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NEUROPSYCHOLOGICAL FACTORS OF SUBJECTIVE COGNITIVE COMPLAINTS OF THE OLDER ADULTS

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SUMMARY

Background: Subjective cognitive complaints (SCCs) are defined as belief of the decline of a cognitive condition compared with an earlier period of functioning. Many studies have shown the relationship between SCCs with objective neuropsychological results as well its dependency on psychological characteristics. Considering the complex nature of SCCs, this study tested the relationship between SCCs reported in the attention domain with the results obtained in neuropsychological attention tasks, as well as with psychological characteristics and among complaints reported in various domains of functioning.

Material/ Methods: Sixty participants over 60 years of age took part in the study. Subjects were tested for the intensity of SCCs in everyday functioning, psychological characteristics (mood; anxiety, state and trait; and personality traits) and various aspects of attention domain (switching, divided, and focus).

Results: The SCC intensity reported in various areas of functioning was associated with each other as well as with psychological characteristics (personality traits, anxiety, and mood/depression). There were no significant relations between the SCC intensity reported in the attention domain and the outcomes obtained in neuropsychological attention tasks.

Conclusions: Our results showed that the intensity of SCCs may be a result of subjects' psychological characteristics and that the tendency to report complaints in various spheres of functioning simultaneously may be observed. It seems to be important to consider that SCCs are related to several psychological factors when it is included in a cognitive diagnosis and treated as a direct indicator of a cognitive condition.

Keywords: SCCs, switching of attention, divided attention, focus of attention, anxiety, personality traits

INTRODUCTION

Subjective cognitive complaints (SCCs) are defined in the subject literature as a belief that cognitive status has decreased when compared with a previous time period (Jessen et al., 2014). SCCs are considered to be an important aspect of neuropsychological diagnosis, a fact emphasized by including SCCs in the classification in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychological Association [APA], 2013) in which it is treated as a criterion required for diagnosing mild cognitive impairment (MCI), understood as a risk state for developing serious disorders (Kawagoe, Onoda, & Yamaguchi, 2019).

The etiology of SCCs seems to be complex. Reported complaints are an indicator (or predictor) of results obtained in neuropsychological tests, but research has revealed the discrepancy between the simultaneous subjective and objective evaluation of cognitive skills (Mendonça, Alves, & Bugalho, 2016). The relationship between SCCs and objective decline has been verified in research that employed neuropsychological and neuroimaging tools. Participants who assessed their cognitive status as good achieved higher results in memory and verbal fluency tasks (Gagnon et al., 1994; Jessen et al., 2007; Jorm et al., 2004; Koppara et al., 2015; Van Bergen, Jelicicic, & Merckelbach, 2009), attention and psychomotor speed tests (Dufouil, Fuhrer, & Alpérovitch, 2005), orientation in time and space (Jonker, Launer, Holler, & Lindeboom, 1996), and in their general cognitive state (Dufouil et al., 2005; Jonker et al., 1996). Furthermore, the higher intensity of reported complaints was associated with a weaker performance of the applied tests (Dufouil et al., 2005; Jonker et al., 1996).

SCCs are also considered to be a predictor of the cognitive state. Indeed, generating numerous complaints can be linked to the later higher cognitive decline in the attention (Dufouil et al., 2005), memory (Hohman et al., 2011; Schofield et al., 1997), and executive function (Dik et al., 2001) domains. More importantly, research has also revealed the relationship between SCCs and specific cognitive impairments, including MCI (Donovan et al., 2014; Erro et al., 2014; Perrotin et al., 2017) and Alzheimer's disease, even if the participants were cognitively intact during the first neuropsychological assessment (Geerlings et al., 1999; Jessen et al., 2010). Neuroimaging results have confirmed the relationship between SCCs and objective cognitive status. The differences in brain functioning and structure across participants reporting and not reporting SCCs have included lower activity and greater gray matter loss in the temporal area (Hafkemeijer et al., 2013; Hohman et al., 2011; Rodda et al., 2011; Saykin et al., 2006; Van der Flier et al., 2004), greater activity and thinner gray matter in the parietal and occipital areas (Hohman et al., 2011; Schultz et al., 2015), and pathological changes specific for Alzheimer's disease in the frontal area (Ding et al., 2014; Hafkemeijer et al., 2013). Researchers have postulated that the changes in brain functioning constitute a compensation for the gradual neuronal loss (Ashraf, Fan, Brooks, & Edison, 2015; Kawagoe et al., 2019).

