STUDIA UBB PSYCHOL.-PAED., LXIX, 1, 2024, p. 27-50
(Recommended Citation)
DOI:10.24193/subbpsyped.2024.1.02

Executive Functions in Clinical and Non-Clinical Populations. A Comparative Analysis

Dana A. ICLOZAN[1*], Iulia F. POP[2]

ABSTRACT. The primary aim of the study was to assess and compare executive functions in psychiatric inpatients (n=65) with those of a matched control group of healthy individuals (n=65). Both cohorts underwent rigorous evaluation using neuropsychological performance-based tests and self-assessment scales. Findings indicated a superior performance by the control group in both self-assessed and computerized evaluations. Notably, there was an absence of correlation between results from the performance-based test (Corsi) and self-assessments of executive function. Subsequent analysis focusing on primary diagnostic categories highlighted that patients diagnosed with depression consistently undervalued their performance in the self-assessment as opposed to the objective, computer-based evaluations. This undervaluation was observed across total scores and individual subscales. In contrast, patients diagnosed with alcohol dependence exhibited a tendency to overestimate their performance in self-assessments relative to the objective tests. The study investigates the causes of these observed differences and considers their implications for subsequent research and clinical practices.

Keywords: executive functions, performance-based measurements, self-assessment scales, depression, alcohol dependency.

1 Department of Psychology, Babes-Bolyai University, Cluj-Napoca, Romania; Municipal Clinical Hospital Cluj-Napoca, Psychiatric Unit, Romania
2 Faculty of Animal Sciences and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania
* Corresponding author: dana.iclozan@ubbcluj.ro

INTRODUCTION

Executive Functions (EF) is one of the most invoked constructs in cognitive sciences, and there is no consensus concerning definition and measurement of EF. The definition of EF has evolved and changed over time, one of the most quoted definitions in the literature is the one given by Barkley (2014): EF represent a set of self-regulating processes that help us achieve our goals, often in a social context (Barkley, 2014). The concept of EF is a meta construct that involves several mental processes or abilities that interact and jointly contribute to EF. Dysfunctions in one module can affect EF in different ways compared to dysfunctions in other modules, highlighting the complexity and multifactorial nature of these cognitive functions. According to Barkley (2014), the components of EF include self-directed attention (monitoring), inhibition, working memory (nonverbal - especially visual images and verbal working memory), planning, and problem-solving. The operationalization and quantification of executive functions remain pivotal concerns, influencing the conclusions drawn regarding these cognitive competencies. Procedures used in studies for operationalizing EF in clinical environments use performance-based tests or self-assessment scales. Performance-based ones involve standardized procedures that are administered by an examiner and usually evaluate accuracy and/or response time. EF evaluation can also be done through self-assessment scales. The purpose of this study was to examine the relationship between these two types of EF measurements, and to compare them with similar assessments in the non-clinical population. The aim of the study is to provide clinicians with a theoretically and empirically grounded perspective for the use of these evaluations in the context of a clinical assessment.

Conventional measurement of EF has been based on cognitive performance tests (Pennington & Ozonoff, 1996). Performance-based tests are administered under extremely standardized conditions. Stimulus presentation is carefully controlled so that each examinee experiences and completes the task in exactly the same way as everyone else. Additionally, performance measures usually rely on response accuracy, response time, and/or rapid response under a time constraint (Toplak, West, & Stanovich, 2013).

Thus, performance tests are administered under standardized conditions with a single examiner who provides specific feedback or direct recommendations to the examinee to guide performance. Accuracy and response time are the dependent values of these tests.

Self-assessment scales have been developed to provide a valid ecological indicator of executive functioning in complex, everyday problem-solving situations (Roth, Isquith, & Gioia, 2005). The assumption behind the use of these self-assessment scales is that they measure behaviours that are related to processes that are assessed through performance tests of EF (Toplak, West, & Stanovich, 2013).

If computerized tests and self-reporting tests evaluate the same general construct, then these measures should show a strong and positive correlation. That is, high competence measured by computerized tests should be associated with high competence on self-assessment scales. From an operationalization perspective, the two types of measurements differ in how they are administered and scored. Toplak and colleagues (2013) performed a literature analysis on the correlation between the two types of assessments and concluded that they are only minimally correlated. The authors argue that the two types of measurements evaluate different aspects of cognitive and behavioural functioning, which independently contribute to clinical problems. According to the authors, the algorithmic level refers to mental processes that occur automatically and are often outside conscious control. These processes are efficient, quick, and rely on pre-set mental algorithms. The reflective level refers to mental processes that are consciously controlled and involve deliberation and reflection. These processes are slower, but allow for greater flexibility and adaptability.

Performance tests, which evaluate aspects such as inhibition and attention, can be seen as the equivalent of the algorithmic level, they measure cognitive processes that are often quick and automatic. On the other hand, EF self-assessment can be seen as the equivalent of the reflective level. This involves reflective processes, which pertain to how a person controls and directs their behaviour in everyday life in order to achieve their goals. Thus, EF self-assessment could capture aspects of executive functioning that are not necessarily highlighted by performance tests, especially those aspects that involve conscious and directed control of behaviour. Only self-assessment scales measure rational control, which relate to behaviour in the real environment, and which serves to achieve a goal. Performance tests are often used to evaluate EF and can be very efficient in measuring certain aspects of these, for example, inhibition. However, performance tests may not fully address EF aspects such as rational pursuit of goals and they may not fully capture the complexity and variety of these functions, especially when it comes to efficient planning and pursuit of goals (Toplak et al., 2013).

