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Personality factors and cognitive functioning in patients with somatic symptom and related disorders

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ABSTRACT

Objective: Somatic symptom and related disorders (SSRD) are often complicated by cognitive symptoms, including reduced information processing speed, memory, and planning. Depression has been related to poor cognitive functioning in SSRD, but the role of underlying personality factors is poorly understood. This study investigates the association between personality factors (neuroticism, extraversion, openness, agreeableness, and conscientiousness) with cognitive functioning in patients with SSRD.

Methods: Data from 366 patients with SSRD from a tertiary care expert center (mean age = 42.1 years (*SD* = 13.4), 59.6% women) were analyzed using a cross-sectional design. Neuropsychological assessments included measures of information processing speed, memory, attention, and executive function. Personality factors were assessed using the NEO-FFI and depressive symptoms using the PHQ-9.

Results: Regression analyses showed associations between neuroticism with poorer performance on visual memory ($B = -0.09$, SE = 0.04, $\beta = -0.14$, $p = .019$), and planning ($B = -0.09$. $SE = 0.02$, $\beta = -0.23$, $p < .001$). Extraversion was also inversely associated with visual memory ($B = -0.13$, $SE = 0.05$, $\beta = -0.18$, $p = .011$) and planning ($B = -0.07$, $SE = 0.03$, $\beta = -0.17$, $p = .021$) and openness was associated with better visual memory ($B = 0.17$, $SE = 0.05$, $\beta = 0.19$, $p = .002$). These associations were attenuated but remained significant after adjusting for depressive symptoms.

Conclusion: Neuroticism, extraversion, and low openness were associated with lower cognitive functioning (particularly planning and visual memory) in patients with SSRD, which remained significant after taking depressive symptoms into account.

1. Introduction

Somatic symptom and related disorders (SSRD) are a cluster of disorders diagnosed when someone experiences somatic complaints that are associated with high symptom burden, limitations in daily functioning and impaired quality of life [3]. The Diagnostic and Statistical Manual of Mental Disorders 5 (DSM 5) [3] has dropped the criterion of having no medical explanation for the somatic symptoms. The diagnosis in the SSRD cluster therefore includes symptoms without medical explanation and conditions where (some) pathology is known paired with disproportionate thoughts, feelings, and behaviors [3]. As a consequence of the recent introduction of SSRD in the DSM-5, relatively little is known about SSRD compared to our knowledge of former categories in this domain [2]. In this study, we investigated the associations of personality factors with cognitive functioning, and the role of depressive symptoms in SSRD.

Previous studies found that patients with SSRD show cognitive dysfunctioning and deficits across a broad range of cognitive domains [12,13] which warrants further research regarding etiology and interventions. Cognitive functioning is relevant with regard to the treatment of SSRD because of the potential for detrimental effects on therapy outcome and therapy dropout [13]. Maladaptive personality characteristics are considered common in this patient group [3]. The role of specific personality factors in the etiology of SSRD – and similar diagnostic categories related to somatization prior to DSM-5 - has been discussed previously (e.g., [6]) but not yet studied in relation to

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Table 1
Descriptive statistics of a sample ($N = 366$) of patients with somatic symptom and related disorders and distribution of personality domains and cognitive domains.

Variables	Mean / n (%)	SD
Age (years)	42.4	13.6
Sex		
Female	218 (59.6)	
Education level		
Low (Verhage 1–4)	88 (24.0)	
Middle (Verhage 5)	150 (41.0)	
High (Verhage 6–7)	119 (32.5)	
Missing	9 (2.5)	
Work status		
Full-time / Part-time	76 (20.7)	
Unemployed / Retired	68 (18.6)	
Cannot work due to physical complaints	124 (33.9)	
Studying	8 (2.2)	
Different / Unknown	90 (24.6)	
Marital status		
Married / Registered partnership	141 (38.5)	
Partner / Living together	87 (23.8)	
Single	92 (25.1)	
Divorced / Widower	12(3.2)	
Living with parents	11 (3.0)	
Missing	23 (6.6)	
Depression		
Mean score PHQ-9	13.92	5.96
No depression	95 (25.0)	
Positive for depression	265 (72.4)	
Missing	6 (1.6)	
Personality domain scores (NEO-FFI)		
Neuroticism	41.5	9.9
Extraversion	33.3	8.9
Openness	34.9	7.2
Agreeableness	42.9	7.2
Conscientiousness	41.8	8.2
Cognitive domain (raw NPA scores)		
Information processing speed (Coding subtest of WAIS-IV; $n = 324$)	64.5	17.4
Memory		
Working memory (Digit span of WAIS-IV; $n = 314$)	24.8	6.7
Verbal memory (RAVLT; $n = 337$)	8.9	3.8
Visual memory (ROCFT; $n = 326$)	18.5	6.6
Attention		
Sustained attention (d2; $n = 323$)	147.0	45.4
Divided attention (TMT—B; $n = 331$)	80.4	47.1
Executive functioning		
Mental flexibility (Rule shift of BADS; $n = 328$)	18.9	3.3
Planning (Zoo Map test of BADS $n = 327$)	11.7	3.9

