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Look who is complaining: Psychological factors predicting subjective cognitive complaints in a large community sample of older adults

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ABSTRACT

Subjective cognitive complaints (SCCs) are not directly related to objective impairments in cognition. This study examines the role of psychological factors in predicting SCCs in the domains of executive functioning, memory, and attention in older adults. A community sample of 1,219 Dutch adults, aged 40 year or older, completed the BRIEF-A, MSEQ, FEDA, NEO-FFI, DASS-21, and a demographic questionnaire. Participants were randomly divided into exploratory ($n = 813$) and confirmatory samples ($n = 406$). In the exploratory sample, we analyzed whether personality factors, symptoms of depression and anxiety, perceived stress, and demographics could predict SCCs in the different cognitive domains. For this purpose, a two-step regression approach with bootstrapping was used. To independently validate the results, these analyses were repeated in the confirmatory sample. Concerning executive functioning, complaints regarding the ability to regulate behavior and emotional responses were predicted by lower agreeableness levels and higher levels of neuroticism and perceived stress. Complaints regarding the ability to actively solve problems in different circumstances were predicted by a lower conscientiousness level, higher agreeableness level, and more depressive symptoms. Attentional complaints were predicted by lower levels of conscientiousness and extraversion, together with a higher level of neuroticism. For memory, no significant predictors were consistently found. Psychological factors are of influence on the subjective experience of cognitive complaints. In particular personality factors, perceived stress, and symptoms of depression, seem to predict SCCs in the domains of executive functioning and attention. Clinicians should take these factors into account in older adults who have SCCs.

KEYWORDS

Attention; executive functioning; personality; negative affective states; subjective cognitive complaints

Introduction

Subjective cognitive complaints (SCCs) refer to an individual's experience of deterioration of capacities in one or more cognitive domains (Jessen et al., 2014). SCCs are frequently reported by older adults, with prevalence rates up to 90% in individuals between the ages of 70 and 90 years (Slavin et al., 2010). The presence of subjective deterioration in cognitive functioning is even a necessary criterion for the diagnosis of mild cognitive impairment (American Psychiatric Association, 2013), which is considered as a prodromal stage of Alzheimer's disease. The latter is supported by findings showing that older adults with SCCs have an increased prevalence of biomarker abnormalities consistent with Alzheimer's disease (Amariglio et al., 2012; Rami et al., 2011) and by longitudinal studies showing that SCCs in older adults represent a risk factor for future cognitive decline and mild cognitive impairment, as well as for Alzheimer's disease (Mitchell et al., 2014).

However, the relationship between SCCs and objective cognitive functioning is not straightforward. Objective cognitive functioning refers to the cognitive ability in any domain (e.g., memory, attention) measured by standardized cognitive tests. Overall, there is only limited support for a link between SCCs and the concurrent level of objective performance on cognitive tests (e.g., Burmester et al., 2016; Fuermaier et al., 2015; Koerts et al., 2012). However, unimpaired performance on a cognitive test does not necessarily mean that cognitive functioning is fully intact. For example, it is possible that subtle cognitive impairments are difficult to detect with standardized cognitive testing due to a lack of sensitivity and specificity. Additionally, unimpaired performance on objective cognitive tests could be the result of

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successful compensation by the subject or a lack of ecological validity of the test.

Another explanation for the lack of an association between SCCs and objective cognitive functioning is the presence of other (psychological) factors influencing the subjective experience of cognitive complaints. This is supported by studies indicating that the majority of older adults with SCCs do not deteriorate more rapidly than their peers (e.g., Mitchell et al., 2014) and the disappearance of the subjective impression of cognitive impairment occurs frequently (Vestberg et al., 2010).

In the literature, several psychological factors are suggested that may contribute to experiencing SCCs. First, it has been suggested that SCCs are associated with certain personality factors. The most frequently reported personality factor predicting SCCs is a high level of neuroticism (Kliegel & Zimprich, 2005; Reid & MacLullich, 2006). In addition, conscientiousness and openness are noted to have an inverse relation with SCCs (Slavin et al., 2010). Second, negative affective states seem to play an important role in the subjective experience of cognitive impairment. Several studies indicate that SCCs positively correlate with the number and severity of symptoms of depression, anxiety, and perceived stress (Balash et al., 2013; Rönnlund et al., 2013; Zlatar et al., 2018;). Third, an older age, in the context of negative age stereotypes or "dementia worry", could lead to an over-reporting of cognitive complaints (Kessler et al., 2012; Kliegel & Zimprich, 2005). Fourth, some studies found an association between gender and SCCs, reporting a higher rate of SCCs for women in comparison to men (Tomita et al., 2014). However, not all studies reported an effect of gender (e.g., Markova et al., 2017). Finally, various other factors may be related to SCCs, such as sleep (Tsapanou et al., 2018), quality of life (Hill et al., 2017), perceived health status (Montejo et al., 2020), and availability of emotional support (Ha & Pai, 2018).

In sum, the explanations for SCCs in older adults can be multifactorial. The aim of the current study is to investigate which factors best predict SCCs in the cognitive domains of executive functioning, memory, and attention. Based on previous literature, aspects such as personality factors, negative affective states, and demographic information are taken into account. For this study a large community sample of adults aged 40 years or older was used in order to allow generalization of the results.

Methods

Participants

A community sample of 1,219 adults from the general Dutch population participated in this online study. The sample consisted of 567 men (46.5%) and 652 women (53.5%) with a mean age of 60.5 years ($SD = 11.3$, range 40–97). Educational level was rated on an eight-point scale ranging from primary school to university master. Of all the participants, 16.4% reported to have a lower education level (i.e., primary education or preparatory secondary vocational education), 36.3% an intermediate education level (i.e., secondary vocational education, senior general secondary education, or pre university education), and 46.9% a higher education level (i.e., higher vocational education or university). Four participants did not rate their level of education. Participants were recruited in two ways: (a) via personal contacts or social media of the researchers (these participants received no monetary reward) or (b) via a Dutch online research panel (i.e., https://panelinzicht.nl/; these participants received a small monetary reward). The exclusion criteria and the number of participants that were excluded are presented in Figure 1. Participants were informed about the aim of the study prior to the start of the online survey and gave electronic consent for participation. The study was approved by the Ethical Committee Psychology of the University of Groningen, the Netherlands.

Materials

Demographics

The demographic questions in the survey focused on age (in years), gender (male/female), education level (eight answer alternatives ranging from primary school to university master), marital status (married, living together, partner but not living together, not married, divorced, widow/widower, other), having children (yes/no), having pets (yes/no), profession (open-ended question), net income (6-point scale ranging from <€1,000 to >€5,000 per month), weight (in kilograms), and length (in centimeters). Additionally, questions about sleep (average hours of sleep per night and sleep quality rated by a grade from 0–10), self-rated health ("What do you generally think of your health?" on a 5-point scale ranging from bad to excellent), and quality of life ('How would you rate your quality of life?' rated by a grade from 0 to 10) were included. Finally, participants were asked four questions about their medical history ("Did you ever visit a neurologist, cardiologist, internist, or psychiatrist/psychologist? If yes, for what reason?"). These latter questions were used for the exclusion of participants (Figure 1).