Numerous studies have shown that generating SCCs can be related to psychological factors. Increased SCC intensity may be linked to mood decline and anxiety. One of the characteristic features of a reduced mood and anxiety are cognitive distortions (Jarema et al., 2014; Wells, 2010) oriented to capture negative information (Kołodziej & Brzezicka, 2015). People with depression (also people without depression but with higher results on a depression scale) have a tendency to generate more complaints about their health than the objective measurement would suggest (Lautenschlager, Flicker, Vasikaran, Leedman, & Almeida, 2005; Yates, Clare, & Woods, 2017). In a similar way, personality traits can be understood as factors that impact cognitive complaint reporting (Nijsse et al., 2017). Considering Costa and McCrae's (1992) model of personality (which includes neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness), the most frequent relationship has been observed between SCCs and a higher level of neuroticism and anxiety (Nijsse et al., 2017; Perrotin et al., 2017; Van der Hiele et al., 2012). The relationships between SCCs and other personality traits have often not provided clear conclusions (Nijsse et al., 2017; Slavin et al., 2010).

Given the complex nature of the SCCs and their role in neuropsychological diagnosis, it seems to be important to test their determinants and predictors. Therefore, the main aim of our study was to assess the relationship between SCCs reported in the attention domain and attention task performance as well as the relationship between SCCs and particular psychological characteristics. In addition, we examined the connection between complaints reported among different areas of cognitive functioning.

METHODS

Participants

Sixty participants took part in the project. Participants were recruited from among students of the University of the Third Age in Torun and from amongst attendees of the "Kamienica Inicjatyw" Senior Citizen Club in Torun. The subjects who met the inclusion criteria – (1) age ≥ 61 years; (2) lack of dementia (Mini-Mental State Examination [MMSE] > 24); (3) lack of visual problems (normal or corrected-to-normal); and (4) good general health – were included in the analysis. The analysis included the data from 51 participants (44 women and 7 men), between 61 and 86 years old (M = 69.61, SD = 5.048 years). The subjects had a minimum of 8 years of education (M = 14.48, SD = 3.49): 66% of the subjects reported a secondary or vocational education, and 41% higher education.

Procedure

At the beginning of the meeting, participants were familiarized with the information about the project and provided written informed consent to participate

after all study details had been fully explained. Each person performed tasks in the same order: (1) the State-Trait Anxiety Inventory (STAI), (2) interview for collecting basic data about participants, (3) MMSE, (4) attention tasks from the Vienna Test System (VTS), (5) the attention task from Cambridge Neuropsychological Test Automated Battery (CANTAB), (6) the Beck Depression Inventory (BDI), (7) the Personality Inventory (NEO-FFI), and (8) the Patient-Reported Outcomes in Cognitive Impairment (PROCOG). All tests were performed during a single session that lasted approximately 2 hours (with short breaks between tasks).

Measures

Psychological tools

The following tools were used to assess psychological characteristics: (1) the STAI, to evaluate state and trait anxiety intensity (Sosnowski, Wrześniewski, Jaworowska, & Fecenec, 2006); (2) the BDI, to monitor mood/severity of depression (Beck, Steer, & Carbin, 1988); and (3) the NEO-FFI, to measure the intensity of personality traits, including neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (McCrae & Costa, 1991).

The PROCOG

The PROCOG questionnaire (Frank et al., 2006) served to estimate the SCC intensity. The scale comprises 55 items divided into seven subscales that describe cognitive difficulties and their consequences for everyday functioning from the last two weeks. The subscales include the following domains: attention and thinking, long-term memory, episodic memory, semantic memory, emotional reactions to perceived cognitive difficulties, the sense of loss of acquired skills, and social restrictions associated with cognitive deficits. Subjects are asked to assess their difficulty on 5-point scale. The maximum score is 220.