Abbreviations: PHQ; Patient Health Questionnaire, NEO-FFI; Neuroticism-Extraversion-Openness Five-Factor Inventory, SD; Standard Deviation, NPA; neuropsychological assessment, WAIS-IV; Wechsler Adult Intelligence Scale, RAVLT; Rey Auditory Verbal Learning Test; ROCFT; Rey Osterreith Complex Figure Test, TMT—B; part B of the Trail Making Test, BADS; Behavioral Assessment of the Dysexecutive Syndrome.
Note: higher scores indicate poorer cognitive functioning; d2, TMT—B, lower scores indicate poorer cognitive functioning; Coding subtest and Digit span of WAIS-IV, RAVLT, ROCFT, Rule shift and Zoo Map test of BADS.

cognitive functioning in patients with SSRD. Personality is conceptualized by the influential Big Five personality model with five personality dimensions: neuroticism, extraversion, openness, agreeableness, and conscientiousness [10]. Evidence suggests that these personality factors are associated with elevated levels of persistent or recurrent somatic symptoms. For example, levels of neuroticism and conscientiousness have been associated with general upper and lower gastrointestinal symptoms, and lower levels of agreeableness with upper gastrointestinal and respiratory symptoms [28]. High neuroticism predicted psychological distress in medically unexplained symptoms, which may contribute to higher levels of somatic symptoms [27].

Furthermore, low cognitive functioning and Big Five personality domains are both related to SSRD, but the inter-relation of these factors

Table 2
Correlations between personality scores and cognitive scores in a sample of patients with somatic symptom and related disorders.

Cognitive domains	n	NE	EX	OP	AG	CO
Information processing speed (Coding subtest of WAIS-IV)	324	0.08	0.03	**0.19**	0.08	0.02
Memory						
Working memory (Digit span of WAIS-IV)	314	0.05	−0.04	**0.19**	0.03	−0.09
Verbal memory (RAVLT)	337	−0.01	**0.15**	**0.26**	**0.21**	0.09
Visual memory (ROCFT)	326	−0.04	0.00	**0.20**	0.04	0.02
Attention						
Sustained attention (d2)	323	0.00	**0.12**	**0.22**	0.08	−0.06
Divided attention (TMT-B)	331	0.07	−0.05	**-0.21**	−0.05	0.07
Executive functioning						
Mental flexibility (Rule shift of BADS)	328	0.01	−0.01	0.06	−0.04	−0.05
Planning (Zoo Map test of BADS)	327	**−0.12**	0.00	**0.13**	0.03	−0.08

Abbreviations: WAIS-IV; Wechsler Adult Intelligence Scale, RAVLT; Rey Auditory Verbal Learning Test; ROCFT; Rey Osterreith Complex Figure Test, TMT—B; part B of the Trail Making Test, BADS; Behavioral Assessment of the Dysexecutive Syndrome, NE; neuroticism, EX; extraversion, OP; openness, AG; agreeableness, CO; conscientiousness.
Results printed in bold represent significant findings at $p < .05$.

is unknown. Results of studies investigating the relationship between the Big Five personality traits and cognitive functioning in healthy samples report the following results. Neuroticism tends to be negatively related to cognitive performance measures [41], such as decision making [50]. Neuroticism has been negatively [29,50] associated with executive function. Extraversion has been positively associated with information speed processing [7], working memory [50], and retrieving of words, a measurement of verbal memory [14]. Focused attention was better in high sensation seekers, related to high extraversion [4] Openness to experience has been positively associated with information speed processing and memory [41]. Like neuroticism, openness to experience has both been positively [29] and negatively [50] associated with executive function. Agreeableness has been negatively associated with executive function [41]. In older patients, memory function has been positively associated with higher conscientiousness and openness, attention, and executive function with higher conscientiousness and lower neuroticism, language function with higher openness, and visual-spatial function was found to be negatively associated with higher neuroticism [9]. A meta-analysis study showed that participants with lower scores in neuroticism, and higher sores in conscientiousness, openness, and extraversion performed better within the domain of verbal fluency [43]. Sutin, Stephan, Luchetti, and Terracciano [44] reported that, in general, high scores on neuroticism were related to poorer cognitive performance and openness with better verbal abilities but extraversion was related with poorer performance in verbal and numeric reasoning. The overall pattern of results suggests that neuroticism, and agreeableness are associated with poorer cognitive functioning, whereas extraversion, openness, and conscientiousness are associated with better cognitive functioning among healthy individuals, although findings are not consistent across studies.