In conclusion, numerous studies have shown that the relationship between self-reported questionnaires and objective, performance-based tests of EF is weak and often non-existent (Bogod, Mateer, & MacDonald, 2003; Burgess, Alderman, Evans, Emslie, & Wilson, 1998; Nęcka, Lech, Sobczyk, & Śmieja, 2012; Wingo, Kalkut, Tuminello, AsConape, & Han, 2013). Factors that may contribute to this lack of association include differences in abilities measured by these methods, self-reports influenced by personality traits (for example, healthy individuals with higher levels of neuroticism tend to report more dysfunction), and, for clinical populations, a lack of insight, which itself results from psychopathology (Goldberg, 2017).

Several neurological and psychiatric disorders have been linked to difficulties with executive functions. These include: traumatic brain injuries (Labudda et al., 2009), schizophrenia (Nakamura et al., 2008), substance abuse (Barry & Petry, 2008), obsessive-compulsive disorder (Lawrence et al., 2006), psychopathy (Mahmut, Homewood, & Stevenson, 2008), attention-deficit/hyperactivity disorder (Toplak, Jain, & Tannock, 2005), and pathological gambling (Toplak, Liu, MacPherson, Toneatto, & Stanovich, 2007).

Research on the elderly population has demonstrated that older adults with depression and executive dysfunction might have a less favourable response to antidepressant therapy. The specific elements of this complex construct that contribute to a poorly response to medication is not yet fully understood. Pimontel and colleagues (2016) conducted a meta-analysis to determine whether executive dysfunction is a predictive factor for a diminished treatment response in geriatric depression, and to identify which specific areas of executive functions play a role in this correlation. The findings indicated a significant association between diminished treatment response and problems with planning and organization. Uncovering the factors that could help predict a patient's likelihood of having a poor reaction to medication could enhance our understanding of the physiological mechanisms involved in treatment response, and could potentially guide the development of individualized treatment strategies. Moreover, this understanding could be beneficial for clinicians in predicting the likely outcomes of treatment for depressed patients, and in making informed decisions about future therapeutic approaches (McLennan & Mathias, 2010).

Gustavson and colleagues (2016) found that patients over 65 with depression and executive dysfunction who received problem-solving therapy exhibited a reduction in suicidal ideation compared to those who received supportive therapy, both during the treatment and 24 weeks later. Given the decrease in suicidal ideation and other positive outcomes associated with problem-solving therapy for patients with executive dysfunctions, mental health professionals are encouraged to consider this therapy when deciding on the treatment course for older individuals suffering from depression and executive dysfunctions (Gustavson et al., 2016).

In conclusion, the measurement of EF in clinical settings is very important, given their role in various neurological and psychiatric conditions. The proper assessment of EFs can provide critical information about the patients' cognitive abilities, can also predict treatment outcomes, guide therapeutic approaches.

Given the findings of previous studies on clinical and non-clinical populations, the primary aim of this study is to assess executive functions through performance tests and self-assessment scales in patients with psychopathology, in an ecological setting - during hospitalization and medication. These results will be compared with those from the non-clinical population.

Hypotheses

There is a positive relationship between evaluations of executive functions through performance tests and self-assessment scales. In other words, we expect the results from performance tests and self-assessment scales to correlate positively, hence achieving significant and positive correlations between the BDEFS scale and the Corsi and Stroop tests, and a significant negative correlation between the BDEFS scale and the RT Choice test (where a high score implies better performance).

There is a significant difference in executive functions between clinical patients, in conditions of hospitalization and medication, for both types of evaluations - performance tests and self-assessment scales, compared to the non-clinical population. We expect the clinical population to exhibit a deficit in executive functions.

There is no significant difference in executive functions between the depression group and the alcohol dependence group for both types of evaluations - performance tests and self-assessment scales. We expect people with alcohol dependence to show a similar deficit in executive functions as people with depression.

METHOD

Participants

The participants in the clinical group (n=65) were recruited from the Psychiatry Clinic of the Municipal Clinical Hospital in Cluj-Napoca, Romania, and they were in-patients at the time of the study. In the clinical cohort, there were 32 females (49.2%) and 33 males (50.8%), ranging in age from 23 to 73 years, with a mean age of 51.25 years, *SD*=9.82, with diagnoses of recurrent depressive disorder, alcohol dependence, generalized anxiety disorder, bipolar affective disorder - manic episode, somatization disorder, organic delusional disorder. From a socio-demographic point of view, 13.8% of participants had higher education, the majority come from urban areas (58.5%), were married or in a relationship (70.7%) and all were under psychiatric treatment. The participants' medication belonged from the following classes: benzodiazepines, SNRI antidepressants, SSRI antidepressants, tricyclic antidepressants, other antidepressants, anxiolytics, antiepileptics, barbiturates, antipsychotics, hypnotics and sedatives, systemic antihistamines and/or metabolism of nerve cells and blood circulation in the brain. After obtaining informed consent, they were tested during their hospitalization period.

The non-clinical sample (n=65) was randomly drawn from a larger sample of the general population (non-clinical). This group comprised 32 females (49.2%) and 33 males (50.8%), with ages ranging from 24 to 75 years and a mean age of 50.55 years, *SD*=9.88. None of these participants had a history of psychiatric conditions or a current diagnosis. Individuals from the non-clinical sample were matched for gender and age with those from the clinical sample. From a socio-demographic perspective, 87.8% of participants had higher education, the majority come from urban areas (86.2%), were employed (50.8%) or were entrepreneurs (32.3%), and without current or prior psychiatric treatment.

