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Personality Traits Prospectively Predict Verbal Fluency in a Lifespan Sample

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Abstract

In a community-dwelling sample (*N*=4,790; age range 14–94), we examined whether personality traits prospectively predicted performance on a verbal fluency task. Open, extraverted, and emotionally stable participants had better verbal fluency. At the facet level, dispositionally happy and self-disciplined participants retrieved more words; those prone to anxiety and depression and those who were deliberative retrieved fewer words. Education moderated the association between Conscientiousness and fluency such that participants with lower education performed better on the fluency task if they were also conscientious. Age was not a moderator at the domain level, indicating that the personality-fluency associations were consistent across the lifespan. A disposition towards emotional vulnerability and being less open, less happy, and undisciplined may be detrimental to cognitive performance.

Keywords

Verbal fluency; Personality; Five-Factor Model; Semantic fluency

Verbal fluency has been particularly useful in aging research, as fluency measures are vulnerable to both normative aging and age-related disorders. Verbal fluency is typically assessed by asking participants to list as many exemplars of a category (e.g., animals; known as semantic fluency) or as many words starting with a specific letter (e.g., S; known as letter fluency) as possible within a specified time limit (usually 60 seconds). Performance on such tasks is dependent on both the ability to retrieve words from long-term storage and on executive functions that provide the cognitive flexibility to shift rapidly from word to word within the selected category.

Verbal fluency measures are among the most common tasks included in neuropsychological test batteries (Lezak, 2004). The animal fluency task is particularly useful when making comparisons across groups (e.g., age, culture, etc.), as there is little semantic ambiguity with this category (Ardila, Ostrosky-Solís, & Bernal, 2006). Differences in task performance can be seen in a variety of disorders across the lifespan. For example, children with attention deficit hyperactivity disorder or high functioning autism retrieve fewer words on verbal fluency tasks than age-matched control children (Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2004). At the other end of the age spectrum, those suffering from chronic coronary heart disease tend to score lower on verbal fluency tasks (Singh-Manoux et al., 2008) and an

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accelerated decline in verbal fluency is observed approximately three years before diagnosis of Alzheimer's disease (Grober et al., 2008).

In addition to age, performance on verbal fluency tasks across the lifespan may reflect other demographic and individual difference variables. For example, an individual's typical way of thinking, feeling, and behaving – i.e., personality traits – may contribute to the ability to retrieve specific words. In particular, features of the traits that define the Five-Factor Model (FFM) of personality, Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness, may be associated with an individual's verbal fluency skills. Although personality is weakly related to general measures of intelligence (Ackerman & Heggestad, 1997; Beauducel, Liepmann, Felfe, & Nettelnstroth, 2007), characteristics of the traits may contribute to performance on specific cognitive tasks. Below we outline why several FFM personality traits may be associated with verbal fluency.

Tests of verbal fluency have typically been interpreted as measures of executive functioning. Although executive function contributes to task performance, verbal fluency reflects, in large part, an individual's verbal abilities (Lamar, Zonderman, & Resnick, 2002). Given that extraverted and open individuals tend to have exceptional language skills, such individuals should perform better on this task. Extraverts tend to be talkative, measured either through behavioral coding (Sneed, McCrae, & Funder, 1998) or through unobtrusive electronic monitoring of conversations in everyday life (Mehl, Gosling, & Pennebaker, 2006). Across two days of monitoring, for example, Extraversion was strongly associated with engaging in conversations and with the total number of words spoken (Mehl et al., 2006). Extraverts also easily produce speech, even in a second language (Dewaele & Furnham, 2000).

Open individuals are perceived to be verbally fluent, humorous, and expressive (Sneed et al., 1998). Such individuals have good language skills, as evidenced by higher scores on the verbal section of the SATs (Noftle & Robins, 2007). And, even after accounting for the effect of education, Openness is associated with cognitive performance among both younger (Bates & Shieles, 2003) and older adults (Booth, Schinka, Brown, Mortimer, & Borenstein, 2006; Sharp, Reynolds, Pedersen, & Gatz, 2010). In addition to language skills, open individuals have the cognitive flexibility and superior executive functioning (Ayotte, Potter, Williams, Steffens, & Bosworth, 2009) necessary to perform well on measures of verbal fluency.