In addition to research in healthy individuals, several studies have investigated the relationship between personality factors and cognitive functioning in a wide range of patient groups. A complete review of this topic is beyond the scope of this introduction, therefore, a summary is provided of selected studies in this area. For instance, patients with multiple sclerosis and lower conscientiousness scores had more cognitive impairments [37]. Furthermore, a study among women with fibromyalgia showed that differences were observed between women without fibromyalgia with regards to personality and memory [5]. Memory dysfunction in this group was related to high agreeableness and high conscientiousness, and these memory problems were further

Table 3
Regression analyses for cognitive functioning in a sample of patients with somatic symptom and related disorders, with predictive values of age, sex, and education, personality domains and depressive symptoms.

Predictors	Information processing speed (Coding subtest of WAIS-IV) $n = 312$			Working memory (Digit span of WAIS-IV) $n = 304$			Verbal memory (RAVLT) n = 323		
	B	SE B	95% CI	B	SE B	95% CI	B	SE B	95% CI
Model 1									
Age	**-0.50**	**0.06**	**-0.63-0.38**	**-0.09**	**0.03**	**-0.15-0.04**	**-0.05**	**0.02**	**-0.08-0.02**
Sex	2.72	1.67	−0.56–6.00	0.37	0.74	−1.09–1.84	**1.66**	**0.41**	**0.85–2.47**
Education	**4.55**	**0.80**	**2.99–6.12**	**1.30**	**0.36**	**0.60–2.01**	0.23	0.20	−0.16–0.61
R^2 change	**0.30**			**0.10**			**0.08**		
F Change	**44.16**			**10.91**			**9.87**		
Model 2									
Age	**-0.53**	**0.07**	**-0.66-0.40**	**-0.09**	**0.03**	**-0.15-0.03**	**-0.05**	**0.02**	**-0.08–0.02**
Sex	2.54	1.74	−0.88–5.96	0.30	0.78	−1.23–1.84	**1.62**	**0.43**	**0.78–2.46**
Education	**4.20**	**0.85**	**2.54–5.87**	**1.13**	**0.38**	**0.38–1.88**	0.08	0.21	−0.32–0.49
Neuroticism	−0.01	0.09	−0.18–0.17	<0.01	0.04	−0.07–0.08	−0.01	0.02	−0.06–0.03
Extraversion	−0.13	0.13	−0.37–0.13	−0.02	0.06	−0.13–0.10	0.04	0.03	−0.02–0.10
Openness	0.17	0.13	−0.08–0.43	0.07	0.06	−0.05–0.18	0.06	0.03	<0.01–0.13
Agreeableness	<0.01	0.14	−0.28–0.28	0.04	0.06	−0.09–0.16	0.01	0.03	−0.05–0.08
Conscientiousness	0.20	0.12	−0.04–0.43	−0.04	0.05	−0.15–0.07	<0.01	0.03	−0.06–0.06
R^2 change	0.01			0.04			**0.04**		
F Change	0.92			0.51			**2.59**		
Model 3									
Depression	**-0.63**	**0.16**	**-0.94-0.32**	**-0.20**	**0.07**	**-0.34-0.06**	−0.07	0.04	−0.14–0.01
R^2 change	**0.03**			**0.02**			0.01		
F Change	**15.74**			**8.01**			2.78		