Instruments / Materials

The study collected demographic data such as age, educational level, marital status, education level, occupation, rural / urban environment, and socio-economic status. Medical data were also collected, including treatment for various somatic diseases, neurological or neurocognitive diagnosis, psychiatric diagnosis, medication treatment, and substance use.

Executive functions were measured through performance tests (neuropsychological tests) and a self-assessment scale, presented below.

The Barkley Deficits in Executive Functioning Scale" long form (BDEFS-LF), developed by Russell A. Barkley and published by Guilford in 2011, is a self-assessment tool that can be used to test adults aged between 18 and 81 years old, and it evaluates the cognitive and behavioural manifestations of executive dysfunction. BDEFS-LF assesses those neuropsychological abilities that support and contribute to self-regulation over time, oriented towards the future: self-management to time, self-organization/problem-solving, self-restraint (inhibition), self-motivation, and self-regulation of emotions. The BDEFS scale is a theoretically and empirically well-founded instrument for evaluating the dimensions of adult executive functioning in everyday life. Evidence indicates that the BDEFS scale is much more predictive for deficits in major life aspects than performance tests that measure executive functions. BDEFS is a self-assessment tool organized on several sub-domains or factors (Barkley et al., 2022). The BDEFS scale has been translated and adapted into Romanian by the company Cognitrom, and has been standardized for the Romanian population. The BDEFS scale has good psychometric properties (reliability, validity), and is useful in evaluating the dimensions of EF in daily activities. In the test manual, Barkley (2011) reported a Cronbach's alpha coefficient of internal consistency >0.91, based on a more representative sample from the USA. The BDEFS manual adapted for the Romanian population reports the internal consistency of each BDEFS-LF subscale (Cronbach's alpha coefficient), which proved to be satisfactory: Self-management to time, αCronbach=0.949; Self-organization/Problem-solving, αCronbach =0.958; Self-restraint, αCronbach =0.930; Self-motivation, αCronbach =0.914; and Emotion self-regulation, αCronbach =0.946.

The Corsi Test (Traditional Corsi Block-Tapping Test, t-Corsi) was initially developed by Philip Michael Corsi (1972) as part of his doctoral thesis. The task assesses visuospatial working memory and has been used for evaluating cognitive deficits in the field of neuropsychiatry, on patients with Korsakoff Syndrome, Alzheimer's disease, Huntington's disease, schizophrenia, and neurological disorders (Berch, Krikorian & Huha, 1998). The test was developed based on Baddeley's model and evaluates the visuospatial component of working memory. The task used in the study was developed by Cognitrom Company based on validated specifications from the specialized literature (Berch, Krikorian & Huha, 1998; Fischer, 2001).

The classic STROOP Test (TIC-S), designed by Stroop (1935), is a widely used neuropsychological test for both experimental and clinical purposes. It evaluates the ability to inhibit cognitive interference that occurs when processing one characteristic of a stimulus affects the simultaneous processing of another attribute of the same stimulus, i.e., the ability to inhibit competing responses in the presence of evident contradictory information (Scarpina & Tagini, 2017). The Interference Test evaluates the extent to which a person is capable of suppressing internal or external stimuli, irrelevant to the task at hand, that initiate an automatic cognitive or behavioural response and can affect the provision of an adequate or necessary response.

Choice RT Test - RTC (reaction time) has been defined as the time in milliseconds from the presentation of the stimulus to a recorded response. There are many types of RT tasks such as simple reaction time, which refers to the time needed to respond to a single stimulus and only one response option is available. SRT does not require substantial cognitive effort; it is sufficient for the tested person to simply indicate that the stimulus is perceived (Johnson & Deary, 2011). Choice RT tasks (RTC) assume minimal processing of informational content. For example, in a four-choice RT task, arrows can appear up, down, left or right, and the corresponding arrow must be chosen from the keyboard (Johnson & Deary, 2011), or the person must give a response that corresponds to the stimulus, such as pressing a key corresponding to a letter if the letter appears on the screen (Kosinski, 2013).

DESIGN

This study employs a correlational and comparative design, conducted in an ecological environment, using a natural situation to analyse EF in patients hospitalized in a psychiatric unit. The objective was to understand the relationship between different measures of EF as variables, as well as to compare the mean scores between the psychiatric patient group and the control group.

Procedure

After the recruitment procedure, the participants took part in a meeting with the researcher. This took place at the premises of the Psychiatry Clinic, as they were hospitalized. The first part of the study involved the computerized evaluation and then the completion of the self-assessment scale. The computerized testing was performed individually, under the same conditions for all participants, receiving the same instructions, in a quiet room, alone with the experimenter. The environment was controlled regarding the testing time, control of distractors, brightness, noise, the presence of other devices in the testing room. First, the computerized testing was performed, namely the Stroop, Corsi, and RT Choice tests, then the BDEFS-LF test and demographic data questionnaires were handed over to be completed later. Information about the medical treatment was taken from the hospital record.

Data analysis

Descriptive statistical methods were used for demographic data analysis: averages, frequencies. The statistical analysis was done using the SPSS version 26 program, one-way analysis of variance (one-way ANOVA), checking the assumptions of the Levene test for homogeneity of variances, followed by post-hoc comparisons using the Games-Howell test, where the assumption of homogeneity of variances was not met. Significant effects were reported at the traditional level of significance ($p < .05$) (Field, 2017).