Subjective cognitive complaints

The Behavior Rating Inventory Executive Function—Adult version (BRIEF-A) is a 75-item rating scale aimed at assessing everyday behaviors associated with specific domains of executive functioning (Roth et al., 2005; Scholte & Noens, 2011). Participants have to indicate on a 3-point scale how often they experienced certain executive functioning problems in daily life during the last month. The scale ranges from never [1] to often [3]. An example of an item is: "*I have trouble changing from one activity or task to another*". The BRIEF-A consists of nine subscales that can be summarized by means of two indexes. The Behavioral Regulation Index (BRI) captures the ability to appropriately regulate behavior and emotional responses, and is composed of four subscales: Inhibit, Shift, Emotional control, and Self-monitor (score range 30–90). The Metacognition Index (MI) captures the ability to actively solve problems in different circumstances, and is composed of five subscales: Initiate,

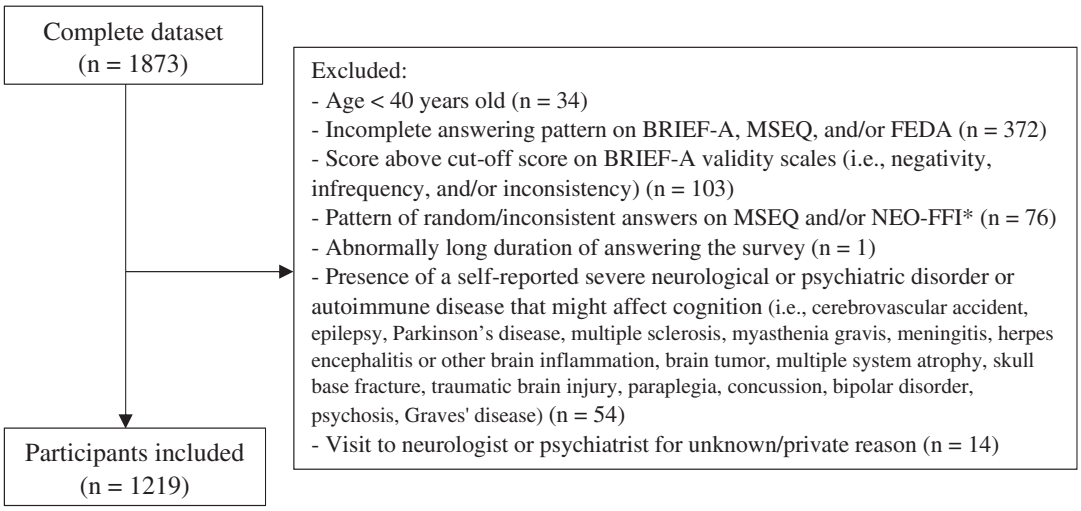

Figure 1. Overview of exclusion criteria. *Note*. *Random answers were patterns with (almost) always the same answer option, and inconsistent answers on the MSEQ were, for example, a higher estimate of remembering the most difficult level as compared to the easiest difficult level. BRIEF-A = Behavior Rating Inventory Executive Function—Adult version; MSEQ = Memory Self-Efficacy Questionnaire; FEDA = Questionnaire for Experiences of Attention Deficits; NEO-FFI = NEO-Five Factor Inventory.

Working memory, Plan/organize, Task monitor, and Organization of materials (score range 40–120). In this study, the BRI and MI were used, as they can be considered separate entities of executive functioning (Scholte & Noens, 2011).

The Dutch version of the Memory Self-Efficacy Questionnaire (MSEQ) is a 20-item rating scale aimed at assessing how participants think about their own memory functioning (Berry et al., 1989). The MSEQ assesses four aspects of memory: (a) where objects were placed, (b) products on a shopping list, (c) names of people, and (d) important points from a story. Each domain is assessed at five levels of difficulty (e.g., for the shopping list, level 1 reflects the experienced self-efficacy to remember 18 out of 18 products, level 2 reflects the experienced self-efficacy to remember 14 out of 18 products). Participants have to estimate, indicated by a percentage between 0 and 100, in steps of 10, how confident they are that they can perform each level (score range 0–100). Higher estimates indicate a higher confidence. In this study, the mean estimation across the four memory aspects and five difficulty levels were used.

The Questionnaire for Experiences of Attention Deficits (German: Fragebogen Erlebter Defizite der Aufmerksamkeit [FEDA]) is a 27-item rating scale aimed at assessing attention deficits in everyday situations (Zimmermann et al., 1991). Participants have to indicate on a 5-point scale how often they experience certain problems with attention. The scale ranges from never [0] to very frequently [4]. An example of an item is: "*It is hard to concentrate when something is going on around me*." The FEDA consists of three subscales, representing Distractibility, Fatigue, and Motivation. In this study, the total score was used, based on the sum of the scores on all items (score range 0-108).

Personality

The NEO-Five Factor Inventory (NEO-FFI) is a 60-item rating scale that measures the Big Five personality factors Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Costa & McCrae, 1992; Hoekstra et al., 2007). On a 5-point scale, which ranges from completely disagree [1 or 5] to completely agree [5 or 1], participants have to indicate to what degree certain statements apply to them. For each personality factor, a total score is calculated (score range 12–60 per factor).

Symptoms of depression, anxiety, and stress

The Depression Anxiety Stress Scale (DASS-21) is a 21-item rating scale aimed at measuring negative emotions (De Beurs et al., 2001). Participants have to indicate on a 4-point scale how often the items apply to them. The scale ranges from never or not applicable [0] to very certainly or often applicable [3]. The DASS-21 consists of three subscales: Depressive symptoms, Anxiety symptoms, and Stress. The DASS-21 is a shortened version of the original DASS consisting of 42 items (Lovibond & Lovibond, 1995). To be able to use the cutoff scores of the original DASS, the scores on the three subscales of the DASS-21 are multiplied by two (score range 0–42 per subscale).

Procedure

All questionnaires and scales were accessible online (Qualtrics, Provo, UT) and completion took approximately 30 min. The survey started with the general questions regarding demographics. Subsequently, the BRIEF-A, MSEQ, FEDA, NEO-FFI, and DASS-21 were administered in this fixed order. It was possible to temporarily pause the survey and continue at a later time. Data was collected between October 2016 and March 2018.

Statistical analyses

For statistical purposes, the variables education level, marital status, and profession were recoded as low/intermediate/

high, having a partner "yes" or "no," and having a profession "yes" or "no," respectively. In total, this study included 21 independent variables: age (in years), gender (male/female), educational level (low/intermediate/high), having a profession (yes/no), having a partner (yes/no), having children (yes/no), having pets (yes/no), income (6 categories), BMI (weight in kilograms/length in meters^2), hours of sleep per night, sleep quality (scale 0–10), self-rated health (scale 1–5), quality of life (scale 0–10), the NEO-FFI personality factors Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, and the DASS subscales Depressive symptoms, Anxiety symptoms, and Stress. For data reduction purposes, five variables were merged into two overall scores: the total score of the DASS as a measure of negative emotional symptoms (i.e., the sum of the subscales Depressive symptoms, Anxiety symptoms, and Stress) and an overall score for sleep (i.e., average of the *z*-scores for hours of sleep per night and sleep quality). Therefore, 18 independent variables were used for analysis.

In the current study, two types of analyses were performed. First, an exploratory analysis was performed to determine which of the 18 independent variables could predict the scores on the dependent variables BRIEF-A BRI, BRIEF-A MI, MSEQ, and FEDA. For this purpose, a two-step regression approach was applied to the data of 813 randomly selected participants (i.e., 2/3 of the total sample). In step 1, simple linear regression analyses were performed in order to assess the predictive value of each independent variable for the dependent variables separately. Additionally, if one of the merged variables turned out to be significant, the predictive value of the variables on which the merged variable was based was also explored (e.g., if the DASS total score was found to be a significant predictor, the three separate subscales were also analyzed). In step 2, multiple regression analyses (enter method) were performed for the four dependent variables using the significant predictors from step 1. To internally validate the results, bootstrapping with 1,000 samples was used to derive 99% bias corrected accelerated (BCa) confidence intervals for the regression coefficients.

Second, a confirmatory analysis was performed in order to determine the robustness of the results from the exploratory analysis (i.e., independent validation). Again, the two-step regression approach as described above was performed, including the bootstrapping procedure, this time on the data of the remaining 406 participants (i.e., 1/3 of the total sample). The only difference here was that in step 2 not only the significant predictors from step 1 were used, but also the significant predictors from step 2 in the exploratory analysis (if not already included).