Predictors	Visual memory (ROCFT) $n = 313$			Divided attention (TMT—B) $n = 317$			Sustained attention (d2) $n = 309$		
	B	SE B	95% CI	B	SE B	95% CI	B	SE B	95% CI
Model 1									
Age	**-0.15**	**0.03**	**-0.20-0.09**	**-1.40**	**0.17**	**-1.71–1.07**	**1.00**	**0.18**	**0.65–1.35**
Sex	−0.52	0.70	−1.90–0.86	7.25	4.42	−1.45–15.95	−7.97	4.65	−17.13–1.18
Education	**0.83**	**0.34**	**0.17–1.50**	**10.45**	**2.11**	**6.31–14.60**	**-10.23**	**2.23**	**-14.63–-5.84**
R^2 change	**0.13**			**0.29**			**0.19**		
F Change	**15.44**			**42.01**			**25.29**		
Model 2									
Age	**-0.16**	**0.03**	**-0.22-0.11**	**1.05**	**0.19**	**0.69–1.42**	**-1.38**	**0.18**	**-1.72-1.03**
Sex	−0.50	0.72	−1.91–0.91	−8.60	4.85	−18.14–0.94	7.44	4.56	−1.53–16.41
Education	0.43	0.35	−0.26–1.12	**-9.10**	**2.38**	**-13.78-4.42**	**10.10**	**2.23**	**5.71–14.48**
Neuroticism	**-0.09**	**0.04**	**-0.16-0.02**	−0.20	0.23	−0.66–0.26	0.22	0.25	−0.27–0.71
Extraversion	**-0.13**	**0.05**	**-0.24–0.03**	0.65	0.33	<0.01–1.30	0.54	0.35	−0.16–1.23
Openness	**0.17**	**0.05**	**0.07–0.28**	0.12	0.34	−0.55–0.79	−0.58	0.36	−1.29–0.14
Agreeableness	−0.02	0.06	−0.13–0.10	0.09	0.36	−0.63–0.80	0.26	0.39	−0.51–1.04
Conscientiousness	0.09	0.05	−0.01–0.19	−0.41	0.31	−1.03–0.21	−0.53	0.24	−1.19–0.13
R^2 change	**0.05**								
F Change	**3.37**			0.02			0.01		
Model 3				1.76			1.05		
Depression	−0.03	0.07	−0.16–0.10	**-1.05**	**0.42**	**-1.87–0.22**	**1.04**	**0.45**	**0.15–1.93**
R^2 change	0.01			**0.01**			**0.01**		
F Change	0.23			**6.26**			**5.25**		

Predictors	Mental flexibilty (Rule shift of the BADS) $n = 315$			Planning (Zoo Map test of the BADS) n = 314		
	B	SE B	95% CI	B	SE B	95% CI
Model 1						
Age	**-0.04**	**0.01**	**-0.06-0.01**	**-0.09**	**0.02**	**-0.12-0.06**
Sex	−0.16	0.37	−0.89–0.58	−0.44	0.42	−1.28–0.40
Education	**0.39**	**0.18**	**0.03–0.74**	0.24	0.20	−0.16–0.64
R^2 change	**0.05**			**0.11**		
F Change	**4.99**			**12.36**		
Model 2						
Age	**-0.04**	**0.02**	**-0.06-0.01**	**-0.10**	**0.02**	**-0.14–0.07**
Sex	−0.24	0.39	−1.00–0.53	−0.57	0.43	−1.42–0.29
Education	0.38	0.19	−0.01–0.75	0.07	0.21	−0.35–0.48
Neuroticism	<0.01	0.02	−0.04–0.04	**-0.09**	**0.02**	**-0.13-0.04**
Extraversion	<0.01	0.03	−0.05–0.06	**-0.07**	**0.03**	**-0.14-0.01**
Openness	-0.01	0.03	−0.07–0.05	0.05	0.03	−0.02–0.11
Agreeableness	0.04	0.03	−0.02–0.10	0.05	0.04	−0.02–0.11

(*continued on next page*)

Table 3 (*continued*)

Predictors	Mental flexibilty (Rule shift of the BADS) $n = 315$			Planning (Zoo Map test of the BADS) n = 314		
	B	SE B	95% CI	B	SE B	95% CI
Conscentiousness	−0.04	0.03	−0.10–0.01	<0.01	0.03	−0.06–0.06
R^2 change	0.01			**0.05**		
F Change	0.69			**3.68**		
Model 3						
Depression	0.03	0.04	−0.05–0.10	0.01	0.04	−0.07–0.09
R^2 change	0.01			0.16		
F Change	0.47			0.03		

Abbreviations: WAIS-IV; Wechsler Adult Intelligence Scale, RAVLT; Rey Auditory Verbal Learning Test. ROCFT; Rey Osterreith Complex Figure Test, TMT—B; part B of the Trail Making Test. BADS; Behavioral Assessment of the Dysexecutive Syndrome.
Note: Model 1 included Age, sex, education; Model 2 included Model 1 + Personality Factors; Model 3 included Model 2 + Depressive symptoms (full models 1 and 2 are displayed in Table 4, full model 3 is displayed in Table S1).
Results printed in bold represent significant findings at $p < .05$.

worsened if anxiety or depressive symptoms were present. These studies indicate that in patients with a wide range of medical disorders, the associations between personality factors with cognitive function are similar to those observed in healthy individuals. Extraversion, openness, and conscientiousness were mostly positively associated with (better) cognitive functioning, whereas neuroticism and agreeableness tend to be negatively associated with cognitive functioning. However, there are contradicting findings in this area and the statistical power of the studies was sometimes limited and to what extent these personality factors are associated with cognitive functioning in patients with SSRD is yet unclear.

