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Personality Structure among Centenarians: The Georgia Centenarian Study

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For the Georgia Centenarian Study

Abstract

We demonstrate that observer-rated factor structure of personality in centenarians is congruent with the normative structure. Prevalence of cognitive impairment, which has previously been linked to changes in personality in younger samples, is high in this age group, requiring observer ratings to obtain valid data in a population-based context. Likewise, the broad range of cognitive functioning necessitates synthesis of results across multiple measures of cognitive performance. Data from 161 participants in the Georgia Centenarian Study (GCS, M_{Age} = 100.3 years, 84% women, 20% African American, 40% community-dwelling, 30% low cognitive functioning) support strong overall correspondence with reference structure (full sample: .94; higher cognitive functioning: .94; lower cognitive functioning: .90). Centenarians with lower cognitive functioning are higher on neuroticism and lower on openness to experience, agreeableness, and conscientiousness. Facet-level differences (higher N1–N6: anxiety, hostility, depression, self-consciousness, impulsiveness, vulnerability to stress; lower E1: warmth, lower O4–O6: actions, ideas, values; lower A1, A3, A4: trust, altruism, compliance; C1, C5: competence, self-discipline) are also observed. Multivariate factor-level models indicate only neuroticism of the five broad factors predicts membership in cognitively impaired group; facet-level models showed that lower-order scales from three of the five domains were significant. Centenarians with: higher self-consciousness (N4), impulsiveness (N5), and deliberation (C6), but lower ideas (O5), compliance (A4), and self-discipline (C5) were more likely to be in the lower cognitive functioning category. Results present first normative population-based data for personality structure in centenarians and offer intriguing possibilities for the role of personality in cognitive impairment centered on neuroticism.

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Keywords

Five factor model; Personality; Procrustes Rotation; Centenarians; Cognitive Impairment; NEO PI-R

Ample research demonstrates the robust structure of the Five Factor Model of personality (FFM) across dimensions including age, gender, race, nationality/language of administration, and self- versus observer-ratings (e.g., Costa & McCrae, 1992a; McCrae, Costa, Del Pilar, Rolland, & Parker, 1998; McCrae & Terracciano, 2005; Terracciano, 2003). Research has also demonstrated mean-level normative age differences as well as short- and long-term age changes in factor- and facet-level scores (e.g., Small et al., 2003; Terracciano et al., 2005). Associations between personality and cognitive impairment are also well-documented in younger samples (e.g., Mroczek & Spiro, 2003; Sharp, et al. 2010). Almost no previous studies have included data from centenarians in their samples, particularly from population-based samples. Collecting data from a population-based sample of centenarians is difficult because prevalence of sensory, physical, and cognitive impairments is high in this age group (Poon et al., 2012), but difficult to measure using existing scales because there is considerable overlap between normal and impaired groups, and measurement using any single scale is likely to result in considerable floor or ceiling effects with the range of functioning observed using a population-based sample (Davey, et al., 2013). To overcome both of these limitations, we provide normative data on observer-rated factor structure of the NEO-PI-R among centenarians. We extend these results by applying a classification variable from previous research (Davey et al., 2013) which has been shown to distinguish two latent classes of cognitive functioning among centenarians (higher and lower cognitive functioning). In this way, it is possible to evaluate the congruence with reference values of personality structure in centenarians showing both normal and impaired cognitive functioning.

Personality Structure

Research suggests that five basic dimensions underlie adult personality and are independent of dominant culture. Broadly speaking, these factors of Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C) are known as the dimensions of the Five-Factor Model (FFM) or the Big Five. This trait conceptualization of personality has received wide-spread support across languages and cultures (McCrae & Costa, 1997; McCrae, Costa, Del Pilar, Rolland, & Parker, 1998; McCrae & Terracciano, 2005; Terracciano, 2003), gender (Costa, Terracciano, & McCrae, 2001), and age (Roepke, et al., 2001). McCrae and colleagues (2011) recently reported that cross-observer reliability of the NEO is quite high, and the structure of traits (i.e., covariation among traits) is robust (McCrae & Costa, 1997).

The FFM, while robust, inherently does not have simple structure from a measurement perspective. Therefore invariance testing using standard confirmatory approaches may lead to inconclusive results. McCrae et al. (1996) have argued that alternative approaches such as comparison of rotation to a reference sample may prove more informative than approaches such as confirmatory factor analysis. For example, Savla and colleagues (2007) applied

Procrustes rotation in a sample of 234 older African Americans from the Baltimore Study of Black Aging. They found very high factor and facet congruence to the normative structure. There was significant congruence on all five factors, and 27 of 30 facets (excepting impulsiveness, ideas, and altruism). When there were differences, they were primarily attributable to differences in factor cross-loadings. In the present paper, we use the technique suggested by these authors to examine whether the personality structure among centenarians is congruent with the structure of a reference sample group that includes no centenarians (Costa & McCrae, 1992b). This approach has been widely used in the cross-validation of personality structures in as many as 50 cultures all over the world (McCrae & Terracciano, 2005). This approach is preferable to confirmatory factor analysis (CFA) for the purposes of this paper for several reasons. First, it provides greater comparability with prior literature by extending previous applications of this method using the NEO-PI-R to a new age range (e.g., McCrae et al., 1996; Savla et al., 2007; Terracciano, 2003). Second, it is the most appropriate method for comparison given the sample size. (Degrees of freedom for a CFA model would exceed the sample size in this study, which would render results from maximum-likelihood approaches suspect.) Third, this model is most consistent with the best-fitting model identified with CFA methods in a larger sample (N=856) of younger individuals (Vassend & Skrondal, 2011). However, it does not provide the kind of fine-grained perspective on factorial invariance suitable for much larger samples.

Personality and Aging

The association between age and personality has received considerable attention using both cross-sectional and longitudinal designs. In a cross-sectional study using a sample of 1,084 Medicare recipients aged 65 to 100 years and screened for cognitive impairment, Weiss et al. (2005) found evidence only of higher agreeableness among individuals, particularly men, aged 80 years and older, compared with individuals aged 65 to 79 years.

Personality is associated with selection out of the population both directly (i.e., through health behaviors serving as risk or protective factors for mortality, (cf. Siegler & Davey, 2012) and indirectly through differences in factors such as treatment adherence (e.g., Wiebe & Christensen, 1996). Thus, longitudinal data are likely to provide better estimates of age-related changes in personality than are possible from cross-sectional studies (see also Masui, Gondo, Inagaki, & Hirose, 2006). In a rigorous study using six-year data from the Victoria Longitudinal Study, Small et al. (2003) found that age (and also gender) was associated only with increases in neuroticism.

Using longer-term (1989–2004) longitudinal data from 1,944 participants in the Baltimore Longitudinal Study of Aging, Terracciano et al. (2005) found that: (1) neuroticism declined up until approximately age 80 and then began to increase again; (2) most facets of extraversion, openness to experience, and conscientiousness declined in later life; and (3) agreeableness generally increased in later life. Not all facets of a factor showed identical patterns of change, however, and differences in change as a function of gender were small.

