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Original Research Report

Personality and Cognitive Decline in Older Adults: Data From a Longitudinal Sample and Meta-Analysis

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Abstract

Objectives: Personality traits are associated with risk of dementia; less is known about their association with the trajectory of cognitive functioning. This research examines the association between the 5 major dimensions of personality and cognitive function and decline in older adulthood and includes a meta-analysis of published studies.

Method: Personality traits, objective and subjective memory, and cognitive status were collected in a large national sample (N = 13,987) with a 4-year follow-up period. For each trait, the meta-analysis pooled results from up to 5 prospective studies to examine personality and change in global cognition.

Results: Higher Neuroticism was associated with worse performance on all cognitive measures and greater decline in memory, whereas higher Conscientiousness and Openness were associated with better memory performance concurrently and less decline over time. All traits were associated with subjective memory. Higher Conscientiousness and lower Extraversion were associated with better cognitive status and less decline. Although modest, these associations were generally larger than that of hypertension, diabetes, history of psychological treatment, obesity, smoking, and physical inactivity. The meta-analysis supported the association between Neuroticism and Conscientiousness and cognitive decline.

Discussion: Personality is associated with cognitive decline in older adults, with effects comparable to established clinical and lifestyle risk factors.

Keywords: Cognitive decline—Conscientiousness—Meta-analysis—Neuroticism—Older adults—Personality

Cognitive health is among the most pressing concerns of older adults, as cognitive decline can precipitate loss of functional status (Nikolova, Demers, & Béland, 2009) and culminate in dementia (Kluger, Ferris, Golomb, Mittelman, & Reisberg, 1999). Cognitive decline, however, is also a natural part of aging, and there are tremendous individual differences in the rate of change (Wilson et al., 2002). Lifestyle and other behavioral factors are known to be associated with cognition but account for a small portion of the variability. Psychological characteristics, such as our characteristic ways of thinking, feeling, and behaving, may also contribute to this variability (see Curtis, Windsor, & Soubelet, 2015 for a review). This study addresses whether the major dimensions of personality as defined by the five-factor model—Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness—are associated with concurrent and prospective changes in memory, subjective memory, and global cognitive status in older adulthood. We

address this issue with a new large sample and combine the results for global cognition with those of existing studies in a meta-analysis.

Among middle-aged and older adults, personality traits are associated with cognitive functioning when measured concurrently (e.g., Aiken-Morgan et al., 2012; Baker & Bichsel, 2006; Booth, Schinka, Brown, Mortimer, & Borenstein, 2006; Boyle et al., 2010; Soubelet & Salthouse, 2011; Williams, Suchy, & Kraybill, 2010). Neuroticism, the tendency to experience negative emotions and difficulties with impulse control, has been related to poorer performance on cognitive tasks in many studies (Booth et al., 2006; Boyle et al., 2010; Meier, Perrig-Chiello, & Perrig, 2002; Soubelet & Salthouse, 2011; Williams et al., 2010), but not all (see Baker & Bichsel, 2006; Jelicic et al., 2003). The association between Extraversion, a measure of sociability, high energy, and excitement-seeking, and cognition seems to be more domain specific (e.g., Baker & Bichsel, 2006; Moutafi, Furnham, & Crump, 2003; Soubelet & Salthouse, 2011): Individuals who score high in Extraversion perform better on speed-based tasks (Pearman, 2009) but worse on tasks that require effortful processing and reasoning (Graham & Lachman, 2012). Openness, a measure of creativity and preference for variety, is consistently linked with better cognitive performance, particularly indices of executive functioning and verbal memory (e.g., Aiken-Morgan et al., 2012; Booth et al., 2006; Sharp, Reynolds, Pedersen, & Gatz, 2010; Soubelet & Salthouse, 2011; Williams et al., 2010). Findings for Conscientiousness, the tendency to be organized and disciplined, are relatively mixed, with studies reporting significant (e.g., Booth et al., 2006; Wilson, Schneider, Arnold, Bienias, & Bennett, 2007) and non-significant (e.g., Aiken-Morgan et al., 2012; Williams et al., 2010) concurrent associations across a range of different cognitive measures. There is no clear evidence for an association between Agreeableness (the tendency to be trusting and altruistic) and cognition (Aiken-Morgan et al., 2012; Graham & Lachman, 2012; Williams et al., 2010).

In addition to measured cognition, personality traits have also been linked to subjective cognitive complaints (e.g., Pearman & Storandt, 2004). Individuals high in Neuroticism and low in Conscientiousness, for example, tend to report more complaints about their memory (e.g., Steinberg et al., 2013); such complaints have been associated with subsequent dementia (Geerlings, Jonker, Bouter, Adèr, & Schmand, 1999).

