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Protective Personality Traits: High Openness and Low Neuroticism Linked to Better Memory in Multiple Sclerosis

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Abstract

Memory impairment in multiple sclerosis (MS) is common, although few risk/protective factors are known. Relationships of personality to memory/non-memory cognition were examined in 80 patients who completed a cognitive battery and a personality scale measuring the “Big 5” traits: openness, neuroticism, agreeableness, extraversion, conscientiousness. Memory was most related to openness, with higher openness linked to better memory and lower risk for memory impairment, controlling for age, atrophy, education, and IQ. Lower neuroticism was also related to better memory, and lower conscientiousness to memory impairment. Non-memory cognition was unrelated to personality. Personality may inform predictive models of memory impairment in MS.

Keywords

multiple sclerosis; personality; cognition; memory; neuropsychological assessment; psychological factors

Many persons with multiple sclerosis (MS) experience memory decline, although few risk/protective factors have been identified. The protective impact of personality on memory in MS is not fully understood. The distillation of personality into five measurable traits allows objective investigation into the relationship of personality to cognitive function. The Five-Factor Theory supports five core traits (i.e., the “Big 5”) underlying personality differences: neuroticism, extraversion, openness, agreeableness, and conscientiousness.[1] In healthy adults, higher openness is linked to better memory[2, 3] and protection from memory decline;[3] higher neuroticism is linked to worse memory.[3] The association of the Big 5 personality traits to memory has never been examined in persons with MS, for whom memory impairment is variable and difficult to predict across patients. Our first goal, therefore, is to investigate whether consideration of personality traits helps to explain differential memory

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function/memory impairment in MS patients. The personality trait of openness encompasses intellectual curiosity, aesthetic sensitivity, and imagination, and is positively correlated with measured intelligence (IQ) and education. Previous research on personality and memory has not controlled for IQ and education, so it is possible that the link between openness and memory is at least partially explained by higher IQ and education. Our second goal is therefore to determine whether personality traits independently contribute to memory function in persons with MS over-and-above IQ and education. Clinical consideration of personality traits may help explain/predict differential memory impairment in persons with MS, thereby representing a measurable risk factor and treatment target for MS patients.

METHODS

Approval was received from the local ethical standards committee on human research. Participants provided written informed consent.

Participants

80 MS patients (60 females, age 49.1±10.3 years, education 15.6±2.2 years, disease duration 14.2±7.9 years, phenotype: 64 relapsing-remitting, 12 secondary progressive, 4 primary progressive) completed the NEO Five-Factor Inventory (NEO-FFI),[1] a 60-item scale yielding five scores: openness, neuroticism, agreeableness, extraversion, conscientiousness. Premorbid intelligence was estimated with the Wechsler Test of Adult Reading (WTAR 109.9±11.7).

Cognitive Function

For all memory measures, T-scores were derived using normative values from published test manuals.[4, 5] Memory was measured as the mean norm-referenced (age-adjusted) T-score across the Hopkins Verbal Learning Test, Revised (Total Learning, Delayed Recall) and Brief Visuospatial Memory Test, Revised (Total Learning, Delayed Recall). Mean T-score was 46.2±11.5 (34th percentile). 33.7% (N=27) of MS sample was impaired (T≤35) in either verbal or visual memory. Non-memory cognitive function was assessed with the following measures: Symbol Digit Modalities Test (SDMT, oral), Stroop (Color-Word Interference), Digit Span (backward span), Paced Auditory Serial Addition Test (PASAT, 3 second version), Controlled Oral Word Association Test (FAS), and Nine Hole Peg Test (9HPT).

Brain Atrophy

Participants underwent high-resolution 3D T1-weighted (isotropic voxel size: 1mm^3) MRIs of the brain performed in a 3.0T GE scanner. Atrophy was measured as normalized total brain volume (NBV) derived from SIENAX (see [11]).

