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RUNNING HEAD: PERSONALITY AND MEMORY

Personality and Memory Performance over Twenty Years:
Findings from Three Prospective Studies

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Abstract

Objective. The present study examined whether personality traits are related to episodic memory over the long-term. **Method** Participants were adults from the Wisconsin Longitudinal Study Graduate (WLSG, N= 3,726) and Sibling samples (WLSS, N= 1,720), and the Midlife in the United States Study (MIDUS, N= 2,411). Five factor model personality traits and demographic factors were measured at baseline. Memory performance on immediate and delayed free recall tasks was assessed at follow-up, almost 20 years later. **Results.** In regression models that accounted for demographic factors, consistent evidence was found across three samples that middle-aged adults who scored higher on neuroticism performed significantly worse on a memory test 20 years later. In the WLSG and WLSS and a meta-analysis, higher openness was also associated with better memory at follow-up. High neuroticism and low openness were also associated with a 20 to 40% increased risk of performing below one and a half standard deviation from the sample mean on the memory task. **Conclusions.** The present study extends previous research with evidence that the association between personality traits and memory function persist over two decades.

Key-words: Personality, memory, prospective studies

1. Introduction

The identification and understanding of factors that shape memory function with aging is of crucial importance for the health and well-being of older adults. Memory impairment predicts functional decline [1], higher risk of dementia [2], and earlier mortality [3]. Among a range of potential influential factors, a growing body of research indicates that personality contributes to memory in old age. Specifically, higher neuroticism (the propensity to experience distress and negative affect) is related to lower episodic memory performance, whereas higher openness (the preference for variety and intellectual curiosity) and conscientiousness (the tendency to be self-disciplined and organized) are associated with better memory function [4-7]. Less consistent associations have been observed between episodic memory performance and both extraversion (the propensity to be active and to experience positive emotions) and agreeableness (the tendency to be altruistic and trusting) [7].

Consistent with cross-sectional findings, longitudinal research suggests that higher openness and conscientiousness mitigate memory decline, whereas higher neuroticism is related to a steeper decline [7,8,9]. These studies have examined the association between personality and memory over follow-up intervals ranging from 4 to 14 years, and the extent to which this association persists over longer period is unknown. The longest study to date had a follow-up of 14 years and examined only neuroticism [5]. There are reasons to expect that personality may predict memory over longer periods. Personality traits, for example, have been found to predict risk of incident Alzheimer's disease over 20 years or more [10, 11]. Given that memory deficits are a core feature of Alzheimer's disease, the association between personality and memory may persist over several decades.

Using data from three large national samples of middle aged and older adults, the present study examines the prospective association between personality and episodic memory

assessed twenty years later. Episodic memory was assessed using immediate and delayed free recall tasks. In line with existing cross-sectional and longitudinal findings, it was hypothesized that higher neuroticism is related to lower memory performance at follow-up. In contrast, higher openness and conscientiousness were expected to be associated with higher memory function. In addition, given that these traits have been related to higher likelihood of AD [10, 11], higher neuroticism, lower openness and conscientiousness were expected to relate to higher likelihood of memory impairment, defined as a score equal to or lower than one and half standard deviations below the sample mean [12].

2. Method

2.1. Participants

Data from the Wisconsin Longitudinal Study (WLS) and from the Midlife in the United States Survey (MIDUS) were used in the present study. Participants with complete data on demographic information, including age, sex, education and race (MIDUS only), and personality at baseline and memory at follow-up were included in each sample. All participants provided written informed consent. Descriptive statistics for the three samples are presented in Table 1.

The Wisconsin Longitudinal Study is a long-term study of a random sample of 10,317 men and women who graduated from Wisconsin high schools in 1957 (WLSG). The WLS sample is broadly representative of white, non-Hispanic American men and women who have completed at least a high school education. Personality and demographic data were obtained in 1992-1993 from a total of 6,673 participants. Of this sample, 3,726 participants aged from 51 to 56 years old also provided memory data in 2011 and were included as the final analyzed sample (54% women, mean age = 53.18, SD = 0.60). Selected siblings (WLSS) of some of the graduates are also included in the WLS. A total of 3,426 individuals provided data on personality and demographic factors in 1993-1994. The final sample was composed of 1,720

