Factor-Analytic Investigations of Personality Structure:

Do Data Take the Shape of Your Measure?

BY

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THESIS

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As Wallace Stegner has said, “there is a sense in which we are all each other’s consequences.” This thesis is dedicated to the entire community of people who have shaped me over the years, with a special acknowledgement to those who have supported me and believed in me through a particularly difficult time: Nicole Mayer, Gregory Bartoszek, E. Sam Winer, and above all, Mark Relyea and Daniel Cervone. Thank you for allowing me to grow as a consequence of your presence.

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SUMMARY

Since the early 1960s, the primary tool for identifying individual differences in personality structure has included the use of factor analysis to identify a small but interpretable number of dimensions that summarize the inter-individual differences in the participants' qualities. Many researchers have interpreted these factor-analytic dimensions as being psychological structures that exist in the mind of individual persons and are causally responsible for the observed variations in psychological characteristics. An alternative interpretation is that the analysis of language-based data primarily yields information about the structure of language. Semantic overlap between items contributes to the obtained correlations among test items and thus influences the resulting factor structure. In principle, the semantic overlap may be *sufficient* to account for the resulting factor structure.

This latter possibility is tested in a novel manner in the present thesis using a computer simulation. At the outset of the simulation, each member of a population of respondents has no personality characteristics (Study 1) or they have a personality structure that is distinct from the most commonly accepted dimensional model of personality structure, the Big Five model (Study 2). Test item responses are then updated as a function of semantic overlap among test items. The empirical question addressed is whether this semantic updating is sufficient, subsequent to factor analysis, to generate traditional factor-analytic personality structures.

The computer simulations do indeed show that in both populations, semantic connections between the items are sufficient to reliably produce a factor-analytic structure that largely coincides with the Big Five. These studies suggest that lexical redundancy or semantic overlap within a measure can indeed shape or re-shape the data collected to reflect the structure entailed within the measure, regardless of whether that structure was present in the original population.

I. INTRODUCTION

A. Background

Since the early 1960s, the primary tool for identifying individual differences in personality structure has been factor analysis (Cattell, 1966). In the most common factor-analytic strategy, a large number of psychological qualities are assessed in a large number of research participants, and factor analysis is used to identify a small but interpretable number of dimensions that summarize the inter-individual differences in the participants' qualities (Cattell, 1965).

This methodology has had profound effects on psychological theory. In one of the two main branches of theory and research in personality psychology in recent decades (Cervone, 1991), many researchers have interpreted the factor-analytic dimensions as being psychological structures. The presumption, in short, is that the statistical factors correspond to psychological structures that exist in the mind of individual persons. This leads to the theoretical interpretation in which parametric variations in these structures are causally responsible for the observed variations in psychological characteristics. The statistical tool is thus seen as yielding an answer to the question of which basic structures constitute the core of human personality.

B. Language and the Data of Personality

Importantly, the most common information source in these investigations has been language-based. Participants describe themselves, or describe others, in terms of brief statements that characterize psychological tendencies or preferences. A common personality questionnaire, the NEO Five Factor Inventory (NEO-FFI), asks respondents the degree to which they agree or disagree with statements such as *I am not a worrier, I really enjoy talking to*

people, and *I work hard to accomplish my goals.* The use of language-based data implies that there are two ways to interpret personality data.

One interpretation is the one stated above: that the results of data analysis yield information about the true structure of personality. In this interpretation, the structure of language is believed to mirror the structure of the world in many cases (Goldberg, 1981). Under the assumption that language mirrors the structure of the world in this particular instance, the statistical factors should indeed correspond to independently-existing structures of personality.

The other interpretation is that the analysis of language-based data primarily yields information about the structure of language (e.g., Shweder, 1975). In a multi-item assessment of personality using language-based statements, it is likely that statements will overlap semantically; similar (or nearly opposite) words and phrases will appear in different test items. The semantic overlap is likely to contribute to the obtained correlations among test items and thus influence the resulting factor structure. In principle, the semantic overlap may be *sufficient* to account for the resulting factor structure.

This latter possibility is tested in a novel manner in the present thesis using a computer simulation. At the outset of the simulation, each member of a population of respondents has no personality characteristics; that is, they respond to the personality questionnaire items randomly. As the program to be presented iterates, test item responses are updated as a function of semantic overlap among test items. The empirical question addressed is whether this semantic updating is sufficient, subsequent to factor analysis, to generate traditional factor-analytic "personality structures."

This possibility is investigated in the context of the most commonly accepted dimensional model of personality structure, the "Big Five" model (Goldberg, 1993).

C. The Big Five Model

By 1990, a number of researchers in the field of personality psychology were suggesting that the fundamental structure of personality had been "discovered" (John, 1990; Digman, 1990; Goldberg, 1993). This robust structure was said to consist of the Big Five factors, then labeled *Surgency, Agreeableness, Conscientiousness, Emotional Stability versus Neuroticism,* and *Openness to Experience* (we are now more familiar with the terms *Extraversion, Agreeableness, Conscientiousness, Neuroticism,* and *Openness to Experience*). These factors were described as a universal and comprehensive structure for personality assessment (McCrae, 1989; McCrae & Costa, 1986) and the structural nature of these five factors was supported by the "emergence" of the factors from personality data by means of factor analysis, which was construed as objective, mathematical evidence for both the existence and importance of these five specific components of personality. Some advocates of the five factor approach even went so far as to claim that the existence of these five factors "…is an empirical fact, like the fact that there are seven continents on earth or eight American presidents from Virginia" (McCrae & John, 1992, p. 194).

However, despite widespread support of the Big Five and increasing use of the Big Five factors in research, some scientists (see, e.g., Eysenck, 1992; Pervin, 1994), notable among them Jack Block (1995), questioned the means by which the Big Five rose to this particular prominence. Two broad areas of concern include the ***interpretation*** of factor analytic results as *de facto* evidence for the substantive nature of those factors and the ***assumptions*** of factor analytic results which require that the indicator variables are locally independent, an assumption which does not appear to be met in the case of the Big Five. The current research first examines the logical and semantic relationships between items in a 60-item version of a Big Five personality inventory, the NEO Five Factor Inventory (NEO-FFI), and then uses computer

simulations to show that these inter-item relationships alone are sufficient to recover a factor structure very similar to the Big Five. A separate simulation demonstrates that even in a population with a personality structure that is *distinct* from the Big Five, enforcing logical coherence among the items results in a factor structure largely resembling the Big Five rather than reflecting the personality structure of the population.

D. Interpreting Factor Analytic Results

Block (1995) outlined a number of concerns with the ***interpretation*** or application of the results of a factor analysis, suggesting that rather than factor analysis leading to a discovery of inherent *structural* dimensions, these dimensions may instead be inherent to or entailed by the *variables* that are themselves analyzed (p. 189). Block reminds us that at its core, factor analysis represents groupings of items based upon common or shared variance. Thus, items with high redundancy will be identified as a factor *regardless* of the importance of these items outside of the dataset being analyzed—the factor may predict important behaviors and outcomes such as longevity or well-being, or it may merely be a collection of highly inter-related items that are highly related to nothing more substantive than left-handedness. Because factor analysis is based upon the shared variance of the items being analyzed rather than an objective truth outside of the items themselves, one can change the number, size, and supposed importance of various constructs merely by altering the distribution of shared or redundant variance among the items being analyzed. In this way, the items themselves may be, in Block's terms, "prestructured," resulting in a factor-analytic structure which is "entailed" within the specific items of the measure rather than substantive.

It is important to note that the same redundancy between variables within a measure that can entail a factor structure also leads to other characteristics of a measure which are typically

considered desirable. Reliability of the scores within each factor, often measured by Cronbach's alpha, is increased by omitting items that tap into alternate or additional facets of the construct being measured (that is, those items which have lower redundancy) and by increasing the number of items with redundant content. The use of reliability measures such as Cronbach's alpha in factor-level measure construction or refinement, while a common practice, thus also tends to increase the degree to which a structure is entailed within the items. This is an unfortunate and possibly unnecessary practice. As Schmitt (1996) points out, it would be reasonable to lower the bar for acceptable alpha values to allow for alphas as low as .49—a level that corresponds to a possibly validity of 0.70—particularly when "a measure has other desirable properties, such as meaningful content coverage of some domain and reasonable unidimensionality" (p. 352). In addition, redundancy of content within the items of each factor, by virtue of entailing a structure within the items, leads to a perceived robustness of the factor structure across time, across samples, and across cultures. This robustness, commonly interpreted as a marker of validity and substantive findings, can then become a shaping force that reinforces the redundancy patterns between items in the process by which such measures are created, revised, adapted, or reduced to create shorter forms. These revised and short forms, with a more concentrated redundancy, are then used as additional evidence for the reliability, robustness, and ultimately the substantive nature of the factor structure that results.

In these ways, even a researcher with no intention of deliberately entailing a structure into a new measure by means of semantic overlap might easily and inadvertently reinforce an entailed structure during the iterative process of measure construction and refinement simply by following their data. We must thus be careful not to ***interpret*** the mathematical structure of a factor analysis as necessary and sufficient evidence for the substantive nature of that structure.

As Thompson and Daniel (1996) remind us, scholars increasingly concur that "no analytic methods, including factor analysis, dictate to us what our constructs or theories are" (p. 202) and that our constructs must be grounded in theory, rather than in data. Although common, this view is not universal; other scholars, Thompson and Daniel among them, believe that analytic results can indeed contribute to the process of theory building. However, note that this view still holds researchers responsible for their theoretical grounds, and merely acknowledges that the process of theory development and refinement can be informed by measurements collected along the way (Thompson & Daniel, 1996). These scholars add that not only are researchers responsible for their theoretical grounding, but they are further responsible for testing the validity boundaries for their scores against plausible alternative hypotheses and serious efforts to *disconfirm* the theory (Thompson & Daniel, 1996).

In the specific case of the Big Five, Block (1995) illustrates several instances in the development of the various measures and factors that point toward prestructured entailment amidst a lack of efforts at disconfirmation or to explore plausible alternative hypotheses. The Big Five originated with a list compiled by Allport and Odbert of 4,504 potential personality traits—a list drawn from standard dictionaries specifically to represent concepts that were theorized to be important by virtue of being included in the human lexicon. In 1943, Cattell added in terminology from the field of psychology relevant to both syndromes and personality constructs—by this act, already stretching or even violating the theoretical basis of the work—and then further personally reduced the list of potential trait descriptors from over 4,500 to a computationally tractable 35 bipolar dimensions. Only these 35 items formed the basis of further work in the field, but as Block (1995) points out, despite being meant to represent the original list of over 4,500 traits, these items already embodied a degree of semantic entailment. Tupes

and Christal's 1957 analyses of datasets using Cattell's 35 items led to factors defined or partially defined by the following groups of labels: Factor one: *secretive, silent, self-contained or reclusive, sociable,* and *talkative.* Factor two: *composed, calm, placid,* and *poised.* Factor three: *good-natured, cooperative*, and *mild*. Factor four: *artistic, imaginative, intellectual.* Factor five: *responsible, scrupulous,* and *seeing a job through in spite of difficulties or temptations.* Within each of these factors, one can already identify semantic redundancy that might have contributed to an entailed structure.

In 1963, Norman then chose 20 items—four items from each factor to best capture that factor—to represent the five factors found by Tupes and Christal. Concerned that these five factors might omit some important concepts, Norman expanded the list of potential trait descriptors to a new list of 2,800 (including the 4,504 items from Allport and Odbert's original list and 175 new items, reduced to exclude items he believed to be physical, obscure, ambiguous, or purely evaluative) which was then reduced again to a little over 1,400 traits based on feedback from undergraduates (Block, 1995, p. 195). Unfortunately, at this point the attempt to test rather than to merely confirm the working theory that there were only five factors of personality went a bit awry. Norman personally sorted all 1,400 traits into the existing five factors found by Tupes and Christal based upon his own understanding of the factors. At the end of this process, only 25 of the 1,400 terms were left unclassified into these Big Five factors and Norman's published work contained only the 20 items chosen specifically to represent the five factors that had been previously identified.

Work on the Big Five progressed from these starting points, but it is clear that, while McCrae and Costa were opposed to including semantic redundancy for the purpose of creating a semantic consistency scale within their Big Five protocols as a validity check (Kurtz & Parrish,

2001), nevertheless, semantic redundancy reinforcing the Big Five factors was a large influence in the development of these Big Five personality inventories. Indeed, more than one researcher along the way reported including the use of *cluster-sampling*—the "systematic omission of those [variables] located in interstitial regions between the clusters" (Goldberg, 1992, p. 28)—in their process of testing the five factor structure of personality. Thus, rather than testing the hypothesis that these five factors were sufficient by exploring possible alternatives, these various researchers instead reinforced and affirmed the existing structure.

E. Assumptions of Factor Analysis

A second broad area of concern revolves around the ***assumptions*** that are implicitly made when using a factor analytic method. There are a few psychological constructs, such as socio-economic status (SES), which are conceptualized using a *formative* model—in this example, SES is believed to be an *effect* of the observable or indicator variables such as education, income, and occupation (Edwards & Bagozzi, 2000; Schmittman, Cramer, Waldorp, Epskamp, Kievit, & Borsboom, 2013). However, most constructs in psychology are theoretically understood as *reflective*, in which the observed values of the indicator variables are *caused* by the construct. In this model, there may be measurement error associated with each indicator variable, but each indicator is treated as an independent measure of the latent variable, similar to the way various thermometers may be used to measure temperature. As a consequence, one may theoretically measure the latent variable with any number or combination of indicator variables without changing the qualitative nature of the measurement. Importantly, in this model, correlations between items are assumed to be due entirely to the shared influence of the latent construct, and thus each item is assumed to be locally independent from the other items—in other words, it is assumed that there are no direct connections between items. This reflective model is the model

that is implicit in common factor analysis (Edwards & Bagozzi, 2000), the technique that has been used to identify the Big Five factors.

A third model of the potential relationship structure between items has been more recently proposed (see, for e.g., Schmittman *et al.,* 2013; van der Maas *et al.,* 2006). This model represents a dynamic network of direct causal relationships between items. In this model, the correlations between the items are due directly to the network of relationships between those items. These three perspectives are illustrated in Figure 1.

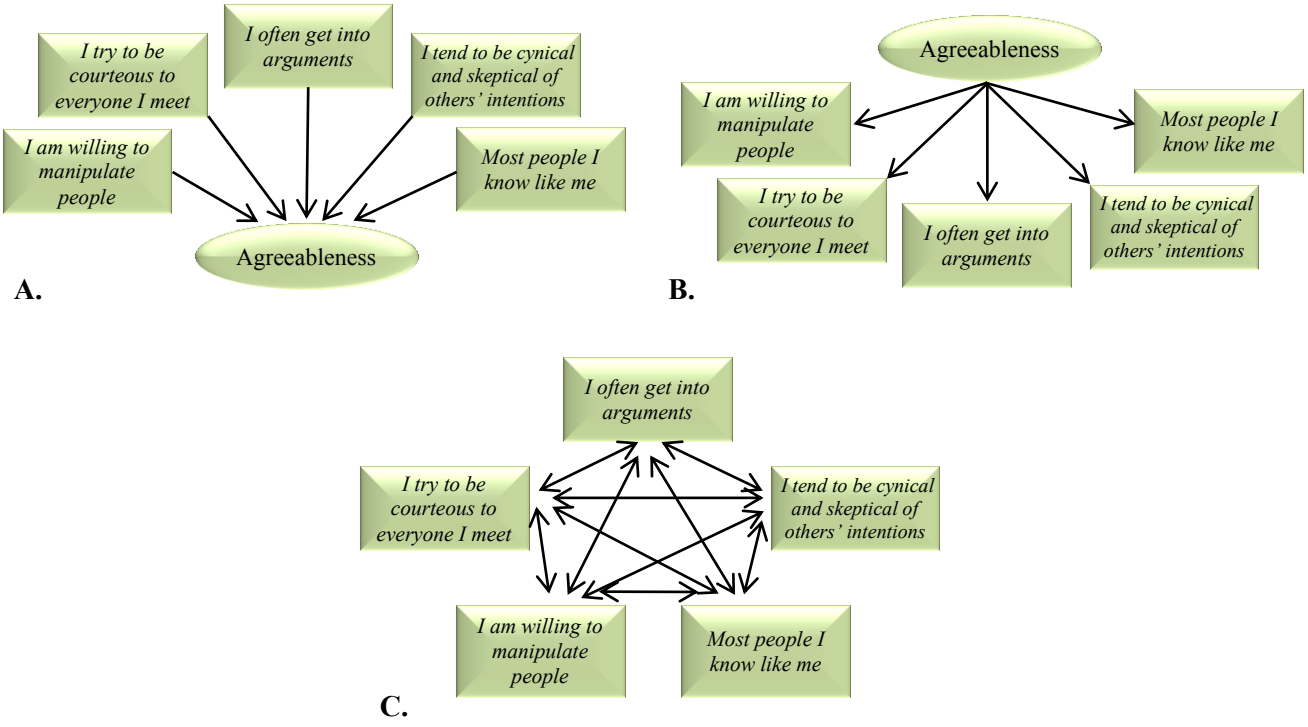

Figure 1. A. A formative model representation of a subset of the NEO-FFI Agreeableness items. **B.** A reflective model representation of the same subset of items. This is the model representing the theoretical understanding of the Big Five factors and the relationships assumed in factor analysis techniques. Note that, while there is an assumption of residual error for each indicator variable (not shown), this model assumes that there are no direct causal relationships between the indicators; instead, the indicator variables are only related to each other through the latent construct. **C.** A network perspective of these same items, reflecting direct causal relationships between items.

In light of the semantic concerns outlined in the history of the formation of the Big Five, it seems clear that the assumption of local independence required by the reflective model is already on tenuous ground. Consider the five NEO-FFI Agreeableness items presented in Figure 1, for example. Is it possible that if one *tries to be courteous to everyone one meets* that one will not therefore have a tendency to *get into arguments* less often than those who value courtesy less? Does it not seem likely that one who is more *willing to manipulate people* than average, unless he or she is duller than average, should also be more *cynical and skeptical of others' intentions,* by logical extension of their own behavior, than those who are unwilling to manipulate others? And, for most understandings of the term *courtesy*, it seems difficult to reconcile being both *courteous to everyone* at the same time that one is willing to *manipulate* them.

Items that are semantically linked can be found in each of the Big Five factors as measured by the NEO-FFI. For example, within the *Neuroticism* factor one finds items such as *I am not a worrier; When I'm under a great deal of stress, I sometimes feel like I'm going to pieces; I often feel tense and jittery;* and *I rarely feel fearful or anxious*—all questions related to experiencing worry and anxiety. One also finds the items *I often feel inferior to others, Sometimes I feel completely worthless, At times I have been so ashamed I just want to hide, I rarely feel lonely or blue,* and *I am seldom sad or depressed,* which contain themes of low self-worth and negative affect / depression.

Within the *Extraversion* factor, one finds items such as *I don't consider myself especially "lighthearted"; I laugh easily; I am a cheerful, high-spirited person;* and *I am not a cheerful optimist* which are all centered upon the concept of cheerfulness or positive affect, and *I like to have a lot of people around me; I really enjoy talking to people; I like to be where the action is; I*

usually prefer to do things alone; and *I would rather go my own way than be a leader of others* which center upon the concept of gregariousness, or desire for / enjoyment of being around others.

Within the *Openness* scale, one finds items such as *I have little interest in speculating on the nature of the universe or the human condition; I have a lot of intellectual curiosity; I often enjoy playing with theories or abstract ideas; I am intrigued by the patterns I find in art and nature;* and *I don't like to waste my time daydreaming.* Again, there is a noticeable degree of redundancy in these items with respect to what one of the items refers to as "intellectual curiosity."

Within the *Agreeableness* scale, we have items regarding courteous and pleasant behavior toward others, such as *I try to be courteous to everyone I meet, I generally try to be thoughtful and considerate; If I don't like people I let them know it; I often get into arguments with my family and co-workers.* There are also multiple items that focus on a more manipulative and cynical approach to interpersonal relationships: *If necessary, I am willing to manipulate people to get what I want; I tend to be cynical and skeptical of others' intentions; I believe that most people will take advantage of you if you let them; Some people think of me as cold and calculating.* Note that these two broad ideas seem likely to be negatively correlated with each other, and some items, such as *Most people I know like me* do not obviously belong to one concept or the other, but could be considered related to both. This high degree of interrelation between all of the items suggests that *Agreeableness* may be one of the most robust factors within the NEO-FFI.

Finally, within *Conscientiousness,* we see some items related to orderliness, such as *I keep my belongings clean and neat; I never seem to be able to get organized;* and *I am not a very*

methodical person. Other items seem related to achievement-striving, such as *I'm pretty good about pacing myself so as to get things done on time; I try to perform all the tasks assigned to me conscientiously; I work hard to accomplish my goals; When I make a commitment, I can always be counted on to follow through; Sometimes I'm not as dependable or reliable as I should be;* and *I am a productive person who always gets the job done.* As with the *Agreeableness* facet, there are some items, such as *I have a clear set of goals and work toward them in an orderly fashion* that are semantically linked to both of these constructs, providing a link between the different semantic facets.