State symptoms of depression and anxiety can inhibit performance on cognitive tests (e.g., Dotson, Resnick, & Zonderman, 2008; Wetherell, Reynolds, Gatz, & Pedersen, 2002). Trait Neuroticism, a chronic susceptibility to anxiety and depression, may have a similar detrimental effect on cognitive testing. In particular, performance anxiety may undermine optimal performance, and a lower score may not fully reflect the individual's cognitive capacity. Among older adults, Neuroticism is associated with lower global cognitive functioning (Boyle et al., 2010) and lower performance on tests of executive functioning (Booth et al., 2006). Neuroticism has also been identified as a risk factor for Alzheimer's disease, as well as cognitive decline more generally (Wilson et al., 2003) and predicts increased risk of cognitive impairment measured 25 years later (Crowe, Andel, Pedersen, Fratiglioni, & Gatz, 2006). Not all studies, however, find an association between Neuroticism and cognitive functioning (e.g., Baker & Bichsel, 2006; Jelicic et al., 2003).

The achievement and healthy lifestyle that characterize individuals high in Conscientiousness may contribute to better cognitive functioning across the lifespan. Conscientious individuals tend to achieve more at school (Noftle & Robins, 2007) and in the workplace (Judge, Higgins, Thoresen, & Barrick, 1999). They are also less likely to smoke and abuse drugs (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008), binge eat and

drink (Rush, Becker, & Curry, 2009), and are more likely to exercise regularly (Hoyt, Rhodes, Hausenblas, & Giacobbi, 2009). In particular, the protective nature of Conscientiousness may become apparent with aging: This trait has been found to be protective against Alzheimer disease, mild cognitive impairment, and normal cognitive decline (Wilson, Schneider, Arnold, Bienias, & Bennett, 2007). Conscientiousness may be more strongly associated with verbal fluency at older than younger ages.

It is yet unknown, however, whether the association between personality and verbal fluency is consistent across the lifespan. Both Neuroticism and Conscientiousness may have cumulative effects that lead to more pronounced associations in older age. For example, one hypothesis is that the sustained physiological reactivity associated with Neuroticism leads to neurological damage with age, impairing performance on cognitive tasks (McEwen, 2000; Wilson et al., 2006). Thus, the negative association between Neuroticism and cognitive ability should be stronger at older ages. Likewise, Conscientiousness may have a greater effect at older ages when a lifetime of maintaining good physical health and an active intellectual life pay off. A large sample that ranges across the adult lifespan is needed to test whether these associations are similar or change with age.

The present study tests a comprehensive set of FFM personality traits as prospective predictors of verbal fluency, assessed approximately three years after personality. Because our large community-dwelling sample covers a broad age range, from adolescence through old age, we have the power to test whether the same associations between personality and verbal fluency are consistent across the lifespan or whether they are age-dependent. In addition to testing age as a moderator, we also test sex and education as moderators of the personality-fluency associations. Based on the previous literature, we expect that participants who score higher on Neuroticism would have lower verbal fluency, whereas participants higher on Extraversion, Openness, and Conscientiousness would perform better on the verbal fluency task; Agreeableness should be unrelated. In addition, we extend previous research by examining the association between fluency and the more circumscribed facets of these five broad dimensions of personality.

Method

Participants

Participants were drawn from the SardiNIA project, a large, on-going multidisciplinary study of the genetic and environmental basis of complex traits and age-related processes (Sutin et al., 2010; Terracciano et al., 2010). Approximately 62% of the population (N = 6,148 individuals; 57% female), aged 14 to 102 years, from a cluster of four towns in the Ogliastra province enrolled in the study. The current study includes 4,790 participants (58% female; mean age = 42.59; SD = 16.32, range = 14–94) who provided valid personality at Wave 1 and valid fluency scores at Wave 2.

Personality assessment

Personality traits were assessed using the Italian version of the Revised NEO Personality Inventory (NEO-PI-R)(Terracciano, 2003), which measures 30 facets, six for each of the five major dimensions of personality (Costa & McCrae, 1992). The 240 items are answered on a five-point Likert scale, from strongly disagree to strongly agree. Participants filled out the self-report questionnaire (89%) or chose to have the questionnaire read by a trained Sardinian psychologist (11%). A variable (test administration) that indicated this difference in the administration of the NEO-PI-R was used as a covariate in the analyses. In this sample, the NEO-PI-R showed good psychometric properties: internal consistency reliabilities for the five factors ranged from 0.80 to 0.87 and the factor structure replicated

the American normative structure. Raw scores were converted to T-scores (M = 5, SD = 1) using American combined-sex norms (Costa & McCrae, 1992).