RESULTS

To compare the two large groups (clinical vs. non-clinical), a one-way ANOVA analysis was performed. The analysis did not require the testing of variance homogeneity as comparisons were made between two groups, so wherever the variance analysis was significant, it means that significant differences between groups were obtained, and further post-hoc analysis was not necessary. There was a significant effect of psychopathology on: the final Corsi score at the level of $p<.05$ [$F(1, 128) = 54.98$, $p <0.001$]; Corsi forward score [$F(1, 128) = 50.74$, $p <0.001$]; Corsi backward score [$F(1, 128) = 37.54$, $p <0.001$]; total BDEFS score [$F(1, 128) = 43.35$, $p <0.001$]; and on the symptom count scale [$F(1, 128) = 33.90$, $p <0.001$] (Table 1).

Table 1. One-way ANOVA analysis

		df	Mean Square	F	*p.*
corsi score final	**Between Groups**	**1**	**88,069**	**54,98**	**<0,001**
	Within Groups	128	1,602		
	Total	129			
corsi fwd span	**Between Groups**	**1**	**88,069**	**50,74**	**<0,001**
	Within Groups	128	1,736		
	Total	129			
corsi bkwd span	**Between Groups**	**1**	**88,069**	**37,54**	**<0,001**
	Within Groups	128	2,346		
	Total	129			
BDEFS total	**Between Groups**	**1**	**4451,406**	**43,35**	**<0,001**
	Within Groups	128	102,687		
	Total	129			
BDEFS symp count	**Between Groups**	**1**	**581,731**	**33,90**	**<0,001**
	Within Groups	128	17,161		
	Total	129			

In the subsequent stages of our analysis, participants belonging to specific diagnostic groups—namely, generalized anxiety disorder, bipolar affective disorder (manic episode), somatization disorder, and organic delusional disorder—were excluded, due to the limited representation of these categories in our sample. Consequently, our analytical cohort was partitioned into two main subsets: clinical and non-clinical. The clinical subset, comprising 56 patients, was further classified into two salient pathological categories: alcohol dependence, with 30 patients, and depression, with 26 patients. Descriptive statistics associated with performance on the EF tests (BDEFS and CORSI) for the three groups are presented in Table 2, with minimum and maximum scores ranging between 2 and 9, and 20 and 66, for the Corsi test and BDEFS, respectively.

Table 2. Descriptive statistics associated with performance on EF tests

		Mean	SD	SE	95% CI		Min.	Max.
					LL	UL		
Corsi final score	non-clinic	5,48	1,05	0,131	5,2237	5,7456	2,50	7,50
	alcohol	3,53	1,72	0,314	2,8904	4,1762	0,00	6,00
	depression	4,35	0,87	0,170	3,9951	4,6972	2,00	6,00
Corsi fwd span	non-clinic	5,68	1,28	0,158	5,3607	5,9931	2,00	9,00
	alcohol	3,77	1,70	0,310	3,1336	4,3998	0,00	7,00
	depression	4,35	0,75	0,146	4,0451	4,6472	3,00	6,00
Corsi bkwd span	non-clinic	5,29	1,06	0,131	5,0305	5,5541	3,00	8,00
	alcohol	3,30	2,04	0,372	2,5395	4,0605	0,00	6,00
	depression	4,35	1,29	0,254	3,8233	4,8690	0,00	6,00
BDEFS total	non-clinic	28,71	7,57	0,939	26,83	30,58	20	47
	alcohol	36,36	11,71	2,138	31,99	40,73	20	61
	depression	43,96	11,42	2,239	39,35	48,58	21	66
BDEFS symp count	non-clinic	1,35	2,27	0,281	0,79	1,92	0	9
	alcohol	3,70	4,46	0,814	2,04	5,36	0	14
	depression	7,12	5,54	1,087	4,88	9,36	0	18

To assess the nature of the observed mean differences between the three groups in the two types of EF evaluations, the ANOVA analysis was followed by post-hoc comparisons using the Games-Howell test (Table 3).

Table 3. Post-hoc Analysis, Games-Howell test for multiple comparisons

Dependent variable

corsi final score	a	b	Mean difference (a-b)	SE	*p.*	95% CI	
						LL	UL
	non-clinic	alcohol	1.951*	0.340	**<0,001**	1.1222	2.7803
		depression	1.138*	0.215	**<0,001**	0.6213	1.6556
	alcohol	non-clinic	-1.951*	0.340	**<0,001**	-2.7803	-1.1222
		depression	-0.813	0.358	.070	-1.6800	0.0544
	depression	non-clinic	-1.138*	0.215	**<0,001**	-1.6556	-0.6213
corsi fwd span		alcohol	0.813	0.358	.070	-0.0544	1.6800
	non-clinic	alcohol	1.910*	0.348	**<0,001**	1.0675	2.7530
		depression	1.331*	0.215	**<0,001**	0.8159	1.8457
	alcohol	non-clinic	-1.910*	0.348	**<0,001**	-2.7530	-1.0675
		depression	-0.579	0.342	.220	-1.4119	0.2529
	depression	non-clinic	-1.331*	0.215	**<0,001**	-1.8457	-0.8159
corsi bkwd span		alcohol	0.579	0.342	.220	-0.2529	1.4119
	non-clinic	alcohol	1.992*	0.394	**<0,001**	1.0290	2.9556
		depression	0.946*	0.286	.006	0.2502	1.6421
	alcohol	non-clinic	-1.992*	0.394	**<0,001**	-2.9556	-1.0290
		depression	-1.046	0.450	.062	-2.1338	0.0415
	depression	non-clinic	-.946*	0.286	**.006**	-1.6421	-0.2502
BDEFS total		alcohol	1.046	0.450	.062	-0.0415	2.1338
	non-clinic	alcohol	-7.654*	2.335	**.006**	-13.33	-1.97
		depression	-15.256*	2.428	**<0,001**	-21.21	-9.31
	alcohol	non-clinic	7.654*	2.335	**.006**	1.97	13.33
		depression	-7.603*	3.096	.045	-15.07	-0.14
	depression	non-clinic	15.256*	2.428	**<0,001**	9.31	21.21
BDEFS symp count		alcohol	7.603*	3.096	.045	0.14	15.07
	non-clinic	alcohol	-2.346*	0.861	.026	-4.45	-0.24
		depression	-5.762*	1.123	**<0,001**	-8.54	-2.98
	alcohol	non-clinic	2.346*	0.861	**.026**	0.24	4.45
		depression	-3.415*	1.358	**.040**	-6.70	-0.13
	depression	non-clinic	5.762*	1.123	**<0,001**	2.98	8.54
		alcohol	3.415*	1.358	**.040**	0.13	6.70