Thus we have seen that, within each of the Big Five factors, there are multiple items that appear to have semantic or logical connections. While this semantic redundancy may be an important aspect of a reliable and robust measure, that redundancy is problematic from a factor-analytic perspective. Because of these inter-item connections, a response to one of these semantically linked items should correlate with semantically linked items *because of the nature of the items themselves*. This interdependence between the items violates the assumption of local independence that is integral to the factor analytic methods that have been used to support the claim that these five factors represent the fundamental structure of personality. Thus, these inter-item connections call into question the common interpretation of the Big Five as causal latent variables.

F. Using Computer Simulations to Test the Influence of Inter-Item Connections upon Factor Analytic Results

Testing the hypothesis that semantic connections between the NEO-FFI items entail a factor analytic structure upon personality data is quite difficult to do with a human population. Ideally, one would find a population of people who are known to have a personality structure distinct from the Big Five and examine the structure that is found when they complete the NEO-

FFI questionnaire to determine the degree to which this data reflects the true population structure versus the Big Five structure. However, this approach requires first identifying at least one population that is known to have a personality structure distinct from the Big Five. If no such populations are known, it is impossible to determine if this is because the Big Five structure is common to all populations, or if it is because the Big Five structure is seen in all populations simply because the structure is indeed entailed within the measure as hypothesized. For this question, then, computer simulations can provide a useful alternative, allowing for an examination of the simulated effects of semantic connections between items within populations whose inherent personality structures can be manipulated precisely.

In the current studies, computer simulations are used to test whether the inter-item relationships between items of the NEO-FFI are sufficient to entail the Big Five structure, as hypothesized by Block (1995). In Study 1 the population is initially modeled as having no inherent personality structure; each individual in the simulated population responds to each of the 60 NEO-FFI items completely independently of their responses to the other items. These responses are then updated in a probabilistic way in accordance with inter-item connections previously identified by independent researchers, and the resulting dataset is submitted to a factor analysis. The factor analytic structure found in this study thus represents the structure that is *entailed* within the items, or the degree to which the data may take on the shape inherent to the measure when there is no inherent shape within the original data but the persons each respond to semantically-linked items in a coherent way. Any factor structure thus obtained supports Block's suggestion that a structure may be entailed within a measure, and provides evidence that the existence of a factor structure does not *necessarily* imply the existence of latent variables within the individuals of the population being measured.

Study 2 examines the possible influence of inter-item connections in a population that has an inherent personality structure which *differs* from the structure that may be entailed by the measure being administered. In this study, the same methods of Study 1 are used, except that the initial population does not contain random responses to the NEO-FFI items, but rather responses that correspond to a structure based upon William James' concepts of the *tough-* and *tender-minded* types (James, 1907). The degree to which the resulting factor structure represents the Big Five rather than James' factors can thus provide insight into the degree to which inter-item connections can obscure the ability of researchers to observe an extant structure in a population.

II. STUDY 1: SUFFICIENCY IN THE ABSENCE OF STRUCTURE

A. Overview

Study 1 tests the hypothesis that inter-item connections are sufficient to produce a factor structure similar to the Big Five even when the underlying population has no inherent personality structure. Four raters independently assessed all possible pairs of items on the NEO-FFI to construct a matrix of non-ignorable connections between items. Computer simulations were then used to examine the effect of these inter-item connections on the observed structure of a dataset representing a population that has no inherent personality structure, but does show reasonable conformity to the inter-item relationships entailed within the NEO-FFI itself. Each simulation was completed in three steps. First, a population of individuals who have no inherent personality structure was created by assigning each person a random value as a response to each question of the NEO-FFI. Second, these values were updated to reflect the connections between items. This step was completed using an asynchronous, stochastic method that can be considered analogous to an individual having an experience relevant to a (random) item which reinforced the current value of that item. This value then affected, in a probabilistic way, the values of all the other items that were determined to be logically and/or semantically influenced by the value of the originally chosen item. This process was then repeated with another randomly selected item until each item had influenced all connected items exactly once. Finally, the resultant dataset was submitted to an exploratory factor analysis to examine the structure resulting from the mere enforcement of connections between items in the absence of an underlying personality structure within the population.

B. Method

1. Construction of the matrix containing non-ignorable relationships between items within the NEO-FFI. In order to determine the influence of semantic and causal connections between items on the perceived structure of those items in a population, we first needed to determine and encode the semantic and logical connections between items, including the strength and direction of each relationship.

a. Identifying item connections within the NEO-FFI. Four researchers independently evaluated all 1770 pairs of the 60 NEO-FFI items for the presence or absence of a semantic or causal link between items. In this step, a link was considered ***semantic*** if the items were based upon synonyms or antonyms or if there was a semantic hierarchy between the items such that one would be considered a subset of the other. A link between items would be considered ***causal*** if, for essentially all persons and cases, one variable would lead to another. In order to be conservative in evaluating lawful links between items, the researchers were instructed to identify only those relationships between items that would be "so obvious that if one were to run a study that identified the relationship, the results would be uninteresting."

The evaluations of each researcher were encoded in a 60 by 60 matrix, with a 1 in each cell [i, j] if the researcher determined that there was a semantic or causal link between the i^{th} and j^{th} item in the NEO-FFI and a 0 otherwise. This data was combined across researchers by adding the matrices together. Only those relationships indicated by at least three of the four researchers—cells with a combined value of 3 or 4—were considered universal enough to be evaluated in the next stage of identification.

b. Evaluation of the Type, Strength, and Direction of each relationship. The combined 60 x 60 matrix was divided into quadrants and each quadrant was assigned to one of the four

original researchers. For each pair of items A and B, we wanted a single researcher to evaluate both the relationship from A to B and the relationship from B to A. Thus, each quadrant represented a subset of the original matrix that was symmetric about the diagonal of the original matrix. Each researcher then evaluated any cell in their quadrant that contained a 3 or 4 to determine the type (*semantic* or *causal*), strength (*strong*, *moderate*, or *none*), and direction (*positive* or *negative*) of the relationship between the items.

This evaluation was carried out as follows: First, each pair of items A and B was assessed for a ***semantic*** relationship. Note that some semantic relationships are hierarchical in nature—for example, all *runners* would be considered *athletes*, but not all *athletes* are necessarily *runners*—while others are not—a dictionary lists *lighthearted* and *cheerful* as a synonyms. If the relationship was semantic and *non-hierarchical*, then we assessed the relationship to be ***strong*** in both directions. The direction of the relationship—whether the items would be ***positively*** or ***negatively*** correlated—was also evaluated. However, if the semantic link was *hierarchical* or if the relationship was not semantic but ***causal*** we continued to the second step of evaluation. This second step consisted of determining whether the items were related lawfully, that is, for essentially *all persons and cases*, a specific level of item A would lead to a corresponding level of item B. In this case, the strength of the relationship from A to B would also be considered ***strong***, and the direction—positive or negative—of this relationship would also be evaluated. Note that in this case, the researcher must also subsequently evaluate the strength of the relationship from B to A. If the relationship was neither semantic and non-hierarchical nor strong, then the researcher evaluated the relationship for a ***moderate*** causal relationship from A to B—one in which for *almost all persons*, a specific relationship from A to B would hold, but it was possible for the researcher to imagine exceptions to the rule. If the relationship was

considered moderate, the researcher also evaluated the direction—positive or negative—of the relationship. As in the previous case, the researcher then independently evaluated the strength of the relationship from B to A. Finally, if the relationship from A to B was neither semantic and non-hierarchical (*i.e.*, bi-directionally strong) nor strong nor moderate, then it was marked as ***none***. Again, the relationship from B to A was evaluated independently.

These evaluations of the specific nature of the relationships between items were then encoded in a new 60 x 60 matrix, **R**. For each row *i* and column *j* in **R**, cell $\mathbf{R_{ij}}$ represented the influence on item *i* by item *j*. The direction of the relationship was indicated by whether the value was positive or negative, with strong relationships indicated by a value of 4 (or -4 for strong negative relationships) and moderate relationships indicated with a value of 3 (or -3). If the strength was neither strong nor moderate (using the conservative criteria listed above), the value in the cell was 0. Thus, if item *j* was determined to have a moderate and negative influence on item *i*, $\mathbf{R_{ij}}$ was given a value of -3.

The final 60 x 60 matrix (see Table 1), consisting of 3,540 non-diagonal cells, contained only 256 cells with a value of 4, 3, -3, or -4. Of these, 123 (48%) had a value of 4 or -4 and 133 (52%) had a value of 3 or -3. Thus, only 7.23% of the potential relationships between items were identified as being non-ignorable in this process, and only half of those were considered to have a strong relationship. Of the inter-item relationships identified in this process, 69 (27%) were between items belonging to 2 different traits. Thus, 27% of the relationships identified in this process will work *against* recovering the Big Five structure. However, note that there are only 660 possible intra-trait relationships, and 187 (28%) of these intra-trait relationships were identified as being non-ignorable in this process—these relationships will *contribute* to recovering a Big Five factor structure.

2. Applying semantic and logical connections between items to otherwise random data. Recall that the purpose of this study is to investigate the structure of a dataset that contains no underlying personality traits—*i.e.*, random data—when the random responses have been adjusted to reflect semantically and logically consistent values between items. This was accomplished by using a computer simulation[1] to update the values in a completely random dataset according to the relationships between items identified as described above.

The simulation works as follows: First, a random dataset of 300 individuals is created. For each person in this dataset, 60 random values are assigned to represent responses to the 60 items in the NEO-FFI. Because the response values in the NEO-FFI are assumed to represent an underlying normal distribution of values, each response is a real number chosen from a normal distribution with a mean of 3 and a standard deviation of 1, ensuring that 98.8% of the values are within the range (0.5, 5.5) which, when rounded to the nearest integer, would produce the likert scale values of 1, 2, 3, 4, and 5. This creates a starting point for each simulated individual that contains no underlying personality structure.

Once the initial dataset is created, the values must be updated to reflect the strength and direction of the relationships between the items. There are several approaches that could be used to update the random data to reflect these relationships between items, including the use of parallel computing procedures, such as the Ising models used to simulate how a hot ferromagnet in which the spins of the various particles are unordered cools to an ordered, homeostatic state based upon the sum of the influences of the spin of each constituent particle. However, some of these models, like the Ising model, can result in local oscillations even within the homeostatic equilibrium rather than resolving to a truly set equilibrium (Latané, Nowak, & Liu, 1994). In

[1] The program to create and update the datasets was written in Perl and will be available online at www.cervonelab.psch.uic.edu.

addition, computer simulations are currently an uncommon practice within social and personality psychology. Making use of a suitable parallel computing algorithm that uses all the information about the connections between items simultaneously to find the equilibrium point for each of the various random starting positions will undoubtedly be a useful future step to help triangulate the degree to which semantic overlap might entail a structure. However, the model used in the present study uses an updating algorithm that was designed to reflect the internal processes involved when an individual has an experience that causes them to update their self-concept, which is then used to respond to all related questions in a coherent and consistent way. This process is one that social and personality psychologists should find both reasonable and straightforward to understand.

The specific process that is being modeled starts with the influence of experience upon the self-concept. Individuals construct a multi-faceted self-concept from statements made by those around them that describe their behavior, by imagining what others think of them based on how they are treated (reflected appraisal), by making inferences from their own behavior and physiological states under circumstances that allow for relatively unconstrained actions (self-perception), and by social comparisons with their peers (Bem, 1972; Markus & Wurf, 1987). In this way, the self-concept can be shaped by experiences and interactions with others. But the self-concept does not merely reflect past behavior, it also influences current and future behavior, thereby reinforcing central components of the self-concept by increasing behaviors that are congruent with those concepts (Markus & Wurf, 1987). Furthermore, individuals are resistant to accounts of themselves or their behavior that are incongruent with central aspects of their self-concept and reject or make situational attributions for accounts of their behavior that are inconsistent with their self-view, suggesting that even when is some evidence to the contrary,

individuals are likely to respond to all questions that touch on core concepts of the self in a very consistent way (Markus & Wurf, 1987). Finally, while individuals are often motivated to learn and grow and to be able to think highly of themselves, these motivations that can inspire change in behaviors and self-concepts are also tempered by a motivation to maintain a sense of continuity and coherence (Markus & Wurf, 1987). Therefore, the algorithm should mimic the development of each individual's responses by reflecting a self-concept that can be influenced by experience and that is maintained with a degree of internal consistency, but which is not so malleable that it reflects abrupt and marked shifts from one time point to the next.

At the level of the current study, these guidelines were interpreted as follows: the simulation is of a person who, in the course of experiencing life events, will have experiences that affirm a particular belief about various items in the NEO-FFI. Because various items are semantically or logically related, the values of these affirmed beliefs then influence the values of semantically (and thus conceptually) related items to reflect the tendency for individuals to create internal consistency within their various beliefs about the self. However, notions of the self can be both nuanced and also influenced by details that an individual considers relevant to the item even if such nuance is not explicit in the item's wording; that is, even with strong relationships between items, the correlations between the values for those items will be strong, but rarely perfect. Accordingly, relationships between items that are only moderately connected will be weaker. The algorithm used to update the item values should thus reflect these imperfect relationships. Therefore, in the current study, each simulated "individual" is updated separately, and according to the following algorithm: First, a random item is chosen from the 60 potential items as the current *influencing* item, to reflect an individual having an experience that reinforces the current value of this item. Items are chosen randomly to reflect different individuals having

different life paths that shape their self-schemas, and also to avoid systematic bias that may produce results that are unique to a single pre-determined order of influence. This *influencing* item then updates the values of all other items (*target* items) in the following way: if the relationship between the items is ***none*** (represented by a 0 in the matrix), then the value of the target item does not change. If the relationship between the items is ***moderate*** and the direction of influence is positive, then the value of the target item is shifted toward the value of the influencing item by a value that is, on average, 42.5% of the difference between the item values. The actual value by which the target item changes is a number drawn from a random distribution with a mean that is 42.5% of the difference between the influencing value and the target value and a standard deviation of 20% of that difference. Thus, the new value of the *target* item, t_{new}, is determined by the original value of target item, t_{orig}, and the current value of the influencing item, i, as follows

$$t_{new} = t_{orig} + (i - t_{orig}) * (X \sim N(.425, .2))$$

Recall that our aim in this simulation is to start with an individual with no inherent personality structure, and whose self-concept can be changed, but not so much that it loses all temporal consistency—this requires the algorithm to truly start from the original value of the item, t_{orig}, rather than merely overwriting that value. This value, however, is shifted to represent a cohesive self-concept by allowing the reinforced value of the influencing item, i, to causally influence this original value according to the semantic and logical relationship between the items themselves. In this case, the relationship between the items was positive, so the value of the target item should be *pulled toward* the value of the influencing item most of the time. The relationship was also judged to be moderate, so that, on average, the value should be shifted to reflect a noticeable relationship, but not an overpowering or deterministic one—there is enough

ambiguity in the overlap of the questions to allow for a cohesive self-concept without requiring near-perfect overlap. If we consider the formula above, we see that, if the value of X is 0 (or 0%), then the value of the target item does not change at all. However, if the value of X is 1 (or 100%), the new target value would be $t_{orig} + i - t_{orig}$, which equals i, the value of the influencing item. For values of X between 0 and 1, the target value is pulled toward the *influencing* value by the corresponding percent of the distance between the original values. In this scenario, X is drawn from a normal distribution centered at .425 (or 42.5%) with a standard deviation of .2 (or 20%). Note that, although on average the *target* value will shift 42.5% of the way toward the influencing value, this formula allows for a wide range of movement for the *target* value, with t_{new} moving *away* from the *influencing* value nearly 2% of the time (when X is less than 0), and t_{new} becoming a more extreme value than the value of the *influencing* item 0.2% of the time (when X is greater than 1), thus reflecting a relationship that is on average a moderate one, but which may vary widely between persons and item pairs.

If the direction of influence is negative, the value of the influencing item is temporarily reverse-coded, and the target item is modified exactly as described, but by the reverse-coded value:

$$t_{new} = t_{orig} + \big((6 - i) - t_{orig}\big) * \big(X \sim N(.425, .2)\big)$$

Notice that here, the formula reflects the value of the influencing item *pushing away* the value of the target item in a manner that reflects exactly the influence strength that would have been used above assuming the influencing item were reverse-coded and thus the relationship between the items was a positive one. Again, the target value remains completely unchanged if X is 0, but when X is 1, the target value evaluates to $t_{orig} + (6 - i) - t_{orig}$ which is simply $(6 - i)$ or

the reverse-coded value of the influencing item, with the same average change and variation as described above.

When the relationship between the items is ***strong*** and the direction of influence is positive, then the value of the target item is shifted toward the value of the influencing item by a value that is, on average, 85% of the difference between the item values, and the actual value being a number drawn from a random distribution with a mean that is 85% of the difference between the influencing value and the target value and a standard deviation of 10%. In this case, essentially every *target* value will be shifted to a value closer to the *influencing* value, and 6.7% of the time the new *target* value will exceed the value of the *influencing* item, consistent with a strong relationship being based upon semantic necessity or an essentially lawful relationship—one that holds for essentially all persons under all circumstances.

$$t_{new} = t_{orig} + (i - t_{orig}) * (X \sim N(.85, .1))$$

Again, if the direction of influence is negative, the value of the influencing item is temporarily reverse-coded, and the target item is modified exactly as described, but by the reverse-coded value of the *influencing* item *i*:

$$t_{new} = t_{orig} + ((6 - i) - t_{orig}) * (X \sim N(.85, .1))$$

Once all of the target items have been updated based on the current influencing item, a new influencing item is chosen and the process is repeated until each of the 60 items has been chosen as the influencing item once and only once. This end-point is somewhat arbitrary—one could imagine stopping after only 30 random items had been chosen, suggesting that most persons only have experiences leading to more schematic beliefs for about half of the items, or allowing the simulation to run on for hundreds of iterations, reflecting a preponderance of experiences that continue to build upon each other and solidify the self-schema. While the latter

might be considered by most to better reflect human experience for these particular items, in this study the goal was to test whether semantic influence is sufficient to create a factor structure, and allowing each item to serve as an influencing value once and only once was determined to be a reasonable yet still slightly conservative test of this hypothesis.

The final output of this process is a dataset of 300 individuals with values for each of the 60 NEO-FFI ratings that were initially random, and have only been updated by the semantic and logical connections identified by at least three of the four researchers. These values represent the assumed continuous distribution of values underlying the measured values of a 1-5 likert scale, and are then rounded to the nearest integer within the range [1, 5] to output a 300-person dataset with NEO-FFI values of 1 through 5 for all items.

C. Results

This dataset was then submitted to two exploratory principal axis factor analyses, one using a varimax rotation as is common in the literature containing Big Five analyses and one using an oblimin rotation to allow for non-zero correlations between factors, to examine the factor structure that arises from imposing these logical and semantic consistencies on an originally structure-less dataset. The results of these analyses can be found in Tables 2, 3, 4, and 5.

The process was repeated multiple times, to explore the effects of an initially uniform (rather than normal) distribution of values, and then to explore the effects of various distributions in the updating process, including the following: distributions for the ***strong*** relationships of $N(1, .1)$, $N(.9, .1)$, $N(.7, .15)$ with distributions for the ***moderate*** relationship of $N(.5, .25)$, $N(.3, .2)$, $N(.4, .2)$, respectively. The results of the factor analyses for these distributions can be found in Tables 6 – 13.

As Tables 2 – 13 show, the full range of these computer simulations result in factor structures that are all very similar to that of the Big Five. In general, a 6-factor solution seemed the best fit and factors representing *Agreeableness*, *Conscientiousness*, and *Openness* replicate the original Big Five structures fairly cleanly except for three variables from *Agreeableness* and *Openness* (these do not load strongly on any factor due to not having any links with any other variables that were considered ***strong*** or ***moderate*** by the raters) and one *Openness* item which loads onto the *Conscientiousness* factor. The *Neuroticism* factor generally represents *Neuroticism* quite well, but also includes items from the Positive Affect facet of *Extraversion*, due to their semantic relationship with the Negative Affect items within the *Neuroticism* factor. This leaves the fifth factor, *Extraversion*, with the items from the scale relevant to the Gregariousness and Activity facets forming two distinct factors. Two *Agreeableness* items and one *Neuroticism* item also tend to load onto the Gregariousness factor.

The 5-factor solutions, which a researcher expecting to recover the Big Five might choose, are very similar to the 6-factor solutions except that both the Positive Affect and the Activity facets of *Extraversion* are incorporated into the *Neuroticism* factor.