Neuropsychological tools

Several computer tasks assessed particular aspects of attention. The attention task from the CANTAB (eclipse version 5.0) evaluated attention switch, while several VTS tasks measured focus and division of attention.

Focus of attention (COG)

The COG task from the VTS was used to assess attention focus ability (Schuhfried, Neuwirth, Benesch, & Hoskovcová, 1994). Two rows of figures were displayed on the computer screen. The top row included four figures and the bottom row had one figure. The subject's task was to assess whether any of the figures placed in the top row were identical to the pattern from the bottom row. The subject was asked to press the green button as fast as possible if the figures were identical and the red button if not. The number of correct and incorrect reactions as well as the reaction times were analyzed.

Divided attention (WAFG)

The WAFG task from the VTS was used to assess divided attention (Schuhfried, Neuwirth, Benesch, & Hoskovcová, 1994). The test comprises several parts. In the first part, squares and triangles were displayed, one by one, on the computer screen. The subject was asked to press the button each time two squares were displayed on the screen in a row. In the second part, the subject listened to high and low sounds and the task was to press the button each time two high sounds were given in a row. In the last part, figures (squares and triangles) and sounds (high and low) were given simultaneously; the task was to press the button each time two squares or two high sounds were given in a row. The number of correct and incorrect reactions (including false alarms and omissions) as well as the reaction times were analyzed.

Attention switching task (AST)

The AST task from the CANTAB was used to assess switching attention ability (Sharma, 2013). The test includes several parts. In the first part, arrows were simultaneously displayed in the center of the computer screen, pointing left or right, and with the question "Which direction?". The task was to press the left button if the arrow was pointing left and the right button if the arrow was pointing to the right. In the second part, the subject's task was to again answer the question about the direction of the arrow, but this time the arrows were displayed on the left or right side of the computer. In the next part of the test the question "Which side?" was displayed on the screen, and the subject was asked to press the right button if the arrow was displayed on the right, and the left button if it was on the left side of the computer, regardless of its direction. In the last part, the questions "Which direction?" and "Which side?" were displayed in a random order on the computer screen. The number of correct and incorrect reactions (including the lack of reactions) as well as the reaction times were analyzed.

Statistical analysis

We analyzed the data as follows: (1) correlation analyses for testing the relationship between the intensity of SCCs in the attention domain and the results of attention tests; (2) correlation analyses for testing the relationship between the intensity of SCCs and the psychological characteristics; and (3) correlation analyses for testing the relationship between the SCCs reported in various areas of functioning.

RESULTS

Table 1 presents descriptive statistics about the variables we measured in the subjects.

Table 1. Descriptive Statistics of Psychological and Attention Measures

	N	M	SD
Anxiety (state)	51	32.03	6.66
Anxiety (trait)	51	39.52	7.64
Mood/level of depression	51	6.67	4.44
Neuroticism	51	17.29	7.49
Extraversion	51	29.59	6.17
Agreeableness	51	33.22	5.60
Conscientiousness	51	33.69	4.71
Openness to experience	51	27.63	5.20
SCCs	51	49.55	28.37
SCCs in the CogF domain	51	11.96	4.98
SCCs in the LTM domain	51	1.43	0.99
SCCs in the MemE domain	51	5.84	3.66
SCCs in the SemM domain	51	6.16	3.18
SCCs in the Aff domain	51	10.59	8.27
SCCs in the SkillL domain	51	5.14	4.67
SCCs in the SocI domain	51	5.00	4.34
AFT (correct reactions)	51	54.45	3.45
AFT (incorrect reactions)	51	5.55	3.45
AFT (average time of correct reactions)	51	3.12	0.82
AFT (average time of incorrect reactions)	51	3.54	1.32
DAT (correct reactions)	51	18.43	3.3
DAT (false alarms)	51	1.98	2.66
DAT (missed reactions)	51	2.57	3.3
DAT (average reaction time)	51	782.22	258.83
AST (correct reactions)	50	134.9	21.62
AST (incorrect reactions)	50	11.9	10.27
AST (lack of reactions)	50	11.84	14.34
AST (average time of correct responses)	50	1116.94	212.94

