



Genetic and environmental influences on verbal and nonverbal measures of the Big Five

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ABSTRACT

This study reports the first behavioral genetic investigation of a nonverbal measure of the Big Five and its relationship with a traditional verbal measure. Participants ($N = 592$ adult twins) completed the Five-Factor Nonverbal Personality Questionnaire and the Revised NEO Personality Inventory. Monozygotic twins were more alike on all domains of the Big Five as assessed by both sets of scales than were dizygotic twins, and univariate behavioral genetic model-fitting showed that individual differences in both the nonverbal and verbally assessed traits were entirely attributable to additive genetic and non-shared environmental factors. Positive phenotypic correlations were found between the same personality factors assessed by the verbal and nonverbal measures and these correlations were themselves entirely attributable to correlated genetic and correlated non-shared environmental factors. The results provide evidence for the validity of the newly-devised FF-NPQ.

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1. Introduction

Personality traits can be viewed as a set of qualities that make people distinct from one another in terms of their assumed roles or typical manners of behaving. Currently, the most popular conceptualization of personality structure is provided by the Five-Factor model. The Five-Factor model comprises the personality dimensions of Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. These five dimensions, the so-called Big Five, are held by many to provide a complete description of personality.

The Five-Factor model is often operationalized by the popular and widely-used Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992). The NEO-PI-R has well-established psychometric properties and has been used in numerous studies around the world. This notwithstanding, one limitation of the questionnaire is its reliance on the verbal representation of its items. A valid nonverbal measure of the Big Five would have several advantages, for example allowing the exact same items to be used in cross-cultural investigations, or in assessments of dyslexics, immigrants, linguistic minorities, or illiterates who might not easily or validly be evaluated with a verbal inventory. Fortunately, such a nonverbal measure exists.

Paunonen, Jackson, and Ashton (2004) constructed a nonverbal questionnaire to assess the same five personality factors as as-

sessed by the NEO-PI-R and its shorter sibling the NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992). The resultant inventory is called the Five-Factor Nonverbal Personality Questionnaire (FF-NPQ). For each Big Five domain, Paunonen et al. created a 12-item nonverbal scale, where each item consists of a line drawing of a central character performing a trait- or factor-relevant behavior in a specific situation. Respondents are asked to consider each item and to indicate, using a 7-point rating scale, the likelihood that they would engage in the type of behavior depicted in the illustration. Because the production of the FF-NPQ was based on the measures used in the NEO-FFI and the NEO-PI-R, it should be the case that ratings of the factors on the FF-NPQ correlate positively with ratings of the same factors on both of those verbal inventories.

Hong, Paunonen, and Slade (2008) employed a multi-trait-multimethod analysis to investigate the construct validity of three Big Five personality questionnaires: the NEO-FFI, the FF-NPQ, and a 50 item-bipolar adjective rating form. Their results suggested that, regardless of the modality of item representations, the three different inventories have construct-valid properties and capture essentially the same five factors of personality. Paunonen (2003) used three different measures of the Big Five factors of personality to predict a variety of criterion variables thought to represent behaviors of some social and cultural significance. Using the NEO-FFI, the NEO-PI-R and the FF-NPQ, results indicated substantial consistency in behavior predictions across the different instruments. Furthermore, there was little evidence that the verbal forms were more similar to each other in predicting criterion variables than was

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either form to the nonverbal inventory. This study also reported relatively high correlations between the FF-NPQ scales and the corresponding scales assessed by the verbal inventories.

The study by [Paunonen \(2003\)](#) is the only one to date that has compared the FF-NPQ and the 240-item NEO-PI-R. The first goal of our study, therefore, is to provide further evidence of convergent validity for the new nonverbal Big Five questionnaire. New measures of personality are required to show this type of convergence with existing measures in order to establish their construct validity. One of the purposes of this study is to verify the correlations found in the past between the scales of the FF-NPQ and the NEO-PI-R.

Another goal of our study is to investigate the extent to which individual differences in the factors assessed by the FF-NPQ are attributable to genetic and/or environmental factors. No previous behavioral genetic (BG) studies of the FF-NPQ have been conducted. However, such studies have been done with verbal Big Five measures, such as the NEO-PI-R. Of course, if the FF-NPQ factors show moderate to large correlations with the same factors assessed by the NEO-PI-R, then it is expected that they will show the same pattern of influence from additive genetic and non-shared environmental factors as has been reported in the great majority of previous BG studies of verbal Big Five measures, including the NEO-PI-R (see [Johnson, Vernon, & Feiler, \(2008\)](#), for a recent review of all such studies).

