a near-perfect simple structure. Instead, personality inventories will represent the personality domain more fully if they assess several distinct facets of each of the major personality dimensions. If such facet-level variables are sampled broadly, then some of those variables should be roughly univocal markers of their factors. But if the facet-level variables are also sampled with a view to assessing subjectively important personality traits—those likely to have the strongest associations with socially significant criterion variables—then personality inventories will include many blended variables, and most of these will represent same-signed blends of factors, most of which are not neutral in social desirability. The inclusion of such traits will produce some departure from orthogonality between the factor-level scales of the inventory, but the unique variance of those traits will allow better prediction of some important criteria. It would seem unwise to exclude from personality inventories a facet-level trait such as Fairness (i.e., moral integrity) merely because it represents a complex blend of Honesty-Humility, Conscientiousness, and Agreeableness, or a facet-level trait such as Anxiety merely because it represents a complex blend of Emotionality, low Extraversion, and low Agreeableness.

Nevertheless, the aim of achieving broad sampling of the personality domain should be kept in mind. Suppose instead that the facet-level variables of an inventory were all sampled from the same regions of the personality space, so that they merely assess similar socially desirable combinations of the major factors. If this were the case, then the inventory would not predict a wide array of criteria; in particular, criteria associated with only one of the personality factors, or associated in "opposite" directions with two of those factors, would be poorly predicted. Moreover, much of the variance of the scales of such an inventory would be due to biases in self-reports (or observer reports) of personality—such as an overall "halo" bias (e.g., Anusic et al., 2009) or two distinct egoistic and moralistic biases (Paulhus & John, 1998)—thereby further limiting the validity of the inventory.[13]

CONCLUSION

Since the late 1990s, considerable research attention has been focused on the issue of higher order factors of personality. The proposal by Digman (1997) of two higher order factors, alpha and beta, has generated a substantial volume of research, as those higher order factors have been studied with regard to their heritability (Jang et al., 2006), their external correlates (e.g., Silvia et al., 2008), or their interpretation as substance or artifact (e.g., Biesanz & West, 2004; DeYoung, 2006; McCrae et al., 2008). However, previous investigations of higher order factors have not examined the question of whether the correlations among scales measuring the broad personality factors are truly due to higher order factors or merely due to variables that represent blends of orthogonal factors. The results of this research indicate that the relations among the personality traits that define the Big Five or HEXACO factors are better explained by the blended variable model than by the higher order factor model. These results therefore suggest that the observed relations among factor-level personality scales can be explained without postulating the

APPENDIX A
Means, Standard Deviations, and Correlations of the 10 Big Five Aspect Scales (BFAS) Variables in the Alberta Sample

Alberta Sample (*N* = 230)	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Volatility (low ES)	2.93	0.72									
2. Withdrawal (low ES)	3.00	0.62	.51								
3. Compassion (A)	3.99	0.54	.10	.07							
4. Politeness (A)	3.63	0.53	–.21	.09	.40						
5. Industriousness (C)	3.17	0.55	–.32	–.45	.12	.16					
6. Order (C)	3.38	0.61	.06	.06	.21	.19	.41				
7. Enthusiasm (Ex)	3.62	0.63	.02	–.19	.52	.18	.18	.17			
8. Assertiveness (Ex)	3.35	0.66	.00	–.44	.23	–.24	.36	.14	.37		
9. Intellect (O)	3.56	0.60	–.17	–.34	.15	–.05	.42	.07	.09	.47	
10. Openness (O)	3.74	0.55	.01	.12	.30	.19	–.09	–.15	.06	.09	.23

NOTE: ES = Emotional Stability; A = Agreeableness; C = Conscientiousness; Ex = Extraversion; O = Openness to Experience.