D. <u>Discussion</u>

A factor structure strongly resembling the Big Five was indeed found when a dataset with initially random values was updated to reflect the logical and semantic links between items that were judged to be essentially irrefutable—that is, links between items that were judged to be "so obvious as to be completely uninteresting." The largest difference between the structure identified herein and the Big Five is that the Positive Affect facet of Extraversion tends to be incorporated into the Neuroticism factor, which contains a Negative Affect facet. As previous studies have shown (e.g., Hermes, Hagemann, Naumann, & Walter, 2011), positive and negative

affect tend to have a significant negative correlation with each other, as do Extraversion and Neuroticism. Thus, the largest difference between the simulation and the Big Five is still in line with known relationships between the factors in studies of humans. If one were to include additional relationships that were still widely recognized (for example, relationships that might have a lower strength, or those that would be recognized by participants themselves), it seems clear that the structure might then follow the proposed structure of the Big Five even more closely.

This study strongly suggests that, as suggested by Schmittmann and colleagues (2013) and Cramer and colleagues (2012a, 2012b), the assumption that the indicator variables of the latent traits of personality are independent of each other is flawed in the case of the NEO-FFI. Independent raters using conservative criteria for identifying a relationship between items nevertheless determined that 28% of the potential relationships between items within the same trait could be identified as dependent based on logical or semantic links between items.

Further, these simulations demonstrate that logical and semantic connections between items can indeed entail a specific structure, even in the absence of an inherent, matching personality structure in the population being measured. This finding calls into question some of McCrae's claims that the Big Five represent the fundamental structure of personality. In addition, it suggests that researchers who use a factor analysis to find or support similar structures should be expected to examine their individual items to ensure that they are indeed independent before viewing such findings as evidence for the existence of the structure.

III. STUDY 2: OBSCURING AN EXISTING STRUCTURE

A. Overview

Study 2 tests the hypothesis that inter-item connections are sufficient to produce a factor structure similar to the Big Five even when the underlying population has an inherent personality structure *which differs from* the Big Five structure. Using the same matrix of connections between items that was described in Study 1, a computer simulation was used to examine the effect of these inter-item connections on the observed structure of a dataset that represented a population with an inherent personality structure corresponding to William James' (1907) concepts of *tough*- and *tender-mindedness* when the dataset is updated to include reasonable conformity to the inter-item relationships within the NEO-FFI. First, items corresponding to James' descriptions of *tough*- and *tender-mindedness* were identified, as were the theoretical strength and direction of response to that item that would be expected from a person who was characteristically *tough*- or *tender-minded*. These relationships were used in the construction of the initial dataset. As in Study 1, the simulation from this point forward was completed in three steps. First, a population with random responses to all questions, was updated such that each individual was assigned a random degree of *tender-mindedness* and an independently random degree of *tough-mindedness* and the responses to items that were *tough*- or *tender*-relevant were shifted probabilistically according to the degree to which the individual "possessed" each trait so that the resulting dataset exhibited a clear two-factor solution representing James' theoretical structure when submitted to a factor analysis. Second, these values were updated to reflect the identified connections between items using the same asynchronous, stochastic method applied in step 2 of Study 1. Finally, the resultant dataset was submitted to an exploratory factor analysis to determine the structure resulting from the enforcement of connections between items in data that

originally displayed a personality structure based upon James' descriptions of *tough-* and *tender-mindedness*, just as in Study 1.

B. Method

1. Identifying James' constructs within the NEO-FFI items. James (1907) outlined two potential personality traits, the *tender-minded*, which he listed as being "Rationalistic (going by 'principles'), Intellectualistic, Idealistic, Optimistic, Religious, Free-willist, Monistic, Dogmatical" (p. 19) and the *tough-minded*, which were in his words, "Empiricist (going by 'facts'), Sensationalistic, Materialistic, Pessimistic, Irreligious, Fatalistic, Pluralistic, Sceptical [*sic*]." (p. 20). He presented these two traits not as a structure of personality, but as useful in considering philosophers and philosophical debate, and suggests that while we can all envision a prototypical example of each type, most people are not purely one or the other but contain a combination of both aspects. We borrow these notions of *tender-* and *tough-mindedness* merely as a potential example of a personality structure that is not clearly aligned with or a subset of the Big Five factors but which consists of potentially-orthogonal dimensions, similar to the theoretically-orthogonal factors of the Big Five.

Based upon James' descriptions of *tender-minded* and *tough-minded*, 16 items of the NEO-FFI were identified as being potentially relevant to the *tender-minded* trait and 14 were identified as potentially relevant to the *tough-minded* trait. A prototypical response pattern for each item was also identified—whether, on average, persons characteristic of that type would respond to the item with a low, moderately low, moderately high, or high response. Note that these specific items, including the response patterns, need not necessarily reflect how James himself might have characterized each type—there might well be errors in this interpretation of his types. However, this pattern of responses can be considered a *possible* inherent structure of

personality which is not based upon the Big Five. As you can see in Table N, these types are not completely orthogonal to the Big Five, nor to each other. The *tender-minded* type includes items from all five Big Five factors, but includes more items from *Openness* (5 items) and *Agreeableness* (6 items) than from *Neuroticism* (2), *Extraversion* (2), and *Conscientiousness* (1). The *tough-minded* type also includes items from multiple factors, but is less diverse, with most items originating from *Agreeableness* (8 items), followed by *Openness* (4) and *Extraversion* (2).

2. Creating a *tough*- and *tender-minded* population. To create a dataset that reflects a population with a *tender*- and *tough-minded* personality structure, each individual was first assigned a random value drawn from a normal distribution for each NEO-FFI item, as in Study 1. They were then assigned a random value of *tenderness* which ranged uniformly between -1 and 1 and an independently selected random value of *toughness* which also ranged uniformly between -1 and 1, reflecting James' concept that each individual is a combination of both types. These values can be interpreted as individual coefficients of *tender-mindedness* and *tough-mindedness*, where a positive 1 represents a person with extreme prototypicality for that type, and a negative 1 represents a person with extreme anti-prototypicality for that type.

The random values that were previously assigned to each item identified as relevant to *tender-mindedness* are then updated to reflect the individual's coefficient of *tender-mindedness* c_{tender} as follows: The initial response, r_{orig}, which was drawn from a normal distribution centered on 3 as in Study 1, is updated to r_{new} using the following equation:

$$r_{new} = r_{orig} + c_{tender} * \mathrm{X}$$

where *X* has a value of 2 if a prototypically *tender-minded* individual would highly endorse the item, 1 if they would moderately endorse or sometimes endorse the item, -1 if they would

respond moderately low or sometimes low to the item, and -2 if they would respond with a low value to the item.

This process was then repeated using the *tough-minded* items and the individual's *tough-minded* coefficient:

$$r_{new} = r_{orig} + c_{tough} * \mathrm{X}$$

Note that the overall effect of these transformations is equivalent to shifting the mean of the normal distribution from which the random value is drawn for each relevant item. For example, for an individual who was assigned a c_{tender} of 0.5, for items that would earn a high (low) response from a prototypically *tender-minded* person, the mean of the normal distribution from which their response for these items would be drawn increases (decreases) by 0.5 * 2 = 1 from the original normal distribution centered on 3 (with a standard deviation of 1). Thus, the individual will still exhibit a normal range of responses for these items, but on average they will report a value of 4 (2) on a scale from 1 to 5. For items that would only be endorsed moderately or sometimes by a prototypically *tender-minded* person, the new average value is only shifted by a value of 0.5; distributed around an average value of 3.5 if a prototypical person would tend to endorse the item, or 2.5 if they would tend not to endorse the item. In this way, each individual can express a unique pattern of responses to the items while still reflecting each type according to the strength of their coefficients.

Once these transformations are complete, a copy of the dataset is printed out so that the *inherent* factor analytic structure can be checked (the *James* dataset), and the dataset is also further updated according to the inter-item connections using the same process described in Study 1 (the *Final* dataset). This allows for a comparison of the factor analytic structure of the

data before and after each individual's responses are changed to reflect a general conformity with the semantic inter-item relationships.

C. Results

The *James* dataset was submitted to a principal axis factor analysis using varimax rotation, to follow common practice in the literature (note that results using an oblimin rotation were very similar). Both a scree plot and parallel analysis both suggested strongly that there were two and only two factors, and the factor loadings follow, unsurprisingly, the relationships outlined in Table N, with some exceptions for items which were identified as relevant to both types. The full factor loadings may be found in Table O. Thus, the data at this point does indeed include evidence of James' two-factor structure.

The *Final* dataset was submitted to the same analysis. In this case, a parallel analysis suggests 7 factors, but the scree plot appears to support a five-factor solution, with a visually obvious drop in eigenvalues after the fifth factor, and a clear leveling off beyond that. Because the current (2010-present) Big Five literature overwhelmingly reports use of scree plots rather than parallel analysis (when a method is reported), and because the scree plot does not suggest ambiguity, we will examine the five factor solution as the solution one would expect to find reported in the literature. The five factor solution is presented in Table P, and the 6 factor solution, to mirror the 6-factor solutions presented in Study 1, is presented in Table Q.

Rather than reflecting James' *tender-* and *tough-minded* factors, both the 5- and 6-factor solutions are highly similar to, if not even closer to the intended Big Five solution, than the results from Study 1. Comparing the 6-factor solutions explicitly, in both studies, the *Neuroticism* factor is recovered quite closely and includes the same 15 items, including 11 of the 12 original *Neuroticism* items and the 4 *Extraversion* items measuring the Positive Affect facet

of *Extraversion*. The *Agreeableness* factor that was represented by only 9 of the 12 NEO-FFI items in Study 1 now includes 11 of the NEO-FFI *Agreeableness* items, though it has also picked up one item from the *Openness* scale and the remaining *Neuroticism* item which seem similar to what one might consider a Compliance facet of *Agreeableness,* namely: *I believe we should look to our religious authorities for decisions on moral issues* and *I often get angry at the way people treat me.* The *Conscientiousness* factor contains the same items in both studies, including all 12 of the NEO-FFI *Conscientiousness* items and one item intended to measure *Openness* but which resembles the Orderliness facet of *Conscientiousness*: *Once I find the right way to do something, I stick to it.* The fourth factor includes 9 of the original 12 NEO-FFI items for *Openness*, just as in Study 1. Similarly, in both studies, the 3 items reflecting the Activity facet of *Extraversion* load onto a single factor. However, in Study 2, the *Extraversion* factor representing the Gregariousness facet contains only the 5 items representing Gregariousness from the NEO-FFI, whereas in Study 1 this factor also included 3 items from other factors, 2 from the *Agreeableness* NEO-FFI factor and one from *Neuroticism*.

Only two items failed to load onto any factor in Study 2, compared to 3 items that failed to load onto a factor from Study 1.

D. <u>Discussion</u>

Overall, in Study 1 eleven of the 60 NEO-FFI items were misclassified or missing from the factor loadings relative to the original NEO-FFI intentions, whereas in Study 2 only nine items were misclassified or missing. And although there were slightly more cross-loadings in Study 2, half of these were loadings with values below 0.4, suggesting that the final dataset from Study 2 represented the Big Five factors equally well, if not slightly better than, the simulated results from Study 1. Most notably, there were no factors in Study 2 that corresponded to the

tough- or *tender-minded* factors. Indeed, the only two items that were newly misclassified in Study 2 relative to Study 1—the items that loaded onto the *Agreeableness* factor that were originally from the *Openness* and *Neuroticism* NEO-FFI factors—were each from a different factor in the *James* dataset, and could both be considered to be logically related to the *Agreeableness* construct. Thus, there is no clear influence of the *James* personality structure in the final dataset, despite the fact that the simulated persons, prior to enforcing the semantic inter-item relationships, exhibited a clear factor solution representing the *tender-minded* and *tough-minded* personality structure. In the case of the NEO-FFI, the resulting factor-analytic structure is a much clearer reflection of the language used to create the items than of the inherent structure of personality within the population.

IV. GENERAL DISCUSSION

For 50 years, factor analysis has been the primary tool for identifying the fewest factors that can account for the largest amount of inter-individual differences, and these factors have then been interpreted as the fundamental structures of personality that exist in the minds of individual persons. However, it is also possible that this form of analysis is illuminating not the structure of personality within humans, but the structure of the language that is used within the assessments themselves.

In the case of the Big Five, the history of the assessment strongly suggests that semantic redundancy between items has had a strong influence upon the shape of the measure itself—this redundancy would then be mathematically interpreted in a factor analysis as important shared variance, thereby entailing the shape of the measure upon the data. In Study 1, a set of computer simulations do indeed show that, even in a population that has no personality structure, semantic connections between items are in fact sufficient to reliably produce a factor-analytic structure that largely coincides with the Big Five. Indeed, the largest difference between the structure identified in our simulations and the Big Five is very much in line with known relationships between the factors and their facets in studies of humans. Study 2 further demonstrated that, even when the population had an inherent personality structure which differed from the structure of the Big Five, after responses were updated to reflect the semantic connections between items, the resulting factor-analytic structure again reflected the Big Five structure as seen in Study 1, with no factors that could be identified that represented the original structure that existed in the population. Taken together, these studies suggest that lexical redundancy or semantic overlap within a measure can indeed shape and even re-shape the data collected to reflect the structure

entailed within the measure, regardless of whether that structure was present in the original population.

As suggested by scholars such as Block (1995), factor analysis does not appear to be an appropriate tool for evaluating a set of responses to text-based questions in order to identify a fundamental structure within persons. Because factor analysis, which is based upon a latent-variable model, assumes local independence between the individual items being analyzed, assessments like the Big Five that contain a great deal of inter-item semantic redundancy fail to meet the assumptions of the technique. This suggests that factor analytic results such as those surrounding the Big Five should not be interpreted as evidence for an underlying structure corresponding to the resulting factors. Even robust factor-analytic results across widely varying populations—usually construed as evidence for a psychological concept so fundamental that it is universal—does not provide any evidence for the existence of those structures within persons when the structure entailed within the language of the measure is itself robust.

Note that these results *do not* constitute evidence that the Big Five does not exist. It may be possible to find some subset of the full 240-item version of the questionnaire that manages to omit all meaningful semantic overlap between items, and then to attempt an exploratory factor analysis upon only those items for various populations in order to determine if the Big Five factor structure exists within that subset of items across populations. Such a finding would indeed support the existence of at least these five factors, though it would not rule out the existence of additional factors that might have been missed in the making of the 240 items. On the other hand, one might find that some other structure emerges, or that no meaningful and robust structure exists across the populations—this would be a challenging endeavor, but it could potentially provide many insights to one of the standard understandings of personality

psychology, and as well as important ramifications for current research in many fields that makes use of one or more of the Five Factors of personality.

Although the confound between language and structure was hypothesized many years ago, it has been a difficult hypothesis to test because one cannot readily assign a specific underlying structure of personality to various individuals. While the computer simulations used in the current research are gross simplifications relative to the dynamic and complex machinery that might one day mimic an actual human personality, I believe that they are sufficient to demonstrate the (usually unremarked-upon) influence of a semantically entailed structure upon the perceived structure of personality within a population of varied individuals. That is, finding a structure within a dataset of many variables across many individuals via factor-analytic methods should not be considered sufficient evidence to claim an insight into the substantive structure underlying those items without a deeper consideration of the potential relationships between the specific items, even if that structure appears to be consistent and robust across a large number of populations. This is particularly relevant for "empirically-discovered" structures that did not originate from a testable theoretical foundation, such as the Big Five.

This is not to claim that all redundancy between items should be removed from all measures. For much research in personality and other fields, semantic redundancy may be important or even necessary when measuring a specific, known construct reliably and validly, as not all people interpret the same words in exactly the same way. In these cases, the current research only suggests that the techniques used to analyze semantically redundant items should be chosen carefully to ensure they are appropriate for dependent constellations of items. Primarily, this research suggests a greater need for critically examining measures for semantic redundancy only when factor analytic results are used to support a claim of a meaningful

structure within the items when those items are both text-based and include semantic redundancy. Further simulations on additional measures would help to clarify the extent to which various assessments have a structure entailed within the items. However, it also suggests more broadly that it is important within the social sciences in general to question how well a theory has been tested, to clearly separate testing from measuring, and to continue to critically consider the suitability of even commonly-accepted methodologies and analytic techniques to various types of scientific questioning.

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Table I

Matrix of Relationships Between NEO-FFI Items Identified in Study 1.

NEO-FFI Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1. I am not a worrier	0	0	0	0	0	0	3	0	0	0	-4	-4	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. I like to have a lot of people around	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	-4	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. I don't like to waste my time	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. I try to be courteous to everyone I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-4	0	0	0	0	0	0
5. I keep my belongings clean and neat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0
6. I often feel inferior to others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
7. I laugh easily	3	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	3	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Once I find the right way to do	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. I often get into arguments with my	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	-3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	3	0	0	0	0	0	0
10. I'm pretty good about pacing myself	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	-4	0	0	0	0	3	0	0	0	0	3	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	3
11. When I'm under a great deal of	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12. I don't consider myself especially	-4	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	4	0	0	0	0	4	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13. I am intrigued by the patterns I find	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
14. Some people think I'm selfish and	0	0	0	-4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	3	0	0	0	0	0	0	-3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0
15. I am not a very methodical person	0	0	0	0	-4	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
16. I rarely feel lonely or blue	0	0	0	0	0	-4	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17. I really enjoy talking to people	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	-3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18. I believe letting students hear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0
19. I would rather cooperate with	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20. I try to perform all the tasks	0	0	0	0	0	0	0	0	0	3	0	0	0	0	-4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
21. I often feel tense and jittery	-4	0	0	0	0	0	-3	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	-3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22. I like to be where the action is	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23. Poetry has little or no effect on me	0	0	3	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24. I tend to be cynical and skeptical of	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25. I have a clear set of goals and work	0	0	0	0	0	0	0	0	0	3	0	0	0	0	-4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	3
26. Sometimes I feel completely	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	3	-3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
27. I usually prefer to do things alone	0	-4	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28. I often try new and foreign foods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
29. I believe that most people will take	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30. I waste a lot of time before settling	0	0	-4	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31. I rarely feel fearful or anxious	4	0	0	0	0	-3	0	0	0	0	-3	-4	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	-4	0	0	0	3	0	0	0	0	-3	0	0	0	0	0	0	0	0	0
32. I often feel as if I'm bursting with	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0
33. I seldom notice the moods or	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34. Most people I know like me	0	3	0	3	0	0	3	0	-3	0	0	0	0	-3	0	0	3	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	-3	3	0	-3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
35. I work hard to accomplish my goals	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
36. I often get angry at the way people	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

37. I am a cheerful, high-spirited person	4	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	0	0	0	0	-3	0	0	-4	0	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0
38. I believe we should look to our	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39. Some people think of me as cold and	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
40. When I make a commitment, I can	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
41. Too often, when things go wrong, I	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	-4	0	0	0	0	4	0	0	0	0	0	0	0	0	0
42. I am not a cheerful optimist	-4	0	0	0	0	0	-3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	-4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43. Sometimes when I am reading	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44. I am hard-headed and tough-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45. Sometimes I'm not as dependable or	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	0
46. I am seldom sad or depressed	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	4	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	-4	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0
47. My life is fast-paced	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
48. I have little interest in speculating	0	0	3	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	-4	0	0
49. I generally try to be thoughtful and	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	-3	0
50. I am a productive person who	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	3	0	0	0	0	4	0	0	0	0	-4	0	0	0	0	0	-3	0	0	0	-3	0	0	0	0	0
51. I often feel helpless and want	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0
52. I am a very active person	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
53. I have a lot of intellectual curiosity	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	0	4	0	0
54. If I don't like people, I let them know	0	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55. I never seem to be able to get	0	0	0	0	-4	0	0	0	0	-4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56. At times I have been so ashamed I	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57. I would rather go my own way than	0	-4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58. I often enjoy playing with theories	0	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	4	0	0	0	0	0	0	0
59. If necessary, I am willing to	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0
60. I strive for excellence in everything I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	3	0	0	0	0	-3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0

Table II

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)
31. I rarely feel fearful or anxious	N	**-0.893**	-0.025	-0.043	-0.038	-0.012
21. I often feel tense and jittery	N	**0.875**	-0.017	0.059	0.050	-0.002
7. I laugh easily	E	**-0.869**	0.008	-0.090	-0.047	0.027
1. I am not a worrier	N	**-0.867**	-0.042	-0.029	-0.001	0.000
42. I am not a cheerful optimist	E	**0.855**	-0.008	0.081	0.078	-0.007
46. I am seldom sad or depressed	N	**-0.789**	-0.016	-0.012	-0.038	-0.036
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.761**	-0.033	0.096	0.097	-0.002
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.693**	-0.022	0.092	0.033	-0.008
6. I often feel inferior to others	N	**0.657**	0.072	0.041	0.095	0.001
32. I often feel as if I'm bursting with energy	E	**-0.624**	-0.037	-0.053	0.035	0.081
26. Sometimes I feel completely worthless	N	**0.610**	0.048	0.030	0.145	-0.032
16. I rarely feel lonely or blue	N	**-0.595**	0.068	0.039	-0.057	0.000
12. I don't consider myself especially "lighthearted"	E	**0.592**	0.021	-0.062	0.044	-0.020
51. I often feel helpless and want someone else to solve my problems	N	**0.559**	-0.128	0.100	0.110	-0.040
37. I am a cheerful, high-spirited person	E	**-0.529**	0.086	-0.037	-0.026	0.056
47. My life is fast-paced	E	**-0.425**	-0.104	-0.078	0.083	0.076
52. I am a very active person	E	**-0.393**	-0.061	-0.052	0.059	0.115
56. At times I have been so ashamed I just want to hide	N	**0.388**	0.087	-0.067	0.110	0.001
40. When I make a commitment, I can always be counted on to follow through	C	-0.007	**0.869**	-0.006	-0.053	-0.019
55. I never seem to be able to get organized	C	-0.044	**-0.864**	0.031	-0.020	0.082