Overall, due to multiple testing and the large sample sizes, a conservative *p*-value of $\leq$.01 was used in order to reduce type I errors. In step 2 of both the exploratory and confirmatory analyses, predictors were considered significant if both the *p*-value was $\leq$.01 and the bootstrap BCa confidence interval (CI) did not include the value 0. Variables were considered relevant predictors if they were significant in both the exploratory and confirmatory regression analyses (i.e., consistent predictors across samples). Effect sizes were indicated by the percentage of explained variance (R^2) and interpreted as small ($\leq$.08), medium (.09–.24), or large ($\geq$.25) (Cohen, 1988). The squared semipartial correlation (sr^2) indicates the percentage of unique contribution of a specific independent variable to the total variation in the dependent variable. The sr^2 was interpreted as small (<.01), medium (.01–.059) or large (>.059) (Fritz et al., 2012). In case of missing values, participants were excluded listwise per analysis.

In both the exploratory and confirmatory sample, the data was checked for influential cases and the assumptions associated with linear regression analysis were tested. To check for the presence of influential cases Cook's distance was calculated. All values were below 1, indicating there were no influential outliers. Linearity was assessed by visual inspection of the partial plots. There was no evidence of a curved pattern in any of the plots. To test whether the residuals were normally distributed, the histograms and probability-probability plots were checked. Overall, the residuals showed a normal distribution. Some slightly skewed distributions were accepted as they are, since sample sizes bigger than 50 are considered to be robust against violations of normality (Casson & Farmer, 2014). For the assumption of homoscedasticity, the scatterplots of the *z*-values of the residuals against those of the predicted values were visually checked and the Koenker test was used (Koenker, 1981). Any violations of homoscedasticity were not corrected, as bootstrapping was additionally performed to determine the significance of a predictor (Hausman & Palmer, 2012). Finally, to test for multicollinearity, the variance inflation factor (VIF) was inspected. All VIF values were well below 10, indicating there were no problematic correlations between the independent variables in the multiple regression models (Belsley et al., 2005). All analyses were carried out using Statistical Package for the Social Sciences version 26.

Results

Table 1 provides an overview of the scores on the dependent and independent variables of both the exploratory and confirmatory sample. There were no significant differences between the two samples regarding these variables.

When comparing the scores of individual participants to the BRIEF-A norms for adults aged 18–65 years old (Scholte & Noens, 2011), a large majority of participants in both samples was found to score in the very low to above average range (i.e., percentile <90) on the two indexes (exploratory sample: BRI = 96.9% and MI = 95.6%; confirmatory sample: BRI = 96.6% and MI = 94.1%). This indicates that the majority of participants report a low to above average number of complaints on these indexes. There was, however, a small number of participants scoring in the high (i.e., percentile $\geq$90) or very high (i.e., percentile $\geq$98) range, indicating a high or very high number/severity of complaints. For the BRIEF-A BRI, in both samples 3.0% of participants scored in the high range and 0.1% and 0.5% of the exploratory and confirmatory sample, respectively, scored in the

Table 1. Demographic characteristics and scores on the dependent and independent variables of the explorative and confirmative sample.

	Exploratory sample ($n = 813$)			Confirmatory sample ($n = 406$)		
	M (*SD*)	Median	min–max	*M* (*SD*)	Median	min–max
Dependent variables						
BRIEF-A BRI	40.3 (7.3)	39.0	30–75	40.7 (7.5)	40.0	30–73
BRIEF-A MI	55.1 (9.9)	54.0	40–107	55.2 (10.4)	53.5	40–89
MSEQ	72.7 (15.7)	74.5	11–100	71.9 (16.9)	74.3	14.5–99.5
FEDA	20.7 (13.8)	19.0	0–82	21.7 (14.5)	19.0	0–72
Independent variables						
Continuous						
Age	60.0 (11.4)	58.0	40–94	61.6 (11.0)	60.0	40–97
Income	2.7 (1.2)	3.0	1–6	2.7 (1.2)	3.0	1–6
BMI	26.4 (4.7)	25.7	17.9–58.6	26.4 (4.6)	25.7	17.4–57.2
Hours of sleep	7.1 (1.0)	7.0	3–10	7.0 (1.0)	7.0	2–10
Sleep quality	7.0 (1.6)	7.0	0–10	7.0 (1.7)	7.0	0–10
Self-rated health	3.2 (0.8)	3.0	1–5	3.2 (0.8)	3.0	1–5
Quality of life	7.7 (1.1)	8.0	2–10	7.7 (1.2)	8.0	1–10
Openness	37.7 (5.7)	37.0	22–55	37.1 (6.1)	37.0	16–55
Consciousness	46.3 (5.4)	46.0	27–60	46.1 (5.4)	46.0	26–60
Extraversion	40.6 (6.2)	41.0	14–58	40.1 (6.2)	40.0	20–58
Agreeableness	45.8 (5.1)	46.0	31–58	45.2 (5.4)	46.0	28–60
Neuroticism	28.1 (7.3)	28.0	12–57	28.8 (7.7)	28.0	12–53
Depressive symptoms	3.9 (5.3)	2.0	0–30	4.6 (6.2)	2.0	0–32
Anxiety symptoms	3.5 (4.5)	2.0	0–28	3.7 (4.7)	2.0	0–32
Stress	5.8 (5.8)	4.0	0–28	6.1 (6.2)	4.0	0–30
Categorical		*n* (%)			*n* (%)	
Gender (female)		442 (54.4%)			210 (51.7%)	
Education level (low / intermediate / high)		121 (14.9%) / 307 (37.8%) / 381 (46.9%)[a]			79 (19.5%) / 136 (33.5%) / 191 (47.0%)	
Partner (yes)		636 (78.2%)			307 (75.6%)	
Children (yes)		700 (86.1%)			343 (84.5%)	
Pets (yes)		358 (44.0%)			188 (46.3%)	
Profession (yes)		441 (54.2%)			203 (50.0%)	

Notes. [a]For Education level the information of four participants in the exploratory sample was missing.

BRIEF-A BRI = Behavior Rating Inventory Executive Function—Adult version Behavioral Regulation Index; BRIEF-A MI = Behavior Rating Inventory Executive Function—Adult version Metacognition Index; MSEQ = Memory Self-Efficacy Questionnaire; FEDA = Questionnaire for Experiences of Attention Deficits; BMI = body mass index.

Income is based on 6-point scale ranging from <€1,000 to >€5,000 per month, sleep quality is indicated by a grade between 0 and 10, self-rated health is based on a 5-point scale ranging from bad to excellent, quality of life is indicated by a grade between 0 and 10.

very high range. On the BRIEF-A MI, 3.7% of participants in the exploratory sample scored high and 0.7% very high and in the confirmatory sample 5.4% scored high and 0.5% very high. For the FEDA and the Dutch version of the MSEQ no normative data was available.

On the NEO-FFI, the majority of participants also scored in the average range (i.e., stanines 3–7) on the five personality factors compared to the normative data of people older than 50 years (Hoekstra et al., 2007). In the exploratory sample, this was 67.6% for Openness; 79.2% for Conscientiousness; 72.9% for Extraversion; 71.2% for Agreeableness; and 76.6% for Neuroticism,. In the confirmatory sample, the percentages of participants that scored in the average range was as follows: Openness, 65.6%; Conscientiousness, 80.2%; Extraversion, 75.5%; Agreeableness, 70.0%; and Neuroticism, 75.1%. A small number of participants scored in the low range (i.e., stanines 1–2) or high range (i.e., stanines 8–9). In the exploratory sample, 2.9%, 8.9%, 5.2%, 4.8%, and 17.4% of participants scored low and 29.5%, 11.9%, 21.9%, 23.9%, and 6.0% of participants scored high, respectively, on the factors Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. In the confirmatory sample, 5.6%, 7.6%, 6.1%, 8.7%, and 17.3% of participants scored low and 28.8%, 12.2%, 18.4%, 21.4%, and 7.6% of participants scored high, respectively, on the factors Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.