Verbal fluency

Semantic verbal fluency was assessed using the Category Fluency Test (Newcombe, 1969). Specifically, participants were asked to list as many animals as they could within a 60-second time period. Verbal fluency scores were the total number of unique animals generated within the time frame. In addition to this total number of animals, the number of perseverations (i.e., repeating the exact same word) and intrusions (i.e., a word from a different category) were noted. Perseverations and intrusions were not included in the total verbal fluency score. Across the full sample, verbal fluency had a mean of 18.71 words (SD = 5.45; range = 0 to 44).

Analytic strategy

We ran a series of linear regressions predicting verbal fluency from personality, controlling for sex, age, age squared, education, and test administration. To examine whether personality is related to errors, we ran a series of linear regressions predicting perseverations1 from personality, controlling for the same set of covariates. In both sets of regressions, we entered the covariates on step 1 and personality on step 2. Finally, using Aiken and West's (1991) methodology for testing interactions, we tested whether age, sex, and education moderated any of these associations. Due to the number of statistical tests, to help balance concerns over Type I and Type II errors, we take a more conservative approach to significance by setting p to < .01.

Results

Consistent with our hypotheses, the regression analyses indicated that participants high on Neuroticism had lower verbal fluency, whereas extraverted and open participants were more verbally fluent (see Table 1). At the facet level, the aspects of Neuroticism most strongly related to experiencing negative emotions were associated with lower verbal fluency. That is, participants who tended to be anxious (N1: Anxiety), quick to anger (N2: Angry Hostility), depressed (N3: Depression), self-conscious (N4: Self-Consciousness), and vulnerable to stress (N6: Vulnerability) had lower verbal fluency; N5: Impulsiveness was unrelated to fluency. Among the facets of Extraversion, E6: Positive Emotion had the strongest association with fluency, followed by E3: Assertiveness, E4: Activity, and E1: Warmth. Consistent with the domain-level association, all aspects of Openness were associated with better verbal fluency. It is of note that the correlations between verbal fluency and Openness and its facets were significant even after controlling for the effect of education. Contrary to our expectations, Conscientiousness at the domain level was unrelated to verbal fluency. At the facet level, however, those who work hard to achieve their goals (C4: Achievement Striving) and those who are highly disciplined (C5: Self-Discipline) had greater verbal fluency, whereas those who think carefully before they act (C6: Deliberation) had lower fluency. A6: Tender-mindedness, but not domain-level Agreeableness, was associated with better verbal fluency. Finally, with the exception of E4: Activity and A2: Straightforwardness, personality was unrelated to perseverations (see Table 1).

Surprisingly, at the domain-level, age and sex did not moderate any of the personality-fluency associations. Thus, across the adult lifespan and across both sexes, personality shared the same relations with verbal fluency. At the facet level, age moderated one

[1]In the current sample, intrusions were too infrequent (<1%) to meaningfully test whether personality was related to them.

association: Although both younger and older participants high on O1: Fantasy had greater fluency than those low on this facet, the association was stronger at younger ages ($\beta_{O1: Fantasy \times Age} = -.04$, $p < .01$).

Finally, education moderated the association between Conscientiousness and verbal fluency ($\beta_{Conscientiousness \times Education} = -.04$, $p = .01$). Among participants with lower education, Conscientiousness mattered: Conscientious participants performed better on the verbal fluency task than participants lower in Conscientiousness. Among more educated participants, Conscientiousness was not associated with verbal fluency scores. Education also moderated the association between fluency and both A2: Straightforwardness and A5: Modesty. At lower levels of education, those high in straightforwardness or modesty performed better on the fluency task than those lower on this trait; the opposite pattern emerged at higher levels of education (both βs = −.04, ps < .01).

Discussion

In the present research, personality traits prospectively predicted performance on a semantic fluency task administered approximately three years later. We found support for most of our hypotheses: emotionally stable (low Neuroticism), extraverted, and open individuals performed better on the verbal fluency task, even after accounting for the effects of age, sex, and education. Moreover, Conscientiousness was associated with better performance among those with lower education but not among those with higher education. Finally, with one exception, the personality-fluency associations were not moderated by sex or age, which indicates that the same pattern of associations holds across men and women and from young adulthood through old age.