The relatively few studies on personality traits and prospective changes in cognition with advancing age have been mixed. For example, higher Conscientiousness and lower Neuroticism are associated with slower rate of cognitive decline in some studies (Chapman et al., 2012; Wilson et al., 2007), but not in others (e.g., Hock et al., 2014; Williams, Suchy, & Kraybill, 2013). Neuroticism and Conscientiousness have also been linked to memory decline, but not with decline in other cognitive domains (e.g., visuospatial ability; Wilson et al., 2007). In addition, although Openness is thought to be protective later in life (Williams et al., 2013), it may be unrelated to maintaining cognitive function over time (Sharp et al., 2010). Such differences may be due partly to differences in methodology across studies, such as the use of specific populations (e.g., clergy; Wilson et al., 2007), the age range considered (i.e., the inclusion of relatively young- and middle-aged adults; Hock et al., 2014; Sharp et al., 2010), the follow-up length, the cognitive and personality domain assessed, and the analytic approach and covariates included. More research is clearly needed to elucidate which traits are prospectively associated with cognitive decline.

This study uses a large longitudinal sample of older adults to examine the association between the five personality traits and three aspects of cognition: memory performance, subjective memory, and global cognitive status. With data drawn from the Health and Retirement Study (HRS), we examine these associations concurrently and test whether personality is associated with changes in cognition over a 4-year follow-up period. We then combine the findings on global cognition with those of published studies to provide a meta-analytic summary of the association between personality traits and cognitive decline in older adulthood. We expect that higher Neuroticism will be associated with worse cognitive performance and more decline over time, whereas Openness and Conscientiousness will be related to better performance, both concurrently and longitudinally. We do not expect Extraversion or Agreeableness to be associated with changes in cognitive performance.

Method

Participants

Participants were drawn from the HRS, a nationally representative longitudinal study sponsored by the National Institute of Aging (grant number NIA U01AG009740) and conducted by the University of Michigan. HRS includes American adults 50 years and older and their spouses. Given that spouses were enrolled regardless of their age, a small proportion of participants were younger than 50 years. To reduce heterogeneity in the current sample, the present work limited the analyses to individuals over the age of 50. Since its inception, participants have completed cognitive tasks designed to measure memory and general cognitive status (Ofstedal, Fisher, & Herzog, 2005; see later). Starting in 2006, HRS implemented an enhanced interview that included a psychosocial questionnaire with a measure of personality traits (Smith et al., 2013). Half of the HRS participants completed the questionnaire in 2006; the other half completed it in 2008. We used the combined 2006–2008 samples as our baseline. Across these two interviews, a total of 13,987 participants (mean age = 68.8 years, *SD* = 9.9, range = 50–107; 59.3% women; education = 12.6 years, *SD* = 3.1, range = 0–17) had at least one valid measure of memory and personality. A subset of

these participants (N = 9,168) also had a valid cognitive status score. In 2010 and 2012, participants completed the same cognitive measures. We combined these two assessments to have a 4-year follow-up for all participants; a total of 11,209 participants completed the memory task and 6,971 completed the cognitive status tasks at follow-up. Participants who did not complete the follow-up were, on average, older and less educated and tended to score worse on the cognitive measures (see Supplementary Material for detailed attrition analysis). Descriptive statistics are presented in Supplementary Table S1.

Measures

Personality

Personality traits were assessed with an adjective checklist, the Midlife Development Inventory (MIDI) Personality Scales (Lachman & Weaver, 1997). Participants were asked to, "Please indicate how well each of the following describes you" on a scale from 1 (*not at all*) to 4 (*a lot*). Neuroticism was measured with four adjectives (e.g., Moody; α = .70), Extraversion was measured with five adjectives (e.g., Outgoing; α = .75), Openness was measured with seven adjectives (e.g., Imaginative; α = .79), and Agreeableness and Conscientiousness were both measured with five adjectives each (e.g., Helpful and Organized, respectively, α = .78 and .67).

Cognition

To assess memory, participants were read a list of 10 words that they recalled immediately and again after a 5-min delay. A composite of the immediate and delayed recall was used as an index of memory functioning (range 0–20). Respondents also rated the perception of their memory, with the question "How would you rate your memory at the present time? Would you say it is excellent, very good, good, fair, or poor?" This item was reverse scored so that higher scores indicated better perceived memory. Lastly, participants completed a variety of tasks that were composited into an index of cognitive status (range 0–15; referred to as Mental Status in HRS documentation): Serial 7s test (count backwards from 100 by 7s), backwards counting (counting backwards from a given number), date naming (reporting the current date), object naming (identifying common objects), and naming the current President and Vice President of the United States. By HRS design (Ofstedal et al., 2005), the cognitive status measure was completed when participants first entered the HRS, regardless of their age, but participants were retested at subsequent waves only if they were 65 years and older.