Finally, on the DASS, most participants in both samples scored in the normal to moderate range on the subscales for Depressive symptoms (exploratory sample: 98.7%, confirmatory sample: 96.9%), Anxiety symptoms (both samples 97.2%), and Stress (exploratory sample: 99.5%, confirmatory sample: 99.2%). On the subscale Depressive symptoms, 0.9% of participants in the exploratory sample scored in the severe range and 0.4% in the extremely severe range. In the confirmatory sample, this was slightly higher with 2.7% of participants scoring in the severe range and 1.0% in the extremely severe range. On the subscale Anxiety symptoms, 1.2% of the participants in the exploratory sample had a severe score and 1.4% an extremely severe score. For the confirmatory sample, this was 1.5% and 1.2%, respectively. Finally, on the subscale Stress, 0.5% of participants in the exploratory sample and 0.7% in the confirmatory sample scored in the severe range. None of the participants scored in the extremely severe range on this subscale.

Exploratory analysis

Step 1: Simple linear regression

Tables 2–5 show the results of the simple linear regression analyses. For the BRIEF-A BRI, BRIEF-A MI, and MSEQ, there were 12 significant predictors and for the FEDA 16 predictors. More complaints on the BRIEF-A indexes and

Table 2. Results of the simple linear regression analyses (step 1) and multiple regression and bootstrap (step 2) for the BRIEF-A BRI in the exploratory and confirmatory sample.

	Exploratory sample ($n = 813$)										Confirmatory sample ($n = 406$)									
	Simple linear regression				Multiple regression and bootstrap						Simple linear regression				Multiple regression and bootstrap					
						BCa 99% CI										BCa 99% CI				
Independent variables	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2
Age	−.055	−2.446	.015	.007							−.095	−2.826	.005*	.019	−.040	−.114	.028	−1.402	.162	.003
Gender	.860	1.683	.093	.003							.102	.136	.892	<.001						
Education level				.006										.019						
- Intermediate	−1.240	−1.590	.112								.915	−.868	.386							
- High	−1.683	−2.221	.027								−2.526	−2.535	.012							
Partner	−.121	−.196	.845	<.001							−.036	−.041	.967	<.001						
Children	−1.178	−1.601	.110	.003							.737	.716	.474	.001						
Pets	.561	1.092	.275	.001							1.318	1.770	.077	.008						
Profession	−.021	−.041	.968	<.001							1.251	1.684	.093	.007						
Income	−.868	−3.961	<.001*	.019	−.424	−.849	.040	−2.283	.023	.004	−1.169	−3.686	<.001*	.033	−.554	−1.342	.122	−2.097	.037	.006
BMI	.009	.170	.865	<.001							.055	.680	.497	.001						
Sleep (overall)[a]	−1.488	−5.155	<.001*	.032							−1.576	−3.817	<.001*	.035						
Hours of sleep	−.918	−3.730	<.001*	.017	−.393	−.956	.242	−1.654	.098	.002	−1.367	−3.700	<.001*	.033	−1.095	−1.944	−.139	−3.065	.002*	.013
Sleep quality	−.833	−5.232	<.001*	.033	.127	−.340	.598	.754	.451	<.001	−.672	−3.054	.002*	.023	.677	.113	1.264	3.001	.003*	.013
Self-rated health	−1.405	−4.656	<.001*	.026	.218	−.772	1.066	.708	.479	<.001	−1.008	−2.234	.026	.012						
Quality of life	−1.687	−7.711	<.001*	.068	−.042	−.717	.568	−.160	.873	<.001	−1.618	−5.290	<.001*	.065	.221	−.454	.919	.759	.448	.001
Openness	−.048	−1.053	.293	.001							−.103	−1.643	.101	.007						
Conscientiousness	−.417	−9.177	<.001*	.099	−.098	−.208	.020	−2.162	.031	.004	−.445	−6.679	<.001*	.102	−.097	−.271	.058	−1.463	.144	.003
Extraversion	−.266	−6.454	<.001*	.052	.089	−.008	.192	2.166	.031	.004	−.242	−4.032	<.001*	.040	.156	−.013	.303	2.717	.007	.011
Agreeableness	**−.438**	**−8.974**	**< .001***	**.095**	**−.201**	**−.336**	**−.068**	**−4.544**	**< .001***	**.016**	**−.390**	**−5.801**	**< .001***	**.079**	**−.169**	**−.332**	**−.013**	**−2.894**	**.004***	**.012**
Neuroticism	**.519**	**17.081**	**< .001***	**.277**	**.273**	**.156**	**.387**	**6.799**	**< .001***	**.036**	**.523**	**12.502**	**< .001***	**.286**	**.275**	**.124**	**.418**	**4.971**	**< .001***	**.035**
DASS total score[b]	.292	17.918	<.001*	.299							.295	14.271	<.001*	.346						
Depressive symptoms	.656	14.967	<.001*	.229	.065	−.146	.260	1.037	.300	.001	.634	11.982	<.001*	.272	.144	−.100	.392	1.872	.062	.005
Anxiety symptoms	.601	11.181	<.001*	.142	−.031	−.210	.174	−.500	.617	<.001	.664	8.840	<.001*	.169	−.040	−.263	.214	−.462	.644	<.001
Stress	**.685**	**17.893**	**< .001***	**.298**	**.451**	**.317**	**.593**	**8.738**	**< .001***	**.060**	**.725**	**14.540**	**< .001***	**.354**	**.456**	**.247**	**.674**	**6.450**	**< .001***	**.060**

Note. [a] and [b] are merged variables. If significant results were found for these merged variables, simple regression analysis were also performed for the separate variables these merged variables were based on.
*Significant if $p \leq .01$. The rows marked bold represent variables that were significant in the simple and multiple regression analyses in the exploratory sample as well as in the confirmatory sample. BRIEF-A BRI = Behavior Rating Inventory Executive Function—Adult version Behavioral Regulation Index; BMI = body mass index; DASS = Depression Anxiety Stress Scales.

Table 3. Results of the simple linear regression analyses (step 1) and multiple regression and bootstrap (step 2) for the BRIEF-A MI in the exploratory and confirmatory sample.