APPENDIX B
Means, Standard Deviations, and Correlations of 12 HEXACO Personality Inventory (HEXACO-PI) Scales

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11
Oregon sample (*N* = 734)													
1. Sincerity (H)	3.66	0.68											
2. Greed Avoidance (H)	3.44	0.84	.33										
3. Flexibility (A)	3.06	0.64	.02	.13									
4. Patience (A)	3.37	0.74	.05	.18	.40								
5. Dependence (E)	3.02	0.75	–.04	–.03	.00	–.15							
6. Sentimentality (E)	3.52	0.72	.06	.05	–.03	–.01	.35						
7. Organization (C)	3.59	0.76	.14	.00	.02	.00	.05	.07					
8. Perfectionism (C)	3.47	0.67	.03	–.04	–.16	–.11	–.05	.11	.32				
9. Social Boldness (X)	3.01	0.84	–.06	–.12	–.10	–.06	.08	–.09	.04	.00			
10. Liveliness (X)	3.65	0.68	–.05	–.01	.14	.17	.01	.04	.15	.03	.36		
11. Inquisitiveness (O)	3.63	0.80	–.09	–.02	.00	–.04	–.07	–.06	–.14	.07	.21	.17	
12. Unconventionality (O)	3.23	0.72	–.10	.02	–.04	–.04	–.05	.00	–.18	–.03	.21	.06	.43
Canadian sample (*N* = 1,618)													
1. Sincerity (H)	3.19	0.79											
2. Greed Avoidance (H)	2.73	0.94	.38										
3. Flexibility (A)	2.81	0.72	.07	.13									
4. Patience (A)	3.17	0.84	.09	.19	.41								
5. Dependence (E)	3.31	0.88	–.05	–.02	.05	–.11							
6. Sentimentality (E)	3.60	0.79	.04	.07	.05	–.07	.50						
7. Organization (C)	3.30	0.91	.10	.01	.04	.05	.06	.06					
8. Perfectionism (C)	3.52	0.77	.05	.01	–.14	–.04	.08	.11	.30				
9. Social Boldness (X)	2.99	0.91	.00	–.02	–.15	–.02	–.08	–.01	.05	.02			
10. Liveliness (X)	3.53	0.77	–.01	–.03	.07	.25	.08	.15	.10	.03	.40		
11. Inquisitiveness (O)	3.04	0.90	.06	.13	.02	.05	–.13	–.13	–.08	.05	.06	–.06	
12. Unconventionality (O)	3.46	0.64	.04	.14	–.06	.06	–.11	–.04	–.15	.01	.20	.04	.38
Dutch sample (*N* = 349)													
1. Sincerity (H)	3.27	0.73											
2. Greed Avoidance (H)	3.08	0.87	.45										
3. Flexibility (A)	2.88	0.64	.00	.14									
4. Patience (A)	3.27	0.78	.02	.17	.45								
5. Dependence (E)	3.61	0.73	–.06	.06	–.02	–.12							
6. Sentimentality (E)	3.66	0.68	–.04	.00	–.03	–.16	.36						
7. Organization (C)	3.10	0.80	.12	.08	.20	.07	.06	–.07					
8. Perfectionism (C)	3.39	0.75	–.02	–.05	.02	–.06	.05	.11	.33				
9. Social Boldness (X)	3.09	0.77	–.11	–.14	–.24	–.19	–.03	–.09	.07	.05			
10. Liveliness (X)	3.58	0.76	–.01	–.05	.02	.07	.06	.03	.06	–.04	.41		
11. Inquisitiveness (O)	3.08	0.82	–.05	–.04	–.03	.12	–.13	–.18	.05	.13	.14	.02	
12. Unconventionality (O)	3.42	0.61	–.07	–.02	–.17	–.02	–.11	–.05	–.14	.11	.25	–.02	.45

NOTE: H = Honesty-Humility; E = Emotionality; X = Extraversion; A = Agreeableness; C = Conscientiousness; O = Openness to Experience.

existence of the two additional causal entities represented by alpha and beta.

NOTES

1. More recently, other researchers (Musek, 2007; Rushton, Bons, & Hur, 2008) have proposed a general factor of personality that accounts for positive correlations among all of the Big Five factors.

2. The Big Five factors themselves have often been found in principal components analyses of personality variable sets constructed as markers of those factors (e.g., McCrae, Zonderman, Costa, Bond, & Paunonen, 1996). However, the Big Five are also recovered from those variable sets when exploratory common factor analysis is applied.

3. Here is one simple way to test the hypothesis that same-signed blends of the Big Five personality factors are more important in person description than opposite-signed blends: Participants would be given the descriptions of personality traits representing same-signed and opposite-signed blends of the Big Five factors (e.g., from the AB5C system; see Hofstee, de Raad, & Goldberg, 1992) and would be asked to rate the importance of assessing individuals' levels of each trait in various contexts (e.g., as potential employee, babysitter, roommate, romantic partner, etc.). We hypothesize that ratings would be higher for the same-signed blends than for the opposite-signed blends, particularly in the regions of the personality space that correspond to alpha and beta.