Note. SCCs, subjective cognitive complaints in all areas; CogF, subjective cognitive complaints in the attention and thinking area; LTM, subjective cognitive complaints in the long-term memory area; MemM, subjective cognitive complaints in the episodic memory area; SemM, subjective cognitive complaints in the semantic memory area; Aff, subjective cognitive complaints in emotional reactions to perceived cognitive difficulties area; SkillL, subjective cognitive complaints in the sense of loss of the acquired skills area; SocI, subjective cognitive complaints in social restrictions associated with the cognitive deficits area; AFT, attention focus task; DAT, divided attention task; AST, attention switching task.

The relationship between the intensity of SCC reported in different areas of functioning

We performed correlation analyses to examine whether the intensity of SCCs reported in various areas of functioning are related to each other. There were positive significant correlations between each of the subscales of SCCs (Table 2). The strength of all these relationships varied from moderate to very strong (see Bedyńska & Cypryńska, 2013).

Table 2. Spearman's Correlation Between Subjective Cognitive Complaints Reported in Various Areas

	CogF	LTM	MemE	SemM	Aff	SkillL
LTM	0.59**					
MemE	0.69**	0.48**				
SemM	0.70**	0.59**	0.70**			
Aff	0.70**	0.60**	0.73**	0.71**		
SkillL	0.71**	0.52**	0.66**	0.60**	0.77**	
SocI	0.82**	0.67**	0.67**	0.71**	0.78**	0.75**

Note. ** $p < 0.01$. CogF, subjective cognitive complaints in the attention and thinking area; LTM, subjective cognitive complaints in the long-term memory area; MemM, subjective cognitive complaints in the episodic memory area; SemM, subjective cognitive complaints in the semantic memory area; Aff, subjective cognitive complaints in emotional reactions to the perceived cognitive difficulties area; SkillL, subjective cognitive complaints in the sense of loss of the acquired skills area; SocI, subjective cognitive complaints in social restrictions associated with the cognitive deficits area.

The relationship between the results of the standard attention tasks and the intensity of SCCs in the attention domain

We used the results obtained by participants in the attention tasks and the intensity of the SCCs reported in the attention domain in a correlation analysis. There were no significant correlations between the variables (Table 3).

The relationship between psychological characteristics and the intensity of SCCs in various areas of functioning

Correlation analyses between the SCCs reported in various areas of functioning and the psychological characteristics were significant (Table 4). The strength

Table 3. Pearson's and Spearman's Correlation Coefficients Between Subjective Cognitive Complaints and Attention Task Scores

	CogF	
	Pearson's r correlation	p
DAT (average reaction time)	0.15	0.302
AST (average time of correct reactions)	0.06	0.667
	Spearman's rho correlation	p
AFT (correct reactions)	0.07	0.61
AFT (incorrect reactions)	-0.07	0.61
AFT (average time of correct reactions)	0.25	0.078
AFT (average time of incorrect reactions)	0.23	0.11
DAT (false alarms)	-0.07	0.627
DAT (missed reactions)	0.04	0.81
DAT (correct reactions)	-0.04	0.81
AST (lack of reactions)	0.02	0.916
AST (incorrect reactions)	-0.09	0.538
AST (correct reactions)	0.03	0.853

Note: CogF, subjective cognitive complaints in the attention and thinking area; DAT, divided attention task; AST, attention switching task; AFT, attention focus task.