	Exploratory sample ($n = 813$)										Confirmatory sample ($n = 406$)									
	Simple linear regression				Multiple regression and bootstrap						Simple linear regression				Multiple regression and bootstrap					
						BCa 99% CI										BCa 99% CI				
Independent variables	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2
Age	−.136	−4.515	<.001*	.025	−.127	−.203	−.040	−4.992	<.001*	.019	−.218	−4.773	<.001*	.053	−.097	−.248	.065	−1.823	.069	.004
Gender	1.063	1.528	.127	.003							.464	.450	.653	.001						
Education level				.006										.004						
- Intermediate	−.750	−.708	.479								−.547	−.373	.709							
- High	.946	.918	.359								.980	.707	.480							
Partner	−1.145	−1.363	.173	.002							−1.039	−.868	.386	.002						
Children	−2.260	−2.260	.024	.006							1.155	.814	.416	.002						
Pets	.678	.970	.332	.001							2.840	2.779	.006*	.019	.409	−1.967	2.668	.481	.631	<.001
Profession	1.549	2.231	.026	.006							4.271	4.242	<.001*	.043	1.738	−1.042	4.768	1.603	.110	.003
Income	−.736	−2.454	.014	.007							−.892	−2.014	.045	.010						
BMI	−.104	−1.401	.162	.002							−.070	−.629	.530	.001						
Sleep (overall)[a]	−1.979	−5.031	<.001*	.030							−2.511	−4.432	<.001*	.046						
Hours of sleep	−1.057	−3.148	.002*	.012	−.237	−1.174	.729	−.738	.460	<.001	−1.813	−3.550	<.001*	.030	−1.206	−2.463	−.027	−2.472	.014	.008
Sleep quality	−1.213	−5.612	<.001*	.037	.003	−.640	.713	.012	.990	<.001	−1.287	−4.282	<.001*	.043	.299	−.510	1.094	.976	.330	.001
Self-rated health	−1.643	−3.987	<.001*	.019	.496	−.694	1.615	1.180	.238	.001	−1.312	−2.106	.036	.011						
Quality of life	−2.003	−6.670	<.001*	.052	.201	−.838	1.231	.568	.570	<.001	−2.473	−5.901	<.001*	.079	.001	−1.151	1.037	.001	.999	<.001
Openness	.142	2.289	.022	.007							.058	.678	.498	.001						
Conscientiousness	**−.958**	**−17.174**	**<.001***	**.279**	**−.812**	**−1.022**	**−.645**	**−13.216**	**<.001***	**.134**	**−1.082**	**−13.584**	**<.001***	**.321**	**−.943**	**−1.170**	**−.709**	**−10.430**	**<.001***	**.149**
Extraversion	−.498	−9.024	<.001*	.097	−.093	−.221	.043	−1.663	.097	.002	−.472	−5.829	<.001*	.080	.083	−.172	.270	1.059	.290	.002
Agreeableness	**−.280**	**−4.024**	**<.001***	**.021**	**.220**	**.075**	**.383**	**3.694**	**<.001***	**.010**	**−.245**	**−2.565**	**.011**	**.017**	**.214**	**.042**	**.405**	**2.734**	**.007***	**.010**
Neuroticism	.571	12.857	<.001*	.178	.048	−.078	.185	.879	.380	.001	.616	10.176	<.001*	.209	.041	−.143	.233	.554	.580	<.001
DASS total score[b]	.345	14.676	<.001*	.222							.328	10.543	<.001*	.224						
Depressive symptoms	**.862**	**14.175**	**<.001***	**.210**	**.245**	**.004**	**.476**	**2.889**	**.004***	**.006**	**.799**	**10.602**	**<.001***	**.226**	**.426**	**.076**	**.765**	**4.054**	**<.001***	**.023**
Anxiety symptoms	.718	9.568	<.001*	.108	.053	−.157	.294	.616	.538	<.001	.674	6.212	<.001*	.091	−.129	−.476	.276	−1.085	.279	.002
Stress	.731	12.929	<.001*	.181	.382	.199	.569	5.452	<.001*	.023	.748	9.743	<.001*	.198	.268	−.013	.567	2.769	.006	.010

Note. [a] and [b] are merged variables. If significant results were found for these merged variables, simple regression analysis were also performed for the separate variables these merged variables were based on.
*Significant if $p \leq .01$. The rows marked bold represent variables that were significant in the simple and multiple regression analyses in the exploratory sample as well as in the confirmatory sample. BRIEF-A MI = Behavior Rating Inventory Executive Function—Adult version Metacognition Index; BMI = body mass index; DASS = Depression Anxiety Stress Scales.

Table 4. Results of the simple linear regression analyses (step 1) and multiple regression and bootstrap (step 2) for the MSEQ in the exploratory and confirmatory sample.

	Exploratory sample ($n = 813$)										Confirmatory sample ($n = 406$)									
	Simple linear regression				Multiple regression and bootstrap						Simple linear regression				Multiple regression and bootstrap					
						BCa 99% CI										BCa 99% CI				
Independent variables	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2
Age	−.119	−2.457	.014	.007							−.232	−3.066	.002*	.023	−.148	−.447	.168	−1.411	.159	.004
Gender	3.161	2.864	.004*	.010	3.261	.056	6.497	2.793	.005*	.009	3.453	2.068	.039	.010	2.268	−2.507	6.863	1.330	.184	.004
Education level				.023										.027						
- Intermediate	6.949	4.152	<.001*		3.664	−.681	8.065	2.179	.030	.005	7.735	3.276	.001*		4.437	−2.806	10.927	1.798	.073	.007
- High	6.273	3.855	<.001*		1.827	−2.812	6.567	1.050	.294	.001	6.187	2.771	.006*		2.529	−4.560	9.435	1.048	.295	.002
Partner	2.848	2.132	.033	.006							3.726	1.916	.056	.009						
Children	1.113	.697	.486	.001							−1.128	−.487	.626	.001						
Pets	1.500	1.349	.178	.002							.020	.012	.990	<.001						
Profession	2.839	2.570	.010	.008							4.904	2.954	.003*	.021	1.106	−5.183	8.475	.495	.621	.001
Income	.762	1.592	.112	.003							1.451	2.009	.045	.010						
BMI	−.061	−.523	.601	<.001							−.079	−.433	.665	<.001						
Sleep (overall)[a]	1.043	1.645	.100	.003							−.978	−1.035	.301	.003						
Hours of sleep																				
Sleep quality																				
Self-rated health	2.652	4.043	<.001*	.020	−.689	−2.953	1.489	−.844	.399	.001	2.398	2.364	.019	.014						
Quality of life	3.231	6.761	<.001*	.053	1.900	−.161	3.886	2.855	.004	.009	2.488	3.548	<.001*	.030	−.090	−1.841	1.754	−.113	.910	<.001
Openness	.318	3.235	.001*	.014	.157	−.132	.452	1.506	.132	.003	.356	2.570	.011	.017						
Conscientiousness	.825	8.230	<.001*	.082	.543	.278	.823	4.537	<.001*	.024	.737	4.844	<.001*	.057	.385	−.076	.905	2.101	.036	.010
Extraversion	.633	7.076	<.001*	.062	.292	−.047	.617	2.670	.008	.008	.785	5.999	<.001*	.084	.373	−.078	.834	2.314	.021	.012
Agreeableness	.450	4.061	<.001*	.021	−.066	−.392	.256	−.544	.586	<.001	.257	1.653	.099	.007						
Neuroticism	−.374	−4.877	<.001*	.030	.048	−.202	.316	.445	.656	<.001	−.431	−3.982	<.001*	.039	−.016	−.430	.407	−.103	.918	<.001
DASS total score[b]	−.215	−5.174	<.001*	.034							−.269	−4.870	<.001*	.058						
Depressive symptoms	−.614	−5.782	<.001*	.042	−.045	−.498	.370	−.273	.785	<.001	−.757	−5.715	<.001*	.078	−.514	−1.130	.205	−2.369	.018	.013
Anxiety symptoms	−.553	−4.449	<.001*	.026	−.242	−.763	.253	−1.456	.146	.003	−.806	−4.516	<.001*	.050	−.286	−1.028	.382	−1.133	.258	.003
Stress	−.326	−3.306	.001*	.014	.042	−.333	.476	.305	.760	<.001	−.367	−2.684	.008*	.018	.307	−.219	.847	1.535	.126	.005

Note. [a] and [b] are merged variables. If significant results were found for these merged variables, simple regression analysis were also performed for the separate variables these merged variables were based on.
*Significant if $p \leq .01$. MSEQ = Memory Self-Efficacy Questionnaire; BMI = body mass index; DASS = Depression Anxiety Stress Scales.

Table 5. Results of the simple linear regression analyses (step 1) and multiple regression and bootstrap (step 2) for the FEDA in the exploratory and confirmatory sample.