20. I try to perform all the tasks assigned to me conscientiously	C	0.058	**0.860**	-0.010	0.011	0.005
25. I have a clear set of goals and work toward them in an orderly fashion	C	0.039	**0.849**	-0.083	0.001	0.001
15. I am not a very methodical person	C	-0.096	**-0.843**	0.030	-0.073	0.052
60. I strive for excellence in everything I do	C	0.019	**0.837**	-0.012	0.014	-0.020
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.094	**0.827**	-0.018	-0.154	0.038
45. Sometimes I'm not as dependable or reliable as I should be	C	0.040	**-0.826**	0.010	0.153	0.007
5. I keep my belongings clean and neat	C	0.082	**0.792**	-0.050	0.061	-0.091
35. I work hard to accomplish my goals	C	-0.015	**0.772**	0.030	-0.011	-0.035
50. I am a productive person who always gets the job done	C	-0.095	**0.735**	-0.034	-0.208	0.022
8. Once I find the right way to do something, I stick to it	O	0.107	**0.678**	0.029	0.021	-0.017
30. I waste a lot of time before settling down to work	C	0.083	**-0.551**	0.080	**0.415**	-0.023
44. I am hard-headed and tough-minded in my abilities	A	0.018	0.104	0.082	0.013	0.075
4. I try to be courteous to everyone I meet	A	0.022	0.033	**-0.914**	0.033	0.015
54. If I don't like people, I let them know it	A	-0.050	0.008	**0.872**	-0.017	0.006
49. I generally try to be thoughtful and considerate	A	-0.010	0.123	**-0.866**	-0.015	-0.050
9. I often get into arguments with my family and co-workers	A	-0.018	-0.056	**0.849**	-0.031	-0.090
14. Some people think I'm selfish and egotistical	A	0.080	-0.025	**0.836**	-0.061	-0.055
39. Some people think of me as cold and calculating	A	0.240	-0.016	**0.725**	-0.027	-0.115
59. If necessary, I am willing to manipulate people to get what I want	A	0.066	-0.005	**0.723**	-0.033	-0.180
34. Most people I know like me	A	-0.204	0.036	**-0.658**	-0.013	**0.324**
19. I would rather cooperate with others than compete with them	A	-0.091	-0.043	**-0.533**	0.030	0.079
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.127	0.033	0.058	**-0.846**	0.038
13. I am intrigued by the patterns I find in art and nature	O	0.050	-0.133	0.072	**0.827**	-0.046
58. I often enjoy playing with theories or abstract ideas	O	0.132	-0.119	-0.002	**0.826**	-0.065
53. I have a lot of intellectual curiosity	O	0.072	0.045	-0.147	**0.767**	-0.077

23. Poetry has little or no effect on me	O	-0.030	0.117	-0.125	**-0.739**	-0.006
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	0.013	-0.100	0.067	**0.715**	0.011
3. I don't like to waste my time daydreaming	O	-0.095	0.253	-0.078	**-0.667**	-0.003
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.063	-0.037	0.104	**-0.453**	-0.005
28. I often try new and foreign foods	O	0.048	0.012	-0.124	**0.316**	0.022
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.004	-0.031	0.006	-0.090	-0.013
2. I like to have a lot of people around me	E	-0.024	0.005	-0.033	-0.054	**0.913**
27. I usually prefer to do things alone	E	0.008	0.050	0.073	-0.011	**-0.849**
17. I really enjoy talking to people	E	-0.046	0.013	-0.114	-0.056	**0.845**
22. I like to be where the action is	E	-0.120	0.042	-0.008	-0.052	**0.822**
57. I would rather go my own way than be a leader of others	E	0.253	-0.011	-0.014	0.098	**-0.532**
24. I tend to be cynical and skeptical of others' intentions	A	0.164	0.026	0.291	-0.121	**-0.443**
36. I often get angry at the way people treat me	N	-0.017	0.048	0.207	-0.072	**-0.403**
29. I believe that most people will take advantage of you if you let them	A	-0.014	0.037	0.156	-0.075	**-0.399**
33. I seldom notice the moods or feelings that different environments produce	O	0.028	-0.017	0.041	-0.044	0.076

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested a 6-factor solution, however this 5-factor solution is also included as it may be preferred by a researcher expecting to recover the Big Five.

Table III

Varimax 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
21. I often feel tense and jittery	N	**0.891**	-0.007	0.068	0.037	0.026	-0.033
31. I rarely feel fearful or anxious	N	**-0.886**	-0.034	-0.051	-0.028	-0.005	0.122
1. I am not a worrier	N	**-0.869**	-0.051	-0.037	0.010	-0.020	0.081
7. I laugh easily	E	**-0.858**	0.000	-0.098	-0.039	-0.042	0.133
42. I am not a cheerful optimist	E	**0.855**	0.001	0.089	0.068	0.026	-0.086
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.763**	-0.025	0.103	0.087	0.018	-0.072
46. I am seldom sad or depressed	N	**-0.754**	-0.021	-0.018	-0.035	0.032	0.230
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.708**	-0.015	0.099	0.021	0.029	-0.013
6. I often feel inferior to others	N	**0.693**	0.082	0.048	0.082	0.025	0.074
12. I don't consider myself especially "lighthearted"	E	**0.616**	0.028	-0.056	0.033	0.042	0.035
26. Sometimes I feel completely worthless	N	**0.611**	0.054	0.036	0.138	0.045	-0.059
16. I rarely feel lonely or blue	N	**-0.583**	0.063	0.034	-0.052	-0.008	0.112
51. I often feel helpless and want someone else to solve my problems	N	**0.574**	-0.122	0.105	0.102	0.057	0.002
37. I am a cheerful, high-spirited person	E	**-0.475**	0.085	-0.040	-0.030	-0.047	0.290
56. At times I have been so ashamed I just want to hide	N	**0.419**	0.094	-0.063	0.100	0.018	0.083
40. When I make a commitment, I can always be counted on to follow through	C	-0.028	**0.869**	-0.006	-0.051	0.013	-0.055
55. I never seem to be able to get organized	C	-0.035	**-0.865**	0.030	-0.018	-0.082	0.009
20. I try to perform all the tasks assigned to me conscientiously	C	0.056	**0.861**	-0.009	0.008	-0.003	0.015
25. I have a clear set of goals and work toward them	C	0.029	**0.849**	-0.082	0.000	-0.003	-0.020

in an orderly fashion							
15. I am not a very methodical person	C	-0.086	**-0.844**	0.029	-0.070	-0.052	0.024
60. I strive for excellence in everything I do	C	0.011	**0.837**	-0.011	0.013	0.019	-0.004
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.107	**0.825**	-0.018	-0.154	-0.043	-0.012
45. Sometimes I'm not as dependable or reliable as I should be	C	0.056	**-0.825**	0.010	0.153	-0.003	0.024
5. I keep my belongings clean and neat	C	0.069	**0.793**	-0.049	0.060	0.089	-0.036
35. I work hard to accomplish my goals	C	-0.033	**0.771**	0.030	-0.010	0.029	-0.043
50. I am a productive person who always gets the job done	C	-0.102	**0.734**	-0.034	-0.208	-0.025	0.013
8. Once I find the right way to do something, I stick to it	O	0.110	**0.680**	0.031	0.017	0.022	0.026
30. I waste a lot of time before settling down to work	C	0.085	**-0.550**	0.079	**0.417**	0.022	-0.036
44. I am hard-headed and tough-minded in my abilities	A	0.032	0.105	0.083	0.010	-0.070	0.060
4. I try to be courteous to everyone I meet	A	0.036	0.034	**-0.913**	0.029	-0.010	0.023
54. If I don't like people, I let them know it	A	-0.069	0.007	**0.872**	-0.012	-0.014	-0.044
49. I generally try to be thoughtful and considerate	A	0.000	0.124	**-0.866**	-0.018	0.054	0.018
9. I often get into arguments with my family and co-workers	A	-0.025	-0.056	**0.849**	-0.029	0.088	0.005
14. Some people think I'm selfish and egotistical	A	0.070	-0.024	**0.837**	-0.059	0.054	-0.016
39. Some people think of me as cold and calculating	A	0.230	-0.014	**0.727**	-0.028	0.118	-0.036
59. If necessary, I am willing to manipulate people to get what I want	A	0.060	-0.004	**0.724**	-0.033	0.181	0.001
34. Most people I know like me	A	-0.183	0.035	**-0.660**	-0.015	**-0.323**	0.073
19. I would rather cooperate with others than compete with them	A	-0.083	-0.044	**-0.534**	0.029	-0.079	0.017
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.132	0.030	0.059	**-0.844**	-0.036	0.028
13. I am intrigued by the patterns I find in art and nature	O	0.046	-0.132	0.071	**0.830**	0.040	-0.055
58. I often enjoy playing with theories or abstract ideas	O	0.143	-0.116	-0.003	**0.824**	0.066	-0.006
53. I have a lot of intellectual curiosity	O	0.083	0.048	-0.148	**0.764**	0.077	0.007
23. Poetry has little or no effect on me	O	-0.027	0.116	-0.123	**-0.742**	0.012	0.045

43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	0.010	-0.099	0.065	**0.718**	-0.018	-0.046
3. I don't like to waste my time daydreaming	O	-0.096	0.251	-0.077	**-0.668**	0.006	0.038
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.081	-0.040	0.104	**-0.450**	0.001	-0.047
28. I often try new and foreign foods	O	0.068	0.014	-0.124	**0.312**	-0.016	0.062
38. I believe we should look to our religious authorities for decisions on moral issues	O	-0.004	-0.031	0.006	-0.088	0.011	-0.028
2. I like to have a lot of people around me	E	0.000	0.003	-0.036	-0.058	**-0.909**	0.057
27. I usually prefer to do things alone	E	-0.007	0.052	0.075	-0.009	**0.850**	-0.014
17. I really enjoy talking to people	E	-0.020	0.011	-0.116	-0.060	**-0.840**	0.067
22. I like to be where the action is	E	-0.060	0.042	-0.009	-0.061	**-0.812**	0.230
57. I would rather go my own way than be a leader of others	E	0.240	-0.008	-0.010	0.098	**0.536**	-0.057
24. I tend to be cynical and skeptical of others' intentions	A	0.183	0.031	0.297	-0.129	**0.463**	0.102
29. I believe that most people will take advantage of you if you let them	A	0.011	0.040	0.159	-0.081	**0.416**	0.139
36. I often get angry at the way people treat me	N	-0.003	0.050	0.209	-0.076	**0.414**	0.093
33. I seldom notice the moods or feelings that different environments produce	O	0.034	-0.017	0.041	-0.046	-0.073	0.021
52. I am a very active person	E	-0.220	-0.053	-0.048	0.044	-0.063	**0.917**
47. My life is fast-paced	E	-0.261	-0.100	-0.079	0.072	-0.019	**0.883**
32. I often feel as if I'm bursting with energy	E	**-0.500**	-0.033	-0.053	0.025	-0.043	**0.697**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested this 6-factor solution, however the 5-factor solution is also included as it may be preferred by a researcher expecting to recover the Big Five.

Table IV

Oblimin 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)
31. I rarely feel fearful or anxious	N	**-0.902**	-0.020	0.011	0.018	-0.029
21. I often feel tense and jittery	N	**0.881**	-0.020	0.005	-0.006	0.015
1. I am not a worrier	N	**-0.878**	-0.033	0.024	0.055	-0.015
7. I laugh easily	E	**-0.872**	0.010	-0.035	0.008	0.008
42. I am not a cheerful optimist	E	**0.856**	-0.006	0.028	0.025	0.012
46. I am seldom sad or depressed	N	**-0.799**	-0.011	0.034	0.012	-0.049
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.759**	-0.027	0.049	0.050	0.018
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.696**	-0.023	0.048	-0.011	0.008
6. I often feel inferior to others	N	**0.654**	0.078	0.003	0.058	0.018
32. I often feel as if I'm bursting with energy	E	**-0.627**	-0.027	-0.009	0.077	0.070
16. I rarely feel lonely or blue	N	**-0.601**	0.072	0.079	-0.014	-0.005
26. Sometimes I feel completely worthless	N	**0.599**	0.059	-0.008	0.110	-0.015
12. I don't consider myself especially "lighthearted"	E	**0.596**	0.015	-0.101	0.003	-0.015
51. I often feel helpless and want someone else to solve my problems	N	**0.551**	-0.119	0.059	0.073	-0.026
37. I am a cheerful, high-spirited person	E	**-0.530**	0.089	0.003	0.013	0.049
47. My life is fast-paced	E	**-0.429**	-0.093	-0.050	0.109	0.066
52. I am a very active person	E	**-0.392**	-0.051	-0.021	0.087	0.108
56. At times I have been so ashamed I just want to hide	N	**0.383**	0.092	-0.088	0.087	0.008
55. I never seem to be able to get organized	C	-0.019	**-0.871**	0.011	-0.049	0.057
40. When I make a commitment, I can always be counted on to follow through	C	-0.021	**0.870**	0.022	-0.019	0.005

20. I try to perform all the tasks assigned to me conscientiously	C	0.041	**0.868**	0.015	0.043	0.032
15. I am not a very methodical person	C	-0.069	**-0.855**	0.012	-0.100	0.024
25. I have a clear set of goals and work toward them in an orderly fashion	C	0.025	**0.851**	-0.058	0.030	0.023
60. I strive for excellence in everything I do	C	-0.001	**0.844**	0.013	0.047	0.006
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.094	**0.816**	0.017	-0.117	0.056
45. Sometimes I'm not as dependable or reliable as I should be	C	0.043	**-0.814**	-0.019	0.121	-0.012
5. I keep my belongings clean and neat	C	0.055	**0.801**	-0.035	0.085	-0.068
35. I work hard to accomplish my goals	C	-0.035	**0.778**	0.054	0.021	-0.010
50. I am a productive person who always gets the job done	C	-0.088	**0.715**	-0.003	-0.178	0.034
8. Once I find the right way to do something, I stick to it	O	0.090	**0.686**	0.044	0.043	0.008
30. I waste a lot of time before settling down to work	C	0.049	**-0.502**	0.058	**0.400**	-0.018
44. I am hard-headed and tough-minded in my abilities	A	0.017	0.111	0.091	0.023	0.086
4. I try to be courteous to everyone I meet	A	0.053	-0.011	**-0.925**	-0.003	-0.044
54. If I don't like people, I let them know it	A	-0.081	0.053	**0.887**	0.022	0.065
49. I generally try to be thoughtful and considerate	A	0.017	0.077	**-0.876**	-0.046	-0.107
9. I often get into arguments with my family and co-workers	A	-0.052	-0.016	**0.853**	-0.002	-0.037
14. Some people think I'm selfish and egotistical	A	0.053	0.010	**0.837**	-0.037	-0.001
59. If necessary, I am willing to manipulate people to get what I want	A	0.030	0.026	**0.715**	-0.016	-0.134
39. Some people think of me as cold and calculating	A	0.211	0.015	**0.710**	-0.020	-0.066
34. Most people I know like me	A	-0.156	0.007	**-0.629**	-0.014	0.282
19. I would rather cooperate with others than compete with them	A	-0.069	-0.066	**-0.530**	0.016	0.043
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.043	-0.065	0.066	**-0.854**	0.008
13. I am intrigued by the patterns I find in art and nature	O	-0.037	-0.030	0.067	**0.841**	-0.013
58. I often enjoy playing with theories or abstract ideas	O	0.047	-0.022	-0.015	**0.831**	-0.036
53. I have a lot of intellectual curiosity	O	-0.007	0.129	-0.154	**0.775**	-0.056

23. Poetry has little or no effect on me	O	0.046	0.022	-0.125	**-0.756**	-0.040
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.059	-0.010	0.069	**0.731**	0.041
3. I don't like to waste my time daydreaming	O	-0.031	0.171	-0.069	**-0.670**	-0.028
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.022	-0.087	0.105	**-0.458**	-0.018
28. I often try new and foreign foods	O	0.023	0.043	-0.125	**0.317**	0.028
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.012	-0.042	0.003	-0.094	-0.017
2. I like to have a lot of people around me	E	0.056	0.007	0.034	-0.023	**0.923**
27. I usually prefer to do things alone	E	-0.064	0.043	0.013	-0.037	**-0.856**
17. I really enjoy talking to people	E	0.032	0.010	-0.051	-0.029	**0.847**
22. I like to be where the action is	E	-0.051	0.046	0.060	-0.015	**0.831**
57. I would rather go my own way than be a leader of others	E	0.204	-0.009	-0.068	0.064	**-0.534**
24. I tend to be cynical and skeptical of others' intentions	A	0.132	0.020	0.253	-0.138	**-0.432**
29. I believe that most people will take advantage of you if you let them	A	-0.045	0.032	0.131	-0.082	**-0.397**
36. I often get angry at the way people treat me	N	-0.051	0.046	0.182	-0.077	**-0.396**
33. I seldom notice the moods or feelings that different environments produce	O	0.038	-0.020	0.044	-0.044	0.078

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested a 6-factor solution, however this 5-factor solution is also included as it may be preferred by a researcher expecting to recover the Big Five. In addition, note that this oblimin solution is nearly identical to the varimax solution presented in Table 2.

Table V

Oblimin 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
21. I often feel tense and jittery	N	**0.907**	-0.018	0.007	-0.016	0.007	0.029
31. I rarely feel fearful or anxious	N	**-0.877**	-0.017	0.010	0.016	-0.029	0.067
1. I am not a worrier	N	**-0.876**	-0.032	0.022	0.058	-0.011	0.025
42. I am not a cheerful optimist	E	**0.852**	-0.007	0.029	0.022	0.009	-0.028
7. I laugh easily	E	**-0.842**	0.013	-0.036	0.004	0.007	0.078
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.758**	-0.027	0.050	0.047	0.015	-0.019
6. I often feel inferior to others	N	**0.730**	0.084	0.006	0.038	0.003	0.132
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.725**	-0.022	0.050	-0.021	-0.001	0.039
46. I am seldom sad or depressed	N	**-0.710**	-0.003	0.035	-0.006	-0.061	0.193
12. I don't consider myself especially "lighthearted"	E	**0.645**	0.018	-0.099	-0.011	-0.026	0.083
26. Sometimes I feel completely worthless	N	**0.600**	0.058	-0.006	0.107	-0.018	-0.012
51. I often feel helpless and want someone else to solve my problems	N	**0.583**	-0.116	0.062	0.063	-0.034	0.049
16. I rarely feel lonely or blue	N	**-0.566**	0.075	0.079	-0.020	-0.008	0.078
56. At times I have been so ashamed I just want to hide	N	**0.449**	0.098	-0.086	0.070	-0.005	0.122
37. I am a cheerful, high-spirited person	E	**-0.401**	0.102	0.006	-0.016	0.029	0.273
55. I never seem to be able to get organized	C	-0.026	**-0.871**	0.011	-0.046	0.058	-0.008
20. I try to perform all the tasks assigned to me conscientiously	C	0.058	**0.869**	0.015	0.037	0.029	0.029
40. When I make a commitment, I can always be counted on to follow through	C	-0.045	**0.867**	0.021	-0.013	0.010	-0.052
15. I am not a very methodical person	C	-0.070	**-0.855**	0.012	-0.098	0.025	0.005