Table 4. Spearman's Correlation Coefficients Between PROCOG Subscales and Psychological Characteristics

	CogF	LTM	MemE	SemM	Aff	SkillL	SocI
Mood/level of depression	0.45**	0.28*	0.34**	0.34**	0.51**	0.41**	0.43**
Anxiety (state)	0.36**	0.17	0.40**	0.27*	0.38*	0.31*	0.28*
Anxiety (trait)	0.51**	0.45**	0.35**	0.40**	0.51*	0.48**	0.57**
Neuroticism	0.44**	0.29*	0.30*	0.37**	0.42*	0.41**	0.41**
Extraversion	-0.36**	-0.09	-0.32*	-0.33*	-0.21	-0.29*	-0.30*
Openness to experience	-0.16	-0.04	-0.28	-0.14	-0.14	-0.19	-0.16
Conscientiousness	-0.26*	-0.17	-0.33*	-0.27*	-0.20	-0.32*	-0.24
Agreeableness	-0.29*	-0.13	-0.33*	-0.27*	-0.18	-0.32*	-0.31*

Note. * $p < 0.05$ ** $p < 0.01$. PROCOG, Patient-Reported Outcomes in Cognitive Impairment; CogF, subjective cognitive complaints in the attention and thinking area; LTM, subjective cognitive complaints in the long-term memory area; MemM, subjective cognitive complaints in the episodic memory area; SemM, subjective cognitive complaints in the semantic memory area; Aff, subjective cognitive complaints in emotional reactions to the perceived cognitive difficulties area; SkillL, subjective cognitive complaints in the sense of loss of the acquired skills area; SocI, subjective cognitive complaints in social restrictions associated with the cognitive deficits area.

of all these relationships varied from weak to strong (see Bedyńska & Cypryńska, 2013).

We found the following significant relationships:

1. A positive correlation between the intensity of SCCs in the area of attention and thinking (CogF) and mood and anxiety (state and trait) and neuroticism, as well as a negative correlation with extraversion, agreeableness, and conscientiousness;
2. A positive relationship between the intensity of SCCs in long-term memory and mood, anxiety (trait) and neuroticism;
3. A positive relationship between the intensity of SCCs in episodic memory and mood, neuroticism, and anxiety (state and trait), as well as a negative relationship with extraversion, conscientiousness, and agreeableness;
4. A positive correlation between the intensity of SCCs in semantic memory and mood, anxiety (state and trait), and neuroticism, as well as a negative significant correlation with extraversion, agreeableness, and conscientiousness;
5. A positive correlation between the intensity of SCCs in emotional reactions to perceived cognitive difficulties and mood, anxiety (state and trait), and neuroticism;
6. A positive correlation between the intensity of SCCs in the sense of loss of acquired skills and mood, neuroticism, and anxiety (state and trait), as well as a negative correlation with extraversion, conscientiousness, and agreeableness;
7. A positive correlation between the intensity of SCCs in the sense of social restrictions associated with cognitive deficits (SocI) and mood, neuroticism, and anxiety (state and trait), as well as a negative correlation with extraversion and agreeableness.

DISCUSSION

The main aim of this study was to evaluate the relationship between the intensity of SCCs reported among different areas of functioning, and its connection to particular psychological characteristics, as well as with the objective results obtained in neuropsychological tests (i.e., complaints reported in the attention domain and the performance of the attention test).

The relationship between SCCs reported in various areas of functioning

Correlation analyses revealed positive significant relationships between SCCs reported in each area of functioning. Therefore, SCCs seem to be a holistic construct that has several aspects, from noticing cognitive deficits, through feeling their impact on various aspects of life, to emotional responses to these phenomena. In particular, the correlation analyses can be divided into those between SCCs reported in cognitive areas, between non-cognitive spheres of functioning, and between cognitive and non-cognitive areas.

The first type of correlations refers to the positive relationship between the subscales of cognitive functioning. Items included in the subscale for attention and thinking (e.g., *Do you lose your way to places you've been many times?*) correlate with subscales relating to particular types of memory: long-term memory (e.g., *How difficult is it for you to recall events from many years ago?*), episodic memory (e.g., *When you go to your room, do you happen to forget why you are there?*), and semantic memory (e.g., *Do you have trouble with finding words when you want to say something?*). The relationship between cognitive areas may be caused by the fact that various cognitive processes can be included when performing a particular task. It is difficult to separate the domains and express each of them by different items both in tests and in life – many activities in everyday life involve more than one cognitive function. The subject assesses their cognitive functioning on the basis of daily activities; hence, SCCs may be more global and relate to many cognitive domains (Pusswald et al., 2015). Furthermore, while attention and memory are treated as strongly connected with each other, attention is understood as the stage of the memory process (Cowan, 1998; Chun & Turk-Browne, 2007).