Personality in Centenarians

Martin (2007) reviewed the small body of research with centenarian samples, which has typically been limited. Most previous studies with this age group have included samples selected for higher cognitive functioning and relied on a limited subset of self-reported items or scales to measure personality (e.g., Martin, Baenziger, MacDonald, Siegler, & Poon, 2009; Martin, da Rosa, Siegler, Davey, MacDonald, and Poon, 2006; Martin, Long, and Poon, 2002; Masui, et al., 2006). Prior research has demonstrated high heritability of personality factors and facets (Jang, McCrae, Angleitner, Riemann, & Livesley, 1998), and offspring of centenarians score lower on neuroticism and higher on extraversion (Givens et al., 2009). All of these preceding studies involving centenarians have relied upon self-report data because all of these studies have been limited to samples selected for high within-cohort cognitive functioning.

Personality and Cognitive Impairment

In much the same way that symptoms precede diagnosis without suggesting that the symptoms are the cause of the underlying illness, previous research has tended to focus on changes in personality as early pre-clinical markers of cognitive impairment (e.g., Balsis et al., 2005). Numerous researchers have linked openness to experience with overall cognitive functioning in older adults (e.g., Schaie et al., 2004). For example, in a cross-sectional sample of 58 healthy older adults, Williams et al. (2010) found that lower neuroticism and higher openness to experience and agreeableness were all associated with higher executive functioning.

Evidence that personality is associated with normative changes in cognitive abilities is somewhat mixed. Sharp et al. (2010) used data from 857 participants in the Swedish Adoption/Twin Study of Aging (SATSA) to examine the prospective association between openness to experience and change in cognitive ability. They found that openness to experience was associated with baseline levels of cognitive ability, but did not predict change in cognitive functioning over time. In contrast, Chapman et al. (2011) used seven-year data from 602 participants in the Ginko Evaluation of Memory (GEM) study to study prospective links between personality, measured on the NEO-Five Factor Inventory, and changes in cognitive functioning assessed every six months using the Modified Mini-Mental State Examination (3MSE). They found that higher neuroticism and extraversion, and lower openness were associated with poorer cognitive functioning. They also found that higher neuroticism was associated with a steeper rate of cognitive decline whereas higher conscientiousness was associated with more gradual cognitive decline.

Looking at the association from the opposite perspective using three-wave data from 1,663 healthy men from the Normative Aging Study with an average age at baseline of 63 years, Mroczek and Spiro (2003) found that memory complaints were associated with lower levels of extraversion (but not changes in extraversion) and higher levels of neuroticism (but not changes in neuroticism). Thus, we expect the normative structure of personality found with older adults in general to be replicated among centenarians, absent pathological changes in cognitive functioning, such as those associated with dementia.

Early research addressing changes in personality associated with cognitive impairment relied on small samples and retrospective observer (caregiver) reports and was built around expectations of accentuated premorbid traits with the onset of dementia (Persson, Berg, Nilsson, & Svanborg, 1991). Nonetheless, results were surprisingly consistent. In Siegler et al. (1994), caregivers of 26 individuals with Alzheimer's disease provided ratings of current and premorbid personality patterns on the NEO-PI. Caregivers reported higher levels of neuroticism (factor and all facets), and lower levels of extraversion (factor and all facets except excitement-seeking), openness (factor and facets excepting aesthetics, actions, and values), and agreeableness and conscientiousness (only factor-level available).

Similarly, Chatterjee et al. (1992) investigated observer ratings of premorbid and current personality for 38 individuals diagnosed with probable Alzheimer's disease. These authors found higher levels of neuroticism (factor and all facets except impulsiveness), and lower levels of extraversion (factor and all facets except gregariousness), openness (factor and facets excepting feelings, actions, and values), and agreeableness and conscientiousness (only factors available in NEO-PI). Likewise, Strauss and Pasupathi (1994) compared caregiver ratings of premorbid and current personality using the NEO-PI for a sample of 29 individuals with dementia. They found that current observer ratings of neuroticism were higher, and current ratings of extraversion and conscientiousness were lower than their premorbid values, reflecting decreases in adaptive behaviors and increases in dysfunctional behaviors. More recently, using both self- and observer-ratings, Duchek et al. (2007) found that, compared with middle aged (n = 36) and healthy older adults (n = 131), individuals with mild (n = 46) or very mild (n = 74) dementia scored higher on neuroticism and lower on openness to experience and conscientiousness. These authors found that self- and observer-reports showed agreement; however, observer reports better discriminated these groups than self-ratings.

Cross-sectional evidence for personality differences between individuals with and without dementia is not limited to the Five Factor Model. Even with a small sample (n = 52 individuals with dementia and n = 15 controls), Talassi et al. (2007), for example, found a shift from positive to negative characteristics for 12 of 18 adjective pairs from the Brooks and McKinaly Personality Inventory. High overall levels of stability in personality coupled with the within-subjects retrospective nature of these designs can be expected to produce larger effect sizes than would be anticipated in between-subjects designs.

Some studies have used prospective designs to link personality and cognitive impairment. Balsis et al. (2005) found that changes in personality, as evaluated using the Blessed Dementia Scale, commonly preceded diagnosis of dementia, and that greater reported change in personality was found among individuals who subsequently converted to a diagnosis of dementia compared with individuals who remained preclinical but with neuropathology at autopsy. The nondemented group showed virtually no changes in personality. Solberger et al. (2011) suggested that decreases in extraversion and increases in neuroticism occur very early in the dementia process. These authors were interested in elaborating the association between premorbid personality and disease type and severity. Interestingly, these authors used a circumplex model, the Interpersonal Adjective Scales, finding that changes in combinations of traits were observed. They found in particular that

decreases in dominance, extraversion, and warmth were greater for individuals with dementia as compared with normal controls.

Using data from the Religious Orders Study, Wilson et al. (2007) looked at the association between conscientiousness (measured using the NEO FFI) and time-to-onset of Alzheimer's disease (n = 176 incident and n = 728 unaffected) over a 12-year follow up period. In bivariate analyses, they found that baseline conscientiousness, extraversion, openness, and agreeableness were lower, and baseline neuroticism higher, in individuals who went on to develop dementia. Their primary interest was understandably with conscientiousness, so it is the only factor they considered in detail. Higher conscientiousness was associated with a lower risk of dementia.

Finally, there is also evidence that premorbid personality may also have implications for the expression of behavior problems associated with dementia. Osborne et al. (2010) conducted a systematic review examining the links between premorbid personality and challenging behavior in individuals with dementia. They found that 72% of studies found positive associations between pre-morbid personality and behavior problems in dementia, with the strongest linkages with neuroticism.

Research Questions

The preceding literature review suggests the following three research questions. (1) To what extent is the observer-rated structure of personality in centenarians congruent with the structure observed in a normative sample of non-centenarians? (2) Are there differences in factor or facet level scores between centenarians previously identified as having higher or lower cognitive function by factor mixture analysis? (3) What are the multivariate predictors of cognitive class membership at the factor and facet levels?