25. I have a clear set of goals and work toward them in an orderly fashion	C	0.021	**0.850**	-0.058	0.030	0.023	-0.012
60. I strive for excellence in everything I do	C	0.005	**0.844**	0.013	0.045	0.004	0.007
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.102	**0.814**	0.016	-0.115	0.058	-0.019
45. Sometimes I'm not as dependable or reliable as I should be	C	0.054	**-0.812**	-0.018	0.119	-0.014	0.025
5. I keep my belongings clean and neat	C	0.049	**0.800**	-0.036	0.085	-0.067	-0.018
35. I work hard to accomplish my goals	C	-0.051	**0.777**	0.054	0.025	-0.007	-0.037
50. I am a productive person who always gets the job done	C	-0.084	**0.715**	-0.004	-0.179	0.034	0.006
8. Once I find the right way to do something, I stick to it	O	0.115	**0.689**	0.045	0.036	0.003	0.045
30. I waste a lot of time before settling down to work	C	0.038	**-0.503**	0.058	**0.404**	-0.017	-0.021
44. I am hard-headed and tough-minded in my abilities	A	0.050	0.114	0.092	0.014	0.080	0.064
4. I try to be courteous to everyone I meet	A	0.059	-0.010	**-0.924**	-0.006	-0.046	0.014
54. If I don't like people, I let them know it	A	-0.099	0.051	**0.887**	0.028	0.069	-0.039
49. I generally try to be thoughtful and considerate	A	0.021	0.077	**-0.876**	-0.049	-0.108	0.011
9. I often get into arguments with my family and co-workers	A	-0.040	-0.016	**0.853**	-0.004	-0.038	0.021
14. Some people think I'm selfish and egotistical	A	0.056	0.010	**0.837**	-0.036	-0.001	0.001
59. If necessary, I am willing to manipulate people to get what I want	A	0.046	0.027	**0.715**	-0.019	-0.137	0.027
39. Some people think of me as cold and calculating	A	0.213	0.014	**0.710**	-0.020	-0.067	-0.005
34. Most people I know like me	A	-0.144	0.008	**-0.628**	-0.017	0.280	0.033
19. I would rather cooperate with others than compete with them	A	-0.071	-0.065	**-0.530**	0.016	0.043	0.000
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.049	-0.066	0.066	**-0.853**	0.010	-0.009
13. I am intrigued by the patterns I find in art and nature	O	-0.049	-0.031	0.067	**0.846**	-0.011	-0.025
58. I often enjoy playing with theories or abstract ideas	O	0.067	-0.020	-0.014	**0.827**	-0.040	0.035
53. I have a lot of intellectual curiosity	O	0.016	0.132	-0.153	**0.769**	-0.060	0.042
23. Poetry has little or no effect on me	O	0.057	0.022	-0.125	**-0.761**	-0.042	0.021

43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.071	-0.010	0.069	**0.736**	0.043	-0.025
3. I don't like to waste my time daydreaming	O	-0.025	0.171	-0.069	**-0.673**	-0.029	0.013
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.057	-0.090	0.104	**-0.449**	-0.011	-0.070
28. I often try new and foreign foods	O	0.062	0.047	-0.123	**0.308**	0.020	0.078
38. I believe we should look to our religious authorities for decisions on moral issues	O	-0.004	-0.044	0.003	-0.090	-0.014	-0.033
2. I like to have a lot of people around me	E	0.050	0.006	0.035	-0.024	**0.920**	-0.003
27. I usually prefer to do things alone	E	-0.037	0.046	0.012	-0.041	**-0.858**	0.043
17. I really enjoy talking to people	E	0.032	0.010	-0.050	-0.031	**0.844**	0.010
22. I like to be where the action is	E	0.036	0.054	0.065	-0.037	**0.820**	0.184
57. I would rather go my own way than be a leader of others	E	0.207	-0.009	-0.068	0.064	**-0.535**	-0.005
24. I tend to be cynical and skeptical of others' intentions	A	0.213	0.027	0.255	-0.159	**-0.450**	0.152
29. I believe that most people will take advantage of you if you let them	A	0.045	0.040	0.132	-0.105	**-0.416**	0.176
36. I often get angry at the way people treat me	N	0.015	0.052	0.184	-0.093	**-0.410**	0.128
33. I seldom notice the moods or feelings that different environments produce	O	0.048	-0.019	0.045	-0.047	0.076	0.019
52. I am a very active person	E	0.044	-0.007	-0.002	-0.006	0.044	**0.957**
47. My life is fast-paced	E	-0.011	-0.054	-0.036	0.022	-0.004	**0.921**
32. I often feel as if I'm bursting with energy	E	**-0.310**	0.006	0.004	0.007	0.017	**0.704**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested this 6-factor solution, however the 5-factor solution is also included as it may be preferred by a researcher expecting to recover the Big Five. In addition, note that this oblimin solution is nearly identical to the varimax solution presented in Table 3.

Table VI

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Uniform Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness & Activity)
31. I rarely feel fearful or anxious	N	**-0.909**	-0.064	-0.113	-0.004	0.034
42. I am not a cheerful optimist	E	**0.907**	0.024	0.133	-0.028	-0.044
7. I laugh easily	E	**-0.902**	-0.011	-0.119	0.014	0.070
21. I often feel tense and jittery	N	**0.890**	0.038	0.124	-0.042	-0.007
1. I am not a worrier	N	**-0.857**	-0.079	-0.097	0.037	0.035
46. I am seldom sad or depressed	N	**-0.789**	0.072	-0.008	-0.052	0.104
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.772**	-0.060	0.073	-0.007	-0.042
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.746**	0.021	0.023	0.008	0.066
16. I rarely feel lonely or blue	N	**-0.724**	-0.015	-0.062	-0.014	0.027
6. I often feel inferior to others	N	**0.665**	-0.002	-0.016	-0.075	-0.042
26. Sometimes I feel completely worthless	N	**0.635**	-0.041	0.067	0.026	0.041
51. I often feel helpless and want someone else to solve my problems	N	**0.593**	-0.187	0.106	0.074	0.022
37. I am a cheerful, high-spirited person	E	**-0.585**	0.007	-0.035	-0.002	0.207
12. I don't consider myself especially "lighthearted"	E	**0.570**	-0.004	0.098	-0.100	-0.048
32. I often feel as if I'm bursting with energy	E	**-0.531**	-0.007	0.050	-0.013	**0.305**
47. My life is fast-paced	E	**-0.376**	-0.036	0.012	0.001	**0.367**
56. At times I have been so ashamed I just want to hide	N	**0.346**	-0.063	-0.090	-0.058	0.018
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.048	**0.879**	-0.055	0.059	0.007
20. I try to perform all the tasks assigned to me conscientiously	C	-0.018	**0.871**	-0.071	0.014	0.043
15. I am not a very methodical person	C	-0.009	**-0.869**	0.021	-0.094	-0.039

10. I'm pretty good about pacing myself so as to get things done on time	C	-0.012	**0.864**	-0.007	-0.160	0.011
55. I never seem to be able to get organized	C	0.029	**-0.854**	0.025	-0.065	-0.015
40. When I make a commitment, I can always be counted on to follow through	C	-0.029	**0.851**	-0.084	-0.097	-0.003
5. I keep my belongings clean and neat	C	-0.029	**0.816**	0.007	0.124	0.031
50. I am a productive person who always gets the job done	C	-0.076	**0.811**	-0.038	-0.200	0.019
45. Sometimes I'm not as dependable or reliable as I should be	C	0.028	**-0.811**	0.093	0.128	-0.036
60. I strive for excellence in everything I do	C	-0.034	**0.772**	-0.146	-0.071	-0.015
35. I work hard to accomplish my goals	C	0.013	**0.772**	0.013	-0.126	0.017
8. Once I find the right way to do something, I stick to it	O	0.016	**0.731**	0.017	0.153	0.041
30. I waste a lot of time before settling down to work	C	0.001	**-0.563**	0.044	**0.480**	0.047
33. I seldom notice the moods or feelings that different environments produce	O	-0.020	-0.091	0.017	0.023	0.073
4. I try to be courteous to everyone I meet	A	-0.004	0.060	**-0.917**	-0.042	-0.045
54. If I don't like people, I let them know it	A	-0.014	-0.017	**0.895**	0.041	0.018
9. I often get into arguments with my family and co-workers	A	0.096	-0.116	**0.872**	-0.003	-0.128
14. Some people think I'm selfish and egotistical	A	0.060	-0.058	**0.867**	-0.022	-0.021
49. I generally try to be thoughtful and considerate	A	-0.001	0.165	**-0.858**	-0.016	0.041
39. Some people think of me as cold and calculating	A	0.186	-0.027	**0.784**	0.085	-0.068
59. If necessary, I am willing to manipulate people to get what I want	A	0.071	-0.058	**0.782**	0.048	-0.143
34. Most people I know like me	A	-0.282	0.073	**-0.637**	-0.053	**0.366**
19. I would rather cooperate with others than compete with them	A	0.031	-0.022	**-0.627**	-0.045	-0.159
36. I often get angry at the way people treat me	A	0.109	-0.106	**0.400**	0.039	**-0.318**
24. I tend to be cynical and skeptical of others' intentions	A	**0.312**	0.006	**0.400**	0.035	**-0.334**
29. I believe that most people will take advantage of you if you let them	A	0.138	0.023	0.279	-0.051	-0.190
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.065	-0.014	-0.161	-0.129	0.121

48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.031	0.021	0.030	**-0.894**	0.081
58. I often enjoy playing with theories or abstract ideas	O	0.006	-0.069	-0.020	**0.865**	-0.054
13. I am intrigued by the patterns I find in art and nature	O	-0.004	-0.106	0.036	**0.841**	0.036
53. I have a lot of intellectual curiosity	O	0.044	0.029	-0.022	**0.778**	-0.098
23. Poetry has little or no effect on me	O	0.046	0.191	-0.091	**-0.722**	-0.072
3. I don't like to waste my time daydreaming	O	0.078	**0.329**	-0.027	**-0.691**	-0.077
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.046	-0.138	0.039	**0.670**	0.048
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.020	-0.086	-0.033	**-0.484**	0.112
28. I often try new and foreign foods	O	-0.059	0.118	0.029	**0.327**	0.000
44. I am hard-headed and tough-minded in my abilities	A	0.049	0.040	0.033	0.074	0.044
2. I like to have a lot of people around me	E	0.040	0.014	-0.123	-0.032	**0.896**
22. I like to be where the action is	E	-0.042	0.044	-0.097	-0.027	**0.887**
27. I usually prefer to do things alone	E	-0.047	-0.024	0.173	0.042	**-0.855**
17. I really enjoy talking to people	E	-0.006	0.057	-0.154	-0.028	**0.848**
57. I would rather go my own way than be a leader of others	E	0.210	-0.019	0.015	-0.020	**-0.550**
52. I am a very active person	E	**-0.380**	-0.049	0.013	-0.024	**0.416**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested either a 5- or a 6-factor solution, so both are included. In addition, note that this solution is extremely similar to the solution from a normal rather than uniform initial distribution presented in Table 2.

Table VII

Varimax 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Uniform Distribution Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
42. I am not a cheerful optimist	E	**0.913**	0.026	0.117	-0.028	-0.062	-0.066
21. I often feel tense and jittery	N	**0.909**	0.041	0.104	-0.040	-0.041	-0.007
31. I rarely feel fearful or anxious	N	**-0.908**	-0.065	-0.101	-0.003	0.040	0.099
7. I laugh easily	E	**-0.888**	-0.011	-0.111	0.017	0.058	0.158
1. I am not a worrier	N	**-0.858**	-0.080	-0.084	0.037	0.045	0.083
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.792**	-0.057	0.052	-0.003	-0.077	0.008
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.775**	0.024	0.004	0.013	0.022	0.062
46. I am seldom sad or depressed	N	**-0.750**	0.074	-0.011	-0.045	0.050	0.275
16. I rarely feel lonely or blue	N	**-0.708**	-0.015	-0.059	-0.011	0.009	0.145
6. I often feel inferior to others	N	**0.656**	-0.002	-0.023	-0.076	-0.035	-0.103
26. Sometimes I feel completely worthless	N	**0.626**	-0.041	0.065	0.024	0.048	-0.098
51. I often feel helpless and want someone else to solve my problems	N	**0.621**	-0.185	0.087	0.079	-0.025	0.073
12. I don't consider myself especially "lighthearted"	E	**0.591**	-0.001	0.079	-0.096	-0.087	0.039
37. I am a cheerful, high-spirited person	E	**-0.526**	0.011	-0.046	0.008	0.118	**0.379**
56. At times I have been so ashamed I just want to hide	N	**0.338**	-0.063	-0.091	-0.059	0.029	-0.062
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.053	**0.879**	-0.051	0.057	0.021	-0.021
20. I try to perform all the tasks assigned to me conscientiously	C	-0.017	**0.871**	-0.069	0.013	0.046	0.014
15. I am not a very methodical person	C	-0.004	**-0.868**	0.016	-0.092	-0.052	0.023
10. I'm pretty good about pacing myself so as to get	C	-0.007	**0.864**	-0.009	-0.160	0.005	0.029

things done on time							
55. I never seem to be able to get organized	C	0.034	**-0.853**	0.020	-0.063	-0.029	0.026
40. When I make a commitment, I can always be counted on to follow through	C	-0.025	**0.852**	-0.086	-0.096	-0.005	0.025
5. I keep my belongings clean and neat	C	-0.039	**0.815**	0.015	0.121	0.052	-0.048
45. Sometimes I'm not as dependable or reliable as I should be	C	0.020	**-0.812**	0.096	0.127	-0.026	-0.050
50. I am a productive person who always gets the job done	C	-0.072	**0.811**	-0.039	-0.200	0.015	0.030
35. I work hard to accomplish my goals	C	0.018	**0.772**	0.012	-0.126	0.010	0.024
60. I strive for excellence in everything I do	C	-0.038	**0.772**	-0.145	-0.072	-0.003	-0.016
8. Once I find the right way to do something, I stick to it	O	-0.007	**0.730**	0.030	0.148	0.081	-0.111
30. I waste a lot of time before settling down to work	C	-0.012	**-0.564**	0.054	**0.477**	0.070	-0.069
33. I seldom notice the moods or feelings that different environments produce	O	-0.016	-0.091	0.018	0.023	0.066	0.030
4. I try to be courteous to everyone I meet	A	-0.006	0.062	**-0.923**	-0.037	-0.025	0.013
54. If I don't like people, I let them know it	A	-0.010	-0.019	**0.899**	0.037	-0.004	-0.007
14. Some people think I'm selfish and egotistical	A	0.060	-0.060	**0.871**	-0.026	-0.038	-0.036
9. I often get into arguments with my family and co-workers	A	0.107	-0.116	**0.864**	-0.004	-0.164	0.003
49. I generally try to be thoughtful and considerate	A	-0.001	0.167	**-0.861**	-0.012	0.059	0.029
39. Some people think of me as cold and calculating	A	0.180	-0.029	**0.786**	0.081	-0.075	-0.081
59. If necessary, I am willing to manipulate people to get what I want	A	0.076	-0.059	**0.776**	0.046	-0.167	-0.025
19. I would rather cooperate with others than compete with them	A	0.029	-0.020	**-0.638**	-0.040	-0.147	-0.009
34. Most people I know like me	A	-0.287	0.071	**-0.619**	-0.055	**0.391**	0.062
29. I believe that most people will take advantage of you if you let them	A	0.158	0.026	0.261	-0.047	-0.232	0.059
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.057	-0.015	-0.155	-0.131	0.135	-0.023
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.042	0.018	0.037	**-0.899**	0.091	-0.027
58. I often enjoy playing with theories or abstract ideas	O	0.009	-0.068	-0.021	**0.867**	-0.052	-0.007

13. I am intrigued by the patterns I find in art and nature	O	-0.007	-0.106	0.042	**0.839**	0.046	-0.023
53. I have a lot of intellectual curiosity	O	0.056	0.032	-0.030	**0.783**	-0.112	0.033
23. Poetry has little or no effect on me	O	0.047	0.191	-0.098	**-0.720**	-0.078	0.009
3. I don't like to waste my time daydreaming	O	0.098	**0.331**	-0.043	**-0.689**	-0.114	0.094
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.043	-0.137	0.043	**0.669**	0.049	0.009
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.012	-0.089	-0.026	**-0.486**	0.122	-0.019
28. I often try new and foreign foods	O	-0.058	0.118	0.031	**0.327**	0.000	0.007
2. I like to have a lot of people around me	E	0.041	0.009	-0.087	-0.040	**0.908**	0.101
27. I usually prefer to do things alone	E	-0.041	-0.018	0.134	0.052	**-0.886**	-0.054
17. I really enjoy talking to people	E	-0.008	0.052	-0.117	-0.036	**0.867**	0.081
22. I like to be where the action is	E	-0.011	0.042	-0.075	-0.029	**0.841**	0.257
57. I would rather go my own way than be a leader of others	E	0.214	-0.015	-0.013	-0.014	**-0.565**	-0.054
36. I often get angry at the way people treat me	N	0.148	-0.101	**0.372**	0.048	**-0.395**	0.133
24. I tend to be cynical and skeptical of others' intentions	A	**0.338**	0.010	**0.374**	0.041	**-0.389**	0.045
47. My life is fast-paced	E	-0.229	-0.027	-0.026	0.029	0.163	**0.892**
52. I am a very active person	E	-0.236	-0.041	-0.020	0.000	0.221	**0.877**
32. I often feel as if I'm bursting with energy	E	**-0.407**	0.003	0.019	0.009	0.109	**0.802**
44. I am hard-headed and tough-minded in my abilities	A	0.033	0.039	0.042	0.071	0.069	-0.078

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor or loaded nearly equally highly on multiple factors. The scree plot suggested either a 5- or 6-factor solution, so both are included. In addition, note that this solution is extremely similar to the solution from a normal rather than uniform initial distribution presented in Table 4.

Table VIII

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(1.0, 0.1) and Moderate Parameters ~N(0.5, 0.25)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness & Activity)
31. I rarely feel fearful or anxious	N	**0.915**	0.071	-0.054	-0.056	-0.033
1. I am not a worrier	N	**0.902**	0.060	-0.009	-0.096	-0.019
7. I laugh easily	E	**0.899**	0.039	-0.035	-0.007	-0.041
21. I often feel tense and jittery	N	**-0.890**	-0.069	0.005	0.074	0.007
42. I am not a cheerful optimist	E	**-0.881**	-0.089	0.046	0.036	0.056
46. I am seldom sad or depressed	N	**0.808**	0.002	-0.089	-0.023	0.018
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**-0.778**	-0.088	0.060	0.028	0.040
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**-0.753**	-0.083	-0.032	0.044	0.051
16. I rarely feel lonely or blue	N	**0.729**	0.050	-0.070	-0.036	0.075
6. I often feel inferior to others	N	**-0.716**	-0.040	0.015	0.036	0.088
26. Sometimes I feel completely worthless	N	**-0.661**	-0.044	-0.013	0.053	0.026
37. I am a cheerful, high-spirited person	E	**0.652**	-0.057	-0.123	-0.021	-0.015
32. I often feel as if I'm bursting with energy	E	**0.578**	-0.098	-0.119	0.087	-0.106
51. I often feel helpless and want someone else to solve my problems	N	**-0.513**	-0.257	-0.027	0.017	0.091
52. I am a very active person	E	**0.488**	-0.123	-0.072	0.059	-0.194
47. My life is fast-paced	E	**0.483**	-0.121	-0.106	0.069	-0.103
12. I don't consider myself especially "lighthearted"	E	**-0.457**	-0.116	-0.104	0.087	0.057
56. At times I have been so ashamed I just want to hide	N	**-0.375**	-0.024	-0.040	-0.022	0.021
44. I am hard-headed and tough-minded in my abilities	A	0.148	0.059	0.035	-0.014	-0.033
25. I have a clear set of goals and work toward them in an orderly fashion	C	0.108	**0.888**	0.021	-0.076	-0.028

20. I try to perform all the tasks assigned to me conscientiously	C	0.063	**0.878**	0.056	0.003	-0.051
55. I never seem to be able to get organized	C	-0.042	**-0.877**	-0.041	0.026	0.009
40. When I make a commitment, I can always be counted on to follow through	C	0.072	**0.845**	-0.058	0.144	-0.010
10. I'm pretty good about pacing myself so as to get things done on time	C	0.064	**0.837**	0.023	0.230	0.036
60. I strive for excellence in everything I do	C	0.059	**0.826**	0.017	0.077	-0.013
15. I am not a very methodical person	C	-0.063	**-0.821**	-0.049	0.113	0.016
35. I work hard to accomplish my goals	C	0.047	**0.816**	-0.042	0.131	-0.027
45. Sometimes I'm not as dependable or reliable as I should be	C	-0.099	**-0.805**	0.061	-0.235	0.041
5. I keep my belongings clean and neat	O	0.016	**0.796**	0.030	-0.132	-0.029
50. I am a productive person who always gets the job done	C	0.065	**0.748**	0.007	0.280	0.006
8. Once I find the right way to do something, I stick to it	O	0.090	**0.660**	0.026	-0.123	-0.080
30. I waste a lot of time before settling down to work	A	0.026	**-0.578**	-0.019	**-0.484**	-0.075
33. I seldom notice the moods or feelings that different environments produce	A	0.003	-0.063	0.006	-0.018	-0.014
4. I try to be courteous to everyone I meet	A	0.009	0.006	**-0.896**	-0.031	0.021
54. If I don't like people, I let them know it	A	0.027	-0.017	**0.872**	-0.019	-0.033
9. I often get into arguments with my family and co-workers	A	0.010	0.011	**0.847**	0.019	0.174
49. I generally try to be thoughtful and considerate	A	0.027	0.107	**-0.838**	0.023	-0.025
14. Some people think I'm selfish and egotistical	A	-0.033	-0.034	**0.769**	0.033	0.141
39. Some people think of me as cold and calculating	A	-0.201	0.040	**0.757**	0.039	0.095
59. If necessary, I am willing to manipulate people to get what I want	A	-0.017	0.010	**0.755**	0.076	0.172
19. I would rather cooperate with others than compete with them	A	-0.074	-0.087	**-0.635**	-0.009	-0.015
34. Most people I know like me	A	0.213	-0.048	**-0.599**	-0.003	**-0.380**
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.063	0.131	0.072	**0.854**	0.041
13. I am intrigued by the patterns I find in art and nature	O	0.047	-0.112	-0.038	**-0.822**	-0.062

58. I often enjoy playing with theories or abstract ideas	O	0.037	-0.158	-0.025	**-0.814**	-0.022
23. Poetry has little or no effect on me	O	-0.047	0.086	0.010	**0.792**	0.102
53. I have a lot of intellectual curiosity	O	0.085	-0.045	-0.068	**-0.736**	-0.009
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	0.088	-0.005	0.010	**-0.720**	-0.051
3. I don't like to waste my time daydreaming	O	-0.035	**0.351**	0.003	**0.655**	0.050
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.008	-0.055	0.032	**0.557**	-0.027
28. I often try new and foreign foods	O	0.006	-0.014	0.035	**-0.444**	0.024
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.094	-0.157	0.019	0.203	0.036
2. I like to have a lot of people around me	E	0.029	0.012	-0.046	-0.011	**-0.890**
27. I usually prefer to do things alone	E	-0.011	-0.025	0.080	0.059	**0.878**
22. I like to be where the action is	E	0.092	-0.027	-0.012	0.005	**-0.836**
17. I really enjoy talking to people	E	0.073	0.014	-0.069	-0.025	**-0.816**
57. I would rather go my own way than be a leader of others	E	-0.263	-0.050	0.020	0.040	**0.541**
36. I often get angry at the way people treat me	N	-0.012	0.045	**0.360**	0.107	**0.493**
24. I tend to be cynical and skeptical of others' intentions	A	-0.223	0.012	**0.343**	0.048	**0.427**
29. I believe that most people will take advantage of you if you let them	A	-0.063	-0.056	0.168	0.037	**0.417**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested either a 5- or a 6-factor solution, so both are included. In addition, note that this solution is extremely similar to the solution using different distributions for updating the strong and moderate connections, presented in Table 2.