Comorbid depression is common in patients with SSRD, with prevalence estimates up to 75% (e.g., [13]). Personality factors, particularly high levels of neuroticism, have been associated with elevated levels of psychological distress and depression [36]. Depression has also been associated with impaired cognitive functioning, more specifically with impaired working memory [17], executive functioning [35], and attention [17,19,35]. As depression has been associated with structural alterations in regional brain volumes and with functional changes in brain circuits (e.g., [15,32,39], this in turn may lead to worse cognitive functioning. Research regarding SSRD, depression, and cognitive functioning is limited, but one study suggested that cognitive functioning is affected in patients with SSRD and depression worsens cognitive functioning even further [13]. However, the role of depression in the association between personality factors with cognitive functioning in patients with SSRD has not been examined yet.

Based on this background, this study investigates the association between the Big Five personality factors and cognitive functioning in patients with SSRD and examines the role of depression in these associations. We hypothesized that high neuroticism and agreeableness would be associated with lower cognitive functioning, including slower information processing speed and poorer attention, memory, and executive functioning, whereas high conscientiousness, openness, and extraversion, were expected to be related to better cognitive functioning. In addition, we tested whether the association between personality factors and cognitive functioning in patients with SSRD would remain significant after adjusting for depressive symptoms.

2. Method

2.1. Setting/participants

A cross-sectional design was used to investigate the association between personality factors with cognitive functioning evaluated by neuropsychological assessments. Participants were adult outpatients ($N = 366$) who were referred to the Clinical Centre of Excellence for Body, Mind, and Health, department of the mental health institution GGz Breburg, Tilburg, The Netherlands. Neuropsychological data were taken from all available routine neuropsychological assessments from 2014 to 2018. Part of this sample was also included in prior studies into cognitive functioning in SSRD ($N = 201$, [13]; $N = 318$, [12]). As a consequence of changes in informed consent regulations, two types of informed consent were used; one part of the study sample ($n = 420$) could object to the use of data from their patient records for scientific studies and one part ($n = 18$) was actively asked for permission to use their data for scientific purposes. The data of patients that were suspected of malingering, as assessed with the Test of Memory Malingering [46] were excluded from the present analyses.

Data from 366 of a total of 438 patients were used for the present analyses. Of the 438 patients, 27 (6.2%) were suspected of malingering. Of the remaining 411 patients, 366 completed the NEO-FFI.

2.2. Measures

Neuropsychological assessment. The neuropsychological assessments were administered by (neuro)psychologists (bachelor and master degree level) with extensive training, supervised by a clinical psychologist. Information processing speed was assessed with the Coding subtest of the Dutch version of the Wechsler Adult Intelligence Scale-IV (WAIS-IV) [49] using the raw scores (total number of processed digit/symbols; meaning higher scores equal faster information processing speed). Working memory was assessed with the Digit Span task of the WAIS-IV [49] using the total raw score (meaning higher scores equal better performance). Verbal memory was assessed with the Dutch version of the Rey Auditory Verbal Learning Test (RAVLT) [38] using the delayed recall (total number of remembered words; meaning the higher the score the better the performance with regards to memory). Visual memory was assessed with the Rey-Osterreith Complex Figure Test (ROCFT) [31]. Sustained attention was assessed with the d2 [8] using the calculated concentration achievement score (as described by [8]; meaning the higher the score the better the performance). Divided attention was assessed with Part B of the Trail Making Test (TMT—B) [34] using the time taken to completion (meaning the lower the score the better the performance). The TMT has also been used as an index of visual attention, task switching ability and executive function, but will be primarily used here as a measure of divided attention. Mental flexibility was assessed with the Rule Shift Cards subtest of the Behavioral Assessment of the Dysexecutive Syndrome (BADS) using the raw score (correct total of items minus the number of errors; meaning the higher the score the better the performance). Planning was assessed with the Zoo Map subtest of the BADS [51] using the raw score (meaning the higher the score the better the performance).