The aspects of Neuroticism that tap into emotional vulnerability were associated with lower performance on the verbal fluency task. Previous research suggested that Neuroticism is associated with lower global cognitive function among older adults (Boyle et al., 2010) and is a risk factor for Alzheimer's disease and cognitive decline more generally (Wilson et al., 2003). To this literature we add that this trait susceptibility to negative emotions is associated with lower verbal fluency, regardless of age. Scores on cognitive tests may be worse for individuals high in Neuroticism, in part, because their performance may be impaired by cognitive noise (Robinson & Tamir, 2005). In particular, cognitive noise may interfere with the working memory and therefore the capacity to perform well on the task. In contrast to emotional vulnerability, the impulsivity facet of Neuroticism was unrelated to fluency. The facet-level analyses provide insight into one potential reason for discrepancies reported across studies: Measures of Neuroticism that tap into its more impulsive aspects may fail to find associations with cognitive measures because this aspect might be unrelated to cognition. In addition, the relatively modest correlation between Neuroticism and verbal fluency suggests that large samples are needed to have the power to detect such effects.

Our findings for Extraversion nicely complement experimental research that shows that inducing positive emotion improves performance on tasks that involve executive functions, including fluency tasks (Phillips, Bull, Adams, & Fraser, 2002). That is, similar to inducing positive emotion, individuals who have the dispositional tendency to experience positive emotion are able to retrieve more unique words. Although positive mood can have detrimental effects on tasks that require visuospatial selective attention, positive mood improves performance on tasks that require cognitive flexibility and creative thinking, perhaps through a broadening of attentional focus (Rowe, Hirsh, & Anderson, 2007). This broadening of attention may attenuate semantic biases that can inhibit the retrieval of weaker associations. These findings have implications for interventions for maintaining fluency with aging. That is, increasing positive emotion and/or decreasing negative emotion should have

a beneficial, and perhaps self-perpetuating, effect on this aspect of cognition. In addition to positive emotion, sociability is another core component of Extraversion that is associated with verbal fluency. Extraverts are talkative (Mehl et al., 2006), and, in particular, both the Warmth and Assertiveness facets have items that directly assess the pleasure and frequency of speaking with others. The present research suggests that this ease in production of words is associated not just with speaking more, but also with the ability to retrieve appropriate words given certain criteria. Finally, it is also notable that E4: Activity was associated with greater fluency: the fast-paced lives of active individuals may extend to a fast-paced production of words.

Perhaps not surprisingly, Openness was the trait most strongly associated with verbal fluency. Individuals high on Openness have an intellectual curiosity that leads them to seek out higher education and to generally read more, both of which likely expose them to new ideas and a larger vocabulary. Their broad knowledge base, coupled with a cognitive flexibility that allows them to manipulate information with ease, likely contributes to their verbal abilities. And, similar to the current study, Openness has been found to be associated with cognitive ability, even after controlling for the effect of education (Sharp et al., 2010). Openness is associated with neural activity in regions of the brain thought to be responsible for working memory and attention (Sutin, Beason-Held, Resnick, & Costa, 2009), which may contribute to performance on this task.

Due to the heterogeneity of associations at the facet level, Conscientiousness at the domain level was unrelated to verbal fluency. In fact, some of the facets went in opposite directions. For example, the two facets most strongly related to achievement – C4: Achievement Striving and C5: Self-Discipline – were associated with greater verbal fluency, whereas a dispositional tendency to think carefully before speaking (C6: Deliberation) was associated with producing fewer words. Although deliberation tends to be associated with positive outcomes (Chopra et al., 2005; Sutin et al., 2009; Terracciano et al., 2008), there appears to be a slight performance tradeoff to this reflective tendency. Finally, the association between domain-level Conscientiousness and verbal fluency appears to vary by level of education. That is, high Conscientiousness partly compensates for the deficit created by lower levels of education. Conscientiousness provided no such advantages at higher levels of education.

Surprisingly, neither age nor sex moderated the association between personality and verbal fluency. High Neuroticism has been found to be a risk factor for Alzheimer's disease and cognitive decline more generally (Wilson et al., 2003), whereas high Conscientiousness has been found to be protective (Wilson et al., 2007). These observations have led to the hypothesis that a lifetime of experiencing negative events and emotions has a cumulative, detrimental effect on cognitive functioning (Wilson et al., 2006), and, likewise, a lifetime of health-promoting behavior is protective of such functioning (Wilson et al., 2007). In the present sample, however, age did not moderate the personality-fluency associations; that is, the correlations between personality and fluency were similar among older and younger adults.

The effect sizes in the current study were in the small-to-moderate range, which indicates that personality and cognitive functioning are two distinct, yet related, areas of individual differences. The findings do suggest, however, that personality may make a modest contribution to performance on verbal fluency tasks. Although the findings presented here may have no direct clinical application, they contribute to our understanding of the association between personality and cognition. A growing literature has documented the links between personality and global cognitive functioning (Boyle et al., 2010), as well as performance on specific cognitive tasks (Schaie, Willis, & Caskie, 2004; Sharp et al., 2010). This evidence suggests that it could be worthwhile to measure personality traits in clinical

interventions to evaluate whether these traits mediate or moderate the effectiveness of different interventions. Given the growing interest in personalized medicine, personality traits may help identify those who are most vulnerable and those could benefit most from early interventions.