	Exploratory sample ($n = 813$)										Confirmatory sample ($n = 406$)									
	Simple linear regression				Multiple regression and bootstrap						Simple linear regression				Multiple regression and bootstrap					
						BCa 99% CI										BCa 99% CI				
Independent variables	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2	*B*	*t*	*p*	R^2	*B*	lower	upper	*t*	*p*	sr^2
Age	−.068	−1.598	.110	.003							−.102	−1.549	.122	.006						
Gender	3.196	3.317	.001*	.013	1.884	−.377	4.512	2.322	.020	.004	2.092	1.454	.147	.005						
Education level				.011										.019						
- Intermediate	−4.383	−2.978	.003*		−.322	−3.095	3.043	−.291	.771	<.001	−5.333	−2.616	.009*		.183	−4.384	4.442	.112	.911	<.001
- High	−3.424	−2.393	.017		1.532	−1.606	4.658	1.367	.172	.001	−4.634	−2.404	.017		2.220	−2.939	6.562	1.299	.195	.002
Partner	−3.864	−3.323	.001*	.013	.002	−2.532	2.615	.002	.998	<.001	−4.372	−2.626	.009*	.017	−.284	−4.398	3.254	−.219	.826	<.001
Children	−3.630	−2.610	.009*	.008	−1.019	−4.052	1.560	−.973	.331	.001	.214	.107	.915	<.001						
Pets	.836	.859	.391	.001							2.343	1.626	.105	.007						
Profession	−1.401	−1.447	.148	.003							.936	.649	.516	.001						
Income	−1.930	−4.668	<.001*	.026	.086	−.809	.975	.237	.813	<.001	−2.774	−4.562	<.001*	.049	−1.084	−2.340	.079	−2.054	.041	.005
BMI	.074	.713	.476	.001							.132	.848	.397	.002						
Sleep (overall)[a]	−3.413	−6.286	<.001*	.047							−3.982	−5.050	<.001*	.059						
Hours of sleep	−1.441	−3.081	.002*	.012	.318	−.898	1.444	.766	.444	<.001	−2.960	−4.159	<.001*	.041	−2.328	−4.305	−.353	−3.465	.001*	.016
Sleep quality	−2.338	−7.913	<.001*	.072	−.257	−1.253	.750	−.870	.385	<.001	−1.991	−4.750	<.001*	.053	.737	−.442	1.856	1.756	.080	.004
Self-rated health	−5.248	−9.558	<.001*	.101	−.767	−2.081	.579	−1.420	.156	.001	−4.451	5.239	<.001*	.064	1.214	−.658	3.303	1.489	.137	.003
Quality of life	−5.002	−12.768	<.001*	.167	−.845	−2.040	.466	−1.835	.067	.002	−4.500	−7.899	<.001*	.134	.150	−1.476	1.814	.242	.809	<.001
Openness	−.142	−1.648	.100	.004							−.114	−.946	.345	.002						
Conscientiousness	**−1.193**	**−14.870**	**<.001***	**.225**	**−.484**	**−.719**	**−.275**	**−6.105**	**<.001***	**.025**	**−1.408**	**−12.157**	**<.001***	**.274**	**−.697**	**−1.001**	**−.372**	**−5.604**	**<.001***	**.041**
Extraversion	**−1.032**	**−14.485**	**<.001***	**.216**	**−.359**	**−.592**	**−.155**	**−4.974**	**<.001***	**.016**	**−1.027**	**−9.638**	**<.001***	**.192**	**−.321**	**−.570**	**−.022**	**−3.043**	**.003***	**.012**
Agreeableness	−.641	−6.771	<.001*	.057	.056	−.144	.266	.698	.485	<.001	−.594	−4.497	<.001*	.049	.100	−.173	.386	.909	.364	.001
Neuroticism	**1.095**	**19.873**	**<.001***	**.341**	**.302**	**.090**	**.516**	**4.198**	**<.001***	**.012**	**1.075**	**13.633**	**<.001***	**.322**	**.303**	**.025**	**.573**	**3.010**	**.003***	**.012**
DASS total score[b]	.597	19.932	<.001*	.345							.569	14.239	<.001*	.345						
Depressive symptoms	1.528	19.882	<.001*	.344	.413	.111	.744	3.779	<.001*	.009	1.268	12.589	<.001*	.292	.174	−.347	.570	1.217	.224	.002
Anxiety symptoms	1.378	14.049	<.001*	.207	.284	−.005	.585	2.583	.010	.004	1.556	11.304	<.001*	.249	.576	.162	1.022	3.478	.001*	.016
Stress	1.147	15.089	<.001*	.232	.341	.123	.549	3.776	<.001*	.009	1.192	11.568	<.001*	.258	.320	−.033	.683	2.437	.015	.008

Note. [a] and [b] are merged variables. If significant results were found for these merged variables, simple regression analysis were also performed for the separate variables these merged variables were based on.
*Significant if $p \leq .01$. The rows marked bold represent variables that were significant in the simple and multiple regression analyses in the exploratory sample as well as in the confirmatory sample.
FEDA = Questionnaire for Experiences of Attention Deficits, BMI = body mass index, DASS = Depression Anxiety Stress Scales.

FEDA and lower estimations of self-efficacy on the MSEQ were consistently found to be predicted by a lower self-rated health and quality of life, lower scores on Conscientiousness, Extraversion, and Agreeableness, and higher scores on Neuroticism, Depressive symptoms, Anxiety symptoms, and Stress. Additionally, more complaints on the BRIEF-A BRI were predicted by a lower income, less hours of sleep, and a lower sleep quality. For the BRIEF-A MI, more complaints were additionally predicted by a lower age, less hours of sleep, and a lower sleep quality. Lower estimations on the MSEQ were additionally found to be predicted by being male, a lower education level, and a lower score on Openness. Finally, more reported complaints on the FEDA were additionally found to be predicted by being female, a lower education level, not having a partner, not having children, a lower income, less hours of sleep, and a lower sleep quality.

Step 2: Multiple linear regression

In the second step, for each dependent variable the significant predictors from step 1 were put into a multiple regression model using the enter method. For the purpose of internal validation bootstrapping was applied (Tables 2–5). More complaints on the BRIEF-A BRI were significantly predicted by a lower score on Agreeableness and higher scores on Neuroticism and Stress. The variable Stress had the highest sr^2; this variable could uniquely explain 6.0% of variance in the BRIEF-A BRI (i.e., large effect). For Agreeableness and Neuroticism the uniquely explained variances were 1.6% and 3.6%, respectively (i.e., medium effects). Partly similar results were found for the BRIEF-A MI. Here, more complaints were significantly predicted by a lower age, a lower score on Conscientiousness, and higher scores on Agreeableness, Depressive symptoms, and Stress. Within this context, the variable Conscientiousness had the highest unique contribution to the total variation, namely 13.4% (i.e., large effect). The other four predictors had small to medium sr^2 values between 0.6% and 2.3%. For the MSEQ, the variables gender (i.e., being male) and a lower score on Conscientiousness significantly predicted a lower confidence estimation. The personality factor Conscientiousness had the highest unique contribution and explained 2.4% of variance in the MSEQ (i.e., medium effect). For gender the uniquely explained variance was 0.9% (i.e., small effect). Finally, for the FEDA, more complaints were predicted by lower scores on Conscientiousness and Extraversion and higher scores on Neuroticism, Depressive symptoms, and Stress. Conscientiousness had again the highest unique contribution (i.e., 2.5%, medium effect). The sr^2 values for the other three significant predictors ranged between 0.9% and 1.6% (i.e., small to medium effects).

The total models for the BRIEF-A BRI, BRIEF-A MI, and FEDA were all significant and had large effect sizes, explaining 42% ($F(12, 740) = 44.252$, $p < .001$), 43% ($F(12, 740) = 46.702$, $p < .001$), and 52% ($F(17, 731) = 45.682$, $p < .001$) of the variance, respectively. The total model for the MSEQ was also significant and explained 14% of variance ($F(13, 736) = 9.494$, $p < .001$). This is considered to be a medium effect size.

Confirmatory analysis

Step 1: Simple linear regression

Tables 2–5 show the results of the simple linear regression analyses in the confirmatory sample. For both the BRIEF-A BRI and BRIEF-A MI, there were 12 significant predictors, for the MSEQ ten, and for the FEDA 14. More complaints on the two BRIEF-A indexes and FEDA and lower estimations of self-efficacy on the MSEQ were all predicted by a lower quality of life, lower scores on Conscientiousness and Extraversion, and higher scores on Neuroticism, Depressive symptoms, Anxiety symptoms, and Stress. Additionally, more complaints on the BRIEF-A BRI were predicted by a lower age and income, less hours of sleep, a lower sleep quality, and a lower score on Agreeableness. A higher number of complaints on the BRIEF-A MI was additionally found to be predicted by a lower age, having pets, having a profession, less hours of sleep, and a lower sleep quality. A lower confidence estimate on the MSEQ was additionally found to be predicted by a higher age, a lower education level, and not having a profession. Finally, for the FEDA more complaints could additionally be predicted by a lower education level, not having a partner, a lower income, less hours of sleep, a lower sleep quality, a lower self-rated health, and a lower score on Agreeableness.