Personality factors. To measure personality factors, the Neuroticism-Extraversion-Openness Five-Factor Inventory (NEO-FFI) was used [10]. The NEO-FFI is a self-report questionnaire used to describe personality factors according to the Big Five model. The questionnaire consists of 60 items that are rated by the patient using a 5-point Likert scale, e.g. item 1: “I am not a worrier.” with 0: “Strongly disagree” and 5: “Strongly

agree". The scores are compared to norm scores of the Dutch population, differentiating between sex, age, and education level, and can be computed to display personality profiles. Prior research of the NEO-FFI has shown good to excellent psychometric properties, with Cronbach's alpha levels >0.80 for all subscales [10].

Depressive symptoms. Depressive symptoms were quantified using the Patient Health Questionnaire-9 (PHQ-9) [25]. The PHQ-9 is a 9-item self-report questionnaire, scored with a 4-point Likert scale, following the question: "Over the last 2 weeks, how often have you been bothered by any of the following problems?", e.g. item 1: "Little interest or pleasure in doing things", with 0: "Not at all" and 3: "Nearly every day". The higher the total score (ranging from 0 to 27), the more likely clinically relevant depressive complaints are present, with a cut-off score of 10 for moderate levels of depression [24].

Demographic variables. During assessment, demographic variables of sex (male/female), age (in years), marital status, work status, and education were obtained. Education levels were defined using the Verhage [48], categorizing in low (Verhage 1–4), average (Verhage 5), and high levels of education (Verhage 6–7).

2.3. Statistical methods

Data are presented as mean (M) ± standard deviation (SD) or frequency (N) and percentages (%). Normality of the distribution of continuous variables was examined visually and using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The distribution of the Digit Span task, RAVLT, d2, TMT—B, and both BADS subtests deviated from the normal distribution (Kolmogorov-Smirnov and Shapir-Wilk tests $p < .001$ for all tests). Log-transformation did not result in normal distribution; therefore, the original variables were used. Scores of the other cognitive tests were normally distributed. Furthermore, the NEO-FFI scores were skewed and deviated from the normal distribution. Therefore we used Spearman's correlation coefficients instead of Pearson's to estimate the bi-variates correlations between personality factors and test scores on the cognitive tests.

The associations of each personality trait with cognitive functioning were analyzed separately with correlation and regression analyses using continuous variables. First, bivariate correlations between personality (continuous NEO-FFI scores of all five domains) and cognitive functioning (continuous WAIS-IV, RAVLT, ROCFT, d2, TMT—B, and BADS scores) were obtained using Spearman's correlations (ρ). Subsequently, the relationship between personality (predictor variables) and cognitive functioning (dependent variables) was examined using regression analyses, adjusting for age, sex, and education level. In order to evaluate the extent to which the associations between personality factors with cognitive function measures were accounted for by depression, the variable depression was added to the regression models. The following models were tested: Model 1 included age, sex, and education, Model 2 added the five personality factors, and Model 3 added the PHQ-9 depressive symptom scores. Changes in the overall R-squared (ΔR^2) as well as the individual unstandardized *B*-coefficients for each of the personality factors were examined. All variation inflation factor values were below 10 and the assumption for non-collinearity was met [16].

The Statistical Package for the Social Sciences version 26 was used for all analyses (IBM [18]). The statistical significance level was set at $p < .05$ for all analyses.

3. Results

3.1. Participants

Table 1 displays the demographic characteristics of the total sample of this investigation ($N = 366$, 218 women; 59.6%). An average level of education was present in 41.0% of the patients, 38.5% were married or had a registered partnership, and 33.9% were unable to work because of somatic complaints. Clinically significant depressive symptoms were found in 265 patients (72.4%).

3.2. Association of personality factors with cognitive functioning in SSRD

Table 1 also shows the average scores of patients on all personality and cognitive domains. The bivariate correlations between all five personality factors with measures of cognitive functioning are shown in Table 3. Higher neuroticism scores were moderately associated with lower scores on planning ($\rho = -0.12$, $p = .029$). Higher scores on extraversion were moderately associated with higher scores on verbal memory ($\rho = 0.15$, $p = .006$) and with higher scores on sustained attention ($\rho = 0.12$, $p = .028$). Furthermore, higher scores on openness were moderately associated with higher scores on information processing speed ($\rho = 0.19$, $p = .001$), working memory ($\rho = 0.19$, $p = .001$), verbal memory ($\rho = 0.26$, $p < .001$), visual memory ($r = 0.18$, $p = .001$), sustained attention ($\rho = 0.22$, $p < .001$), and planning ($\rho = 0.13$, $p = .027$), and with lower scores on divided attention ($\rho = -0.21$, $p < .001$). Higher agreeableness scores were moderately associated with higher scores on verbal memory ($\rho = 0.21$, $p < .001$), Conscientiousness was not associated with scores on the cognitive domains and none of the personality domains were significantly associated with mental flexibility. Other associations between personality factors and measures of cognitive functioning were not significant.