Clinical and behavioral risk factors

At every wave in HRS, participants were asked detailed questions about their medical history. The presence (vs. absence) of modifiable risk factors was evaluated during the health interview, including hypertension, diabetes, treatment for a psychological disorder (i.e., received psychiatric or psychological treatment for any kind of emotional, nervous, or psychiatric problems), obesity, physical inactivity, and smoking. We used the risk factors measured at baseline (i.e., the 2006/2008 visits) so that the risk factors would be concurrent with the personality assessment. These risk factors were chosen based on the literature that links them to cognitive decline (see Barnes & Yaffe, 2011 for a review). In addition to the individual risk factors, a risk index was derived as the sum of the clinical/behavioral risk factors (scores ranged from 0 [*no risk factors present*] to 6 [*all risk factors present*]).

Analytic Strategy

To examine the cross-sectional association between personality traits and cognition at baseline, we ran a series of linear regressions predicting each of the cognitive measures from personality (raw scores), controlling for age, age squared (to account for non-linear change in cognition in later adulthood; Verhaeghen & Salthouse, 1997), sex, ethnicity, and education. We then added the clinical and behavioral risk factors to examine the association between personality and cognition net of and in comparison to these well-established risk factors. We subsequently also tested the risk index in a separate analysis. We used Aiken and West's (1991) procedure for testing interactions to examine whether the association between personality and cognition varied by age, sex, ethnicity, or education and whether there were any interactions between the risk index and any of the traits.

We took a similar approach to testing whether personality was associated with change in cognition over time. We again used linear regression to predict cognitive scores at follow-up from personality, controlling for baseline cognition and demographic factors. We then added the clinical and behavioral risk factors to compare to the effect size of the personality traits. To limit multiple comparison biases, $p < .01$ was considered statistically significant for all analyses.

Meta-analysis

To identify studies for inclusion in the meta-analysis, we searched the Scopus and Web of Science databases, using the following search terms: "neuroticism," "extraversion," "openness," "agreeableness," "conscientiousness" or "five factor model," and "cognitive performance" or "cognitive decline." The search was limited to papers in English published up to April 2014; the search terms yielded 1,176 potential papers. Studies were selected if they met our criteria for study design (i.e., longitudinal design), population (healthy adults), personality measure (five-factor model measure), and outcome (global measure of cognition). Only studies that tested for changes in "global cognition" over

time were selected—that is, studies with personality traits assessed at baseline and measures of cognition collected at two or more time points over the follow-up period. On the basis of the titles and abstracts, we identified 17 full-text articles. After further evaluation, 11 articles were excluded because of the use of data derived from the same cohort studies (2 articles), the partial statistical information reported in the article (4 articles), and the type of outcome considered (5 articles). No additional studies were identified from reference lists. Thus, a total of 6 eligible studies were identified (further information on study selection is provided in Supplementary Figure S1). To reduce variability across studies, we chose the estimates from models that included age, sex, and education as covariates. We performed random-effect model meta-analyses, using the Comprehensive Meta-Analysis software package. Heterogeneity was assessed using the Q statistic.

Results

HRS: Personality and Cognition

Memory

Table 1 shows the cross-sectional and longitudinal associations between personality traits and participants' memory performance and self-rated memory. When measured concurrently and controlling for the demographic factors, those who were more emotionally stable (lower Neuroticism), those who were creative and imaginative (higher Openness), and those who were organized and disciplined (higher Conscientiousness) remembered more words. Subjectively, participants higher in Neuroticism and Agreeableness perceived their memory as poorer, whereas those higher in Extraversion, Openness, and Conscientiousness perceived their memory to be better. Although some of these effects were moderated by demographic factors, there was no consistent pattern and none of the interactions explained more