Statistical analyses

Partial correlations were computed between the five personality factors and memory/non-memory function, controlling for age and NBV. Next, education and IQ were added as covariates. Finally, linear regression was performed to determine the independent contribution of personality traits to memory, with age, NBV, education, and IQ entered in block one, and the five personality traits entered in a stepwise fashion in block two (p=.05,

entry; p=.10 removal). Differences in personality traits across patients with and without memory impairment were also investigated, and logistic regression was performed to identify which personality traits independently predict memory impairment.

RESULTS

Controlling for age and NBV, better memory was associated with high openness, high extraversion, and low neuroticism. These traits remained associated with memory after controlling for education and IQ, and no relationships between personality and non-memory cognitive function remained (Table 1).

The five personality factors were entered into a stepwise regression predicting memory function. The full model was significant, $F(6, 79)=7.672$, $p<.001$. After controlling for age, NBV, education, and IQ ($R^2=.216$, $p<.001$), higher openness ($r_p=.383$, p=.001, Figure 1A) and lower neuroticism ($r_p= -.288$, p=.012, Figure 1B) were the only personality factors retained, accounting for an additional 17.1% of the variance in memory (p<.001).

Differences in personality traits were compared between patients with (n=27) and without (n=53) memory impairment (*subgroup characteristics provided in* Table 2). Controlling for age, NBV, education, and IQ, MANCOVA revealed lower openness in patients with memory impairment (T=47.41 [95%CI: 43.53–51.28]) relative to patients without impairment (T=55.76 [95%CI: 53.09–58.42]; F[1, 74]=11.31, p=.001. Patients with memory impairment also had higher neuroticism (T=54.57 [95%CI: 49.82–59.32] versus 47.28 [95%CI: 44.01 – 50.54]; F[1, 74]=5.75, p=.019) and lower conscientiousness (42.11 [95%CI: 37.58–46.64] versus 50.23 [95%CI: 47.12–53.33]; F[1, 74]=7.83, p=.007). Logistic regression was performed to identify which personality traits independently predict memory impairment. Controlling for aforementioned covariates, memory impairment was best predicted by lower openness (Wald[1]=7.52, p=.006) and lower conscientiousness (Wald[1]=6.04, p=.014).

DISCUSSION

Higher openness and lower neuroticism independently predicted better memory in persons with MS, over-and-above education and IQ. Findings were specific to memory, with no links between personality and non-memory cognition. Openness was also linked to lower risk for memory impairment, and MS patients with memory impairment had lower openness and higher neuroticism as well as lower conscientiousness, relative to patients without impairment. This is the first investigation of the relationship of personality to cognitive function in MS that examined the association of all “Big 5” personality traits to performance across cognitive domains. Prior work in MS examining the relationship of personality to cognition excluded memory,[6, 7] excluded openness,[6, 8] did not control for IQ[6–8], and/or considered only informant-reported personality;[8] these important methodological differences may help to explain differences in results.

In healthy adults, prior studies reveal links between higher openness[2] and higher openness/conscientiousness[3] to better memory, and higher neuroticism to worse memory, [3] although previous studies did not control for IQ. We examined the association of personality to memory in a sample *(unpublished data)* collected from 96 age-, IQ-, and education-matched

healthy controls (HC; 47 females, age 50.5±6.2 years, education 15.8±2.2 years, WTAR 108.8±8.6). Memory was measured as the mean (age-adjusted) z-score on the Selective Reminding Test (SRT; Long Term Storage, Delayed Recall, mean z-score 0.2±.76). Personality was measured with the International Personality Item Pool (IPIP), a highly validated 50-item scale measuring the Big 5 factors.[9] Controlling for age, IQ and education, a trend-level relationship of openness to memory was found (r_p=.187, p=.073); no other personality factors were related to memory. The link between openness and memory in our MS sample is stronger than that seen in healthy persons (here and across previous studies), and higher openness was associated with lower risk for memory impairment. These findings suggest that higher openness modulates risk for memory decline in the context of MS disease over-and-above any premorbid relationship, although differential risk for decline would be more appropriately evaluated by future work employing prospective designs.