Table IX

Varimax 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(1.0, 0.1) and Moderate Parameters ~N(0.5, 0.25)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
21. I often feel tense and jittery	N	**0.890**	-0.055	0.017	-0.065	0.025	-0.126
31. I rarely feel fearful or anxious	N	**-0.882**	0.066	-0.063	0.052	-0.042	0.229
1. I am not a worrier	N	**-0.870**	0.056	-0.018	0.092	-0.027	0.227
42. I am not a cheerful optimist	E	**0.857**	-0.081	0.055	-0.031	0.067	-0.194
7. I laugh easily	E	**-0.846**	0.041	-0.042	0.007	-0.044	0.291
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.816**	-0.064	0.073	-0.012	0.066	0.003
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.788**	-0.061	-0.020	-0.030	0.075	-0.005
46. I am seldom sad or depressed	N	**-0.774**	-0.001	-0.097	0.021	0.012	0.218
6. I often feel inferior to others	N	**0.743**	-0.019	0.026	-0.023	0.111	-0.018
16. I rarely feel lonely or blue	N	**-0.713**	0.043	-0.078	0.032	0.066	0.153
26. Sometimes I feel completely worthless	N	**0.691**	-0.024	-0.003	-0.041	0.048	-0.005
51. I often feel helpless and want someone else to solve my problems	N	**0.577**	-0.230	-0.015	0.001	0.121	0.126
37. I am a cheerful, high-spirited person	E	**-0.566**	-0.041	-0.124	0.031	-0.001	**0.376**
12. I don't consider myself especially "lighthearted"	E	**0.493**	-0.099	-0.096	-0.075	0.077	0.047
56. At times I have been so ashamed I just want to hide	N	**0.417**	-0.004	-0.032	0.035	0.042	0.078
44. I am hard-headed and tough-minded in my abilities	A	-0.123	0.065	0.035	0.017	-0.028	0.103
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.111	**0.890**	0.020	0.072	-0.026	0.017
20. I try to perform all the tasks assigned to me conscientiously	C	-0.056	**0.885**	0.056	-0.005	-0.045	0.045

55. I never seem to be able to get organized	C	0.038	**-0.883**	-0.042	-0.024	0.003	-0.031
40. When I make a commitment, I can always be counted on to follow through	C	-0.091	**0.840**	-0.061	-0.152	-0.013	-0.043
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.090	**0.830**	0.020	-0.239	0.031	-0.068
15. I am not a very methodical person	C	0.056	**-0.829**	-0.050	-0.113	0.009	-0.047
60. I strive for excellence in everything I do	C	-0.075	**0.823**	0.015	-0.083	-0.015	-0.033
35. I work hard to accomplish my goals	C	-0.067	**0.811**	-0.044	-0.138	-0.030	-0.052
5. I keep my belongings clean and neat	C	0.003	**0.810**	0.032	0.135	-0.018	0.079
45. Sometimes I'm not as dependable or reliable as I should be	C	0.131	**-0.794**	0.065	0.246	0.050	0.085
50. I am a productive person who always gets the job done	C	-0.081	**0.743**	0.005	-0.286	0.003	-0.036
8. Once I find the right way to do something, I stick to it	O	-0.065	**0.673**	0.028	0.126	-0.070	0.105
30. I waste a lot of time before settling down to work	C	-0.001	**-0.569**	-0.017	**0.492**	-0.069	0.083
33. I seldom notice the moods or feelings that different environments produce	O	0.003	-0.062	0.006	0.019	-0.012	0.019
4. I try to be courteous to everyone I meet	A	0.001	0.005	**-0.896**	0.031	0.020	0.007
54. If I don't like people, I let them know it	A	-0.026	-0.013	**0.872**	0.020	-0.030	0.030
9. I often get into arguments with my family and co-workers	A	-0.016	0.014	**0.848**	-0.018	0.177	0.012
49. I generally try to be thoughtful and considerate	A	-0.024	0.103	**-0.839**	-0.025	-0.028	-0.012
14. Some people think I'm selfish and egotistical	A	0.015	-0.035	**0.769**	-0.034	0.141	-0.037
39. Some people think of me as cold and calculating	A	0.154	0.032	**0.756**	-0.044	0.089	-0.157
59. If necessary, I am willing to manipulate people to get what I want	A	0.010	0.012	**0.756**	-0.075	0.175	0.000
19. I would rather cooperate with others than compete with them	A	0.105	-0.079	**-0.632**	0.015	-0.007	0.074
34. Most people I know like me	A	-0.199	-0.053	**-0.602**	0.002	**-0.386**	0.046
48. I have little interest in speculating on the nature of the universe or the human condition	O	0.062	0.126	0.072	**-0.854**	0.039	-0.023
13. I am intrigued by the patterns I find in art and nature	O	-0.047	-0.107	-0.038	**0.823**	-0.060	0.018
58. I often enjoy playing with theories or abstract ideas	O	-0.036	-0.152	-0.025	**0.815**	-0.019	0.019

23. Poetry has little or no effect on me	O	0.045	0.080	0.010	**-0.793**	0.099	-0.022
53. I have a lot of intellectual curiosity	O	-0.091	-0.043	-0.069	**0.734**	-0.010	-0.001
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.081	0.002	0.010	**0.722**	-0.048	0.044
3. I don't like to waste my time daydreaming	O	0.009	**0.339**	0.000	**-0.664**	0.041	-0.093
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.031	-0.048	0.035	**-0.551**	-0.018	0.120
28. I often try new and foreign foods	O	-0.021	-0.015	0.034	**0.442**	0.021	-0.040
38. I believe we should look to our religious authorities for decisions on moral issues	O	-0.066	-0.152	0.021	-0.198	0.041	0.102
27. I usually prefer to do things alone	E	0.004	-0.023	0.080	-0.059	**0.882**	0.003
2. I like to have a lot of people around me	E	0.017	0.022	-0.043	0.018	**-0.880**	0.132
22. I like to be where the action is	E	-0.027	-0.012	-0.007	0.004	**-0.825**	0.203
17. I really enjoy talking to people	E	-0.058	0.013	-0.069	0.025	**-0.817**	0.035
57. I would rather go my own way than be a leader of others	E	0.265	-0.042	0.023	-0.035	**0.552**	-0.013
36. I often get angry at the way people treat me	N	0.033	0.057	**0.364**	-0.102	**0.507**	0.092
24. I tend to be cynical and skeptical of others' intentions	A	0.229	0.021	**0.348**	-0.043	**0.439**	0.011
29. I believe that most people will take advantage of you if you let them	A	0.070	-0.050	0.170	-0.034	**0.424**	0.029
47. My life is fast-paced	E	-0.277	-0.069	-0.094	-0.046	-0.048	**0.840**
52. I am a very active person	E	-0.284	-0.072	-0.055	-0.036	-0.153	**0.825**
32. I often feel as if I'm bursting with energy	E	**-0.392**	-0.051	-0.110	-0.067	-0.059	**0.776**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested either a 5- or a 6-factor solution, so both are included. In addition, note that this solution is extremely similar to the solution using different distributions for updating the strong and moderate connections, presented in Table 3.

Table X

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.9, 0.1) and Moderate Parameters ~N(0.3, 0.4)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness & Activity)
1. I am not a worrier	N	**-0.919**	-0.034	0.043	-0.090	0.039
42. I am not a cheerful optimist	E	**0.904**	0.037	0.015	0.070	0.001
31. I rarely feel fearful or anxious	N	**-0.903**	-0.028	0.004	-0.083	0.033
21. I often feel tense and jittery	N	**0.902**	-0.036	-0.050	0.057	-0.002
7. I laugh easily	E	**-0.890**	-0.052	-0.033	-0.077	0.003
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.786**	-0.043	0.047	-0.034	0.021
46. I am seldom sad or depressed	N	**-0.776**	-0.025	-0.088	-0.056	0.034
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.726**	-0.040	-0.026	0.041	-0.043
12. I don't consider myself especially "lighthearted"	E	**0.694**	-0.029	0.022	-0.008	-0.012
6. I often feel inferior to others	N	**0.618**	-0.032	0.093	-0.066	0.028
26. Sometimes I feel completely worthless	N	**0.604**	-0.043	0.060	-0.059	-0.023
51. I often feel helpless and want someone else to solve my problems	N	**0.600**	-0.080	-0.009	-0.002	-0.074
16. I rarely feel lonely or blue	N	**-0.467**	0.022	-0.070	0.023	0.043
32. I often feel as if I'm bursting with energy	E	**-0.440**	-0.048	-0.067	-0.067	0.188
37. I am a cheerful, high-spirited person	E	**-0.418**	-0.057	-0.032	0.007	0.075
56. At times I have been so ashamed I just want to hide	N	**0.395**	-0.045	0.134	-0.122	0.051
47. My life is fast-paced	E	-0.299	-0.051	-0.074	-0.095	0.226
52. I am a very active person	E	-0.290	-0.063	-0.051	-0.067	0.282
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.078	**0.866**	0.013	0.012	0.024
15. I am not a very methodical person	C	0.023	**-0.851**	0.000	-0.029	-0.002

20. I try to perform all the tasks assigned to me conscientiously	C	-0.036	**0.842**	-0.013	0.037	-0.015
55. I never seem to be able to get organized	C	0.038	**-0.812**	-0.008	0.040	-0.015
5. I keep my belongings clean and neat	C	0.003	**0.782**	0.027	0.021	0.038
10. I'm pretty good about pacing myself so as to get things done on time	C	0.039	**0.753**	0.018	-0.219	-0.026
45. Sometimes I'm not as dependable or reliable as I should be	C	-0.003	**-0.719**	0.039	0.124	0.044
40. When I make a commitment, I can always be counted on to follow through	C	0.036	**0.717**	-0.054	0.006	-0.036
50. I am a productive person who always gets the job done	C	-0.023	**0.693**	0.001	-0.186	0.000
8. Once I find the right way to do something, I stick to it	O	0.027	**0.657**	0.078	0.012	-0.004
60. I strive for excellence in everything I do	C	0.006	**0.652**	0.038	0.058	-0.017
35. I work hard to accomplish my goals	C	-0.002	**0.547**	0.016	-0.060	-0.085
4. I try to be courteous to everyone I meet	A	-0.065	0.019	**-0.922**	0.009	-0.074
49. I generally try to be thoughtful and considerate	A	-0.072	0.033	**-0.885**	-0.043	-0.078
54. If I don't like people, I let them know it	A	0.088	-0.024	**0.876**	-0.011	0.057
9. I often get into arguments with my family and co-workers	A	0.115	0.003	**0.839**	-0.050	-0.076
14. Some people think I'm selfish and egotistical	A	0.059	0.076	**0.836**	0.041	-0.019
39. Some people think of me as cold and calculating	A	0.135	-0.059	**0.624**	0.093	-0.040
59. If necessary, I am willing to manipulate people to get what I want	A	0.080	-0.093	**0.584**	0.071	0.000
19. I would rather cooperate with others than compete with them	A	-0.016	-0.099	**-0.494**	-0.038	-0.059
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.060	-0.026	-0.087	0.002	0.048
33. I seldom notice the moods or feelings that different environments produce	O	0.005	-0.022	-0.053	-0.032	0.037
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.079	0.045	-0.080	**-0.808**	0.034
58. I often enjoy playing with theories or abstract ideas	O	0.021	-0.085	-0.002	**0.804**	0.031
53. I have a lot of intellectual curiosity	O	0.085	0.015	0.072	**0.740**	-0.026
13. I am intrigued by the patterns I find in art and nature	O	0.029	0.035	0.070	**0.706**	0.056

23. Poetry has little or no effect on me	O	-0.013	0.025	-0.001	**-0.618**	-0.024
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	0.026	0.013	0.009	**0.568**	-0.001
3. I don't like to waste my time daydreaming	O	0.075	0.239	-0.030	**-0.555**	-0.134
30. I waste a lot of time before settling down to work	O	-0.071	**-0.420**	0.002	**0.506**	0.150
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.067	0.036	-0.059	**-0.441**	0.075
28. I often try new and foreign foods	O	-0.049	0.008	-0.017	0.272	-0.077
27. I usually prefer to do things alone	E	-0.052	-0.023	0.001	0.029	**-0.902**
2. I like to have a lot of people around me	E	0.101	0.010	0.070	0.018	**0.898**
22. I like to be where the action is	E	0.074	0.025	0.058	0.009	**0.874**
17. I really enjoy talking to people	E	0.069	0.089	0.059	-0.049	**0.820**
57. I would rather go my own way than be a leader of others	E	0.091	-0.015	-0.033	-0.072	**-0.471**
34. Most people I know like me	A	-0.159	0.039	**-0.412**	-0.021	**0.463**
24. I tend to be cynical and skeptical of others' intentions	A	0.180	0.005	0.020	-0.019	**-0.351**
36. I often get angry at the way people treat me	N	0.112	0.025	0.081	0.003	-0.271
29. I believe that most people will take advantage of you if you let them	A	0.052	0.066	0.012	0.032	-0.237
44. I am hard-headed and tough-minded in my abilities	A	0.024	-0.064	0.041	0.068	0.093

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested this 5-factor solution. Note that this solution is extremely similar to the solutions using different distributions for updating the strong and moderate connections, presented in Tables 2 and 8.

Table XI

Varimax 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.9, 0.1) and Moderate Parameters ~N(0.3, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
21. I often feel tense and jittery	N	**0.919**	-0.024	-0.039	0.075	-0.031	-0.022
1. I am not a worrier	N	**-0.907**	-0.042	0.034	-0.098	0.037	0.143
42. I am not a cheerful optimist	E	**0.900**	0.046	0.024	0.081	-0.006	-0.102
31. I rarely feel fearful or anxious	N	**-0.885**	-0.034	-0.003	-0.088	0.024	0.166
7. I laugh easily	E	**-0.859**	-0.056	-0.038	-0.077	-0.023	0.226
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.793**	-0.034	0.056	-0.022	0.002	-0.042
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.740**	-0.030	-0.016	0.056	-0.069	-0.014
46. I am seldom sad or depressed	N	**-0.740**	-0.028	-0.091	-0.053	0.000	0.245
12. I don't consider myself especially "lighthearted"	E	**0.719**	-0.018	0.033	0.011	-0.050	0.038
6. I often feel inferior to others	N	**0.627**	-0.024	0.101	-0.054	0.007	-0.014
51. I often feel helpless and want someone else to solve my problems	N	**0.626**	-0.070	0.001	0.016	-0.114	0.047
26. Sometimes I feel completely worthless	N	**0.611**	-0.035	0.068	-0.048	-0.040	-0.029
16. I rarely feel lonely or blue	N	**-0.437**	0.021	-0.071	0.029	0.011	0.189
56. At times I have been so ashamed I just want to hide	N	**0.425**	-0.037	0.144	-0.107	0.009	0.107
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.080	**0.866**	0.011	0.016	0.023	0.029
15. I am not a very methodical person	C	0.024	**-0.852**	0.001	-0.035	0.002	-0.028
20. I try to perform all the tasks assigned to me conscientiously	C	-0.042	**0.842**	-0.014	0.040	-0.013	0.005
55. I never seem to be able to get organized	C	0.043	**-0.812**	-0.006	0.037	-0.018	-0.005
5. I keep my belongings clean and neat	C	0.003	**0.784**	0.027	0.027	0.033	0.032

10. I'm pretty good about pacing myself so as to get things done on time	C	0.039	**0.755**	0.019	-0.213	-0.031	0.019
45. Sometimes I'm not as dependable or reliable as I should be	C	0.006	**-0.719**	0.041	0.123	0.036	0.025
40. When I make a commitment, I can always be counted on to follow through	C	0.023	**0.716**	-0.056	0.007	-0.024	-0.045
50. I am a productive person who always gets the job done	C	-0.035	**0.692**	-0.001	-0.187	0.011	-0.031
8. Once I find the right way to do something, I stick to it	O	0.025	**0.658**	0.078	0.018	-0.007	0.013
60. I strive for excellence in everything I do	C	-0.011	**0.650**	0.035	0.056	0.000	-0.057
35. I work hard to accomplish my goals	C	-0.021	**0.546**	0.013	-0.063	-0.066	-0.074
4. I try to be courteous to everyone I meet	A	-0.055	0.018	**-0.922**	0.007	-0.078	0.015
49. I generally try to be thoughtful and considerate	A	-0.056	0.033	**-0.884**	-0.041	-0.090	0.048
54. If I don't like people, I let them know it	A	0.081	-0.022	**0.877**	-0.008	0.058	-0.010
9. I often get into arguments with my family and co-workers	A	0.110	0.007	**0.842**	-0.044	-0.082	-0.003
14. Some people think I'm selfish and egotistical	A	0.044	0.078	**0.836**	0.043	-0.011	-0.040
39. Some people think of me as cold and calculating	A	0.118	-0.058	**0.624**	0.093	-0.029	-0.068
59. If necessary, I am willing to manipulate people to get what I want	A	0.087	-0.089	**0.588**	0.079	-0.016	0.048
19. I would rather cooperate with others than compete with them	A	0.002	-0.097	**-0.492**	-0.034	-0.077	0.063
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.058	-0.026	-0.087	0.001	0.050	-0.015
33. I seldom notice the moods or feelings that different environments produce	O	0.001	-0.023	-0.054	-0.035	0.045	-0.026
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.066	0.047	-0.078	**-0.808**	0.024	0.050
58. I often enjoy playing with theories or abstract ideas	O	0.008	-0.089	-0.004	**0.801**	0.044	-0.046
53. I have a lot of intellectual curiosity	O	0.071	0.013	0.071	**0.739**	-0.014	-0.055
13. I am intrigued by the patterns I find in art and nature	O	0.035	0.035	0.071	**0.715**	0.045	0.052
23. Poetry has little or no effect on me	O	-0.021	0.024	-0.002	**-0.626**	-0.012	-0.054
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	0.024	0.013	0.009	**0.571**	-0.001	0.003

3. I don't like to waste my time daydreaming	O	0.097	0.245	-0.025	**-0.546**	-0.163	0.082
30. I waste a lot of time before settling down to work	C	-0.086	**-0.426**	-0.003	**0.497**	0.173	-0.060
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.063	0.036	-0.059	**-0.443**	0.074	0.020
28. I often try new and foreign foods	O	-0.040	0.009	-0.015	0.278	-0.090	0.050
27. I usually prefer to do things alone	E	-0.062	-0.018	0.004	0.039	**-0.906**	-0.087
2. I like to have a lot of people around me	E	0.112	0.006	0.068	0.009	**0.897**	0.089
22. I like to be where the action is	E	0.107	0.025	0.060	0.010	**0.840**	0.202
17. I really enjoy talking to people	E	0.077	0.085	0.057	-0.057	**0.822**	0.079
34. Most people I know like me	A	-0.148	0.034	**-0.416**	-0.029	**0.464**	0.072
57. I would rather go my own way than be a leader of others	E	0.067	-0.014	-0.033	-0.073	**-0.449**	-0.150
24. I tend to be cynical and skeptical of others' intentions	A	0.201	0.014	0.027	-0.002	**-0.392**	0.065
36. I often get angry at the way people treat me	N	0.137	0.033	0.089	0.021	**-0.314**	0.100
29. I believe that most people will take advantage of you if you let them	A	0.082	0.074	0.018	0.051	-0.286	0.129
44. I am hard-headed and tough-minded in my abilities	A	0.015	-0.066	0.040	0.063	0.105	-0.040
47. My life is fast-paced	E	-0.140	-0.033	-0.055	-0.045	0.050	**0.904**
52. I am a very active person	E	-0.136	-0.047	-0.031	-0.016	0.120	**0.875**
32. I often feel as if I'm bursting with energy	E	**-0.308**	-0.033	-0.050	-0.019	0.024	**0.804**
37. I am a cheerful, high-spirited person	E	**-0.345**	-0.051	-0.024	0.033	-0.016	**0.419**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested a 5-factor solution, but this 6-factor solution is included for comparison to the other 6-factor solutions. Note that this solution is extremely similar to the solutions using different distributions for updating the strong and moderate connections, presented in Tables 3 and 9.