Table 1. Linear Regressions Predicting Memory

	Cross-sectional associations (βs)								Longitudinal associations (βs)							
	Memory performance				Self-rated memory				Memory performance				Self-rated memory			
Variables	M1	M2	M3	*d*	M1	M2	M3	*d*	M1	M2	M3	*d*	M1	M2	M3	*d*
Demographics																
Age	−.33*	−.33*	−.32*		−.12*	−.12*	−.12*		−.24*	−.24*	−.24*		−.01	−.02	−.02	
Age squared	−.09*	−.08*	−.09*		.05*	.07*	.06*		−06*	−.06*	−.07*		.00	.00	.00	
Sex	.16*	.16*	.16*		.02	.02*	.03*		.08*	.09*	.09*		.02	.03*	.03*	
Ethnicity (black)	−.14*	−.14*	−14*		−.06*	−.08*	−.08*		−.05*	−.05*	−.05*		−.03*	−.04*	−.04*	
Ethnicity (other)	−.06*	−.06*	−.06*		−.02*	−.03*	−.03*		−.01	−.01	−.01		−.01	−.01	−.01	
Education	.29*	.26*	.26*		.22*	.16*	.15*		.15*	.14*	.13*		.09*	.06*	.06*	
Baseline performance	—	—	—		—	—	—		.44*	.43*	.43*		.53*	.49*	.49*	
Personality																
Neuroticism	—	−.06*	−05*	.23	—	−09*	−.07*	.43	—	−.03*	−.02*	.08	—	−.06*	−.05*	.22
Extraversion	—	−.02	−03*	.12	—	.10*	.09*	.45	—	−.02	−.03*	.01	—	.04*	.03*	.18
Openness	—	.05*	.05*	.21	—	.10*	.11*	.51	—	.02*	.03*	.07	—	.06*	.06*	.19
Agreeableness	—	.01	.01	.13	—	−07*	−.06*	.27	—	−.02	−.02	.03	—	−.04*	−.04*	.09
Conscientiousness	—	.06*	.06*	.27	—	.13*	.12*	.60	—	.03*	.03*	.10	—	.05*	.04*	.22
Health-risk factors																
Hypertension	—	—	−.02*	.06	—	—	−.02	.10	—	—	−.00	.02	—	—	−.01	.05
Diabetes	—	—	−.03*	.09	—	—	−.00	.08	—	—	−.04*	.09	—	—	−.01	.05
Treatment for distress	—	—	−.03*	.15	—	—	−.08*	.32	—	—	−.02*	.08	—	—	−.02*	.12
Obesity	—	—	.02*	.03	—	—	.01	.03	—	—	.01	.00	—	—	.00	.02
Physical inactivity	—	—	−.03*	.12	—	—	−.03*	.18	—	—	−.01	.04	—	—	−.02*	.09
Ever smoker	—	—	.00	.02	—	—	−.03*	.10	—	—	.00	.01	—	—	−.02	.04
R^2 adjusted	.292	.305	.309		.077	.146	.153		.429	.431	.433		.316	.329	.331	
R^2 change	.292*	.014*	.004*		.078*	.069*	.008*		.429*	.003*	.002*		.316*	.014*	.002*	
Sample size	N = 13,140				N = 13,140				N = 10,565				N = 10,592			

Notes: βs = standardized regression coefficients; *d* = Cohen's *d* (absolute values), computed by comparing top and bottom quartiles of each personality trait and the absence/presence of each risk factor, controlling for the demographic covariates. A total of 13,987 participants had at least one valid measure of personality and memory at baseline. Given that not all participants completed both measures at follow-up, *N* ranged from 10,565 to 10,592 for longitudinal analysis. The effects were similar when the HRS sampling weights were used in the analyses. M1 = Model 1, which included the demographic factors as predictors on cognition. M2 = Model 2, which additionally included personality. M3 = Model 3, which additionally included the health-risk factors. Health-risk factors were coded 0/1 (i.e., absence/presence, respectively).

*$p < .01$.

than an additional 1% of the variance (Supplementary Material).

All of the associations between personality and the objective and subjective measures of memory remained significant after including the clinical and behavioral risk factors (Model 3, Table 1). In addition, the association between Extraversion and memory reached significance in the fully adjusted model. Although modest, the associations between the traits and memory were comparable to the effect of the clinical (e.g., diabetes) and behavioral (e.g., physical inactivity) risk factors. For example, participants in the lowest quartile of Conscientiousness remembered, on average, almost one word less than participants in the highest quartile (M = 9.15, SE = 0.06 vs. M = 10.04, SE = 0.05; d = 0.27). By contrast, individuals with diabetes (the clinical risk factor with the strongest effect on memory) remembered approximately one-half word less than participants without diabetes (M = 9.49, SE = 0.05 vs. M = 9.80, SE = 0.03; d = 0.09). The risk index had a similar effect on the memory measures as the individual risk factors (β = –.04 and –.06, ps < .001, for objective and subjective memory measures, respectively). There were no interactions between personality traits and the risk factors in predicting either memory measure.

Similar to the cross-sectional associations, Neuroticism, Openness, and Conscientiousness were the strongest personality predictors of change in memory performance: emotionally stable, open-minded, and conscientious participants declined less in their ability to remember between baseline and follow-up. Similar to the cross-sectional findings, these effects remained significant with the inclusion of the clinical and behavioral risk factors, and Extraversion reached significance in this fully adjusted model. The association between personality and change in memory performance was similar to the strongest risk factors (i.e., diabetes and treatment for psychological distress). Finally, personality and subjective memory shared similar associations at the follow-up as at the baseline assessment. The risk index again had a similar effect on the memory outcomes as the individual risk factors (β = –.03 and –.04, ps < .001, for objective and subjective memory measures, respectively), and there were no interactions between personality traits and the risk factors in predicting change in memory.