Methods

Sample and Design

Phase III of the Georgia Centenarian Study (GCS, 2001–2009) was a population-based sample of 244 centenarians and near-centenarians representing an estimated 19% of the total population in this age group from a 44 county region of northeast Georgia. Inclusion criteria for the core sample were verified age-eligibility and consent to blood draw, with no exclusions. Sampling and procedures have been described elsewhere in detail, and comparison with special census tabulations indicated that, barring some minor differences, our sample appeared broadly representative of the characteristics of centenarians within this region (see Arnold et al., 2010, and Poon et al., 2007, for further details).

The GCS contained different studies that were not based on completely overlapping samples. Project 1 (genetics of longevity), for example, included a sample of young control subjects aged 20 to 59 years. The sample used in this study reflects the overlap of Project 3 (neuropsychology and functional status) and Project 4 (resources and adaptations, which included the personality data). Thus, 197 centenarians in the GCS sample had proxy-rated personality data. Of these, 182 centenarians also had sufficient data on cognitive variables to

identify cognition status, as described below. Compared with individuals having complete data on both sets of variables, those without complete data were 0.7 years older, on average ($t(242)=2.35$, $p<.05$), but did not differ by MMSE, sex, race, or residential status. We further excluded 21 cases based on potentially poor-quality personality ratings, described fully in the measures section below, for a final sample size of 161. Participants had a mean age of 100.3 years, were 84% women, 20% African American, 60% resided in facilities, and 30% were in the lower cognitive functioning category. These characteristics are nearly identical to those of the full GCS sample. The study was approved by the University of Georgia Institutional Review Board on Human Subjects.

Procedures

The multidisciplinary nature of the GCS required that a data collection team meet centenarians at their residence. Data collection was divided into four sessions, each of which could be completed within two hours. On the first visit, after explaining the study aims and obtaining informed written consent, demographics, family longevity and mental status information was collected. A second session included a blood draw and a physical examination. The third and fourth sessions focused on neuropsychological and physical functioning, respectively. A fifth session collected information regarding resources and adaptations (including the personality data) of centenarians, both directly from the centenarian and through a proxy according to a set of selection criteria. Because the high prevalence of cognitive impairment in this sample precluded using self-report data for personality, only observer-rated personality is used here. Proxies were selected according to a standardized decision tree to select the living relative/informant most familiar with the centenarian (spouse, if available, followed by children, if available, another relative, or another caregiver). Children were the most common proxies (n = 98), followed nieces or nephews (n = 21), grandchildren (n = 14), other relatives, including spouse (n = 15), or other caregivers (n = 13). All cognitive measures were based on direct assessments of centenarians.

Measures

Personality—Data were collected in paper-and-pencil format using the NEO-PI-R. The NEO-PI-R was designed to provide a description of general personality relevant to clinical, counseling and educational situations. It is based on the FFM and comprised of 240 items rated along a 5-point scale from strongly disagree to strongly agree, and 3 validity items. The NEO-PI-R is designed to measure the broad factors of Openness to Experience (O), Conscientiousness (C), Extraversion (E), Agreeableness (A) and Neuroticism (N) (OCEAN). Each of the five factors consists of six facets and each facet is measured by 8 individual items. Following the procedure of calculating the facet and factor scores described in the NEO-PI-R scoring manual (Costa & McCrae, 1992b), the individual items are summed to produce a raw facet score. In the present sample, the internal consistency coefficients ranged from .87 to .93 for domain scales, and from .54 to .86 for facet scales (Mdn = .76), which are highly comparable to the normative sample (.86 to .92 for domains and .56 to .86 for facets; cf. McCrae, et al., 2011).

As the target matrix for Procrustes rotation, we used the structure from the normative sample comprised of 500 men and 500 women (Costa & McCrae, 1992b, p. 44). Their ages ranged from 21 to 96 years, and approximately 85% of the sample was Caucasian, with an average of 14.7 years of formal education.

Quality of observer-rated personality data were evaluated as in Savla et al. (2007). Specifically, we identified reports with missing responses for more than 40 items (n = 14), apparently random response patterns (n = 0), and acquiescent responses (yea-saying or naysaying, n = 2 and n = 15, respectively), which resulted in exclusion of data from n = 21 additional cases. Consistent with NEO scoring recommendations, remaining cases with missing data values were replaced with sample mean values for each item. Centenarians with apparently poorer quality personality evaluations had lower MMSE scores ($t(180) = 3.63$, $p < .001$) and were younger ($t(180) = -2.04$, $p < .05$), on average, than those with higher quality evaluations, but did not differ by sex, race, or residential status.

Cognitive impairment—Cognitive impairment was identified in a previous study (Davey, et al., 2013). Latent cognition classes were identified using factor mixture analyses adjusting for floor (Mini-Mental State Examination, Folstein, Folstein, & McHugh, 1975; a single letter from the Controlled Oral Word Association Task, Benton, Hamsher, & Sivan, 1997; Wechsler Adult Intelligence Scale-III Similarities sub-test, Wechsler, 1997; Behavioral Dyscontrol Scale, Grigsby, Kaye, & Robbins, 1992; Fuld Object Memory Evaluation Recall and Recognition, Fuld, 1981) and ceiling (Severe Impairment Battery, Saxton, McGonigle-Gibson, Swihart, Miller, & Boller, 1990) and also included an adapted Finger Tapping test (Reitan & Wolfson, 1993). Latent class membership was well-predicted by Global Deterioration Rating Scale (GDRS, Reisberg, Ferris, de Leon, & Crook, 1982) scores, which were not used to identify latent classes. Specifically, 66% of individuals in the lower cognitive functioning group had GDRS scores of 5 or 6 whereas only 17% of individuals in the higher functioning latent class had GDRS scores in this range. Individuals predicted to be in the lower cognitive functioning group were more likely to be older, African American, have less formal education, more depressive symptoms, reside in a facility, have lower plasma folate, carry an ε4 allele of APOE, and to die within the following two years. Factor mixture analysis is preferred to simple cut-points on scales such as the GDRS because in this age group there is often considerable overlap in cognitive functioning between cognitively intact and cognitively impaired individuals due to factors such as low educational attainment and multiple sensory impairments.

Statistical Analysis

Congruence of the factor structure was estimated for the entire sample, as well as separately for individuals in the normative and cognitively impaired latent classes. The statistical procedure began with a principal components analysis extracting five components. Components were then varimax rotated, and the resulting factor loadings were used as input data for a Procrustes rotation to the NEO-PI-R target structure. Facet-level congruence coefficients greater than .85 and .94 are significant at $p < .05$ and $p < .01$, respectively; factor-level congruence coefficients greater than .42 and .46 are significant at $p < .05$ and $p < .01$, respectively. Factor- and facet-level comparisons were made using *t*-tests (with equal

or unequal variances as determined by a robust Levene's test for homogeneity of variances). No further adjustments for multiple testing are required because James's test (a generalized version of Hotelling's multivariate T^2) indicated significant omnibus differences at both the factor and facet levels, analogous to the omnibus test in a MANOVA. Logistic regression was used to identify factor- and facet-level predictors of probability of membership in the cognitively impaired class using a backward elimination procedure.