Table XII

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.7, 0.15) and Moderate Parameters ~N(0.4, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness & Activity)
42. I am not a cheerful optimist	E	**0.919**	0.041	0.030	-0.009	-0.061
31. I rarely feel fearful or anxious	N	**-0.916**	-0.030	-0.016	-0.033	0.032
7. I laugh easily	E	**-0.888**	0.009	-0.044	-0.021	0.057
1. I am not a worrier	N	**-0.888**	-0.031	0.014	-0.033	0.088
21. I often feel tense and jittery	N	**0.873**	0.024	0.026	0.036	-0.103
46. I am seldom sad or depressed	N	**-0.823**	0.061	-0.018	0.072	0.093
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.785**	-0.036	0.086	0.064	-0.046
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.752**	0.014	-0.075	0.031	-0.138
16. I rarely feel lonely or blue	N	**-0.746**	0.012	-0.104	0.057	0.051
26. Sometimes I feel completely worthless	N	**0.629**	-0.082	0.049	0.059	-0.096
12. I don't consider myself especially "lighthearted"	E	**0.603**	0.068	-0.026	0.049	-0.007
37. I am a cheerful, high-spirited person	E	**-0.596**	0.058	-0.045	0.040	0.229
6. I often feel inferior to others	N	**0.559**	0.029	0.002	0.042	-0.047
51. I often feel helpless and want someone else to solve my problems	N	**0.498**	-0.153	0.028	0.074	-0.060
56. At times I have been so ashamed I just want to hide	N	0.278	0.014	-0.024	-0.065	0.000
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.016	**0.825**	-0.046	-0.142	0.037
20. I try to perform all the tasks assigned to me conscientiously	C	0.023	**0.819**	-0.078	0.061	-0.042
40. When I make a commitment, I can always be counted on to follow through	C	-0.002	**0.812**	-0.047	-0.075	0.041
55. I never seem to be able to get organized	C	-0.020	**-0.807**	0.064	-0.057	-0.003
25. I have a clear set of goals and work toward them in	C	-0.007	**0.803**	-0.046	0.046	-0.047

an orderly fashion						
60. I strive for excellence in everything I do	C	-0.093	**0.770**	-0.016	-0.008	0.043
45. Sometimes I'm not as dependable or reliable as I should be	C	-0.001	**-0.766**	0.012	0.133	-0.024
15. I am not a very methodical person	C	-0.018	**-0.764**	0.067	-0.130	0.080
50. I am a productive person who always gets the job done	C	-0.096	**0.754**	-0.045	-0.281	0.028
35. I work hard to accomplish my goals	C	-0.035	**0.729**	-0.041	-0.018	0.011
5. I keep my belongings clean and neat	C	0.023	**0.678**	-0.124	0.154	-0.070
8. Once I find the right way to do something, I stick to it	O	0.010	**0.613**	-0.079	0.150	-0.034
30. I waste a lot of time before settling down to work	C	0.122	**-0.600**	-0.006	**0.370**	-0.069
4. I try to be courteous to everyone I meet	A	-0.001	0.061	**-0.873**	0.049	-0.004
49. I generally try to be thoughtful and considerate	A	-0.012	0.157	**-0.818**	0.029	-0.015
14. Some people think I'm selfish and egotistical	A	0.006	-0.064	**0.804**	-0.004	-0.077
54. If I don't like people, I let them know it	A	-0.002	-0.027	**0.804**	-0.026	0.016
9. I often get into arguments with my family and co-workers	A	0.028	-0.024	**0.797**	-0.005	-0.136
59. If necessary, I am willing to manipulate people to get what I want	A	0.042	-0.047	**0.684**	0.024	-0.131
39. Some people think of me as cold and calculating	A	0.085	-0.046	**0.669**	-0.030	-0.154
19. I would rather cooperate with others than compete with them	A	0.010	0.019	**-0.585**	0.048	-0.015
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.020	0.063	-0.093	-0.043	0.015
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.039	0.007	0.015	**-0.857**	-0.002
58. I often enjoy playing with theories or abstract ideas	O	0.044	-0.066	0.013	**0.847**	0.012
13. I am intrigued by the patterns I find in art and nature	O	-0.038	0.001	-0.059	**0.804**	-0.026
53. I have a lot of intellectual curiosity	O	0.002	0.059	-0.003	**0.738**	-0.019
23. Poetry has little or no effect on me	O	-0.022	0.087	0.066	**-0.703**	0.035
3. I don't like to waste my time daydreaming	O	-0.024	**0.310**	0.074	**-0.691**	-0.029
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.019	-0.029	-0.033	**0.628**	-0.008

18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.005	0.000	-0.030	**-0.328**	-0.025
28. I often try new and foreign foods	O	-0.006	0.121	0.062	0.245	0.035
44. I am hard-headed and tough-minded in my abilities	A	-0.006	0.048	-0.084	0.159	-0.111
33. I seldom notice the moods or feelings that different environments produce	O	0.035	-0.006	0.022	0.056	0.048
2. I like to have a lot of people around me	E	-0.020	-0.073	-0.062	-0.007	**0.821**
17. I really enjoy talking to people	E	-0.032	-0.005	-0.086	-0.001	**0.817**
22. I like to be where the action is	E	-0.035	-0.076	-0.040	-0.021	**0.809**
27. I usually prefer to do things alone	E	0.049	0.055	0.070	0.021	**-0.774**
34. Most people I know like me	A	-0.166	0.033	**-0.417**	-0.009	**0.492**
57. I would rather go my own way than be a leader of others	E	0.182	0.086	0.033	0.025	**-0.484**
52. I am a very active person	E	-0.213	0.096	0.034	0.010	**0.406**
24. I tend to be cynical and skeptical of others' intentions	A	0.120	-0.042	**0.329**	0.014	**-0.401**
47. My life is fast-paced	E	-0.207	0.089	0.040	0.001	**0.366**
32. I often feel as if I'm bursting with energy	E	**-0.350**	0.100	0.027	0.023	**0.356**
36. I often get angry at the way people treat me	N	0.040	-0.022	0.241	-0.056	**-0.352**
29. I believe that most people will take advantage of you if you let them	A	-0.007	0.015	0.209	-0.007	-0.250

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested either a 5- or possibly a 6-factor solution. Note that this solution is extremely similar to the solutions using different distributions for updating the strong and moderate connections, presented in Tables 2, 8, & 10, except that here the Activity facet of Extraversion is in the fifth rather than first factor.

Table XIII

Varimax 6 Factor Structure Loading of Simulated Data Initialized with Random Data Drawn from a Continuous, Normal Distribution Using Strong Parameters ~N(0.7, 0.15) and Moderate Parameters ~N(0.4, 0.2)

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
42. I am not a cheerful optimist	E	**0.925**	0.033	0.024	-0.014	-0.065	0.018
31. I rarely feel fearful or anxious	N	**-0.921**	-0.024	-0.010	-0.029	0.032	-0.013
1. I am not a worrier	N	**-0.892**	-0.025	0.018	-0.029	0.080	0.023
7. I laugh easily	E	**-0.887**	0.011	-0.044	-0.018	0.032	0.057
21. I often feel tense and jittery	N	**0.881**	0.015	0.019	0.031	-0.109	0.014
46. I am seldom sad or depressed	N	**-0.816**	0.057	-0.026	0.073	0.036	0.144
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.796**	-0.046	0.076	0.059	-0.067	0.063
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.761**	0.005	-0.081	0.027	-0.145	0.013
16. I rarely feel lonely or blue	N	**-0.742**	0.010	-0.109	0.058	0.012	0.089
26. Sometimes I feel completely worthless	N	**0.622**	-0.077	0.058	0.059	-0.039	-0.145
12. I don't consider myself especially "lighthearted"	E	**0.617**	0.056	-0.039	0.044	-0.048	0.116
37. I am a cheerful, high-spirited person	E	**-0.587**	0.050	-0.060	0.040	0.147	0.237
6. I often feel inferior to others	N	**0.555**	0.031	0.007	0.041	-0.013	-0.082
51. I often feel helpless and want someone else to solve my problems	N	**0.503**	-0.159	0.024	0.071	-0.064	0.019
56. At times I have been so ashamed I just want to hide	N	0.270	0.021	-0.016	-0.064	0.043	-0.106
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.019	**0.829**	-0.042	-0.142	0.036	-0.014
20. I try to perform all the tasks assigned to me conscientiously	C	0.025	**0.820**	-0.076	0.060	-0.050	-0.006
40. When I make a commitment, I can always be counted on to follow through	C	-0.001	**0.812**	-0.047	-0.076	0.024	0.030

55. I never seem to be able to get organized	C	-0.021	**-0.809**	0.062	-0.057	0.006	-0.002
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.004	**0.803**	-0.045	0.045	-0.058	0.002
60. I strive for excellence in everything I do	C	-0.089	**0.769**	-0.018	-0.009	0.016	0.056
45. Sometimes I'm not as dependable or reliable as I should be	C	-0.001	**-0.768**	0.009	0.133	-0.019	0.001
15. I am not a very methodical person	C	-0.024	**-0.761**	0.068	-0.128	0.101	-0.026
50. I am a productive person who always gets the job done	C	-0.099	**0.758**	-0.042	-0.281	0.026	-0.011
35. I work hard to accomplish my goals	C	-0.031	**0.726**	-0.043	-0.020	-0.015	0.053
5. I keep my belongings clean and neat	C	0.022	**0.681**	-0.119	0.154	-0.063	-0.049
8. Once I find the right way to do something, I stick to it	O	0.015	**0.611**	-0.080	0.148	-0.055	0.033
30. I waste a lot of time before settling down to work	C	0.121	**-0.599**	-0.004	**0.370**	-0.046	-0.055
4. I try to be courteous to everyone I meet	A	0.000	0.060	**-0.874**	0.049	-0.009	-0.009
49. I generally try to be thoughtful and considerate	A	-0.010	0.156	**-0.820**	0.029	-0.025	-0.001
54. If I don't like people, I let them know it	A	-0.003	-0.025	**0.805**	-0.027	0.020	0.011
14. Some people think I'm selfish and egotistical	A	0.012	-0.069	**0.799**	-0.005	-0.094	0.052
9. I often get into arguments with my family and co-workers	A	0.029	-0.025	**0.799**	-0.006	-0.126	-0.026
59. If necessary, I am willing to manipulate people to get what I want	A	0.042	-0.047	**0.688**	0.024	-0.111	-0.052
39. Some people think of me as cold and calculating	A	0.085	-0.046	**0.673**	-0.030	-0.135	-0.052
19. I would rather cooperate with others than compete with them	A	0.004	0.025	**-0.578**	0.050	0.017	-0.100
29. I believe that most people will take advantage of you if you let them	A	-0.009	0.017	0.217	-0.006	-0.211	-0.131
38. I believe we should look to our religious authorities for decisions on moral issues	O	0.017	0.066	-0.090	-0.042	0.025	-0.024
48. I have little interest in speculating on the nature of the universe or the human condition	O	-0.040	0.004	0.012	**-0.857**	-0.008	0.020
58. I often enjoy playing with theories or abstract ideas	O	0.046	-0.065	0.013	**0.847**	0.012	0.000
13. I am intrigued by the patterns I find in art and nature	O	-0.039	0.006	-0.054	**0.806**	-0.011	-0.047
53. I have a lot of intellectual curiosity	O	0.005	0.059	-0.004	**0.737**	-0.026	0.009

23. Poetry has little or no effect on me	O	-0.022	0.084	0.062	**-0.704**	0.022	0.041
3. I don't like to waste my time daydreaming	O	-0.021	**0.306**	0.070	**-0.692**	-0.047	0.042
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.021	-0.024	-0.027	**0.630**	0.010	-0.050
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.002	0.005	-0.023	**-0.327**	0.008	-0.087
28. I often try new and foreign foods	O	-0.002	0.118	0.058	0.245	0.015	0.053
44. I am hard-headed and tough-minded in my abilities	A	0.001	0.043	-0.088	0.157	-0.129	0.021
2. I like to have a lot of people around me	E	-0.046	-0.045	-0.045	0.000	**0.903**	-0.018
27. I usually prefer to do things alone	E	0.074	0.030	0.057	0.016	**-0.835**	-0.001
17. I really enjoy talking to people	E	-0.051	0.013	-0.083	0.003	**0.822**	0.114
22. I like to be where the action is	E	-0.048	-0.063	-0.042	-0.019	**0.789**	0.174
57. I would rather go my own way than be a leader of others	E	0.196	0.073	0.029	0.022	**-0.496**	-0.038
34. Most people I know like me	A	-0.170	0.037	**-0.423**	-0.008	**0.454**	0.152
24. I tend to be cynical and skeptical of others' intentions	A	0.125	-0.047	**0.333**	0.013	**-0.377**	-0.102
36. I often get angry at the way people treat me	N	0.053	-0.033	0.238	-0.059	**-0.367**	0.001
47. My life is fast-paced	E	-0.153	0.046	-0.008	-0.007	0.114	**0.906**
52. I am a very active person	E	-0.162	0.058	-0.012	0.004	0.168	**0.869**
32. I often feel as if I'm bursting with energy	E	**-0.312**	0.064	-0.018	0.019	0.119	**0.792**
33. I seldom notice the moods or feelings that different environments produce	O	0.039	-0.009	0.017	0.055	0.029	0.059

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor or did not load clearly onto one factor over the others. The scree plot suggested either a 5- or possibly a 6-factor solution. Note that this solution is extremely similar to the solutions using different distributions for updating the strong and moderate connections, presented in Tables 3, 9, & 11.

Table XIV

Theoretical responses to NEO-FFI items based on the Tender- and Tough-Minded Constructs

NEO-FFI Factor	NEO-FFI Item	Tender Response	Tough Response
O	3. I don't like to waste my time daydreaming		high
A	4. I try to be courteous to everyone I meet		low
A	9. I often get into arguments with my family and co-workers		mod. high
N	11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	low	
E	12. I don't consider myself especially "light-hearted"		high
O	13. I am intrigued by the patterns I find in art and nature	high	
A	14. Some people think I'm selfish and egotistical	mod. low	mod. high
O	23. Poetry has little or no effect on me		high
A	24. I tend to be cynical and skeptical of others' intentions	mod. low	high
A	29. I believe that most people will take advantage of you if you let them	mod. low	high
N	36. I often get angry at the way people treat me	mod. high	
E	37. I am a cheerful, high-spirited person	mod. high	
O	38. I believe we should look to our religious authorities for decisions on moral issues	mod. high	low
A	39. Some people think of me as cold and calculating	low	mod. high
C	40. When I make a commitment, I can always be counted on to follow through	high	
E	42. I am not a cheerful optimist	low	high
C	48. I have little interest in speculating on the nature of the universe or the human condition	low	mod. high
A	49. I generally try to be thoughtful and considerate	mod. high	
O	53. I have a lot of intellectual curiosity	high	
A	54. If I don't like people, I let them know it		high
O	58. I often enjoy playing with theories or abstract ideas	high	
A	59. If necessary, I am willing to manipulate people to get what I want	low	high

Table XV

Oblimin 2 Factor Pattern Loading of the James Dataset Initialized with an Inherent Tough- and Tough-Minded Structure

NEO-FFI Item		Factor 1: Tough-Minded	Factor 2: Tender-Minded
54. If I don't like people, I let them know it	A	**0.796**	0.109
4. I try to be courteous to everyone I meet	A	**-0.782**	-0.188
3. I don't like to waste my time daydreaming	O	**0.777**	0.150
23. Poetry has little or no effect on me	O	**0.766**	0.090
12. I don't consider myself especially "lighthearted"	E	**0.760**	0.129
24. I tend to be cynical and skeptical of others' intentions	A	**0.721**	-0.208
29. I believe that most people will take advantage of you if you let them	A	**0.712**	-0.218
38. I believe we should look to our religious authorities for decisions on moral issues	O	**-0.677**	0.243
42. I am not a cheerful optimist	E	**0.569**	**-0.469**
59. If necessary, I am willing to manipulate people to get what I want	A	**0.561**	**-0.464**
9. I often get into arguments with my family and co-workers	A	**0.525**	0.096
53. I have a lot of intellectual curiosity	O	0.041	**0.810**
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	-0.124	**-0.779**
40. When I make a commitment, I can always be counted on to follow through	C	0.050	**0.776**
13. I am intrigued by the patterns I find in art and nature	O	0.054	**0.771**
58. I often enjoy playing with theories or abstract ideas	O	0.078	**0.764**
39. Some people think of me as cold and calculating	A	0.236	**-0.710**
48. I have little interest in speculating on the nature of the universe or the human condition	O	0.259	**-0.668**
36. I often get angry at the way people treat me	N	0.141	**0.537**
49. I generally try to be thoughtful and considerate	A	0.074	**0.516**
37. I am a cheerful, high-spirited person	E	0.104	**0.461**
14. Some people think I'm selfish and egotistical	A	**0.378**	**-0.435**
45. Sometimes I'm not as dependable or reliable as I should be	C	0.114	0.114
33. I seldom notice the moods or feelings that different environments produce	O	0.107	-0.031
21. I often feel tense and jittery	N	0.107	0.070
46. I am seldom sad or depressed	N	-0.106	-0.010

60. I strive for excellence in everything I do	C	-0.105	-0.032
20. I try to perform all the tasks assigned to me conscientiously	C	0.089	-0.063
55. I never seem to be able to get organized	C	-0.084	-0.014
2. I like to have a lot of people around me	E	0.076	-0.061
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.068	0.007
31. I rarely feel fearful or anxious	N	0.049	-0.008
27. I usually prefer to do things alone	E	-0.037	-0.021
6. I often feel inferior to others	N	0.033	-0.027
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	0.029	0.026
30. I waste a lot of time before settling down to work	C	-0.027	-0.027
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.018	-0.007
34. Most people I know like me	A	-0.017	-0.011
44. I am hard-headed and tough-minded in my abilities	A	0.023	0.164
56. At times I have been so ashamed I just want to hide	N	0.046	-0.148
51. I often feel helpless and want someone else to solve my problems	N	-0.077	0.145
8. Once I find the right way to do something, I stick to it	O	0.086	0.108
47. My life is fast-paced	E	0.061	0.100
25. I have a clear set of goals and work toward them in an orderly fashion	C	0.045	0.082
52. I am a very active person	E	0.010	0.082
32. I often feel as if I'm bursting with energy	E	-0.071	-0.075
7. I laugh easily	E	0.040	0.067
50. I am a productive person who always gets the job done	C	-0.018	0.065
26. Sometimes I feel completely worthless	N	-0.007	0.065
5. I keep my belongings clean and neat	C	0.013	-0.063
19. I would rather cooperate with others than compete with them	A	-0.009	-0.054
57. I would rather go my own way than be a leader of others	E	0.003	-0.053
28. I often try new and foreign foods	O	0.029	0.049
17. I really enjoy talking to people	E	0.038	0.047
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.039	-0.046
15. I am not a very methodical person	C	-0.026	-0.046

1. I am not a worrier	N	-0.011	-0.041
16. I rarely feel lonely or blue	N	-0.012	-0.040
35. I work hard to accomplish my goals	C	0.000	-0.018
22. I like to be where the action is	E	-0.010	-0.013

The factor-analysis results of the initial dataset show distinct tough- and tender-minded factors that cut across the Big Five factors. All loadings stronger than |0.3| are presented in bold.

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor.