participants aged from 29 to 75 years old at baseline who also provided complete memory data in 2011 (54% women, mean age = 52.44, SD = 6.90). In the WLSG, participants without memory data at follow-up were older, $t(6671) = 4.73$, $p < .001$ and had less education, $t(6671) = 6.35$, $p < .001$. In addition, they had higher neuroticism, $t(6671) = 4.93$, $p < .001$ and lower extraversion, $t(6671) = 2.35$, $p < .05$, openness, $t(6671) = 3.36$, $p < .001$, and agreeableness, $t(6671) = 2.09$, $p < .05$. No differences were found for conscientiousness, $t(6671) = 0.65$, $p = .51$, and sex, $\chi^2(1, 6673) = 0.34$, $p = .56$. In the WLSS, participants without memory data at follow-up were older, $t(3424) = 8.81$, $p < .001$, had less education, $t(3424) = 5.90$, $p < .001$, and had lower openness, $t(3424) = 2.56$, $p < .05$. No differences were found for extraversion, $t(3424) = 1.43$, $p = .15$, agreeableness, $t(3424) = 1.85$, $p = .06$, neuroticism, $t(3424) = 0.91$, $p = .36$, conscientiousness, $t(3424) = 0.32$, $p = .75$, and sex, $\chi^2(1, 3426) = 1.83$, $p = .17$.

The MIDUS is a sample of non-institutionalized, English-speaking adults. Data were drawn from the first (1994-1995, MIDUS I) and third (2013-2014, MIDUS III) waves. Complete baseline demographic and personality data were obtained from 6,075 participants. The final analyzed sample was composed of 2,411 individuals aged from 29 to 75 years old who also provided memory data at follow-up (55% women, mean age=45.78, SD=11.11). In the MIDUS, participants without memory data at follow-up were older, $t(6073) = 5.23$, $p < .001$, had less education, $t(6073) = 15.11$, $p < .001$, were less likely to be white, $\chi^2(1, 6075) = 63.07$, $p < .001$, more likely to be male, $\chi^2(1, 6075) = 8.01$, $p < .01$, and had higher neuroticism, $t(6073) = 4.14$, $p < .001$, lower conscientiousness, $t(6073) = 5.27$, $p < .001$, and lower openness $t(6073) = 2.57$, $p < .05$. No differences were found for agreeableness, $t(6073) = 0.86$, $p = .39$ or extraversion, $t(6073) = 1.20$, $p = .23$.

2.2. Personality

Participants in the WLSG and WLSS samples completed a 29-item version of the Big Five Inventory (BFI) [13]. Participants were asked whether they agreed or disagreed with descriptive statements assessing neuroticism (e.g. “To what extent do you agree that you see yourself as someone ... who worries a lot?”), extraversion (e.g., “...is talkative”), openness (e.g., “...values artistic, aesthetic experiences”), agreeableness (e.g., “...who is generally trusting”) and conscientiousness (e.g., “...who does things efficiently”). Answers were given using a 6-point rating scale, ranging from 1 (*disagree strongly*) to 6 (*agree strongly*). In the MIDUS, the Midlife Development Inventory (MIDI) was used [14]. The MIDI includes 26 adjectives that assess neuroticism (e.g., “nervous”), extraversion (e.g., “friendly”), openness (e.g., “creative”), agreeableness (e.g., “caring”), and conscientiousness (e.g., “organized”). Participants were asked how much each adjective described them on a scale ranging from 1 (*not at all*) to 4 (*a lot*). Cronbach alphas for the WLSG, the WLSS, and the MIDUS were, respectively, .77, .75, and .75 for neuroticism, .77, .77, and .77 for extraversion, .62, .59 and .74 for openness, .68, .68, and .81 for agreeableness, and .63, .66, and .57 for conscientiousness.

2.3. *Episodic Memory.*

In the MIDUS, participants were asked to listen to a list of 15 words and then to recall as many words as possible both immediately and after a delay of approximately 12 minutes. In both the WLSG and WLSS, participants were asked to repeat as many words as they could from a list of 10 words, both immediately and after a delay of approximately 5 minutes. In the three samples, the number of correct words for immediate and delayed recall were summed to give a memory performance score.

2.4. *Covariates.*

The analysis controlled for age, sex, and education in the three samples because these demographic factors are likely to influence memory performances [15]. Education was

reported in years in both the WLSG and the WLSS, and on a scale from 1 (*no grade school*) to 12 (*doctoral level degree*) in the MIDUS. Because of its effect on memory [15], race was an additional covariate in the MIDUS.

2.5. Data analysis

Linear regression analyses were conducted to examine the relation between personality and memory. In each sample, memory performance at follow-up was predicted by each personality trait, controlling for age, sex, education, and race (MIDUS only). Results from the three samples were combined in a random effects meta-analysis with Comprehensive Meta-Analysis software. Finally, the association between personality and memory impairment, defined as a memory performance equal to or lower than 1.5 SD below the mean [12], was tested with logistic regressions, with the traits as predictors of likelihood of memory impairment, controlling for demographic factors. In both the WLSG and WLSS, IQ in adolescence was included as covariate in additional analysis.