3.3. Multivariate regression analyses

Table 3 shows the results of the regression analyses to examine the associations between personality and cognitive functioning in patients with SSRD. When adjusting for age, sex, and education, neuroticism, extraversion, and openness were moderately associated with visual memory. Furthermore, extraversion and neuroticism were moderately associated with planning. Other associations were not significant.

3.4. The role of depression in the association between personality factors and cognitive functioning

After controlling for depressive symptoms, neuroticism, extraversion, and openness were significantly associated with visual memory. Neuroticism and extraversion also remained significantly associated with planning (see Table S1).

Neuroticism ($\rho = 0.47$, $p < .001$), conscientiousness ($\rho = -0.31$, $p < .001$), extraversion ($\rho = -0.41$, $p < .001$), openness ($\rho = -0.11$, $p = .03$), and agreeableness ($\rho = -0.21$, $p < .001$) were all correlated with depressive symptom scores on the PHQ-9. For the multivariate regression models, adding depressive symptoms in Model 3 significantly explained an extra 3% of the variance for information processing speed (R^2 change = 0.03, F change (5306) = 15.74, $p < .001$), an extra 2% for working memory (R^2 change = 0.02, F change (5298) = 8.01, $p = .005$), 1.4% for sustained attention (R^2 change = 0.01, F change (5303) = 6.26, $p = .013$), and 1.3% for divided attention (R^2 change = 0.01, F change (5311) = 5.25, $p = .023$). The full model 3, including age, sex, education level, the five personality factors and depression as predictors of each of the neuropsychological test scores is presented in Supplemental Table S1.

4. Discussion

This study demonstrates that personality factors are moderately associated with cognitive functioning in patients with SSRD. We found that patients with SSRD show lower scores on tasks of information processing speed, (working) memory, and attention. Neuroticism, extraversion, and openness were moderately associated with specific domains of cognitive functioning (visual memory and planning) in SSRD when adjusting for age, sex, and education level. However, conscientiousness and agreeableness were not associated with any of the measures for cognitive functioning. Furthermore, the association between

neuroticism with poorer planning and visual memory remained significant after adjusting for depressive symptoms. A similar pattern of associations was found for extraversion. Openness to experiences was associated with better visual memory performance in the fully adjusted models. These findings indicate that some personality factors might play a role in the level of cognitive functioning of patients with SSRD and suggests that psychological processes other than depression may contribute to cognitive symptomatology in patients with SSRD.

Consistent with our hypothesis, patients with SSRD and high scores on neuroticism showed lower cognitive functioning, specifically visual memory and planning. Neuroticism tends to be negatively associated with cognitive measures in healthy individuals [41]. Regarding executive functioning, it has both been positively and negatively associated with neuroticism in healthy samples [29,50]. In this study, neuroticism was negatively associated with executive function (planning), which is in line with a previous study among patients with cardiovascular disease [47]. Another study also reported that neuroticism was associated with less performance regarding semantic fluency [44] which was consistent with the findings by Sutin et al. [43] who also described these results in their meta-analysis. In our sample, extraversion was related to lower scores on visual memory and planning in adjusted models which was also found by previous studies [43,44]. High openness was associated with higher scores on visual memory which is in line with previous studies in healthy [41] and elderly individuals [9]. Furthermore, openness was negatively correlated with divided attention (which means better performance because of the scoring of the test) in the current study. Given that the openness trait has been considered to represent aspects of "intellect" [41], the predominantly positive association between openness and cognitive functioning might be explained by this background factor. Another study also showed that openness was positively associated with fluency [44].

In women with fibromyalgia, high agreeableness has been found to be related to memory dysfunction [5], but our results suggest improved verbal memory in case of high agreeableness (only significant in the unadjusted correlation analyses) which is also found by Sutin et al. [44]. One possible explanation for these results may might be that agreeableness is related to the ability to form trustful and cooperative relationships, for example with clinicians [42], which would enhance the cooperation. As a consequence of such positive patient-clinician relationships during assessment, patients with high agreeableness in our sample could have remembered more words, resulting in the positive association between agreeableness and verbal memory. Conscientiousness was not related to cognitive functioning, whereas we expected that low scores on this personality trait would be associated with poorer cognitive functioning. Previous studies have shown that low conscientiousness is associated with impairments in attention and executive function in healthy samples [9], and in patients with multiple sclerosis [37] and fibromyalgia [5]. These findings are consistent with the perspective outlined by Sutin et al. [43] who concluded that personality factors have pervasive associations with cognitive functioning.