The next group includes positive correlations between subscales concerning cognitive functioning and non-cognitive factors: the emotional reaction to perceived cognitive difficulties (e.g., *Do you feel embarrassed about forgetting*?), the sense of the loss of acquired skills (e.g., *Can't you do hobbies or other things because of memory or thinking difficulties?*), and social restrictions associated with cognitive deficits (e.g., *Are you withdrawing from your social contacts because of memory or thinking problems?*). A possible way to explain this phenomenon may be connected with a high level of intelligence or education (Stanciu & Papasteri, 2018). These factors may have a direct impact on high emotional intelligence; therefore, the subjective experience of cognitive decline can bring about the belief of difficulties in social functioning. A good example of this explanation can be the

relationship between SCCs among semantic memory and the emotional reaction to perceived cognitive difficulties, the sense of a loss of skills, and a deterioration in social functioning.

Semantic memory refers to the memory of facts, laws, rules, etc.; a higher level can provide a greater emotional reaction and feeling of a loss of ability because of an awareness of one's potential as observed in a previous period of time. These conclusions can reduce social participation. The likely explanation for this dependence can be found in the simple, heuristic thinking that one will be criticized by others (Gualtieri & Denison, 2018; Kahneman & Tversky, 1973). Indeed, the discomfort associated with a subjective decline in functioning may translate itself into the belief that it could be noticed by people and, therefore, relationships will be modified because of it. In addition, previous research has shown the correlation between the size of the social network and the objective functioning of particular types of memory, including semantic memory (Kelly et al., 2017; Sörman et al., 2017). Thus, it seems that cognitive functioning may play an important aspect for well-being and social relations.

The last group is related to correlations between the non-cognitive subscales. The likely explanation for this phenomenon may be the impact of a general negative affect, which causes one to perceive problems in various areas of our functioning (Guo, Liu, Wang, & Sun, 2018; Velotti, Garofalo, Bottazzi, & Caretti, 2017).

The relationship between SCCs and cognitive characteristics

Statistical analysis revealed no significant relationship between SCCs reported in the attention domain and the performance of attention tests. However, one correlation showed a trend for statistical significance: the reaction time of correct responses in the attention domain tasks was associated with an increase in SCCs in the area of attention. Our findings are consistent with the literature that did not confirm the importance of SCCs in the neuropsychological tests score (Dux et al., 2008).

Among the factors that may underlie the lack of the relationship between the subjective assessment of the cognitive condition and the objective test results are demographic factors, e.g., age and education. Healthy aging is related typically to subtle changes in cognitive functioning. It can be linked with difficulties in the subjective assessment of one’s capabilities; therefore, subjects with greater decline should more accurately estimate their cognitive functioning (Zelinski et al., 2001). A better assessment of one’s cognitive condition should also be more characteristic for the oldest participants who may experience the greatest declines (Zelinski et al., 2001). On the other hand, the oldest group may report more complaints because of the expectation of the decline in cognitive functioning related to the aging process (Parisi et al., 2011).

Participants with more education can show a better insight into their own cognitive abilities. Therefore, the relationship between subjective estimation and the results obtained in neuropsychological tasks may be stronger (Zelinski et al., 2001).

The type of tests used in research can also affect the relationship between subjective assessment and objective results. When subjects estimate their cognitive capabilities, they usually rely on the memory of success in fulfilling everyday tasks. Thus, tests similar to these ecological terms may more accurately show the relationship between subjective assessment and objective outcomes (Schmidt, Berg, & Deelman, 2001).

Another explanation for the lack of the relationship between results from tests and the subjective assessment of one's cognitive capabilities is the differences in the participants' psychological profiles. Previous research as well as our study has shown that psychological characteristics modify this relationship (Babson, Trainor, & Bunaciu, 2008; Crumley, Steller, & Horhota, 2014) and the tendency to experience a negative and positive affect was combined with a possible worse/better insight as to the possessed capabilities (Subramaniam, Kounios, Parrish, & Jung-Beeman, 2009; Tu̇rksoy, Tu̇kel, Ȯzdemir, & Karali, 2002).