Cognitive status

Table 2 shows the cross-sectional and longitudinal associations between personality traits and cognitive status. Lower scores on Neuroticism and Extraversion and higher scores on Conscientiousness were concurrently associated with better cognitive functioning. Similar to the memory measures, some of these effects were moderated by demographic factors (Supplementary Material), but there was no specific pattern and none of the interactions accounted for more than an additional 1% of the variance. Again, these effects remained significant after the inclusion of the other risk factors for cognitive decline. The association between Conscientiousness and cognitive status translated into a nearly one point worse performance among participants in the lowest quartile of Conscientiousness than participants in the highest quartile (M = 12.26, SE = 0.05 vs. M = 12.90, SE = 0.04; d = 0.24). By contrast, the association between cognitive status and treatment for distress, the risk factor with the largest association with cognitive status, translated into a less than one-half point difference between those who had been treated versus those not treated (M = 12.33, SE = 0.06 vs. M = 12.74, SE = 0.02; d = 0.16). Moreover, the risk index had a similar effect as the individual risk factors on cognitive status (β = –.03, p < .01), and there were no significant interactions between personality and the risk factors.

Personality traits had a more modest relation with change in cognitive status over time. Conscientiousness and Extraversion were the only traits associated significantly with change in cognitive status: Individuals high in Conscientiousness or low in Extraversion declined less over the follow-up period. These associations remained significant with the addition of the clinical and behavioral risk factors and were similar to the association between treatment for distress, the strongest clinical predictor, and cognitive decline. The risk index had a similar effect (β = –.04, p < .001), and there were no significant interactions between personality and the risk factors in predicting cognitive decline.

Meta-Analysis: Personality and Cognitive Decline

Including the HRS sample, we identified seven prospective studies that examined personality traits as predictors of change in measures of global cognition. Of these seven samples, five had data on Neuroticism (total N = 11,081) and Conscientiousness (N = 7,609), four had data on Openness (N = 6,944), and three had data on Extraversion and Agreeableness (N = 6,087). All studies included at least age, sex, and education as covariates. Some studies used a global measure of general cognitive status (e.g., Mini-Mental State Examination; Chapman et al., 2012; Hock et al., 2014; Williams et al., 2013), whereas others derived a composite measure of global cognition by different cognitive tests (Sharp et al., 2010; Wilson et al., 2005, 2007); we considered the cognitive status score in HRS as an index of global cognition. See Supplementary Material for detailed information on the studies included in the meta-analyses (Supplementary Table S2).

By pooling the results across studies (Table 3), the meta-analysis confirmed a significant (positive) association between Conscientiousness and global cognition (estimate = 0.024; 95% confidence interval [CI], lower limit 0.016, upper limit 0.032; p < .001): Higher scores on Conscientiousness were associated with less decline over time. Neuroticism also showed a significant (negative) association (estimate = –0.010; 95% CI, lower limit –0.015, upper limit –0.006; p < .001): Higher scores on Neuroticism

Table 2. Linear Regressions Predicting Cognitive Status

	Cross-sectional associations (βs)				Longitudinal associations (βs)			
Variables	M1	M2	M3	*d*	M1	M2	M3	*d*
Demographics								
Age	.00	−.00	.00		−.07*	−.07*	−.07*	
Age squared	−.14*	−.14*	−.14*		−.06*	−.07*	−.07*	
Sex	.06*	.07*	−.06*		−.02	−.02	−.02	
Ethnicity (black)	−.22*	−.22*	−.21*		−.09*	−.09*	−.09*	
Ethnicity (other)	−.04*	−.04*	−.04*		−.00	−.01	−.01	
Education	.38*	.37*	.36*		.15*	.15*	.14*	
Baseline performance	—	—	—		.49*	.49*	.48*	
Personality								
Neuroticism	—	−.06*	−.04*	0.19	—	−.02	−.01	0.06
Extraversion	—	−.04*	−.04*	0.04	—	−.04*	−.04*	0.04
Openness	—	−.02	−.01	0.04	—	−.01	−.00	0.01
Agreeableness	—	.02	.03	0.05	—	.00	.01	0.02
Conscientiousness	—	.09*	.08*	0.24	—	.05*	.04*	0.09
Health-risk factors								
Hypertension	—	—	.00	0.02	—	—	−.01	0.04
Diabetes	—	—	−.04*	0.09	—	—	−.03	0.06
Treatment for distress	—	—	−.04*	0.16	—	—	−.04*	0.13
Obesity	—	—	.02	0.02	—	—	−.00	0.02
Physical inactivity		—	−.03*	0.09		—	−.01	0.04
Ever smoker			.01	0.02			−.00	0.00
R^2 adjusted	.248	.259	.263		.382	.384	.386	
R^2 change	.248*	.012*	.005*		.383*	.003*	.003*	
Sample size		*N* = 8,590				*N* = 5,475		