The pairwise comparisons of means using the post-hoc Games-Howell test indicated significant comparisons as follows: the average EF total score for the depression group (M = 43.96, SD = 11.42) was significantly different from the non-clinical group (M = 28.71, SD = 7.57); the average EF total score for the depression group (M = 43.96, SD = 11.42) was significantly different from the alcohol dependence group (M = 36.36, SD = 11.71); and also the average EF total score for the alcohol dependence group (M = 36.36, SD = 11.71) was significantly different from the non-clinical group (M = 28.71, SD = 7.57). The results for the average total EF score are graphically presented in Figure 1.

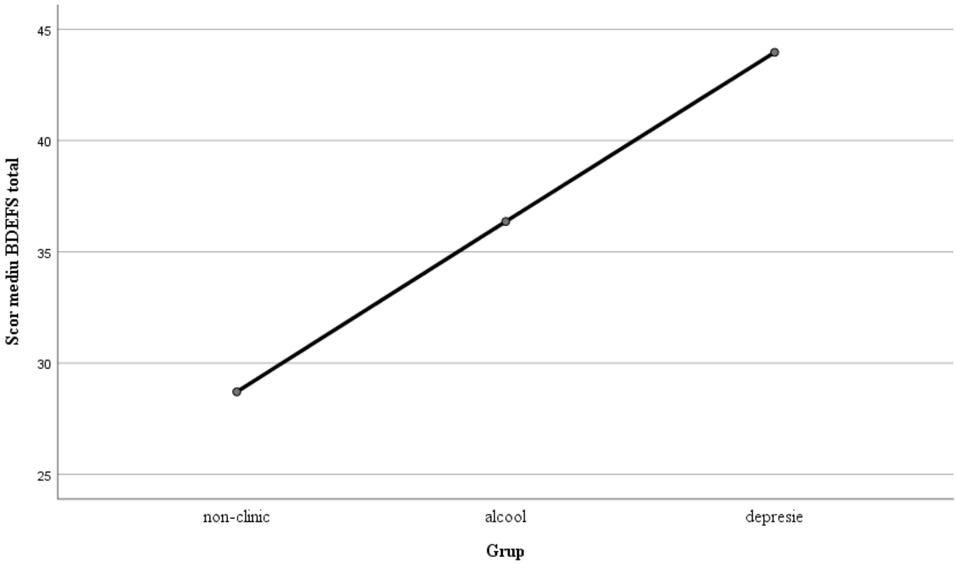

Figure 1. Mean score on total EF in the three groups.

If we looked at the BDEFS scale that evaluates the number of symptoms, the results are similar: the average symptom score of EF for the depression group (M = 7.12, SD = 5.54) was significantly different from the non-clinical group (M = 1.35, SD = 2.27); the average symptom score of EF for the depression group (M = 7.12, SD = 5.54) was significantly different from the alcohol dependence group (M = 3.70, SD = 4.46); and also the average total EF score for the alcohol dependence group (M = 36.36, SD = 11.71) was significantly different from the non-clinical group (M = 1.35, SD = 2.27). The results for the average number of EF symptoms are graphically presented in Figure 2.

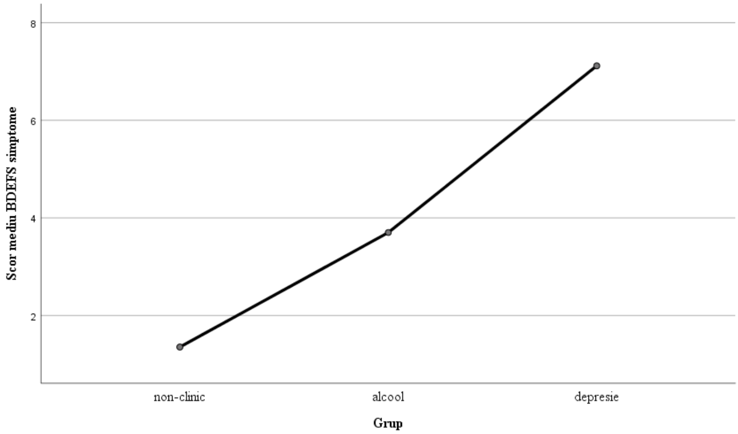

Figure 2. Mean score on number of symptoms in the three groups.

Regarding the total score on the Corsi test, the average score for the depression group (M = 4.35, SD = 0.87), as well as the average score for the alcohol dependence group (M = 3.53, SD = 1.72) were significantly different from the non-clinical group (M = 5.48, SD = 1.05) (here a larger absolute value meaning better performance). There were no statistically significant differences between the depression group (M = 4.35, SD = 0.87) and the alcohol dependence group (M = 3.53, SD = 1.72). Even though these differences were not statistically significant, looking at the average values we observe that the average score in people with depression was higher than the score of people with alcohol dependence, meaning that people with depression had better performance. The results for the total score of the Corsi test are graphically presented in Figure 3.