This study had several strengths. First, we used a comprehensive measure that covered both the broad domain level and the more circumscribed facet level of personality. Second, we had a large sample that ranged in age from adolescence through old age. Third, the same personality and fluency measures were administered to everyone in the sample, which allowed us to examine the personality-fluency associations across the lifespan using the same measures. Despite these strengths, future research would benefit from addressing some limitations. First, we had only one measure of verbal fluency; a larger battery of cognitive tests would provide a more nuanced understanding of the association between personality traits and cognitive ability. Second, fluency was measured at only one time point, so we could only test the prospective personality predictors of this measure; in the SardiNIA sample, we do not yet have data to test whether personality predicts change in fluency over time. With more assessments, we could test the hypothesis, for example, that a tendency towards negative emotions has a cumulative effect on cognition (Wilson et al., 2006). Finally, although the use of a relatively homogenous rural population reduced the number of confounds and provided a broad distribution in terms of age, sex, and educational achievement, similar studies on more cosmopolitan samples are needed to test whether these associations differ across different settings, ethnicities, and cultures. Despite the apparent uniqueness of the Sardinian population, however, their personality structure is similar to that of mainland Italy and the US (Pilia et al., 2006), and our findings are consistent with those from very different populations.

In sum, a disposition towards emotional vulnerability, lower happiness and being less open and disciplined has a detrimental effect on cognitive performance. Related lines of research suggest that these traits are risk factors for cognitive decline (Wilson et al., 2003; Wilson et al., 2007). The findings from the present research provide a reference point from which to evaluate associations between personality and cognition in clinical samples with cognitive impairments.

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Table 1

Means (SD) and Linear Regressions Prospectively Predicting Verbal Fluency Scores and Perseverations from Personality Traits

	Mean (SD)	Verbal Fluency	Perseverations
Personality			
Neuroticism	5.53 (.91)	−.06**	.00
Extraversion	4.88 (.88)	.08**	.02
Openness	4.64 (1.01)	.15**	−.01
Agreeableness	4.66 (.96)	.03	−.03
Conscientiousness	4.91 (.94)	.02	.01
Facets			
N1: Anxiety	5.71 (.92)	−.04**	−.01
N2: Angry Hostility	5.38 (.94)	−.04**	.02
N3: Depression	5.48 (.96)	−.08**	−.02
N4: Self-Consciousness	5.27 (1.02)	−.05**	.01
N5: Impulsivity	4.79 (.93)	.01	.01
N6: Vulnerability	5.73 (1.08)	−.06**	−.02
E1: Warmth	4.81 (.93)	.05**	.01
E2: Gregariousness	5.45 (.96)	.00	.03
E3: Assertiveness	4.73 (.82)	.08**	.01
E4: Activity	5.22 (.85)	.06**	.04**
E5: Excitement-Seeking	4.74 (1.00)	.02	.02
E6: Positive Emotions	4.54 (1.04)	.09**	.00
O1: Fantasy	5.12 (1.01)	.12**	−.01
O2: Aesthetics	5.20 (.87)	.09**	−.01
O3: Feelings	4.61 (.96)	.12**	.00
O4: Actions	4.96 (1.00)	.04**	.00
O5: Ideas	4.4.7 (1.00)	.12**	.00
O6: Values	4.13 (.92)	.05**	−.02
A1: Trust	4.29 (1.03)	.02	.00
A2: Straightforwardness	4.78 (1.01)	.02	−.04**
A3: Altruism	4.72 (.98)	.03	.01
A4: Compliance	4.36 (1.12)	−.03	−.01
A5: Modesty	5.21 (.93)	.00	−.03
A6: Tender-Mindedness	5.34 (1.03)	.07**	−.02
C1: Competence	4.24 (.95)	.01	.02
C2: Order	4.84 (.96)	.01	.02
C3: Dutifulness	5.07 (.97)	.03	−.01
C4: Achievement Striving	4.99 (.94)	.04**	.02

	Mean (SD)	Verbal Fluency	Perseverations
C5: Self-Discipline	4.81 (.92)	.04**	.01
C6: Deliberation	5.54 (1.10)	−.04**	−.02

Note. $N = 4790$. The regressions control for age, age squared, sex, education, and test administration.

** $p < .01$.