Notes: βs = standardized regression coefficients; *d* = Cohen's *d* (absolute value), computed by comparing top and bottom quartiles of each personality factor and the absence/presence of each risk factor, controlling for the demographic covariates. Of 13,987 participants with valid measure of personality and memory at baseline, a subset of 9,168 had also a valid cognitive status score. Given the discrepancy in the number of participants who completed each of the cognitive status tasks, *N* ranged from 8,590 for cross-sectional analysis to 5,475 for longitudinal analysis. The effects were similar when the HRS sampling weights were used in the analyses. M1 = Model 1, which included the demographic factors as predictors on cognition. M2 = Model 2, which additionally included personality. M3 = Model 3, which additionally included the health-risk factors. Health-risk factors were coded 0/1 (i.e., absence/presence, respectively).
*$p < .01$.

were associated with greater declines in cognition. There was no evidence of heterogeneity for Conscientiousness or Neuroticism. There was no significant association between Extraversion, Openness, and Agreeableness and cognitive decline.

Discussion

The present research examined the cross-sectional and longitudinal associations between personality and cognition in a large sample of middle-aged and older adults and then combined the effects with those of published studies in a meta-analysis. As hypothesized, Conscientiousness and Openness were associated positively with objective and subjective measures of memory, whereas Neuroticism had negative associations with the memory measures, both concurrently and longitudinally. Although not hypothesized, Extraversion and Agreeableness were associated with the memory measures. High Conscientiousness and low Extraversion were also associated with less decline in cognitive status across the follow-up period. The meta-analysis supported the association between both Conscientiousness and Neuroticism and cognitive decline, but not Openness.

Across all three measures of cognition in the HRS, conscientious individuals performed better concurrently and declined less across the follow-up period. The meta-analysis further strengthened the evidence for the association between Conscientiousness and cognitive aging: Combining the five studies, Conscientiousness was associated with maintaining better cognitive function over time. These findings are consistent with accumulating evidence that Conscientiousness is associated with a range of more positive outcomes across the life span (e.g., Jaconelli, Stephan, Canada, & Chapman, 2013; Sutin, Zonderman, Ferrucci, & Terracciano, 2013). Conscientious individuals tend to engage in fewer health-risk behaviors, such as smoking and sedentary behaviors (Rhodes & Smith, 2006; Terracciano & Costa, 2004), have better health profiles, such as healthier weight and

Table 3. Cognitive Decline Associated With Personality Traits Reported in Each Study, Meta-Analytical Effect Sizes, and Heterogeneity

Sample	*N*	Max. follow-up (years)	Cognition measures	Neuroticism (95% CI)	Extraversion (95% CI)	Openness (95% CI)	Agreeableness (95% CI)	Conscientiousness (95% CI)
ECA Study	561	12.1	1	−0.013 (−0.027, 0.001)	0.008 (−0.007, 0.023)	0.009 (−0.007, 0.025)	0.011 (−0.003, 0.024)	0.017 (0.003, 0.031)
CHAP	4,392	>5[a]	2	−0.010 (−0.016, −0.004)	—	—	—	—
GEM Study	602	7.3	1	−0.047 (−0.094, 0.000)	—	—	—	0.041 (0.008, 0.074)
ROS	920	12	2	—	—	—	—	0.030 (0.012, 0.048)
SATSA	857	18	2	—	—	0.01 (−0.00, 0.02)[a]	—	—
Williams et al. (2013)	51	2.7	1	−0.030 (−0.112, 0.052)	0.009 (−0.087, 0.105)	0.099 (0.021, 0.177)	0.040 (−0.052, 0.132)	0.013 (−0.058, 0.084)
HRS	5,475	4	2	−0.009 (−0.018, 0.001)	−0.017 (−0.030, −0.004)	−0.003 (−0.015, 0.010)	0.002 (−0.013, 0.017)	0.025 (0.012, 0.039)
Meta-analysis, random model				−0.010 (−0.015, −0.006)	−0.004(−0.026, 0.018)	0.007 (−0.002, 0.017)	0.007 (−0.003, 0.017)	0.024 (0.016, 0.032)
Heterogeneity *Q* (*p*-value)				2.84 (.58)	6.32 (.04)	7.95 (.09)	1.22 (.54)	2.53 (.64)