Our study has a third purpose. To the extent that the FF-NPQ factors correlate with those from the NEO-PI-R, our goal is to determine the extent to which these observed (or phenotypic) correlations are themselves attributable to correlated genetic and/or correlated environmental factors. Large genetic or environmental correlations between factors assessed by the two inventories would indicate that they are not just measuring the same phenotypes, but that those genes or environmental factors that contribute to individual differences in one of the factors overlap substantially with the genes and environmental factors that contribute to variation in the other. This, in turn, would provide additional support for the construct validity of the FF-NPQ.

2. Method

2.1. Participants

Participants were 232 pairs of monozygotic (MZ) twins (160 female pairs, 72 male pairs) and 64 pairs of same-sex dizygotic (DZ) twins (43 female pairs, 21 male pairs) ranging from 18 to 78 years of age ($M = 28.4$, $SD = 12.3$). They were recruited via newspaper and internet advertisements from across Canada and the United States. Participants came from 8 of 13 of the Canadian provinces and from 38 of 50 US States. As such, we consider them to be fairly representative of these countries' populations.

2.2. Materials

2.2.1. NEO-PI-R

This self-report questionnaire measures the Big Five factors with 240 items, each rated on a 5-point scale ([Costa & McCrae, 1992](#)). Each of the five factor scales of the NEO-PI-R has 48 items. Respondents rate each statement according to how much it relates to them, from strongly disagree to strongly agree. Internal consistency coefficients for the scales range from .86 to .95 ([Costa & McCrae, 1992](#)). It has proven to be one of the most accepted and widely-used measures of the Big Five by psychological researchers ([Jang, McCrae, Angleitner, Riemann, & Livesley, 1998](#)).

2.2.2. FF-NPQ

The FF-NPQ ([Paunonen et al., 2004](#)) comprises 60 nonverbal pictorial items which measure the Big Five factors, with 12 items per scale. It was developed using an item pool of psychometrically established nonverbal items to mirror the Big Five factors defined in [Costa and McCrae's \(1992\)](#) NEO-FFI. All items consist of pictorial depictions of personality-relevant behaviors being exhibited in specific situations. For example, an item measuring extraversion might show a picture of someone clearly enjoying being the center of attention at a party. Respondents rate the likelihood that they would engage in the type of behavior depicted using a 7-point scale ranging from extremely unlikely to extremely likely. The FF-NPQ scales have demonstrated satisfactory levels of internal consistency reliability, with coefficients ranging from .75 to .82 ([Paunonen et al., 2004](#)). Examples of nonverbal items have been published elsewhere (e.g., [Paunonen, Ashton, & Jackson, 2001](#); [Paunonen & Jackson, 1979](#); [Paunonen, Jackson, & Keinonen, 1990](#); [Paunonen et al., 1996](#)).

2.3. Procedure

Adult twins responding to advertisements were contacted by phone or e-mail and the nature of the study was described to them. Those who agreed to participate were sent a letter of information, consent form, and a package of questionnaires which included the NEO-PI-R, the FF-NPQ, and a questionnaire assessing their zygosity ([Nichols & Bilbro, 1966](#)). They were also provided with a pre-addressed, stamped, return envelope.

Participants were asked to complete the questionnaires on their own and at their own pace. After they returned their completed questionnaires, they were sent remuneration and their names were entered into a draw for one of 10 cash prizes. Over 95% of the twins who initially responded to the advertisements agreed to participate and, of these, over 90% returned completed questionnaires ($N = 296$ pairs).

3. Results

We first computed coefficient alpha reliabilities for the nonverbal and verbal scales. The FF-NPQ scale reliabilities ranged from .69 to .82 with a mean of .76, whereas the NEO-PI-R reliabilities ranged from .88 to .93 with a mean of .90. The nonverbal scales' reliabilities might appear significantly lower than those of the verbal scales, but recall that the verbal scales at 48 items each are four times longer than the nonverbal scales at only 12 items each. A fair comparison can be made by using the Spearman–Brown formula to correct the NEO-PI-R 48-item reliabilities to 12-item reliabilities. This computation resulted in a mean estimated reliability of .69 for the verbal scales, which is somewhat lower than the .76 mean reliability for the FF-NPQ scales.

Before performing any behavior genetic analyses, we first performed tests of homogeneity to confirm that there are no differences between our MZ and DZ twins' means or variances on the NEO-PI-R and the FF-NPQ. All of these tests were non-significant ($p > .05$). We also corrected all of our data for age and sex, using the regression approach proposed by [McGue and Bouchard \(1984\)](#).

We next calculated the MZ and DZ twin correlations for each Big Five factor measure, as represented by both the NEO-PI-R and the FF-NPQ. These correlations are shown in [Table 1](#). The MZ correlations are all significantly larger than DZ correlations; all MZ correlations are significantly greater than zero, and any DZ correlations greater than .21 are significantly different from zero. These results allowed us to proceed with univariate model-fitting analyses. Also shown in [Table 1](#) are the genetic and environmental parameter estimates, which were derived from univariate behavioral genetic

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