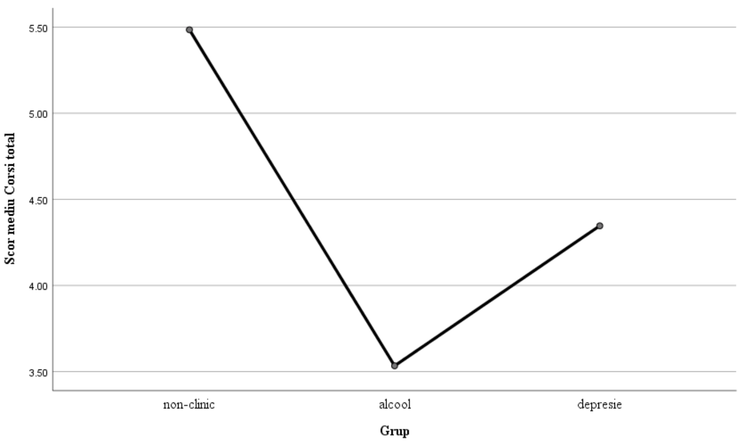

Figure 3. Mean score on total score on the Corsi test in the three groups.

Similar results are also observed on the Corsi sub-scales, as follows: looking at the Corsi forward sub-scale, the average score for the depression group (M = 4.35, SD = 0.75), and the average score for the alcohol dependence group (M = 3.77, SD = 1.70) were significantly different from the average scores of the non-clinical group (M = 5.68, SD = 1.28) (here again, a higher absolute value meaning better performance). There were no statistically significant differences between the depression group (M = 4.35, SD = 0.75) and the alcohol dependence group (M = 3.77, SD = 1.70). Similarly, looking at the average values we observe that the average score in people with depression was higher than the score of people with alcohol dependence, meaning that people with depression had better performance. The results for the score on the Corsi forward test are graphically presented in Figure 4.

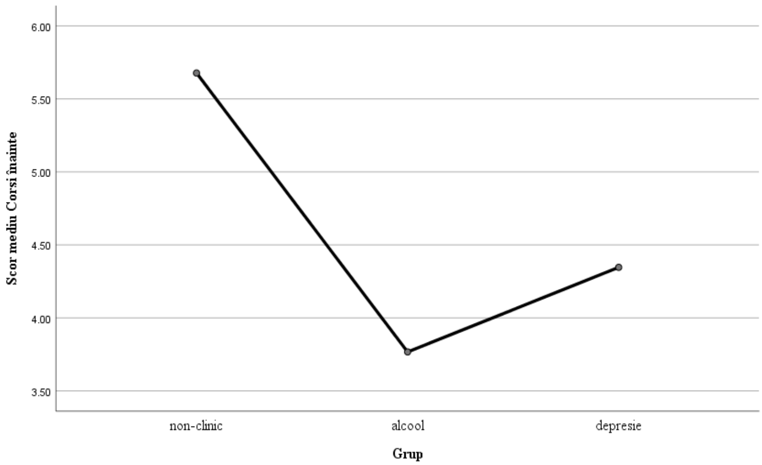

Figure 4. Mean score on total score on Corsi forward sub-scale in the three groups.

In the case of the Corsi backwards sub-scale, the average score for the depression group (M = 4.35, SD = 1.29), as well as the average score for the alcohol dependence group (M = 3.30, SD = 2.04) were significantly different from the non-clinical group (M = 5.29, SD = 1.06) (again, a higher absolute value indicating better performance). There were no statistically significant differences between the depression group (M = 4.35, SD = 0.75) and the alcohol dependence group (M = 3.77, SD = 1.70), but looking at the average values we observe that the average score in people with depression was higher than the score of people with alcohol dependence, meaning that people with depression had better performance. The results for the score on the Corsi backwards test are graphically presented in Figure 5.

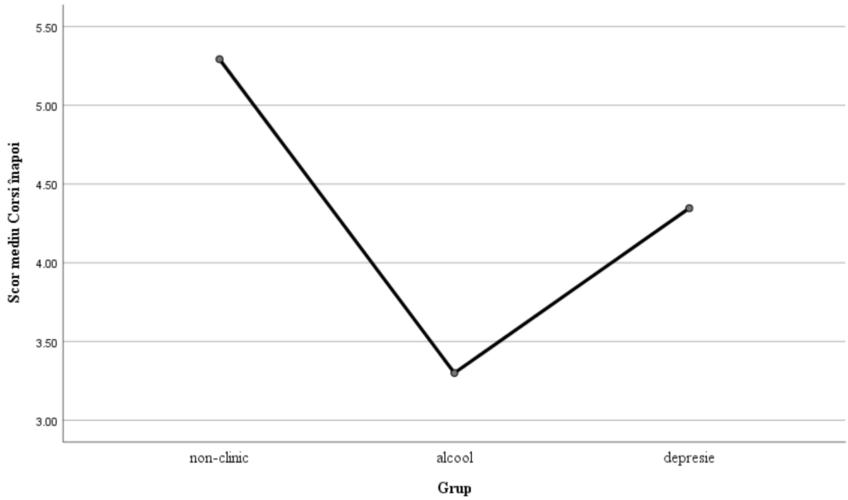

Figure 5. Mean score on total score on Corsi backwards sub-scale in the three groups.