Notes: CHAP = Chicago Health and Aging Project (Wilson et al., 2005); CI = confidence interval; ECA Study = Baltimore Epidemiologic Catchment Area Study (Hock et al., 2014); GEM Study = Ginkgo Evaluation of Memory Study (Chapman et al., 2012); HRS = Health and Retirement Study; ROS = Religious Orders Study (Wilson et al., 2007); SATSA = Swedish Adoption/Twin Study of Aging (Sharp et al., 2010). All studies controlled for age, sex, and education. Ethnicity was an additional covariate in ECA Study and RO Study. The SATSA and GEM Study adjusted further for activities of daily living and cardiovascular disease and other health-risk factors. Five sample with data Neuroticism (total *N* = 11,081) and on Conscientiousness (*N* = 7,609), four sample with data on Openness (*N* = 6,944), and three samples with data on Extraversion and Agreeableness (*N* = 6,087) were included; total *N* refers to the number of participants that had completed at least one follow-up assessment. For Cognition Measures column, 1 = Use of a measure of general cognitive status, 2 = Use of a composite measure derived by different cognitive tests. Detailed characteristics of the samples included in the meta-analyses are reported in Supplementary Table S2.

[a]See original study.

lower disease burden (Chapman, Lyness, & Duberstein, 2007; Sutin, Ferrucci, Zonderman, & Terracciano, 2011), have a lower risk of incident dementia (Terracciano et al., 2014; Wilson et al., 2007), and tend to live longer (Kern & Friedman, 2008). Previous studies using HRS data have found that Conscientiousness is associated with reduced risk of obesity (Jokela et al., 2013) and diabetes (Jokela et al., 2014). The present research extends the association between Conscientiousness and health outcomes to cognitive health. Of note, the effect of Conscientiousness on cognition was independent of, and consistently larger than, the effect of the clinical and behavioral risk factors.

The association between Neuroticism and cognition was more complex than for Conscientiousness. Neuroticism was consistently associated with worse cognition when measured concurrently and with greater declines in objective and subjective memory over time but was not significantly related to change in cognitive status in HRS. Although some studies have previously shown an association between Neuroticism and memory tasks (e.g., Meier et al., 2002), others have found no association with other aspects of cognition (e.g., Jelicic et al., 2003). Neuroticism may thus be more strongly related to some cognitive tasks than others, and different mechanisms may underlie these associations. For example, the tendency to experience intrusive thoughts that characterize individuals high in Neuroticism likely taxes attentional control, which may impede cognitive abilities (Munoz, Sliwinski, Smyth, Almeida, & King, 2013). Additional pathways, such as physiological mechanisms, are also plausible—indeed, the greater dysregulation of physiological systems associated with Neuroticism may contribute to decline in cognitive functioning among older adults (Karlamangla et al., 2014). Of note, differences across studies for Neuroticism may partly be attributable to differences in the scales used to assess this trait, such as scales that emphasize anxiety and depression versus impulsivity and anger. Thus, different facets of Neuroticism may be differentially associated with cognition (Wilson, Begeny, Boyle, Schneider, & Bennett, 2011). Combining multiple samples in the meta-analysis, however, did indicate that Neuroticism is associated with declines in cognitive functioning.

Results from the HRS were consistent with the typical finding in the literature that individuals who score higher on Openness perform better on cognitive tasks in general (e.g., Sharp et al., 2010). Open individuals tend to be more educated and are more likely to engage in cognitive, social, and physically stimulating activities that help foster a higher level of cognitive function (Stephan, Boiché, Canada, & Terracciano, 2014). The findings were more mixed in regard to Openness as a predictor of change in cognition over time. In partial support for our hypothesis, Openness in the HRS was associated positively with memory performance over time but was not associated with changes in global cognitive status over the follow-up period. Moreover, even in the meta-analysis, Openness was

unrelated to change in global cognition; in fact, Openness was significant in only one of the primary studies. Thus, even if open individuals have a higher level of performance on global measures of cognition, their rate of decline does not seem to differ from that of less open individuals. It may also be the case that Openness is more strongly related to memory than cognition in general. Given the scarce and contradictory findings in the literature (Sharp et al., 2010; Williams et al., 2013), future research needs to further tease apart the association between Openness and the trajectory of cognition in older adulthood.

Although unexpected, an interesting pattern emerged for Extraversion in the HRS. Consistent with previous work (Chapman et al., 2012), individuals high in Extraversion performed worse on the tasks that measured memory and global cognitive functioning at the baseline assessment. As suggested by Chapman and colleagues (2012), individuals who are extraverted may be highly activated by external stimuli and may thus underperform in processing cognitive tasks. Individuals who were more extraverted, however, subjectively evaluated their memory as better compared with those who were more introverted. Consistent with our finding, Extraversion has been linked to higher confidence judgments about memory performance (Buratti, Allwood, & Kleitman, 2013). More broadly, individuals who are extraverted tend to be optimistic and perceive the world in positive ways, which may also apply to perceptions of their own health (Löckenhoff, Sutin, Ferrucci, & Costa, 2008), weight (Sutin & Terracciano, in press), and cognition. This study thus indicates that individuals high in Extraversion are less likely to report memory problems and may have an overly positive perception of their cognitive ability that does not necessarily match their performance on memory tests.