The relationship between SCCs and psychological characteristics

The personality traits: extraversion, agreeableness, neuroticism, and conscientiousness

Our results have revealed that a higher level of extraversion, agreeableness, and conscientiousness was connected with lower SCC intensity in particular areas of functioning (attention and thinking, episodic and semantic memory, the sense of loss of acquired skills, and social restrictions associated with cognitive deficits [excluding conscientiousness]). Furthermore, a higher level of neuroticism was linked with reporting more SCCs in each of the areas of functioning. These outcomes are consistent with previous results that have shown that a higher level of extraversion and agreeableness is connected with a lower intensity of SCCs (Spiro, Aldwin, Levenson, & Bosse, 1990; Studer, Donati, Popp, & von Gunten, 2014). A lower level of conscientiousness, as well as a higher level of the neuroticism, is linked with reporting more problems in health (Jerram & Coleman, 1999; Roberts, Smith, Jackson, & Edmonds, 2009) and a lower subjective assessment of one's health (Roberts et al., 2009). This relationship also occurs when no objective decline in functioning was observed (Dorsey & Bootzin, 1997).

Personality traits are linked with the severity of a positive/negative affect (McCrae & Costa, 1991), which is considered to be connected with fewer or more concerns about health (Jerram & Coleman, 1999; Watson & Pennebaker, 1989). In addition, personality traits are connected with several characteristics of functioning. A tendency to focus on even subtle changes and deficits in functioning can be typical for a person with higher neuroticism (Blagrove & Akehurst, 2001; Costa & McCrae, 1987). Conversely, extraversion and agreeableness may be associated with undertaking more activities that support good health conditions (Booth-Kewley & Vickers, 1994; Jerram & Coleman, 1999), while lower conscientiousness can be linked with the lack of the ability to act purposefully and persistently, as well as in the sphere of taking care of one's health (Booth-Kewley & Vickers,

1994; Castanier, Scanff, & Woodman, 2010; Clarke & Robertson, 2005; Friedman, 2000; Vollrath & Totgersen, 2002). Therefore, a person may consider their awareness of any possible influential activities on their condition.

Personality traits: openness

In our research, there was no significant relationship between openness and SCCs. Previous research has confirmed the lack of a relationship (Pearman, 2009; Pearman & Storandt, 2004), as well as the occurrence of a relationship between these two factors (Williams, Suchy, & Kraybill, 2013). This discrepancy can be explained by the complex nature of the openness trait. A higher level of openness can be linked to a higher acceptance for the novelty in life and being flexible toward changes (Williams et al., 2013). However, greater openness can be associated with performing risky behaviors (Booth- Kewley & Vickers, 1994), which can be included in estimating one's conditions. A lower level of openness is associated with a fixation on the negative aspects of situations (Miller, 1991) and is also linked simultaneously to the problems in recognizing and expressing emotions (Mohn, Vassend, Krogstad, & Knardahl, 2010).

Anxiety

In our research, participants with a higher level of anxiety (trait and state) reported more SCCs in each area of functioning (excluding the relationship between complaints in the area of long term memory and anxiety as a state). These findings are consistent with previous studies that confirmed anxiety can be linked to the higher intensity of reported SCCs (Balash et al., 2013; Cohen et al., 1995). This relationship can be explained by how information is processed by people with a higher level of anxiety. It might include focusing attention on threatening events (Mogg, Bradley, & Hallowell, 1994), interpreting neutral situations or behaviors as dangerous (Derakshan & Eyesenck, 1997; Eysenck, 1997), and estimating a greater probability that negative events will occur (Wells, 2010). In the context of generating SCCs, we expect a similar mechanism, such that people with a higher anxiety level would focus on failures in performing cognitive tasks. What is more important, however, is that these episodes could be interpreted as unambiguous evidence of serious problems.