Trait adjective analysis describes openness as imaginative, intellectually curious, creative, and liberal.[2] These traits are also characteristic of higher IQ, and openness was indeed correlated with IQ in our MS sample (r=.397, p< 001). It is possible, therefore, that links of openness to memory in previous research were mediated through IQ. Our study is the first in any population to isolate the independent contribution of personality (and specifically openness) to memory after controlling for IQ/education.

High openness may predispose individuals to participate in stimulating activities that benefit/protect cognition,[3] perhaps representing a personality substrate supporting cognitive reserve. Indeed, among healthy adults, openness is linked to greater participation in cognitive, physical, and social activities.[10] In a post-hoc analysis of 64 MS patients, we found a relationship between higher openness and adulthood participation in a variety of enriching cognitive leisure activities (controlling for education and IQ, r_p=.333, p=.008), including fine arts, hobby activities, playing musical instruments, and reading/writing (described elsewhere,[12]). In contrast to openness, high neuroticism may be linked with a more cautious approach to the world, and resistance to explore novel enriching opportunities. (Indeed, lack of exploratory behavior is a behavioral marker of anxiety in rodents,[13] and neuroticism was marginally related to less engagement in enriching activities in our sample, r_p= −.208, p=.104).

Limitations of the present study include restriction of memory measurement to two tests; future work should incorporate more comprehensive evaluation of memory. In addition, our sample was predominantly RRMS patients. In progressive patients (N=16), the relationship of openness to memory was significant (r=.879, p<.001), while still maintained in the RRMS group (N=64) at a trend level (r=.228, p=.080). Finally, the complex interplay of personality, cognition, and mood requires further exploration, although we re-ran our analysis controlling for depression (Beck Depression Inventory, BDI-II) and results were largely unchanged *[(i.e., associations of personality factors were only found for memory: Openness (r_p = .472, p<.001); trend-level assocations were shown for Neuroticism (r_p= −.238, p=.077) and Extraversion (r_p= .243, p=.072*)], supporting a link between memory and neuroticism not explained by depression. Our findings support inclusion of personality in predictive models of memory impairment in MS, and encourage research on behavioral interventions targeting personality factors in MS patients.

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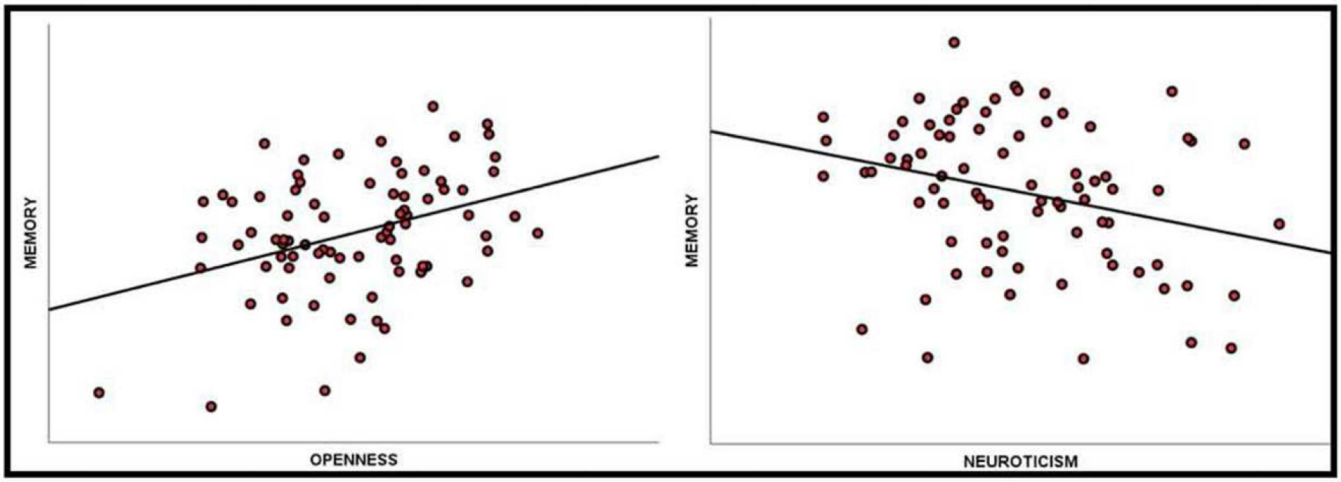

Figure 1.