Results

Congruence of Personality Structure

Following McCrae et al. (1996), we used Procrustes rotation to assess the degree of correspondence within this sample of centenarians to the normative sample. The analysis proceeded in three steps. The results from each of these steps are presented below.

Principal components analysis with varimax rotation—Principal component analysis was first used to extract five factors from the facet level data. These factors were then rotated toward simple structure using varimax rotation. Table 1 illustrates the five-factor structure with varimax rotation in the centenarian sample. All five factors were clearly recognized with facets having their highest loadings on the factors they are assigned with some exceptions, despite the very small sample size. Impulsive (N5) loaded most highly and negatively on agreeableness; vulnerability (N6) loaded most highly and negatively on conscientiousness; activity (E4) loaded most highly on conscientiousness; and feelings (O3) loaded most highly on extraversion.

Procrustes rotation—In the second step, using the orthogonal Procrustes transformation procedure described in McCrae et al. (1996), our solutions were rotated to maximal similarity with the reference sample matrix (normative structure) by minimizing the residual sum of squares between the two configurations. In the third step, we calculated the facet-level, factor-level and total congruence coefficients in order to evaluate the degree of cross-validation between the two samples. The right hand column in Table 2 illustrates the factor loadings and congruence coefficients for factors and facets in the centenarian group subsequent to the Procrustes rotation.

Factor-level congruence—Based on the critical values provided by McCrae et al. (1996), the results indicate significant total congruence with the reference sample matrix at .94 ($p < 0.01$). Significant factor congruence ($p < 0.01$), with coefficients ranging from .89 (E, O) to .98 (A), is also noted. Although significant, the lowest congruence coefficient was noted for the O factor. It is likely that in this extremely old cohort (and thus their typically old proxy reporters), this may be attributable to literacy levels. Nevertheless, we obtained highly significantly congruent factors with the NEO normative structure.

Facet-level congruence—Significant facet-level congruence was obtained for 29 of the 30 facets; 17 facets showed a significant congruence coefficient at $p < 0.01$, and another 12 facets at $p < 0.05$. However, three of the facets differed from the normative sample matrix. The activity (E4) facet had weak loadings overall and loaded most strongly on conscientiousness and (negatively) agreeableness. In summary, significant overall factor

congruence is achieved at domain level, and for all but one of the 30 scales at the lower-order facet level.

We repeated the procedures above separately for the higher and lower cognitive functioning groups. Basically, we obtained similar significant congruence results for the cognitively high or normal centenarians (E4 became significant and O3 became nonsignificant but borderline at .85) and a lower but reasonable degree of congruence for the cognitively impaired centenarians. Specifically, all five factors showed significant congruence at $p < .01$; 12 facets (N1–N3, N6; E1–E2; A2, A4, A6; C1–C3) showed significant congruence at $p < .01$, and another 10 (N4; E3, E6; O1, O3, O4; A1; C4–C6) showed significant congruence at $p < .05$.

Factor- and Facet-Level Differences by Cognitive Impairment

Table 3 presents descriptive statistics for factors and facets by cognition category. James's test indicated significant omnibus differences by cognition category at both the factor, $F(5,84.4) = 4.81$, $p = 0.001$, and facet, $F(30,76.5) = 1.77$, $p = 0.024$, levels.

Centenarians in the cognitively impaired group had significantly higher levels of neuroticism (53.6 vs. 47.5, $p < .001$), openness to experience (39.5 vs. 42.9, p=.019), agreeableness (44.3 vs. 48.6, $p = .009$), and lower levels of conscientiousness (41.8 vs. 46.4, $p = .008$) than cognitively intact centenarians, but there were no differences on extraversion.

At the facet level, cognitively impaired centenarians had significantly higher scores on all six facets of neuroticism (anxiety, hostility, depression, self-consciousness, impulsiveness, vulnerability to stress). They also scored lower on warmth (E1: 47.8 vs. 51.7, $p = .026$), actions (O4: 37.3 vs. 40.6, $p = .018$), ideas (O5: 42.6 vs. 46.3, $p = .022$), values (O6: 37.5 vs. 40.6, $p = .018$), altruism (A3: 47.5 vs. 52.7, p =.005), compliance (A4: 47.1 vs. 51.6, $p = .007$), competence (C1: 40.4 vs. 45.5, $p = .010$), and self-discipline (C5: 43.7 vs. 48.4, $p = .002$). In each case, effects sizes were of moderate magnitude ($0.39 \leq d \leq 0.68$).

Multivariate Factor- and Facet-Level Predictors of Cognitive Impairment

A logistic regression model predicting probability of membership in the cognitively impaired category from factor-level scores (Table 4) indicated that only neuroticism remained in the equation, with each standard deviation increase in neuroticism scores associated with twice the probability of being in the cognitively impaired category, $\chi^2(1) = 15.57$, $p = .001$. Positive and negative predictive values were 55.6% and 73.4%, respectively.

A parallel model at the facet-level (Table 4), indicated that higher self-conscientiousness (N4), impulsiveness (N5) and deliberation (C6), but lower ideas (O5), compliance (A4), and self-discipline (C5) were more likely to be in the cognitively impaired category, $\chi^2(6) = 24.03$, $p < .001$. Positive and negative predictive values were 53.3% and 76.0%, respectively.

Discussion

Previous research has provided strong evidence for the robust nature of personality structure across a wide variety of dimensions. In this paper, we set out to address four questions regarding the structure of personality among centenarians using a population-based sample. This is an important question because cognitive impairment is highly prevalent in this age group (Davey et al., 2013; Poon et al., 2012). Associations between personality and cognitive impairment are likely to be bidirectional. Cognitive impairment has been linked to changes in personality (e.g., Siegler et al., 1992), and personality may also predict the rate of cognitive change in: 1) normal aging (Wilson et al., 2007) and 2) behavior problems observed in dementia (Osborne et al., 2010). Centenarians also represent a small and highly selected group of exceptional survivors (Siegler, Bosworth, Davey, & Elias, 2012). Given the well-established associations between personality and both risky and protective (cf. Siegler & Davey, 2012) health behaviors, and survival (e.g., Hagberg & Samuelsson, 2008; Mroczek & Spiro, 2007; Siegler, Bastian, Steffens, Bosworth, & Costa, 2002; Terracciano, Löckenhoff, Zonderman, Ferrucci, & Costa, 2008; Weiss & Costa, 2005), individuals in this age group might also be expected to differ from younger samples even in the absence of cognitive impairment.

Overall, we find very clear evidence that observer-rated personality structure among centenarians is highly congruent (.94) with normative structure established in a considerably younger sample. We observed significant congruence on all five personality factors and 29 of 30 personality facets. What is surprising, however, is that we also observed significant congruence with normative structure on all five factors and 22 of 30 facets among the approximately one-third of centenarians identified as cognitively impaired. Overall congruence with normative structure was estimated to be .90 among the cognitively impaired centenarians. This is, to our knowledge, the first population-based evaluation of the congruence of personality structure in centenarians to normative structure, and to extend these analyses to groups of cognitively intact and cognitively impaired centenarians.