Mood / level of depression

Our study showed the positive relationship between mood and each of the examined SCC areas: attention and thinking, episodic memory, semantic memory, and long-term memory. Moreover, the symptoms of depression correlate with non-cognitive attributions, namely the sense of a loss of acquired skills and social restrictions associated with cognitive deficits. Our findings are consistent with those from previous research that has investigated the relationship between depressive symptoms and SCCs in the area of memory (Balash et al., 2013; Chin et al., 2014; Lehrner et al., 2013), attention (Slavin et al., 2010; Zamarian et al., 2014), or executive functions (Szepietowska & Kuzaka, 2019).

Despite the comprehensive subject literature in this area, we are still uncertain about the nature of the relationship between depression and SCCs: Does the change in mood cause SCCs, or is it the other way around (Chin et al., 2014)? Research has shown that depression may be both a consequence of the SCCs observed by patients (Heser, Tebarth, & Wiese, 2013) and its cause (Fischer et al., 2008). Our research, like other correlation studies, will not provide an explanation for the direction of this relationship, so this association in our study may be bidirectional.

Considering that depression is a possible cause of SCCs is based on research that has shown the cognitive distortions in the course of depression (Jarema et al., 2014). It includes the tendency to present negative information from the environment (Beck, 2008), and how this tendency is observed in participants with a lower mood but without a depression diagnosis (Becker & Leinenger, 2011). The argument for treating depression as an effect of SCCs is based on the results of research indicating that efficient cognitive functioning determines the quality of life and well-being of older people (Danthiir et al., 2011). Hence, we suppose that SCCs can lead to a lower mood and, in extreme cases, even to depression. The results of previous research on the relationship between SCCs and depression indicate the importance of controlling both these variables during neuropsychological diagnosis. Longitudinal studies indicate that older people who report SCCs in the domain of memory and additionally show symptoms of depression are more often diagnosed with mild cognitive impairment (Albert et al., 2011) or dementia (Reisberg et al., 2010) in subsequent years.

Limitations

Our research has several limitations. The study only included a one-time assessment. Considering the results obtained in previous research, SCCs are considered to be a better predictor rather than an indicator of cognitive conditions. Longitudinal studies allow for the assessing of the relationship between the objective outcomes and SCCs, including the dynamics of changes in the cognitive domains, which seems to be easier to capture than the very subtle decrease in score obtained in a one-off neuropsychological assessment.

The second limitation is the chosen tools. Depression/mood in older adults should be assessed with a tool other than the BDI. There are also doubts about assessing SCCs. The set of the items dedicated for evaluating SCCs in the attention domain may not allow consideration of each of its aspects, including those measured by cognitive tasks, the performance of which we correlated (as an objective measure of attention) with the level of complaints about the attention processes. Furthermore, this set may also contain items that could better correspond to other cognitive domains (e.g., memory). This possibility may underlie the lack of association with neuropsychological test results.

Considering the modulating role of psychological characteristics in the relationship between SCCs and objective test results, the analysis within the subgroups based on psychological characteristics (higher and lower scores) should be

performed with a sufficiently large group. It would be advisable to compare the results of the subgroups separated by the cut-off point for scores for a given tool. The mentioned analysis could determine in which particular cases (considering the psychological characteristics) SCCs would be a good marker for the cognitive condition. However, the small number of participants in our own study prevented us from making such a comparison.

CONCLUSIONS

Our study focused on developing knowledge about the determinants of SCCs, which are considered to be a potential indicator or predictor of changes in cognitive functioning. We found no significant correlations between the outcomes obtained by participants in attention tasks and SCCs reported in the attention domain. A significant relationship between SCCs and psychological characteristics was observed, as well as correlations between SCCs reported in various areas of functioning obtained. These results may indicate that SCCs tend to be reported simultaneously in several spheres of functioning. Furthermore, reported complaints may be driven by stable psychological factors, e.g., personality traits, and be related to the current situation of patients, e.g., anxiety. Therefore, monitoring the psychological aspects of patients seems to be important while analyses of SCCs are made. In summary, our results emphasize that were SCCs to be included in an early neuropsychological diagnosis as an indicator of cognitive conditions its complex nature should be considered.

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