Table XVI

Varimax 5 Factor Pattern Loading of Simulated Data Initialized with the James Tough- and Tender-Minded Dataset Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2) in the Semantic Updating

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect & Activity)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)
31. I rarely feel fearful or anxious	N	**-0.920**	0.005	-0.092	0.094	0.080
42. I am not a cheerful optimist	E	**0.904**	0.013	0.092	-0.093	-0.056
21. I often feel tense and jittery	N	**0.903**	0.012	0.107	-0.105	-0.071
1. I am not a worrier	N	**-0.899**	-0.028	-0.129	0.077	0.088
7. I laugh easily	E	**-0.894**	0.028	-0.164	0.050	0.070
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.809**	-0.050	0.077	-0.089	-0.054
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.802**	-0.011	0.141	-0.101	-0.059
12. I don't consider myself especially "lighthearted"	E	**0.735**	-0.039	0.023	-0.105	-0.134
46. I am seldom sad or depressed	N	**-0.728**	0.034	-0.119	0.056	0.076
6. I often feel inferior to others	N	**0.718**	0.017	0.141	-0.030	0.002
26. Sometimes I feel completely worthless	N	**0.699**	-0.064	0.172	-0.011	-0.056
51. I often feel helpless and want someone else to solve my problems	N	**0.696**	-0.171	0.032	-0.041	0.000
32. I often feel as if I'm bursting with energy	E	**-0.585**	-0.035	-0.018	0.075	0.242
16. I rarely feel lonely or blue	N	**-0.520**	0.050	-0.128	-0.018	-0.048
47. My life is fast-paced	E	**-0.474**	-0.030	0.034	0.042	**0.325**
56. At times I have been so ashamed I just want to hide	N	**0.466**	-0.010	0.103	-0.015	0.027
37. I am a cheerful, high-spirited person	E	**-0.458**	0.026	-0.240	0.064	0.057
52. I am a very active person	E	**-0.455**	-0.034	0.031	0.020	**0.404**
40. When I make a commitment, I can always be counted on to follow through	C	-0.010	**0.856**	0.043	0.024	0.016
55. I never seem to be able to get organized	C	0.001	**-0.819**	0.070	-0.078	0.040

10. I'm pretty good about pacing myself so as to get things done on time	C	0.006	**0.817**	0.091	-0.101	0.032
20. I try to perform all the tasks assigned to me conscientiously	C	-0.067	**0.811**	-0.016	0.137	-0.008
45. Sometimes I'm not as dependable or reliable as I should be	C	0.024	**-0.805**	-0.048	0.068	-0.014
35. I work hard to accomplish my goals	C	-0.022	**0.795**	0.024	-0.058	0.022
50. I am a productive person who always gets the job done	C	-0.057	**0.785**	0.117	-0.139	0.014
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.125	**0.770**	-0.077	0.082	-0.057
60. I strive for excellence in everything I do	C	-0.038	**0.767**	0.057	-0.009	0.065
5. I keep my belongings clean and neat	C	0.042	**0.742**	-0.091	0.119	-0.013
15. I am not a very methodical person	C	0.033	**-0.736**	0.131	-0.110	0.035
30. I waste a lot of time before settling down to work	C	-0.044	**-0.613**	-0.238	**0.420**	-0.042
8. Once I find the right way to do something, I stick to it	O	-0.046	**0.611**	-0.088	0.121	0.033
4. I try to be courteous to everyone I meet	A	-0.125	-0.018	**-0.923**	0.094	0.025
54. If I don't like people, I let them know it	A	0.100	0.019	**0.909**	-0.088	-0.027
49. I generally try to be thoughtful and considerate	A	-0.087	0.094	**-0.903**	0.108	0.036
9. I often get into arguments with my family and co-workers	A	0.185	-0.042	**0.892**	-0.136	-0.124
14. Some people think I'm selfish and egotistical	A	0.176	0.044	**0.845**	-0.128	-0.119
59. If necessary, I am willing to manipulate people to get what I want	A	0.158	-0.052	**0.831**	-0.259	-0.129
39. Some people think of me as cold and calculating	A	0.239	-0.017	**0.800**	-0.202	-0.109
34. Most people I know like me	A	-0.274	0.068	**-0.760**	0.142	**0.303**
36. I often get angry at the way people treat me	N	0.144	0.012	**0.662**	-0.128	**-0.386**
19. I would rather cooperate with others than compete with them	A	-0.168	-0.112	**-0.628**	-0.036	-0.030
24. I tend to be cynical and skeptical of others' intentions	A	**0.307**	-0.074	**0.580**	-0.238	**-0.390**
29. I believe that most people will take advantage of you if you let them	A	0.170	-0.035	**0.523**	-0.294	**-0.335**
38. I believe we should look to our religious authorities for decisions on moral issues	O	-0.130	-0.021	**-0.500**	0.229	0.142

33. I seldom notice the moods or feelings that different environments produce	O	-0.032	-0.009	0.144	-0.017	0.009
44. I am hard-headed and tough-minded in my abilities	A	-0.024	-0.041	-0.054	0.035	0.022
48. I have little interest in speculating on the nature of the universe or the human condition	O	0.142	-0.013	0.270	**-0.889**	-0.077
53. I have a lot of intellectual curiosity	O	-0.124	0.073	-0.234	**0.878**	0.077
58. I often enjoy playing with theories or abstract ideas	O	-0.135	-0.025	-0.290	**0.841**	0.062
13. I am intrigued by the patterns I find in art and nature	O	-0.146	-0.012	**-0.436**	**0.797**	0.101
23. Poetry has little or no effect on me	O	0.082	0.098	**0.528**	**-0.658**	-0.105
3. I don't like to waste my time daydreaming	O	0.110	**0.331**	**0.420**	**-0.650**	-0.077
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.076	-0.049	**-0.517**	**0.622**	0.116
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	0.013	-0.181	-0.102	**-0.588**	0.088
28. I often try new and foreign foods	O	-0.056	0.102	-0.019	**0.536**	0.000
2. I like to have a lot of people around me	E	-0.045	0.026	-0.199	0.004	**0.908**
22. I like to be where the action is	E	-0.129	0.013	-0.102	0.002	**0.904**
27. I usually prefer to do things alone	E	0.139	-0.005	**0.344**	-0.113	**-0.791**
17. I really enjoy talking to people	E	-0.048	0.058	-0.284	0.151	**0.786**
57. I would rather go my own way than be a leader of others	E	0.176	0.018	0.084	0.034	**-0.658**

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested this 5-factor solution, which, despite the population initially reflecting a personality structure that did not correspond to the Big Five, is very similar to the 5-factor results from Study 1 but with slightly more items factored into their intended Big Five factors than in Study 1 and slightly more items that cross-load between factors. A 6-factor solution is also included in Table Q for comparison to the 6-factor solutions from Study 1.

Table XVII

Varimax 6 Factor Pattern Loading of Simulated Data Initialized with the James Tough- and Tender-Minded Dataset Using Strong Parameters ~N(0.85, 0.1) and Moderate Parameters ~N(0.425, 0.2) in the Semantic Updating

NEO-FFI Item		Factor 1: Neuroticism & Extraversion (Positive Affect)	Factor 2: Conscientious-ness	Factor 3: Agreeable-ness	Factor 4: Openness	Factor 5: Extraversion (Gregariousness)	Factor 6: Extraversion (Activity)
21. I often feel tense and jittery	N	**0.906**	0.016	0.099	-0.108	-0.091	-0.086
31. I rarely feel fearful or anxious	N	**-0.905**	0.004	-0.090	0.095	0.082	0.158
42. I am not a cheerful optimist	E	**0.896**	0.015	0.089	-0.095	-0.065	-0.127
1. I am not a worrier	N	**-0.890**	-0.029	-0.126	0.079	0.097	0.134
7. I laugh easily	E	**-0.872**	0.029	-0.166	0.053	0.064	0.186
41. Too often, when things go wrong, I get discouraged and feel like giving up	N	**0.821**	-0.046	0.066	-0.091	-0.083	-0.038
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces	N	**0.821**	-0.005	0.128	-0.104	-0.096	-0.009
6. I often feel inferior to others	N	**0.735**	0.022	0.130	-0.033	-0.031	-0.006
51. I often feel helpless and want someone else to solve my problems	N	**0.729**	-0.165	0.017	-0.042	-0.046	0.055
12. I don't consider myself especially "lighthearted"	E	**0.726**	-0.038	0.018	-0.105	-0.139	-0.119
26. Sometimes I feel completely worthless	N	**0.715**	-0.059	0.162	-0.014	-0.089	-0.008
46. I am seldom sad or depressed	N	**-0.680**	0.041	-0.133	0.056	0.034	0.294
16. I rarely feel lonely or blue	N	**-0.516**	0.050	-0.129	-0.016	-0.043	0.064
56. At times I have been so ashamed I just want to hide	N	**0.481**	-0.006	0.095	-0.017	0.000	0.015
37. I am a cheerful, high-spirited person	E	**-0.409**	0.034	-0.256	0.066	0.010	0.269
40. When I make a commitment, I can always be counted on to follow through	C	-0.020	**0.854**	0.047	0.022	0.027	-0.045
55. I never seem to be able to get organized	C	0.002	**-0.819**	0.071	-0.078	0.040	0.011
10. I'm pretty good about pacing myself so as to get things done on time	C	-0.009	**0.814**	0.095	-0.104	0.047	-0.067
20. I try to perform all the tasks assigned to me	C	-0.073	**0.810**	-0.012	0.136	0.000	-0.024

conscientiously							
45. Sometimes I'm not as dependable or reliable as I should be	C	0.031	**-0.804**	-0.049	0.069	-0.020	0.029
35. I work hard to accomplish my goals	C	-0.036	**0.792**	0.028	-0.059	0.038	-0.059
50. I am a productive person who always gets the job done	C	-0.078	**0.782**	0.122	-0.142	0.037	-0.091
25. I have a clear set of goals and work toward them in an orderly fashion	C	-0.134	**0.769**	-0.074	0.083	-0.044	-0.035
60. I strive for excellence in everything I do	C	-0.036	**0.767**	0.058	-0.011	0.064	0.010
5. I keep my belongings clean and neat	C	0.063	**0.748**	-0.099	0.119	-0.038	0.082
15. I am not a very methodical person	C	0.016	**-0.741**	0.138	-0.111	0.054	-0.071
8. Once I find the right way to do something, I stick to it	O	-0.027	**0.615**	-0.093	0.121	0.013	0.082
30. I waste a lot of time before settling down to work	C	-0.040	**-0.611**	-0.233	**0.425**	-0.040	0.018
4. I try to be courteous to everyone I meet	A	-0.108	-0.015	**-0.929**	0.107	0.022	0.077
54. If I don't like people, I let them know it	A	0.083	0.016	**0.915**	-0.101	-0.024	-0.076
49. I generally try to be thoughtful and considerate	A	-0.074	0.097	**-0.907**	0.121	0.037	0.054
9. I often get into arguments with my family and co-workers	A	0.173	-0.044	**0.890**	-0.149	-0.130	-0.065
14. Some people think I'm selfish and egotistical	A	0.152	0.040	**0.851**	-0.140	-0.109	-0.117
59. If necessary, I am willing to manipulate people to get what I want	A	0.154	-0.052	**0.824**	-0.272	-0.144	-0.026
39. Some people think of me as cold and calculating	A	0.222	-0.019	**0.801**	-0.214	-0.109	-0.093
34. Most people I know like me	A	-0.268	0.067	**-0.751**	0.154	**0.318**	0.056
36. I often get angry at the way people treat me	N	0.154	0.016	**0.646**	-0.138	**-0.421**	0.025
19. I would rather cooperate with others than compete with them	A	-0.157	-0.110	**-0.634**	-0.027	-0.031	0.054
24. I tend to be cynical and skeptical of others' intentions	A	**0.329**	-0.068	**0.558**	-0.247	**-0.441**	0.055
29. I believe that most people will take advantage of you if you let them	A	0.177	-0.032	**0.506**	**-0.301**	**-0.363**	0.006
38. I believe we should look to our religious authorities for decisions on moral issues	O	-0.153	-0.027	**-0.483**	0.237	0.183	-0.088
33. I seldom notice the moods or feelings that different environments produce	O	-0.015	-0.007	0.138	-0.019	-0.012	0.078
48. I have little interest in speculating on the nature of	O	0.132	-0.015	0.258	**-0.892**	-0.077	-0.056

the universe or the human condition							
53. I have a lot of intellectual curiosity	O	-0.106	0.077	-0.225	**0.881**	0.067	0.089
58. I often enjoy playing with theories or abstract ideas	O	-0.129	-0.024	-0.277	**0.844**	0.066	0.040
13. I am intrigued by the patterns I find in art and nature	O	-0.151	-0.013	**-0.418**	**0.804**	0.123	-0.012
23. Poetry has little or no effect on me	O	0.098	0.101	**0.508**	**-0.667**	-0.139	0.063
3. I don't like to waste my time daydreaming	O	0.111	**0.332**	**0.406**	**-0.656**	-0.092	-0.005
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement	O	-0.096	-0.053	**-0.496**	**0.631**	0.155	-0.082
18. I believe letting students hear controversial speakers can only confuse and mislead them	O	-0.005	-0.186	-0.102	**-0.587**	0.111	-0.076
28. I often try new and foreign foods	O	-0.050	0.104	-0.014	**0.536**	-0.005	0.030
2. I like to have a lot of people around me	E	-0.022	0.026	-0.185	0.004	**0.900**	0.139
22. I like to be where the action is	E	-0.098	0.013	-0.091	0.001	**0.884**	0.184
17. I really enjoy talking to people	E	-0.042	0.056	-0.264	0.154	**0.801**	0.060
27. I usually prefer to do things alone	E	0.123	-0.003	**0.327**	-0.115	**-0.796**	-0.108
57. I would rather go my own way than be a leader of others	E	0.185	0.024	0.062	0.035	**-0.692**	-0.005
47. My life is fast-paced	E	**-0.317**	-0.005	0.001	0.039	0.171	**0.864**
52. I am a very active person	E	-0.298	-0.010	0.000	0.014	0.265	**0.842**
32. I often feel as if I'm bursting with energy	E	**-0.450**	-0.012	-0.054	0.074	0.092	**0.770**
44. I am hard-headed and tough-minded in my abilities	A	-0.010	-0.038	-0.059	0.036	0.006	0.066

Note: All pattern loadings stronger than |0.3| are highlighted in bold. For ease of interpretation, each item is highlighted according to Big Five factor the item was intended to load upon: Neuroticism (N) in blue, Extraversion (E) in red, Conscientiousness (C) in purple, Agreeableness (A) in green, and Openness to Experience (O) in orange. Items in lighter shades did not have a factor loading stronger than |0.3| for any factor. The scree plot suggested a 5-factor solution, presented in Table P. This 6-factor solution is included for comparison to the 6-factor solutions from Study 1. Specifically, this solution, despite the population initially reflecting a personality structure that did not correspond to the Big Five, is very similar to the 6-factor solutions from Study 1 except that more items load onto their intended Big Five factors than in Study 1, although there are also slightly more items that cross-load on multiple factors.

VITA

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EDUCATION

Ph.D. Student, University of Illinois at Chicago (2010-present)
Advisor: Daniel Cervone, Ph.D.

B.S., Mathematics and Physics, Harvey Mudd College (1998-2002)
High Distinction and Honors in Mathematics
Thesis title: *Special Lagrangian Submanifolds in C_3*

SCHOLARSHIPS AND FELLOWSHIPS

Achievement Rewards for College Scholars (ARCS) Scholarship (1999-2002)

AWARDS AND DISTINCTIONS

Achievement Rewards for College Scholars (1999-2002)
Freshmen Mathematics Award (1999)

CONFERENCE & INVITED TALKS/ SYMPOSIA/COLLOQUIA

Murphy, M.C., Mercurio, L.D., Garcia, J., & Zirkel, S. (2013, January) Experts' lay theories shape women's experiences of STEM settings. Paper presented at the 14th annual meeting of the Society for Personality and Social Psychology (SPSP), New Orleans, LA.

Mercurio, L.D., Murphy, M.C., Zirkel, S., & Garcia, J. (2012, June) The roles of environments and lay theories in shaping the outcomes of women in STEM. Paper presented at the 9th Biennial Convention of the Society for the Psychological Study of Social Issues (SPSSI), Charlotte, NC.

Mercurio, L.D. & Murphy, M.C. (2012, May). Messages about malleability of abilities protect women from stereotype threat. Paper presented at the 84th annual meeting of the Midwestern Psychological Association (MPA), Chicago, IL.

CONFERENCE POSTER PRESENTATIONS

Mercurio, L. D., Cervone, D., Bartoszek, G., & Mayer, N. D. (2014, February). *Factor-analytic investigations of personality structure: Do data take the shape of your measure?* Presented at the 15th annual meeting of the Society for Personality and Social Psychology (SPSP), Austin, TX.

Khare, M. M., Tam, M. S., Shipley, B., & Mercurio, L. D. (2013, March). *Work climate for STEM faculty at the University of Illinois at Chicago.* Presented at the 11th annual workshop for the National Science Foundation (NSF) ADVANCE Program, Alexandria, VA.

Mercurio, L. D., Bartoszek, G., Mayer, N. D., & Cervone, D. (2013, January). *Personality trait structure emerges from causal linkages among cognitive, behavioral, and affective components: A computer simulation on random inputs.* Presented at the Social Dynamics Preconference at the 14th annual meeting of the Society for Personality and Social Psychology (SPSP), New Orleans, LA.

*Antonic, M., Emerson, K.T.U., Mercurio, L.D., & Murphy, M.C. (2012, May). *Switching genders: Analyzing elements of stereotype threat*. Presented at the 84th annual meeting of the Midwestern Psychological Association (MPA), Chicago, IL.

*Antonic, M., Emerson, K.T.U., Mercurio, L.D., & Murphy, M.C. (2012, April). *Switching genders: Analyzing elements of stereotype threat*. Presented at the UIC Student Research Forum, Chicago, IL.

Mercurio, L.D., Murphy, M.C., Garcia, J.A., & Zirkel, S. (2012, January). *You can become smarter: Messages about the malleability of STEM abilities protect women from stereotype threat*. Presented at the 13th annual meeting of the Society for Personality and Social Psychology (SPSP), San Diego, CA.

*Wright, L., Mercurio, L.D. & Murphy, M.C. (2011, April). *The effects of gender roles on STEM performance and attitudes among gay and straight women*. Presented at the UIC Student Research Forum, Chicago, IL.

** Indicates work in collaboration with UIC undergraduates*

TEACHING AND RELATED ACTIVITIES

Contact Teaching Assistant:

Social Psychology Laboratory (PSCH 313), UIC, Fall 2012, Spring 2014
Statistical Methods in Behavioral Science (PSCH 343), UIC, Fall 2011
Research Methods (PSCH 242), UIC, Fall 2010

Teaching Assistant:

Personality Psychology (PSCH 210), UIC, Spring 2013
Social Psychology (PSCH 312), UIC, Spring 2011; Summer 2011; Fall 2011

ADDITIONAL PROFESSIONAL CONTRIBUTIONS

Assisted Drs. Cervone and Lilley in preparation of an NSF grant to fund research investigating the potential contribution of idiographic social-cognitive techniques to successful mentorship of STEM graduate students.

The first study of the above project (conducted at the undergraduate level) was awarded a College of Engineering Grant, "A Person-Centered Social-Cognitive Analysis of Undergraduate Freshmen in Mechanical and Industrial Engineering."

Co-reviewer (with Dr. Daniel Cervone) for an article for the journal *Cognitive Science.*

Assisted Drs. Brooke Shipley and Manorama Khare in the preparation of an NSF grant to fund the creation of online unconscious bias training modules for faculty hiring and promotion and tenure.

Created a *Case Studies Discussion Guide* for facilitators to use in unconscious bias awareness training for recruitment and hiring and promotion and tenure decisions.

Created a package in R, *LARK*, that automates the process of (and provides visualizations to aid researchers in) testing linear assumptions in regression, with Mark Relyea (first prototype presented 30 April, 2013).

ADDITIONAL TRAINING

Modeling Diary Data and Dyadic Data Workshop, Center for Research on Families Workshop, Amherst University, Amherst, MA (June, 2011)

Network Modeling, APS-SMEP Methodological Workshop Series, Association for Psychological Science 23rd Annual Convention, Washington, D.C. (May, 2011)

Doing Bayesian Data Analysis, APS-SMEP Methodological Workshop Series, Association for Psychological Science 23rd Annual Convention, Washington, D.C. (May, 2011)

PROFESSIONAL SERVICE: STUDENT MENTORING

UIC Undergraduate Research Advising and Mentoring

Mirjana A. Antonic, UIC. "Switching genders: Analyzing elements of stereotype threat." Winner of a Kabbes Undergraduate Research Award (April, 2011) and a College of Liberal Arts and Sciences Undergraduate Research Initiative (LASURI) award (2011-2012).

Laurel Wright, UIC. "The effect of gender roles on STEM performance and attitudes among gay and straight women." Winner of a Kabbes Undergraduate Research Award from the UIC honors College (January, 2011) and the 2010 Chancellor's Undergraduate Research Award. Elected to Phi Beta Kappa.

PROFESSIONAL AFFILIATIONS

American Psychological Society (APS)
Society for Personality and Social Psychology (SPSP)
Society for the Psychological Study of Social Issues (SPSSI)