Significant congruence of structure should not be taken to indicate that personality trait levels do not differ between cognitively intact and cognitively impaired individuals. Thus, we also set out to identify factor- and facet-level differences between higher and lower cognitively functioning centenarians. At the factor-level, consistent with prior research, neuroticism is higher and openness to experience, agreeableness, and conscientiousness lower among cognitively impaired centenarians. At the facet-level, all six neuroticism facets are lower among cognitively impaired centenarians. We also find differences on one facet of extraversion (E1: warmth), three facets of openness to experience (O4–O6: actions, ideas, values), three facets of agreeableness (A1, A3, A4: trust, altruism, compliance), and two facets of conscientiousness (C1, C5: competence, self-discipline).

In multivariate models, only neuroticism is predictive of probability of being in the cognitively impaired group at the factor-level, providing confirmatory evidence that cognitive status and levels of N facets are related. This is in contrast to some previous research which has found greater differences on conscientiousness and agreeableness. It is interesting to note, however, that similar results were found (using a different measure of

personality, the Swedish Universities Scales of Personality) in a recent study comparing individuals with subjective (memory complaints but normal cognitive performance) versus mild cognitive impairment (Ausén, et al., 2009). Thus these differences may be consistent with comparisons of groups which differ less in cognitive functioning than demented and non-demented younger individuals. At the facet-level, we see evidence that facets from each factor except extraversion (N: self-consciousness and impulsiveness; O: ideas; A: compliance; C: self-discipline and deliberation) predict probability of being in the cognitively impaired group. These findings highlight the interrelated nature of personality domains, and it will be interesting to see how well these findings replicate as larger population-based samples of centenarians become available

A number of limitations should be noted for this study. First, sample size is small, but so is the population. This study drew data from a parent sample that included approximately one-fifth of the entire population from which it was drawn and contains more centenarians and near-centenarians than the Health and Retirement Study and a comparable number to the National Long-Term Care Survey, which over-sampled individuals aged 95 years and older. This prevented some additional analyses, such as comparisons of structure between men and women. Second, these data are cross-sectional. Data using prospective or longitudinal designs are very difficult with centenarians, whose life expectancy is approximately two years. Thus, we do not have information to disentangle cognitive risk and protective associations with personality from personality changes associated with cognitive impairment. We might expect, for example, that differences as a function of openness to experience might emerge with data spanning a longer time-frame. Likewise, using data from the Georgia Centenarian Study and Health and Retirement Study, Siegler and Davey (Siegler & Davey, 2012) demonstrated small associations between personality factors and health behaviors (smoking, alcohol use, overweight, and vigorous exercise). Notably, only conscientiousness was consistently associated with all four health behaviors. We might also expect conscientiousness to play a larger role in determining how successfully centenarians reach this age as the long-term results of accumulated salubrious and avoided insalubrious activities. Finally, future research should elaborate on the role of neuroticism as it relates to other personality factors in differentiating individuals with and without cognitive impairment.

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References

Arnold J, Dai J, Nahapetyan L, Arte A, Johnson MA, Hausman D, et al. Predicting successful aging in a population-based sample of georgia centenarians. Current Gerontology and Geriatrics Research. 201010.1155/2010/989315

Ausén B, Edman G, Almkvist O, Bogdanovic N. Personality features in subjective cognitive impairment and mild cognitive impairment: Early indicators of dementia? Dementia and Geriatric Cognitive Disorders. 2009; 28:528–535.10.1159/000255104 [PubMed: 20016183]

Balsis S, Carpenter BD, Storandt M. Personality change precedes clinical diagnosis of dementia of the Alzheimer type. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2005; 60:P98–P101.10.1093/geronb/60.2.P98

Benton, AL.; Hamsher, K.; Sivan, AB. Multilingual aphasia examination. Iowa City, IA: AJA; 1976.

Chapman B, Duberstein P, Tindle HA, Sink KM, Robbins J, Tancredi DJ, et al. Personality predicts cognitive function over 7 years in older persons. American Journal of Geriatric Psych. 2011 Publish Ahead of Print. 10.1097/JGP.1090b1013e31822cc31829cb

Chatterjee A, Strauss ME, Smyth KA, Whitehouse PJ. Personality changes in Alzheimer's disease. Archives of Neurology. 1992; 49:486–491.10.1001/archneur.1992.00530290070014 [PubMed: 1580810]

Costa PT, McCrae RR. Normal personality assessment in clinical practice: The NEO Personality Inventory. Psychological Assessment. 1992a; 4:5–13.10.1037/1040-3590.4.1.5

Costa, PT., Jr; McCrae, RR. Revised NEO PI-R) and the NEO Five-Factor Inventory (NEO-FFI) professional manual. Odessa, FL: Psychological Assessment Resources; 1992b.

Costa PT Jr, Terracciano A, McCrae RR. Gender differences in personality traits across cultures: Robust and surprising findings. Journal of Personality and Social Psychology. 2001; 81:322–331.10.1037/0022-3514.81.2.322 [PubMed: 11519935]

Davey A, Dai T, Woodard JL, Miller LS, Gondo Y, Johnson MA, … Poon LW. Profiles of cognitive functioning in a population-based sample of centenarians using factor mixture analysis. Experimental Aging Research. 2013; 39:125–144. [PubMed: 23421635]

Duchek JM, Balota DA, Storandt M, Larsen R. The power of personality in discriminating between healthy aging and early-stage Alzheimer's disease. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2007; 62:P353–P361.

Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research. 1975; 12:189–198.10.1016/0022-3956(75)90026-6 [PubMed: 1202204]

Fuld, PA. The Object Memory Evaluation. Chicago, IL: Stoelting Instrument Company; 1981.

Givens JL, Frederick M, Silverman L, Anderson S, Senville J, Silver M, et al. Personality traits of centenarians' offspring. Journal of the American Geriatrics Society. 2009; 57:683–685.10.1111/j.1532-5415.2009.02189.x [PubMed: 19392961]

Grigsby JIM, Kaye K, Robbins LJ. reliabilities, norms and factor structure of the Behavioral Dyscontrol Scale. Perceptual and Motor Skills. 1992; 74:883–892.10.2466/pms.1992.74.3.883 [PubMed: 1608726]

Hagberg B, Samuelsson G. Survival after 100 years of age: A multivariate model of exceptional survival in Swedish centenarians. The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences. 2008; 63A:1219–1226.

Jang KL, McCrae RR, Angleitner A, Riemann R, Livesley WJ. Heritability of facet-level traits in a cross-cultural twin sample: Support for a hierarchical model of personality. Journal of Personality and Social Psychology. 1998; 74:1556–1565.10.1037/0022-3514.74.6.1556 [PubMed: 9654759]

Martin P. Personality and coping among centenarians. Annual Review of Gerontology and Geriatrics. 2007; 27:89–106.