4. The very high correlations between alpha and beta—ranging from .64 in the Oregon sample to .96 in the Ontario sample—reflect the fact that the correlations of alpha-related Big Five factors with beta-related Big Five factors were generally almost as large as the correlations between alpha-related factors and between beta-related factors. Because the weak distinction between alpha and beta suggested the possibility of a general factor, we also repeated the analyses of Figure 5 with a single higher order factor instead of alpha and beta. The fit of the general factor model in the three samples (SRMR = .148, .137, and .152, and RMSEA = .210, .202, and .210, for the Oregon, Ontario, and Alberta samples, respectively) was similar to that of the alpha/beta model and, thus, much poorer than that of the

blended variable model. The general factor model, like the alpha/beta model, does not explain the finding of several near-zero correlations among BFAS variables.

Because the strong link between alpha and beta contributed strongly to the fit of the higher order factor model, we did not restrict the blended variable model to exclude secondary loadings of an alpha-related variable on a beta-related factor and vice versa. For the sake of completeness, we did compare a higher order factor model based on uncorrelated alpha and beta factors with a blended variable model in which the four secondary loadings did not cross between alpha-related and beta-related factors. The blended variable model again showed better fit than did the higher order factor model in all three samples. (Details of this analysis are available from the authors upon request.)

5. Of course, the variables must be scored independently. Their intercorrelations will be artificially depressed if, instead, the scores have been standardized within subjects or if one or more scales contrasts one trait with other traits (whether through an ipsative item format, through heterogeneous item content, or through "double-barreled" items). In addition, if the scales are not at least roughly balanced for the direction of keying of their items, then intercorrelations between scales having positively keyed items and scales having negatively keyed items will also be artificially depressed.

6. We thank an anonymous reviewer for suggesting this analysis.

7. The latter sample subsumes the sample of Alberta university students used in analyses of the Big Five Aspect Scales.

8. The only case in which neither of these problems occurred was that of the general factor model in the Dutch sample. However, this general factor was loaded by high Agreeableness and high Honesty-Humility along with low Openness to Experience and low Extraversion. The opposing signs of these loadings are inconsistent with the definition of the general factor of personality as described elsewhere (e.g., Musek, 2007).

9. By extension, the hypothesis of a general factor of personality is rendered even more implausible by the existence of six mutually uncorrelated variables representing the six HEXACO factors.

10. Contemporary objections to the *g* factor are not based on any claim that there exist mutually uncorrelated markers of the major aspects of mental ability, but rather on the use of the common factor model itself, and in particular the problem of factor indeterminacy (see Schönemann, 1997).

11. It is, of course, possible to construct a personality variable set in such a way as to produce an apparent higher order factor, simply by ensuring that each marker variable of the lower order factors is actually a same-signed blend of each of those factors. (In fact, such a variable set will tend to occur by default if the researcher includes only those variables that are highly desirable or undesirable.) But again, the fact that one can identify sets of mutually uncorrelated marker variables suggests that such a higher order factor is spurious. (Note that some previous studies—Church and Burke (1994) and McCrae et al. (1996)—have demonstrated that the addition of many secondary loadings allows models of orthogonal personality factors to produce levels of fit approximating those of models of oblique personality factors; however, those studies did not explicitly identify mutually orthogonal marker variables.)

12. In contrast to the situation for the personality domain as a whole, there are no sets of several mutually uncorrelated variables within the subdomain of any one broad personality factor. As one example, consider the five sets of 15 facet-level scales (i.e., 9 IPIP-AB5C and 6 NEO-PI-R) analyzed by DeYoung, Quilty, and Peterson (2007); each of these variable sets consists of facet-level scales that are primarily associated with the same Big Five factor. In the Oregon participant sample, none of those five variable sets contained even one set of 3 facet-level scales whose intercorrelations were all below .15.

13. It is presumed that rater biases can be identified for any personality variable, regardless of its social desirability. But, when an inventory consists mainly of variables that represent certain same-signed blends of factors—blends that tend to represent highly desirable traits—then rater biases associated with those sets of correlated traits will become large sources of variance across the scales of the inventory. (See Bäckström, Björklund, and Larsson, 2009, for a measure of the Big Five in which variance due to rater biases associated with socially desirable traits has been minimized.)

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