Overall, the significant predictors in step 1 for the confirmatory analysis were highly similar to the significant predictors of this step in the exploratory sample. However, a smaller number of variables reached statistical significance in the confirmatory sample. For the BRIEF-A BRI, this was self-rated health, for the BRIEF-A MI self-rated health and Agreeableness, for the MSEQ gender, self-rated health, Openness, and Agreeableness, and for the FEDA gender and having children. Additionally, there were some predictors that were statistically significant in the confirmatory analysis that were not statistically significant in the exploratory analysis. These were age for the BRIEF-A BRI and MSEQ, having a profession for the BRIEF-A MI and MSEQ, and having pets for the BRIEF-A MI.

Step 2: Multiple linear regression

Tables 2–5 show the results of the multiple regression analyses and bootstrapping for the four dependent variables using the significant predictors from step 1. Additionally, for the BRIEF-A MI the variable Agreeableness and for the MSEQ the variable gender were added to the multiple regression models, as these were found to be significant predictors in step 2 of the exploratory analyses. For the other two dependent variables no other variables were added.

For the BRIEF-A BRI, the variables Agreeableness, Neuroticism, and Stress were significant predictors, just as in the exploratory analysis. Additionally, the variables hours of sleep and sleep quality were found to be significant predictors in the confirmatory analysis. More complaints were

predicted by fewer hours of sleep, a higher sleep quality, a lower score on Agreeableness, and higher scores on Neuroticism and Stress. Just as in the exploratory sample, Stress had the highest unique contribution to the total variation, namely 6.0% (i.e., large effect). For Neuroticism this was 3.5% and for Agreeableness 1.2% (medium effects); both are highly similar to the sr^2 values in the exploratory sample. Hours of sleep and sleep quality could both uniquely explain 1.3% (i.e., medium effects). For the BRIEF-A MI, the variables Conscientiousness, Agreeableness, and Depressive symptoms were again significant predictors. More complaints on the BRIEF-A MI could be predicted by a lower score on Conscientiousness and higher scores on Agreeableness and Depressive symptoms. Similar to the results of the exploratory analysis, Conscientiousness could uniquely explain 14.9% of variance (large effect). The unique contribution of Depressive symptoms was 2.3% and of Agreeableness 1.0% (medium effects). The variables age and Stress did not have the same significant predictive value here as they had in the exploratory analysis. For the MSEQ, none of the predictors was statistically significant in the confirmatory analysis, while in the exploratory analysis the variables gender and Conscientiousness were found to be significant predictors. However, the variable Depressive symptoms could uniquely explain 1.3% of variance (medium effect) and showed a trend toward significance. Despite the lack of significant predictors, the total model of MSEQ was statistically significant. For the FEDA, the personality factors Conscientiousness, Extraversion, and Neuroticism were again found to be significant predictors. These variables uniquely explained 4.1%, 1.2%, and 1.2% of the variance in the FEDA, falling in the same medium range as in exploratory analysis (i.e., 2.5%, 1.6%, and 1.2%). Additionally, the variables hours of sleep and Anxiety symptoms were significant in the confirmatory analysis, both uniquely explaining 1.6% of variance in FEDA (i.e., medium effects). Overall, more complaints could be predicted by less hours of sleep, lower scores on Conscientiousness and Extraversion, and higher scores on Neuroticism and Anxiety symptoms. In contrast to the exploratory analysis, the variables Depressive symptoms and Stress were not found to significantly predict the scores on the FEDA.

The total models for the BRIEF-A BRI, BRIEF-A MI, and FEDA all had a large effect size and explained 47% ($F(12, 373) = 27.389$, $p < .001$), 49% ($F(13, 372) = 27.523$, $p < .001$), and 52% ($F(15, 370) = 26.811$, $p < .001$) of variance, respectively. The total model for the MSEQ explained 17% of variance ($F(12, 373) = 6.313$, $p < .001$), which is a medium effect size. These R^2 values are similar to those found in the exploratory analysis (i.e., maximum of 6% difference).

Discussion

The current study examined a large community sample of adults aged 40 years and older in order to assess to what extent psychological factors contribute to the subjective experience of cognitive complaints in the domains of executive functioning, memory, and attention. Using a two-step regression approach with bootstrapping for internal validation, it was first examined which factors could predict the presence of complaints in the different cognitive domains in an exploratory sample and subsequently these results were independently validated in a second confirmatory sample.

The results of the present study indicate that for the domain of executive functioning, in both the exploratory and confirmatory sample, more complaints about the ability to appropriately regulate behavior and emotional responses (i.e., BRIEF-A BRI) were predicted by a lower level of agreeableness and higher levels of neuroticism and perceived stress. More complaints about the ability to actively solve problems in different circumstances (i.e., BRIEF-A MI) were predicted by a lower level of conscientiousness, higher levels of agreeableness, and more (severe) depressive symptoms. Regarding attention, more complaints in this domain were consistently found to be predicted by lower levels of conscientiousness and extraversion, together with a higher level of neuroticism. For the cognitive domain of memory, no significant predictors were consistently found across the exploratory and confirmatory samples. Other independent variables included in the study, such as age, gender, sleep, quality of life, perceived health, and other demographic factors, did not consistently predict complaints in any of the cognitive domains.

These results show that personality factors were consistently found to predict SCCs, in particular neuroticism, conscientiousness, agreeableness, and extraversion. Just as in previous studies, a higher level of neuroticism predicted more complaints (Kliegel & Zimprich, 2005; Reid & MacLullich, 2006). Research shows that people who score higher on neuroticism tend to experience higher levels of anxiety, worry more often, and are less able to cope with stress and frustration, in comparison to people with lower neuroticism scores (Hoekstra et al., 2007). Additionally, they are more likely to recall negative things, including cognitive complaints. As predicted, conscientiousness showed an inverse relation with SCCs (Slavin et al., 2010). It is assumed that people who score low on this factor are more messy and less dutiful, disciplined, and achievement-striving than people scoring high on this factor. They have lower levels of self-awareness related to their health and probably their cognitive functioning, and are less likely to exhibit preventive health behaviors such as using mnemonics to prevent memory failures (Kliegel & Zimprich, 2005).

For the personality factors agreeableness and extraversion, there were no clear expectations as, according to our knowledge, they are not consistently mentioned as associated with SCCs in the literature. In this current study, however, lower levels of extraversion were found to be associated with SCCs in the domain of attention. A lower score on this personality factor points to introversion. Introverted people have been described to tend to focus their attention more often on their own feelings, thoughts, and activities, instead of being focused on their environment like extraverts do (Hoekstra et al., 2007). This could make them more aware of any

SCCs earlier or more frequently than people who score higher on extraversion. For the factor agreeableness, findings were mixed regarding the two indexes of executive functioning. More complaints regarding the ability to regulate behavior and emotional responses (i.e., BRIEF-A BRI) were predicted by lower levels of agreeableness, while more complaints regarding actively solving problems in different circumstances (i.e., BRIEF-A MI) were predicted by a higher agreeableness level. It is important to note that for the latter executive functioning ability, the simple linear regression analysis in both samples indicated that more complaints were predicted by lower levels of agreeableness. This means that, in the multiple regression models this was reversed for the BRIEF-A MI. The exact reason for this is unclear, but it could be due to interactions between agreeableness and the other independent variables included in the models. In general, people who score high on agreeableness are relatively altruistic, helpful, friendly, and orientated toward the experiences, interests, and goals of others. Low scorers, conversely, are more antagonistic and egocentric, and their attitude is more competitive (Hoekstra et al., 2007). Previous studies did not find a relationship between agreeableness and subjective executive functioning in older adults (e.g., Bell et al., 2020). However, in children, there seems to be a positive association between agreeableness and effortful (or executive) control, which refers to the ability to use attentional resources and inhibit behavioral responses in order to regulate emotions and behaviors (Ode & Robinson, 2007). It has been suggested that effortful control is an important precursor for agreeableness in adulthood (e.g., Jensen-Campbell et al., 2002). In particular, this could explain the predictive value of lower levels of agreeableness for complaints regarding the ability to regulate behavior and emotional responses (i.e., BRIEF-A BRI).