Martin P, Baenziger J, MacDonald M, Siegler I, Poon L. Engaged lifestyle, personality, and mental status among centenarians. Journal of Adult Development. 2009; 16:199–208.10.1007/s10804-009-9066-y [PubMed: 21132076]

Martin P, da Rosa G, Siegler I, Davey A, MacDonald M, Poon L, et al. Personality and longevity: findings from the Georgia Centenarian Study. Age. 2006; 28:343–352.10.1007/s11357-006-9022-8 [PubMed: 22253500]

Martin P, Long MV, Poon LW. Age changes and differences in personality traits and states of the old and very old. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2002; 57:P144–P152.10.1093/geronb/57.2.P144

Masui Y, Gondo Y, Inagaki H, Hirose N. Do personality characteristics predict longevity? Findings from the Tokyo Centenarian Study. Age. 2006; 28:353–361.10.1007/s11357-006-9024-6 [PubMed: 22253501]

McCrae RR, Costa PT Jr. Personality trait structure as a human universal. American Psychologist. 1997; 52:509–516.10.1037/0003-066x.52.5.509 [PubMed: 9145021]

McCrae RR, Costa PT, Del Pilar GH, Rolland JP, Parker WD. Cross-cultural assessment of the Five-Factor Model. Journal of Cross-Cultural Psychology. 1998; 29:171–188.10.1177/0022022198291009

McCrae RR, Kurtz JE, Yamagata S, Terracciano A. Internal consistency, retest reliability, and their implications for personality scale validity. Personality and Social Psychology Review. 2011; 15:28–50.10.1177/1088868310366253 [PubMed: 20435807]

McCrae RR, Terracciano A. Universal features of personality traits from the observer's perspective: Data from 50 cultures. Journal of Personality and Social Psychology. 2005; 88:547–561.10.1037/0022-3514.88.3.547 [PubMed: 15740445]

McCrae RR, Zonderman AB, Costa PT, Bond MH, Paunonen SV. Evaluating replicability of factors in the Revised NEO Personality Inventory: Confirmatory factor analysis versus Procrustes rotation. Journal of Personality and Social Psychology. 1996; 70:552–566.10.1037/0022-3514.70.3.552

Mroczek DK, Spiro A. Modeling intraindividual change in personality traits: Findings from the Normative Aging Study. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2003; 58:P153–P165.10.1093/geronb/58.3.P153

Mroczek DK, Spiro A III. Personality change influences mortality in older men. Psychological Science. 2007; 18:371–376.10.1111/j.1467-9280.2007.01907.x [PubMed: 17576273]

Osborne H, Simpson J, Stokes G. The relationship between pre-morbid personality and challenging behaviour in people with dementia: A systematic review. Aging and Mental Health. 2010; 14:503–515.10.1080/13607861003713208 [PubMed: 20480417]

Persson G, Berg S, Nilsson L, Svanborg A. Subclinical dementia: Relation to cognition, personality and psychopathology: A nine-year prospective study. International Journal of Geriatric Psychiatry. 1991; 6:239–247.10.1002/gps.930060409

Poon L, Jazwinski M, Green R, Woodard J, Martin P, Rodgers W, et al. Methodological considerations in studying centenarians: lessons learned from the Georgia Centenarian Studies. Annual Review of Gerontology and Geriatrics. 2007; 27:231.

Poon LW, Woodard J, Miller LS, Green RC, Gearing M, Davey A, Arnold J, Martin P, Siegler IC, Nahapetyan L, Kim YS, Markesbery W. Understanding dementia prevalence among centenarians. Journal of Gerontology: Biological Sciences. 201210.1093/gerona/glr250

Reisberg B, Ferris SH, de Leon MJ, Crook T. The Global Deterioration Scale for assessment of primary degenerative dementia. The American Journal of Psychiatry. 1982; 139:1136–1139. [PubMed: 7114305]

Reitan RM, Wolfson D. Category Test and Trail Making Test as measures of frontal lobe functions. The Clinical Neuropsychologist. 1995; 9:50–56.

Roepke S, McAdams LA, Lindamer LA, Patterson TL, Jeste DV. Personality profiles among normal aged individuals as measured by the NEO-PI-R. Aging and Mental Health. 2001; 5:159–164.10.1080/13607860120038339 [PubMed: 11511063]

Savla J, Davey A, Costa PT, Whitfield KE. Replicating the NEO-PI-R factor structure in African-American older adults. Personality and Individual Differences. 2007; 43:1279–1288.10.1016/j.paid.2007.03.019

Saxton J, McGonigle-Gibson KL, Swihart AA, Miller VJ, Boller F. Assessment of the severely impaired patient: Description and validation of a new neuropsychological test battery.

Psychological Assessment: A Journal of Consulting and Clinical Psychology. 1990; 2:298–303.10.1037/1040-3590.2.3.298

Schaie KW, Willis SL, Caskie GIL. The Seattle Longitudinal Study: Relationship between personality and cognition. Aging, Neuropsychology, and Cognition. 2004; 11:304–324.

Sharp ES, Reynolds CA, Pedersen NL, Gatz M. Cognitive engagement and cognitive aging: Is openness protective? Psychology and Aging. 2010; 25:60–73.10.1037/a0018748 [PubMed: 20230128]

Siegler IC, Bastian LA, Steffens DC, Bosworth HB, Costa PT. Behavioral medicine and aging. Journal of Consulting and Clinical Psychology. 2002; 70:843–851.10.1037/0022-006x.70.3.843 [PubMed: 12090387]

Siegler, IC.; Bosworth, HB.; Davey, A.; Elias, MF. Disease, health and aging in the first decade of the 21st century. In: Lerner, RM.; Mistry, J.; Easterbrooks, A., editors. Handbook of psychology, 2nd ed., Vol. 6. Developmental psychology. New York: Wiley; 2012. p. 437-449.

Siegler, IC.; Davey, A. Behavioral stability and change in health across the adult years. In: Whitbourne, SK.; Sliwinski, M., editors. Handbook of developmental psychology: Adulthood and aging. London: Wiley-Blackwell; 2012. p. 118-131.