Higher openness (R^2=.133) and lower neuroticism (R^2=.083) independently predicted memory over and above IQ and education.

TABLE 1

Partial correlations of age-adjusted scores for each neuropsychological measure and the 5-factors of personality controlling for a) age and normalized brain volume, and b) IQ and education.

		Memory	SDMT	Stroop	Digit Span	PASAT	FAS	9HPT
Neuroticism	**a.**	r_p = −.260 p = .045	r_p = −.138 p = .294	r_p = −.143 p = .276	r_p = −.078 p = .552	r_p = −.139 p = .289	r_p = .016 p = .903	r_p = .180 p = .168
	b.	r_p= −.273 p = .038	r_p= −.139 p = .298	r_p= −.144 p = .282	r_p= −.068 p = .612	r_p= −.136 p = .307	r_p= .034 p = .802	r_p= .177 p = .183
Extraversion	**a.**	r_p = .286 p = .027	r_p = .203 p = .120	r_p = −.021 p = .875	r_p = .141 p = .282	r_p = .146 p = .267	r_p = −.028 p = .830	r_p = −.134 p = .306
	b.	r_p= .284 p = .031	r_p= .190 p = .153	r_p= −.050 p = .707	r_p= .139 p = .297	r_p= .148 p = .266	r_p= −.059 p = .661	r_p= −.166 p = .213
Openness	**a.**	r_p = .503 p < .001	r_p = .204 p = .118	r_p = .165 p = .207	r_p = .279 p = .031	r_p = .311 p = .016	r_p = .311 p = .016	r_p = −.200 p = .125
	b.	r_p= .442 p < .001	r_p= .107 p = .423	r_p= −.034 p = .802	r_p= .108 p = .422	r_p= .140 p = .295	r_p= .181 p = .173	r_p= −.149 p = .264
Agreeableness	**a.**	r_p = .035 p = .789	r_p = .137 p = .295	r_p = −.082 p = .535	r_p = .163 p = .214	r_p = .214 p = .101	r_p = .171 p = .192	r_p = −.083 p = .530
	b.	r_p= −.033 p = .803	r_p= .085 p = .526	r_p= −.178 p = .182	r_p= .111 p = .408	r_p= .174 p = .192	r_p= .117 p = .383	r_p= −.104 p =.437
Conscientiousness	**a.**	r_p = .029 p = .828	r_p = .033 p = .805	r_p = −.144 p = .272	r_p = −.072 p = .586	r_p = −.059 p = .652	r_p = .024 p = .854	r_p = .063 p = .631
	b.	r_p= .044 p = .743	r_p= .040 p = .767	r_p= −.127 p = .341	r_p= −.036 p = .787	r_p= −.015 p = .911	r_p= .054 p = .687	r_p= .010 p = .938

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Table 2

Statistical comparison of patients with (n=27) and without (n=53) memory-impairment.

	Memory-impaired	Non memory impaired	difference
Age (years)	48.6 ± 10.4	49.4 ± 10.3	ns
Education (years)	15.0 ± 2.5	15.9 ± 2.1	ns
IQ	105.0 ± 13.6	112.4 ± 9.9	t(78)= −2.76, p= .007
NBV	1423.03 ± 98.1	1436.26 ± 80.0	ns
Sex (F/M)	18/9	42/11	ns[t]

NBV=normalized brain volume; IQ estimated with WTAR;

[t] nonparametric test