With regard to negative affective states, the presence of self-reported depressive symptoms and stress was consistently found to predict subjective complaints regarding the ability to actively solve problems in different circumstances (i.e., BRIEF-A MI) and the ability to appropriately regulate behavior and emotional responses (BRIEF-A BRI), respectively. Additionally, anxiety symptoms were close to reaching statistical significance for the prediction of complaints with regard to attention functioning (i.e., FEDA). Prior studies already reported a positive association between more (severe) depressive symptoms and self-reported complaints regarding executive functioning on the BRIEF-A (e.g., Meltzer et al., 2017; Rabin et al., 2006). It appears that people who report more symptoms of depression are relatively more likely to misconceive normal lapses in cognitive functioning as representing cognitive impairment and overrate any actual cognitive errors, while downplaying cognitive successes (Meltzer et al., 2017). Such misinterpretations can lead to an increased report of complaints regarding their cognitive functioning. A similar explanation is proposed for perceived stress; it creates attentional biases toward cognitive errors, promoting worrying and over-awareness of cognitive functioning (Bell et al., 2020). Additionally, people with higher levels of perceived stress are more likely than people with low levels of stress to ruminate negative events (Willis & Burnett, 2016), such as cognitive errors, which in turn magnifies the body's stress reaction (Zoccola & Dickerson, 2012). In sum, negative affective states, such as depressive symptoms and stress, are associated with biases toward a more unpleasant perception, attention, interpretation, and recall from memory of emotional information, including cognitive errors (Gomez et al., 2002).

In the final models, the included psychological factors could explain about half of the variance of the scores for subjective executive functioning and attention. This emphasizes the importance of these psychological factors in understanding the subjective experience of complaints in these cognitive domains. These findings fit with the biopsychosocial model of health (Engel, 1980), which states that both health and disease can be explained by a dynamic interaction between biological, psychological, and social factors. The results of this study imply that clinicians should take psychological factors into account when dealing with patients who present with SCCs. In particular, if standardized cognitive testing does not clearly indicate cognitive impairment, the assessment of psychological factors, such as personality factors and negative affective states, is indicated. If patients for instance show high levels of perceived stress, interventions for stress management have the potential to reduce SCCs and improve wellbeing and quality of life.

In general, the findings of this study suggest that both objective and subjective measures of cognition should be taken into account when conducting a neuropsychological assessment in an individual subject. Previous studies indicated that there is only limited support for a link between SCCs and the concurrent level of objective performance on cognitive tests (e.g., Burmester et al., 2016; Fuermaier et al., 2015; Koerts et al., 2012). There might be several explanations for the lack of an association. First, different aspects of cognition might be measured with objective and subjective measures. Whereas objective measures of cognition often take a snapshot of behavior and require optimal performance, subjective self-report measures require subjects to evaluate their average or typical performance over a certain period of time (e.g., the last two months). Second, objective measures might lack ecological validity, since they are rather structured and often aim at measuring a single aspect of cognition. Subjective measures of cognition focus more often on everyday performance that requires the integration of multiple cognitive functions. Third, there might be differences in motivation when performing objective cognitive measures compared to performance in everyday life as measured with self-report measures. Fourth, unimpaired performance on objective cognitive tests could be the result of successful compensation by the subject while the subject still reports cognitive complaints on self-report measures. Finally, it is possible that subtle cognitive impairments are difficult to detect with objective cognitive measures due to a lack of sensitivity and specificity even though they are reported on self-report measures of cognition. Therefore, both objective measures of cognition and self-report

measures of SCCs should be taken into account when integrating and interpretating the results of a neuropsychological assessment since both can provide valuable information.

Strengths of the current study were the recruitment of a large heterogeneous community sample of adults aged 40 years and older; the use of the BRIEF-A validity scales as exclusion criteria; the assessment of three different cognitive domains; the division of the total sample into exploratory and confirmatory samples, which allows independent validation; and the application of both *p*-values and bootstrapping to determine significant predictors, which allows internal validation. These strengths together make the results of this study reliable and generalizable to the general population.

However, the considerably lower percentage of explained variance for memory and the lack of significant predictors in this cognitive domain are noteworthy. Memory is probably a cognitive construct that is easier for people to understand and observe; therefore, it could be that participants had a better feeling of what memory failure is, making their self-evaluations more fitting and less influenced by other factors such as personality and negative affect states. In addition, the MSEQ does not directly measure the presence of memory complaints, but instead assesses memory self-efficacy. This refers to an individual's belief or confidence in one's own capacity to remember different memory aspects (i.e., the location of objects, shopping list, names, important points from a story). In this regard, the MSEQ is different from the BRIEF-A and FEDA, as these questionnaires directly ask how often certain complaints regarding executive functioning or attention occur in daily life. The reason for using a measure of memory self-efficacy was that most memory questionnaires measure subjective memory complaints in relation to a specific disorder (e.g., Alzheimer's disease). These questionnaires assess rather severe memory complaints and cannot be applied to the normal population, as they would result in ceiling effects. One may therefore assume that the MSEQ measures subjective cognitive complaints in a different way than the other two questionnaires. An alternative for future research could be to use a questionnaire for relatively minor subjective memory complaints in the general population, such as for instance the Prospective Retrospective Memory Questionnaire (Crawford et al., 2003).

A limitation of this study is the fact that there were relatively few participants in the exploratory and confirmatory sample with (very) high scores on the BRIEF-A indexes and DASS scales (i.e., depressive symptoms, anxiety symptoms, and stress). This indicates that the participants in this study were relatively healthy regarding their cognitive and mental functioning. This could have influenced the results and the observed patterns may not be maintained in clinical samples with greater variability in cognitive and mental abilities. A recommendation for future research is, therefore, to conduct studies on SCCs in clinical samples. In this context, the number of factors that is explored can be reduced so that smaller samples can be used to examine explanatory hypotheses. Second, about 20% of the participants were excluded from the analysis because they did not fully complete the BRIEF-A, MSEQ, and FEDA. This may have resulted in a selection bias; participants with more cognitive and/or mental complaints could have had relatively more difficulties with completing the survey. Third, the study did not include objective measures of cognition. Therefore, an unknown number of participants might have had actual cognitive impairments; participants who should have been excluded from the present study. Fourth, regarding the independent variable hours of sleep per night, which we considered as a continuous variable, it is important to mention that more hours of sleep is not always better. Both too little and too much sleep can be unhealthy and could affect SCCs (e.g., Devore et al., 2014). A fifth limitation is that no causal conclusions can be drawn from the current study. Both dependent and independent variables could potentially overlap, share an underlying etiology, or simultaneously influence each other. Finally, there might be other confounding variables affecting SCCs that were not included in the study, such as social support, previous life events, or neuropsychiatric symptoms (e.g., mild behavioral impairment, Rouse et al., 2021). Future research could focus on disentangling the differential effects of the independent variables on the cognitive domains and look into causality using a prospective longitudinal design. Other avenues worth exploring are the interactions between measures and the effects of confounding variables.

Conclusion

In sum, the results of this study highlight the role of psychological factors in the subjective experience of cognitive complaints. In particular, personality factors and negative affective states, such as perceived stress and depressive symptoms, seem to predict the presence of SCCs in the domains of executive functioning and attention.

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Data availability statement

All data files are available from the dataverseNL database: https://doi.org/10.34894/QNVTOA.

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