Considering the associations with personality factors and cognitive performance, the mechanisms behind the complex interplay of personality factors and cognitive factors in patients with SSRD are unknown. The somatic amplification theory explains the existence of somatic complaints in patients with SSRD [1,21–23,33]. Following this model, in which complex interactions between hormones and inflammation leads to the experience of somatic symptoms, one can suggest that individuals with high neuroticism are prone to psychological distress [40] which triggers the physiological pathway of stress hormones. Hormones such as cortisol [30], neurotrophic factors [45], and other inflammation markers [26] may in this case also worsen cognitive performance. The extent to which the somatic amplification theory offers a model for the experience of cognitive symptoms and explains the interplay between personality factors and cognitive performance in patients with SSRD should be explored in future studies.

In line with our hypothesis, the results of our study showed that associations between personality factors and cognitive functioning in SSRD remained significant after adjusting for depressive symptoms. Depressive symptoms were highly prevalent in this sample (i.e., over 70%) and depressive symptoms were related to lower cognitive functioning, and correlated to higher neuroticism and lower conscientiousness, extraversion, openness, and agreeableness. Depressive symptoms are relevant to cognitive functioning in SSRD [12,13], but appears not to be a necessary factor in the relationship between cognitive functioning and personality factors. A patient-centered treatment approach including cognitive rehabilitation therapy is therefore advocated in order to improve cognitive functioning in patients with SSRD.

5. Strengths and limitations

Interpretation of the results of the current study needs to be considered in the context of a few limitations. Firstly, self-reports of personality-related characteristics may be associated with impaired introspection and mentalization in this patient group, which are needed for reliable self-reports [52]. Moreover, somatizing patients tend to be less likely to express emotional and personal issues to healthcare providers [20]. The use of self-report measures may therefore not have led to optimal insights regarding the personality factors of our study sample. Secondly, the data was not normally distributed, which may have interfered with the interpretation of the multivariable regression models. However, the bivariate analyses presented in Table 2 are based on non-parametric tests and therefore provide a non-biased assessment of the associations between personality factors with cognitive functioning. Another limitation is that the cross-sectional design of the present study precludes causal inferences. The statistical analyses were not adjusted for multiple testing, which may have resulted in statistical type I error. Furthermore, we also did not measure somatic symptom severity so we are unable to conclude whether cognitive functioning is associated with symptom severity in patients with SSRD. Finally, even though we found several significant associations, the beta values were relatively low, indicating statistically significant but small to moderate effect sizes. To which extent these associations are clinically relevant requires further investigation and future longitudinal and intervention studies are needed to explore the role of personality factors in cognitive dysfunction among patients with SSRD.

There are also several strengths of this study. As mentioned before, this study is the first study, to the best of our knowledge, to explore the associations between personality factors and cognitive functioning in patients with SSRD. Furthermore, other strengths include the large sample size, using depressive symptoms as a covariate, given their substantial role in SSRD, and the broad array of neuropsychological assessment tools and tasks to document cognitive functioning. Nevertheless, the results should be interpreted with caution while generalizing these results to other patient groups, since our sample included patients with SSRD and high complexity from a tertiary care specialized mental health institution. However, we do believe that patients with SSRD in general do experience the described pervasiveness of personality traits with regards to cognitive functioning, but perhaps in a lesser extent than compared to our sample. Future studies should explore these differences.

6. Conclusion and recommendations

We conclude that personality factors and depression are associated with lower cognitive functioning in patients with SSRD. More specifically, neuroticism and extraversion were negatively associated with visual memory scores, whereas openness was positively associated with visual memory. Furthermore, extraversion and neuroticism were negatively associated with planning in age, sex, and education-adjusted models. Future studies should further explore the role of personality regarding cognitive functioning in patients with SSRD and whether these patient aspects should be part of a patient-centered treatment

approach including cognitive rehabilitation therapy [11] which may help improve cognitive functioning in patients with SSRD. Whether or not cognitive functioning is worsened by somatic symptom severity or other patient characteristics that form complex associations with each other is yet unknown but should be further explored in the future. Furthermore, depressive symptoms were related to lower performances in several cognitive domains (information processing speed, working memory, and divided attention). The role of depression on neural processes and, in turn, cognitive functioning in patients with SSRD is unknown. Future studies should therefore explore brain alterations in patients with SSRD and its role regarding their cognitive functioning, preferably using (functional) neuroimaging.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2022.111067.

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