3. Results

Descriptive statistics indicated that the three samples were relatively similar for sex and race, and that the MIDUS was slightly younger than the WLS samples (Table 1). In all three samples, there was consistent evidence that higher neuroticism at baseline was associated significantly with worse memory performance almost 20 years later (see Table 2). Higher neuroticism accounted for 0.1%, 0.2% and 0.5% of the memory variance in the WLSG, WLSS, and MIDUS, respectively, controlling for demographic factors. The difference in memory performance between the high (top quartile) and low (bottom quartile) neuroticism was $d = .11$ and $d = .12$ for the WLSG and the WLSS, respectively, and $d = .16$ for the MIDUS. In addition, higher openness was associated with better memory in the WLS samples and explained, respectively, 0.2% and 0.4% of variance in memory in the WLSG and

WLSS. The difference in memory performance between high (top quartile) and low (bottom quartile) openness was $d = .12$ for the WLSG and $d = .13$ for the WLSS. Conscientiousness, extraversion, and agreeableness were not significant predictors of memory performance. The overall pattern of associations was similar across samples, with little evidence of heterogeneity (Table 2). In the WLSG and the WLSS, the pattern of associations changed when IQ was included in the analysis. Indeed, the association between neuroticism and memory was no longer significant in both the WLSG ($\beta = -.02, p = .23$) and the WLSS ($\beta = -.05, p = .06$). Furthermore, openness was no longer significantly related to memory in both samples ($\beta_{\text{WLSG}} = .02, p = .12; \beta_{\text{WLSS}} = .04; p = .16$).

Finally, we examined the association between personality and memory impairment. There were 228 participants (6%) in the WLSG, 113 participants in the WLSS (7%), and 154 participants (6%) in the MIDUS who had memory performance $1.5 \text{ SD} \leq$ the mean. Logistic regression analysis revealed that neuroticism was related to the risk of memory scores $\leq 1.5 \text{ SD}$ in both the WLSS and the WLSG: one standard deviation higher score on neuroticism was related to an approximately 20-40% higher risk of memory $\leq 1.5 \text{ SD}$ in the WLSG (odds ratio = 1.19, 95% CI: 1.04-1.36, $p < .05$) and WLSS (odds ratio = 1.40, 95% CI: 1.14-1.71, $p < .01$). In addition, one SD higher score on openness was associated with a 25% reduced risk of memory $\leq 1.5 \text{ SD}$ in the WLSS (odds ratio = 0.74, 95% CI: 0.59-0.93, $p < .05$). Conscientiousness, extraversion, and agreeableness were not associated with risk of memory scores $\leq 1.5 \text{ SD}$. No significant associations were found in the MIDUS. When IQ was included as a covariate, neuroticism remained significantly related to memory impairment in both the WLSG (odds ratio = 1.15, 95% CI: 1.01-1.32, $p < .05$) and the WLSS (odds ratio = 1.38, 95% CI: 1.12-1.71, $p < .01$), and the relationship between openness and memory impairment persisted in the WLSS (odds ratio = 0.78, 95% CI: 0.62-0.98, $p < .05$).

4. Discussion

Using three large longitudinal survey of middle-aged and older individuals ($N > 7,000$), the present study examined the long-term associations between personality traits and episodic memory function. Consistently across the three samples, higher neuroticism was related to lower memory performance assessed almost 20 years later. In addition, higher openness was associated with better episodic memory in two of three samples and in the meta-analysis. Contrary to past research, however, conscientiousness was not a significant predictor of memory performance. The present study extends existing research by providing the longest prospective evidence of an association between personality traits and episodic memory.

The consistent association between neuroticism and memory performance assessed two decades later supports the hypothesis and extends existing cross-sectional and shorter-term longitudinal research [4-9]. In addition, higher neuroticism was associated with higher likelihood of memory impairment, defined as performance 1.5SD below the mean. There may be behavioral, affective, and biological implications of neuroticism that may be deleterious for memory function not only in the short-term but also over at least two decades. Neuroticism, for example, is related to higher stress sensitivity [16] and physiological dysregulation [17], which may alter memory function decades later. In addition, higher neuroticism is related to higher depressive symptoms [18], sleeping difficulties [19], and to health-risk behaviors, such as smoking [20], physical inactivity [21] and alcohol use [22], which may have long-term implications for memory.

As expected, higher openness to experience was related to better long-term memory performance. Higher openness was also associated with a lower likelihood of memory impairment in one sample. This result adds to past research having found a protective role of openness for memory over shorter time spans [7]. Openness to experience is associated with cognitively stimulating activities, such as cultural [23] and physical activities [21]. This active

and cognitively stimulating lifestyle may have a cumulative beneficial effect for memory over the long term. Furthermore, higher openness is related to lower inflammation [24], which may also contribute to better memory.