Taken together, these results suggest that the clinical groups, depression and alcohol dependence, performed worse than the non-clinical group, both on the self-assessment scale of EF and the Corsi test, both on total scores and on sub-scale scores. Upon examining the performances of both the depression and alcohol dependence cohorts, a notable observation emerges: the depression group consistently underestimates their abilities in self-evaluations compared to the alcohol dependence group. However, the outcomes from the objective tests do not corroborate these perceived disparities.

For a more detailed assessment of EF, the study was narrowed to only encompass participants with alcohol dependency and depression. This decision was predicated on the limited representation of other disorders, which were insufficient to produce statistically significant outcomes. This part of the study comprised a total of 56 individuals (N=56) divided into two groups: the group of patients with alcohol dependence (n1=30) aged between 30 and 73 years, with an average age of M=53.03, and the group of patients with depression (n2=26) aged between 23 and 62 years, with an average age of M=49.88. The results from the Corsi, Stroop, and RT choice tests, presented in Table 4, indicate average values of 3.5 and 4.5 for Corsi, 15.1 and 16.8 for Stroop, and 695.1 and 705.8 for RT-choice, when referring to patients with alcohol dependence and depression, respectively.

Table 4. The mean scores from Corsi, Stroop, and RT choice tests for the clinical population

		N	Mean	SD	SE	95% CI		Min.	Max.
						LL	UL		
Corsi final score	alcohol	30	3.5	1.7	0.314	2.890	4.176	0.0	6.0
	depression	26	4.3	0.9	0.170	3.995	4.697	2.0	6.0
	Total	56	3.9	1.4	0.192	3.525	4.296	0.0	6.0
Stroop final score	alcohol	30	15.1	6.5	1.187	12.683	17.540	2.884	30.034
	depression	25	16.8	8.1	1.615	13.450	20.115	5.049	37.267
	Total	55	15.9	7.2	0.976	13.914	17.828	2.884	37.267
Rt choice final score	alcohol	30	695.1	157.5	28.749	636.316	753.913	499.991	1101.857
	depression	26	705.8	170.8	33.504	636.798	774.802	381.889	1089.803
	Total	56	700.1	162.4	21.700	656.589	743.562	381.889	1101.857

The variance analysis highlights a statistically significant effect only in the case of the total Corsi score [$F(1, 56) = 4.74$, $p = .035$]. For the total Stroop and RT Choice scores, no statistically significant effect was found (Table 5).

Table 5. ANOVA variance analysis on the Corsi, Stroop, and RT choice tests for clinical population

		df	Mean Square	F	Sig.
Corsi final score	Between Groups	1	9.202	4.74	0.034
	Within Groups	54	1.942		
	Total	55			
Stroop final score	Between Groups	1	38.070	0.72	0.399
	Within Groups	54	52.657		
	Total	55			
Rt choice final score	Between Groups	1	1590.194	0.06	0.809
	Within Groups	54	26827.597		
	Total	55			

The results of the BDEFS subscales in the two categories of patients indicate average values of 37.4 and 45.7 for the Self-organization subscale, 45.4 and 57.3 for the Time management subscale, 36.8 and 40.0 for the Self-control subscale, 19.4 and 21.7 for the Self-motivation subscale, 26.5 and 31.7 for the Emotion regulation subscale, 165.5 and 196.3 for the total EF score, 18.5 and

31.4 for the EF Symptoms subscale, when referring to patients with alcohol dependence and depression, respectively. On all measured dimensions, patients with depression scored higher averages than patients with alcohol dependence.

Table 6 shows that there was a significant effect of the diagnostic group on the BDEFS Self-organization subscale levels of happiness, F(1,54) = 4.83, p = 0.032; on time management F(1,54) = 7.11, p = 0.010; on emotional self-regulation F(1,54) = 5.12, p = 0.028; on the total EF score F(1,54) = 5.29, p = 0.025; on ADHD symptoms F(1,54) = 4.46, p = 0.039; and on the number of EF symptoms, F(1,54) = 5.13, p = 0.028. There was no significant effect of the diagnostic group on the Self-control subscale F(1,54) = 1.28, p = 0.262; and on the Self-motivation scale F(1,54) = 1.37, p = 0.247.

Table 6. Variance analysis (ANOVA) of the BDEFS test subscales for the clinical population

		df	Mean Square	F	Sig.
Self-organization	Between Groups	1	950.318	4.83	0.032
	Within Groups	54	196.912		
	Total	55			
Time management	Between Groups	1	1970.282	7.11	0.010
	Within Groups	54	276.981		
	Total	55			
Self-control	Between Groups	1	144.773	1.28	0.262
	Within Groups	54	112.784		
	Total	55			
Self-motivation	Between Groups	1	70.616	1.37	0.247
	Within Groups	54	51.597		
	Total	55			
Emotion regulation	Between Groups	1	372.894	5.12	0.028
	Within Groups	54	72.802		
	Total	55			
FE total score	Between Groups	1	13216.039	5.29	0.025
	Within Groups	55	2498.624		
	Total	55			
Index ADHD	Between Groups	1	166.294	4.46	0.039
	Within Groups	54	37.325		
	Total	55			
FE Symptoms	Between Groups	1	2338.169	5.13	0.028
	Within Groups	54	455.885		
	Total	55			

When looking at the average values to see the direction in which these differences were significant, we observe that: the average score on the self-organization subscale for the depression group (M = 45.7, SD = 15.0) was higher than the alcohol dependence group (M = 37.4, SD = 13.1); the average score on the self-management in relation to time subscale for the depression group (M = 57.3, SD = 16.3) was higher than the alcohol dependence group (M = 45.4, SD = 16.9); the average score on the emotion regulation subscale for the depression group (M = 31.7, SD = 8.6) was higher than the alcohol dependence group (M = 26.5, SD = 8.5); the average score on the scale that measures the total EF score for the depression group (M = 196.3, SD = 47.4) was higher than for the alcohol dependence group (M = 165.5, SD = 52.1); as well as on the ADHD index, the average score for the depression group (M = 22.5, SD = 6.0) was higher than the alcohol dependence group (M = 19.0, SD = 6.2).