Finally, although unexpected, a somewhat similar pattern was observed for Agreeableness: Agreeableness was unrelated to the performance-based cognitive measures, but competitive and antagonistic (i.e., less agreeable) individuals reported better self-rated memory at both time points. It is possible that less agreeable individuals are less modest in self-reporting their skills and have an overrated perception of their memory. Such a negative association has also been found in a sample of older adults with mild cognitive impairment (Studer, Donati, Popp, & von Gunten, 2013). Consistent with our expectations, however, Agreeableness was unrelated to performance on the memory or cognitive status measures.

A variety of factors—for example, age and education, health, and genetics—are likely to modulate the rate of cognitive decline in older adults. Any one factor is thus bound to show only a modest association, which can be evaluated in absolute terms and in comparison with other risk factors. Of note, the associations between personality and cognitive decline were comparable to or larger than that of the clinical and lifestyle risk factors. It has previously been estimated that up to half of the cases of Alzheimer's disease may be attributable to the modifiable risk factors included in this study (Barnes & Yaffe, 2011). It is thus of note that personality was associated with cognitive decline independent of these risk factors and that the associations between personality and cognitive decline were larger than established risk factors, such as diabetes, smoking, and physical inactivity.

This study had several strengths, including a large longitudinal sample, the inclusion of all five major dimensions of personality, task-based and self-rated measures of cognition, and the inclusion of risk factors for cognitive impairment in the analyses. Furthermore, the meta-analysis provided a quantitative synthesis of current knowledge. A number of limitations, however, need to be taken into account. First, the attrition pattern found in HRS may have weakened the observed associations. That is, the traits associated with worse performance (e.g., high Neuroticism, low Conscientiousness) were also the ones associated with having completed only the baseline assessment (Supplementary Material). Such participants likely need to be incentivized to participate at follow-up assessments. Although retaining such participants would strengthen the findings, recent evidence suggests that attrition differences may not limit the generalizability of results (Salthouse, 2014). Second, the personality scale in HRS only measured the five broad dimensions with a few items; detailed measures of the facets of personality would provide a deeper understanding of the links with cognition. Likewise, the cognition measures were limited to memory and general cognitive status. Other aspects of cognition (e.g., executive functioning; Williams et al., 2010) may have different associations with personality traits and, nevertheless, with specific personality facets (Williams et al., 2013). Third, the meta-analysis was limited by the different methodologies used to assess change in cognition over time. Cognitive decline, for example, was defined and measured with a global measure of cognitive status (e.g., Mini-Mental State Examination) in some studies and a composite measure derived from specific cognitive tasks in others. This difference in measures likely contributes to variability across studies and also indicates the robustness of the reported findings. Decline might also be more apparent when considering a specific domain (i.e., memory) rather than global cognition. Unfortunately, there are too few published studies for a meta-analysis of the longitudinal association between personality traits and specific cognitive domains. Finally, the observational nature of the data does not allow causal inferences. Personality traits may contribute to cognitive changes, but it is also possible that cognitive decline may have an effect on personality. In future research, it would thus be useful to have more comprehensive measures of both personality and cognition and address premorbid levels of personality traits and their changes.

Since cognitive decline can culminate in functional or cognitive impairments, and given the well-known personality link with health outcomes (e.g., incident dementia; Terracciano et al., 2014), this study potentially has

important clinical implications. Most individuals in this sample are cognitively healthy but represent the age group at risk of developing dementia. Based on this evidence, personality traits could be tested as part of prognostic models to identify individuals at greater risk of cognitive decline and dementia. Identifying vulnerable individuals is essential for targeted prevention and early intervention programs. Furthermore, personality traits may help aid in tailoring interventions to reduce cognitive decline and risk of dementia. In line with the need for more patient-centered approaches, matching interventions to the individual's personality could improve acceptability, adherence, and effectiveness of interventions. In a clinical trial designed to improve behavioral symptoms of dementia, for example, matching specific leisure activities to the personality of the patients with dementia significantly improved engagement, alertness, and attention compared with patients whose activities were mismatched with their personality (Kolanowski et al., 2011). Personality-tailored interventions, even when the aim of the intervention is not to change personality, may be particularly effective in achieving the desired outcome.

In sum, high Conscientiousness and low Neuroticism had the most consistent associations with better cognition in old age, whether considering specific domains of cognitive functioning (e.g., memory) or global cognition. By contrast, the inconsistent results for Extraversion pose the need to replicate current findings and clarify its relation with cognition. Additional studies that address the specific facets of Neuroticism, Openness, and Conscientiousness are also needed to better understand the relations between personality and cognitive decline.

Supplementary Material

Please visit the article online at http://gerontologist.oxfordjournals.org/ to view supplementary material.

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