Siegler IC, Dawson DV, Welsh KA. Caregiver ratings of personality change in Alzheimer's disease patients: A replication. Psychology and Aging. 1994; 9:464–466.10.1037/0882-7974.9.3.464 [PubMed: 7999331]

Siegler IC, Peterson BL, Barfoot JC, Williams RB. Hostility during late adolescence predicts coronary risk factors at mid-life. American Journal of Epidemiology. 1992; 136:146–154. [PubMed: 1415138]

Small BJ, Hertzog C, Hultsch DF, Dixon RA. Stability and change in adult personality over 6 years: Findings from the Victoria Longitudinal Study. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 2003; 58:P166–P176.10.1093/geronb/58.3.P166

Sollberger M, Neuhaus J, Ketelle R, Stanley CM, Beckman V, Growdon M, et al. Interpersonal traits change as a function of disease type and severity in degenerative brain diseases. Journal of Neurology, Neurosurgery and Psychiatry. 2011; 82:732–739.10.1136/jnnp.2010.205047

Strauss ME, Pasupathi M. Primary caregivers' descriptions of Alzheimer patients' personality traits: Temporal stability and sensitivity to change. Alzheimer's Disease and Associated Disorders. 1994; 8:166–176.10.1097/00002093-199408030-00003

Talassi E, Cipriani G, Bianchetti A, Trabucchi M. Personality changes in Alzheimer's disease. Aging and Mental Health. 2007; 11:526–531.10.1080/13607860601086603 [PubMed: 17882590]

Terracciano A. The Italian version of the NEO PI-R: conceptual and empirical support for the use of targeted rotation. Personality and Individual Differences. 2003; 35:1859–1872.10.1016/s0191-8869(03)00035-7 [PubMed: 19002272]

Terracciano A, Löckenhoff CE, Zonderman AB, Ferrucci L, Costa PT Jr. Personality predictors of longevity: Activity, emotional stability, and conscientiousness. Psychosomatic Medicine. 2008; 70:621–627.10.1097/PSY.0b013e31817b9371 [PubMed: 18596250]

Terracciano A, McCrae RR, Brant LJ, Costa PT Jr. Hierarchical linear modeling analyses of the NEO-PI-R Scales in the Baltimore Longitudinal Study of Aging. Psychology and Aging. 2005; 20:493–506.10.1037/0882-7974.20.3.493 [PubMed: 16248708]

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

Wechsler, D. Wechsler Adult Intelligence Scale. 3. San Antonio, TX: Harcourt Assessment; 1997. WAIS-3®

Weiss A, Costa PT Jr. Domain and facet personality predictors of all-cause mortality among Medicare patients aged 65 to 100. Psychosomatic Medicine. 2005; 67:715–723.10.1097/01.psy.0000181272.58103.18 [PubMed: 16204429]

Weiss A, Costa PT Jr, Karuza J, Duberstein PR, Friedman B, McCrae RR. Cross-sectional age differences in personality among Medicare patients aged 65 to 100. Psychology and Aging. 2005; 20:182–185.10.1037/0882-7974.20.1.182 [PubMed: 15769223]

Wiebe JS, Christensen AJ. Patient adherence in chronic illness: Personality and coping in context. Journal of Personality. 1996; 64:815–835.10.1111/j.1467-6494.1996.tb00945.x [PubMed: 8956514]

Williams PG, Suchy Y, Kraybill ML. Five-factor model personality traits and executive functioning among older adults. Journal of Research in Personality. 2010; 44:485–491.10.1016/j.jrp.2010.06.002

Wilson RS, Schneider JA, Arnold SE, Bienias JL, Bennett DA. Conscientiousness and the incidence of Alzheimer disease and mild cognitive impairment. Archives of General Psychiatry. 2007; 64:1204–1212.10.1001/archpsyc.64.10.1204 [PubMed: 17909133]

Table 1

Varimax Rotated Factor Loadings for NEO-PI-R

	N	E	O	A	C
N1	**0.79**	−0.09	−0.05	−0.21	−0.16
N2	**0.47**	−0.17	−0.02	*−0.72*	−0.15
N3	**0.74**	−0.12	−0.15	−0.29	−0.31
N4	**0.65**	−0.29	−0.02	−0.15	−0.04
N5	0.31	0.17	0.21	*−0.51*	−0.34
N6	**0.52**	−0.14	−0.14	−0.25	*−0.64*
E1	−0.16	**0.67**	0.12	*0.57*	0.18
E2	−0.11	**0.80**	−0.01	0.16	0.13
E3	−0.25	**0.49**	0.21	−0.29	*0.43*
E4	−0.21	0.18	0.24	−0.30	*0.46*
E5	−0.16	**0.53**	*0.43*	−0.28	−0.01
E6	−0.23	**0.54**	0.35	0.35	0.29
O1	0.08	*0.40*	**0.41**	−0.22	−0.32
O2	0.19	0.19	**0.70**	0.18	0.28
O3	0.38	*0.44*	0.30	0.01	*0.43*
O4	−0.29	0.13	**0.65**	0.09	0.15
O5	−0.14	0.13	**0.63**	0.08	*0.41*
O6	−0.32	−0.15	**0.60**	0.11	−0.03
A1	−0.30	0.25	0.02	**0.71**	0.20
A2	−0.11	−0.09	−0.04	**0.83**	0.15
A3	−0.19	0.29	0.15	**0.74**	0.28
A4	−0.18	0.00	0.04	**0.85**	0.00
A5	0.23	*−0.43*	0.06	**0.60**	−0.12
A6	0.22	0.13	0.32	**0.66**	0.04
C1	−0.25	0.20	0.15	0.26	**0.76**
C2	−0.01	0.10	0.05	0.06	**0.74**
C3	−0.03	0.09	−0.04	*0.40*	**0.75**
C4	0.05	0.15	0.18	−0.12	**0.82**

	N	E	O	A	C
C5	−0.22	−0.01	0.07	0.15	**0.87**
C6	−0.11	−0.08	−0.01	*0.56*	**0.54**

Note: Primary loadings indicated in bold and secondary loadings in italics when greater than |0.40|.

Table 2

Procrustes Rotation of NEO Facets to Normative Structure with Congruence Coefficients

	Overall					
	N	**E**	**O**	**A**	**C**	**Facet Congruence**
Facet						
N1	0.82	−0.09	−0.06	−0.04	−0.08	0.99 **
N2	0.61	−0.19	−0.01	−0.59	−0.13	0.98 **
N3	0.81	−0.14	−0.17	−0.12	−0.23	0.97 **
N4	0.66	−0.28	−0.02	−0.02	0.05	0.94 **
N5	0.43	0.15	0.19	−0.41	−0.37	0.89 *
N6	0.62	−0.19	−0.17	−0.09	−0.58	0.96 **
E1	−0.29	0.70	0.09	0.49	0.14	0.98 **
E2	−0.16	0.81	−0.04	0.10	0.07	0.98 **
E3	−0.23	0.52	0.22	−0.38	0.33	0.99 **
E4	−0.19	0.21	0.26	−0.38	0.38	0.82
E5	−0.10	0.54	0.41	−0.31	−0.11	0.90 *
E6	−0.32	0.58	0.34	0.26	0.23	0.87 *
O1	0.15	0.39	0.38	−0.17	−0.38	0.91 *
O2	0.13	0.25	0.70	0.19	0.26	0.96 **
O3	0.33	0.49	0.30	0.03	0.42	0.88 *
O4	−0.30	0.17	0.65	0.03	0.08	0.97 **
O5	−0.18	0.19	0.64	0.03	0.36	0.92 *
O6	−0.33	−0.13	0.61	0.07	−0.07	0.88 *
A1	−0.45	0.27	0.01	0.62	0.20	0.96 *
A2	−0.29	−0.06	−0.04	0.78	0.20	0.94 *
A3	−0.35	0.34	0.13	0.65	0.28	0.89 *
A4	−0.34	0.03	0.03	0.80	0.05	0.97 **
A5	0.13	−0.42	0.06	0.65	−0.02	0.86 *

	Overall					
	N	E	O	A	C	Facet Congruence
A6	0.09	0.17	0.30	0.69	0.09	0.96 **
C1	−0.37	0.26	0.18	0.13	0.72	0.99 **
C2	−0.10	0.15	0.08	−0.01	0.73	0.92 *
C3	−0.18	0.16	−0.02	0.31	0.77	0.97 **
C4	−0.01	0.21	0.22	−0.19	0.78	0.99 **
C5	−0.32	0.05	0.11	0.02	0.84	0.96 **
C6	−0.27	−0.03	0.02	0.47	0.57	0.89 *
Factor Congruence	0.95	0.89	0.89	0.98	0.97	0.94 **

* Congruence higher than that of 95% of rotations from random data.