In contrast to our hypothesis, conscientiousness was not related to memory across the three samples. This finding suggests that the memory benefits of this trait observed in cross-sectional and short-term longitudinal research [4,7] may dissipate over time. The lack of significant association between conscientiousness and memory over 20 years stands in contrast with studies that find an association between higher conscientiousness and lower AD risk over two decades [10,11]. Taken together, past studies combined with the present results suggest that conscientiousness may be more strongly related to complex cognitive dimensions implicating a myriad of cognitive processes over the long term, than to single measures assessing one type of ability.

Unexpectedly, the meta-analysis revealed also that higher extraversion was related to better memory at follow-up. This finding contrasts with existing research that found longitudinal associations between higher extraversion and lower memory performance [7]. However, it is close to a recent report of a positive cross-sectional link between extraversion and delayed recall [4]. Extraversion is related to memory-enhancing pathways, such as frequent social interactions [25], reduced reactivity to stressors [16], better sleep quality [19], and a physically active lifestyle [21], which may accumulate to benefit long-term memory performance. Consistent with existing research, agreeableness was unrelated to memory performance.

The present study has several strengths including the identification of the prospective association between personality and memory across three large samples of middle-aged and older adults, over a follow-up of almost 20 years, and a meta-analysis. However, there are also limitations to consider. The observational design of the present study

limits the ability to conclude causal relations between personality and memory. With such a design, it is only possible to test for a correlation between personality and memory. Therefore, although personality was tested as a predictor of memory, reciprocal associations may also exist. In this study, baseline assessments of memory function were lacking, and it was not possible to examine the association between personality and change in memory over time. Furthermore, the generalizability of our findings is limited by the positive selection of the three samples. The results were also specific to episodic memory. Future research must test whether the associations observed extend to other types of memory. The size of the association between personality and memory was relatively small. However, this size must be considered with regard to the 20-year follow-up period of the present study. In addition, memory is multi-determined and reflects a wide range of factors, each of which may only have a relatively small effect size. In addition, personality is a distal predictor that acts through behavioral, affective and biological factors that are proximal to memory function. Further research is needed to examine the mediating role of these factors in the link between personality and episodic memory. The present study only controlled for age, sex, education and race, but the results were potentially influenced by other confounding factors such as baseline memory or dementia status, which were not available in the three samples. Future research should account for possible confounding and mediating factors. Finally, future research should include a facet-level analysis of the association between personality and long-term memory.

Despite these limitations, the present study provides new evidence of the long-term association between personality and memory across adulthood. From a practical perspective, this finding suggests that personality assessments may prove useful to identify individuals at risk of long-term memory difficulties and who may benefit from interventional efforts.

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Table 1.
Characteristics of the Samples at Baseline and Memory Performance at Follow-Up.

Variables	WLSG		WLSS		MIDUS	
	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>	<i>M/%</i>	<i>SD</i>
Age (Years)	53.18	0.60	52.44	6.90	45.78	11.11
Sex (% women)	54%	-	54%	-	55%	-
Race (% White)	100%	-	100%	-	95%	-
Education	13.87	2.40	14.03	2.51	7.45	2.45
Neuroticism	3.15	0.97	3.21	0.94	2.19	0.66
Extraversion	3.86	0.89	3.78	0.90	3.21	0.55
Openness	3.67	0.80	3.64	0.75	3.04	0.50
Agreeableness	4.76	0.73	4.71	0.72	3.48	0.49
Conscientiousness	4.87	0.67	4.77	0.71	3.46	0.43
Memory Performance	9.00	2.90	9.07	3.07	11.21	4.73

Note. WLSG: N= 3,726; WLSS: N= 1,720; MIDUS: N= 2,411

See method section for differences in the assessment of memory, personality, and education in each sample.

Table 2

Regression Analysis Predicting Follow-up Memory Performance from Baseline Personality

	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
WLSG ^a	-.04*	.01	.04*	-.01	-.01
WLSS ^a	-.05*	.04	.07**	.02	.02
MIDUS ^b	-.07***	.03	.03	-.03	.03
Meta-analysis Random Effect	-.05 (-.082;-.028)***	.02 (.001;.046)*	.05 (.024;.068)***	-.01 (-.035;.014)	-.01 (-.035;.022)
Heterogeneity I ²	31%	0%	0%	17%	37%

Note. WLSG: N= 3,726; WLSS: N= 1,720, MIDUS: N= 2,411

Coefficients are standardized coefficients

^a Adjusted for age, sex, and education.

^b Adjusted for age, sex, education, and race.

* $p < .05$, ** $p < .01$, *** $p < .001$