** Congruence higher than that of 99% of rotations from random data.

Table 3

Descriptive Statistics and Mean Comparisons for Factors and Facets by Cognition Category

		Higher (n=113)				Lower (n = 48)				
Variable		**M**	**SD**	**Min**	**Max**	**M**	**SD**	**Min**	**Max**	**p-value**
Factors										**0.001**
N	**Neuroticism**	**47.5**	**8.4**	**26.4**	**71.6**	**53.6**	**8.0**	**39.2**	**70.1**	**0.001**
E	Extraversion	46.4	9.6	22.6	71.5	43.3	10.1	17.7	69.4	0.066
O	**Openness to experience**	**42.9**	**8.6**	**21.4**	**65.9**	**39.5**	**7.4**	**15.0**	**56.1**	**0.019**
A	**Agreeableness**	**48.6**	**8.7**	**22.2**	**66.6**	**44.3**	**11.2**	**11.9**	**63.3**	**0.009**
C	**Conscientiousness**	**46.4**	**10.0**	**19.7**	**67.3**	**41.8**	**9.7**	**13.0**	**59.8**	**0.008**
Facets										**0.05**
N1	**Anxiety**	**48.7**	**8.0**	**31.1**	**77.4**	**52.4**	**7.1**	**36.7**	**68.1**	**0.007**
N2	**Hostility**	**46.6**	**8.3**	**30.3**	**70.2**	**52.4**	**8.7**	**35.6**	**70.0**	**0.001**
N3	**Depression**	**48.2**	**9.7**	**26.9**	**75.5**	**54.3**	**9.9**	**39.1**	**78.3**	**0.001**
N4	**Self-Consciousness**	**48.6**	**8.7**	**27.6**	**72.9**	**52.6**	**7.3**	**33.5**	**66.4**	**0.006**
N5	**Impulsiveness**	**46.0**	**7.6**	**26.5**	**68.1**	**50.0**	**7.7**	**36.9**	**72.3**	**0.003**
N6	**Vulnerability to Stress**	**50.7**	**11.7**	**26.3**	**84.9**	**56.7**	**10.8**	**38.5**	**84.9**	**0.003**
E1	**Warmth**	**51.7**	**10.3**	**13.3**	**68.3**	**47.8**	**9.3**	**25.8**	**65.8**	**0.026**
E2	Gregariousness	48.8	7.6	30.7	68.8	46.8	7.8	28.5	66.9	0.119
E3	Assertiveness	46.7	9.6	27.5	71.8	45.8	8.6	26.7	67.8	0.601
E4	Activity	41.6	9.9	13.3	76.3	39.9	8.2	19.8	60.2	0.298
E5	Excitement Seeking	45.9	11.0	23.8	72.8	46.9	10.4	23.6	65.8	0.584
E6	Positive Emotion	50.9	10.3	12.3	72.7	48.6	10.6	20.6	72.1	0.191
O1	Fantasy	50.4	8.7	31.0	73.8	51.1	8.6	31.0	81.0	0.665
O2	Aesthetics	45.4	9.5	22.3	71.8	44.6	7.2	30.6	57.8	0.588
O3	Feelings	47.2	8.2	22.7	69.0	45.9	8.6	27.6	59.3	0.376
O4	**Actions**	**40.6**	**9.3**	**17.5**	**65.1**	**37.3**	**7.2**	**19.0**	**54.9**	**0.018**
O5	**Ideas**	**46.3**	**9.6**	**20.5**	**67.5**	**42.6**	**7.9**	**25.9**	**60.7**	**0.022**
O6	**Values**	**40.6**	**7.3**	**23.3**	**60.5**	**37.5**	**8.0**	**20.9**	**53.5**	**0.018**
A1	**Trust**	**47.0**	**7.6**	**21.6**	**62.1**	**43.0**	**9.7**	**21.6**	**63.8**	**0.006**
A2	Straightforwardness	49.0	9.7	20.0	68.0	46.5	11.4	20.0	64.0	0.149

		Higher (n=113)				Lower (n = 48)				
Variable		**M**	**SD**	**Min**	**Max**	**M**	**SD**	**Min**	**Max**	**p-value**
A3	**Altruism**	**52.7**	**10.4**	**18.4**	**69.7**	**47.5**	**10.9**	**26.5**	**69.7**	**0.005**
A4	**Compliance**	**51.6**	**9.6**	**24.0**	**74.9**	**47.1**	**9.2**	**25.8**	**64.1**	**0.007**
A5	Modesty	44.3	8.4	18.4	62.4	45.3	9.9	18.4	71.1	0.538
A6	Tendermindedness	50.1	9.2	27.0	73.2	49.6	9.7	21.6	75.7	0.753
C1	**Competence**	**45.5**	**11.7**	**10.0**	**67.9**	**40.4**	**10.9**	**7.4**	**62.6**	**0.010**
C2	Order	49.2	9.7	18.5	68.5	47.7	8.4	21.6	70.4	0.355
C3	Dutifulness	42.1	9.2	14.4	62.2	39.8	10.1	21.6	61.8	0.152
C4	Achievement Striving	45.4	9.4	18.9	66.6	43.5	7.8	30.8	63.3	0.206
C5	**Self-Discipline**	**48.4**	**8.4**	**26.1**	**68.3**	**43.7**	**8.2**	**21.5**	**56.1**	**0.002**
C6	Deliberation	50.9	9.7	18.0	75.4	49.3	9.3	24.7	63.0	0.351

Note. Entries in bold differ at $p < .05$.

Table 4

Logistic Regression Models Predicting Probability of Being in Low Cognition Group from Factors and Facets

Factor-Level

Predictor	b	SE(b)	p-value
N	0.09	0.02	0.001
Intercept	−5.20	1.12	0.001

Facet-Level

Predictor		b	SE(b)	p-value
N4	Self-Consciousness	0.04	0.02	0.086
N5	Impulsiveness	0.07	0.03	0.027
O5	Ideas	−0.04	0.02	0.068
A4	Compliance	−0.05	0.02	0.014
C5	Self-Discipline	−0.08	0.03	0.005
C6	Deliberation	0.09	0.03	0.006
Intercept		−2.25	2.70	0.403