If we look at the subscales that measure the number of symptoms, the difference between the depression group and the alcohol dependence group is quite large (M = 31.4, SD = 22.1), respectively (M = 18.5, SD = 20.7). If we look at the significant differences found at the Corsi test, the average score of the depression group (M = 4.3, SD = 0.9) is higher than that of the alcohol dependence group (M = 3.5, SD = 1.7), here a higher score meaning better performance. At the Stroop and RT Choice tests, the differences between groups were insignificant, which shows that the two diagnostic groups had similar performances.

If we look at the total mixed psychopathology sample (table 7), the total EF score correlates positively with the total score on the RT Choice task (r=.294, n=65, p <0.05), high scores representing EF dysfunctions. The total BDEFS score does not correlate with the Corsi score, and correlates negatively and significantly with the total Stroop score (r=-.363, n=65, p <0.001). The total scores at Corsi and Stroop correlate positively and significantly (r=.338, n=65, p <0.001), and the total scores at Corsi and RT Choice correlate negatively and significantly (r=-.262, n=65, p <0.05), the total scores at Corsi and RT Choice correlate negatively and significantly (r=-.442, n=65, p <0.001).

Table 7. Spearman bivariate correlation coefficients between EF tests in the clinical population

	1	2	3
1. BDEFS total			
2. Corsi scor final	-.117		
3. Stroop scor final	-.363**	.338**	
4. Rt choice scor final	.294*	-.262*	-.442**

Note: **. Correlation is significant at the p < 0.001 level
*. Correlation is significant at the p <0.05 level

We also compared the scores of the two gender groups at the BDEFS and CORSI subscales through a one-way analysis of variance (one-way ANOVA). Making a comparison within the clinical group, between 32 women and 33 men, statistically significant differences were observed at the Self-organization/ Problem solving [$F(1, 65)= 9.27$; $p=.003$], Self-management [$F(1, 65)= 15.14$; $p<.001$], Self-control [$F(1, 65)= 0.048$; $p<.048$], Emotion regulation [$F(1, 65)= 14.09$; $p<.001$] subscales and the total EF score [$F(1, 65)= 12.58$; $p=.001$]. The differences in mean scores for these subscales were quite large, with all women reporting higher average scores than men. No significant differences were observed on the Self-motivation scale [$F(1, 65)= 3.56$; $p=.064$] (or they were marginally significant) although, women reported higher scores than men. Therefore, significant gender differences emerged at four of the five subscales, and in the case of the fifth subscale, the result approached the threshold of statistical significance. Also, the examination of mean differences showed that there are relatively significant differences. By comparing the two gender groups, it is observed that when speaking of self-report scales, the women in the clinical sample tend to self-evaluate more poorly, having lower performances than the value obtained in the performance test (objective value). By comparing the average scores on the subscales, as well as the scores on the total EF, we notice that women report a higher score, meaning a lower performance. But if we take into account objective performance measurements, that is, if we look at the scores on the performance scales, respectively the scores on the CORSI subscales and the final score, we observe that there are no statistically significant differences here. Therefore, the discrepancy appears to be related to self-perception, not objective performance.

DISCUSSIONS AND CONCLUSIONS

Assessing EF in clinical environments presents challenges, given patient resistance, unfamiliarity with computers, and other variables that could affect outcomes (Toplak, West, & Stanovich, 2013). There's a gap in research comparing EF in those with depression and alcohol dependence.

Traditionally, EF measurement relies on performance-based cognitive tests. They provide standardized stimulus presentation, ensuring every participant undergoes the same experience. Moreover, these tests emphasize response accuracy, speed, and time-constrained reactions. In contrast, self-assessment scales of EF attempt to gauge one's competence in real-life situations. Ideally, if these self-assessment scales and performance-based tests tap into the same construct, they should show a strong positive correlation (Toplak, West, & Stanovich, 2013).

Although both metrics are meant to gauge the same construct— a fundamental aspect of convergent validity— they often don't correlate as expected, various studies revealing a significant dissociation between the two. While performance-based tests evaluate cognitive abilities under controlled settings, self-assessment scales provide insights into how individuals function in everyday, unstructured situations.

In our study, it was observed that out of the three computerized tests employed to gauge EF, only one did not show a significant correlation with self-assessment scores. Specifically, while the Stroop and RT Choice tests both demonstrated significant correlations with participants' self-assessments of their EF, the Corsi task did not. Such a divergence in correlation might reveal the unique nature of each test. The Corsi task predominantly evaluates visual-spatial working memory. It's plausible that individuals may not consistently recognize or assign significant relevance to their visual-spatial working memory capacities in the context of daily activities, thereby resulting in an incongruence between the task's outcomes and self-assessment scores.

The clinical group, as expected, displayed poorer performance across both evaluation methods compared to the non-clinical group. Educational background might be a confounding factor, given that 87.8% of the non-clinical group had a higher education compared to only 13.8% of the clinical group. Past studies have linked higher education with enhanced cognitive test performance (Godard, Grondin, Baruch, & Lafleur, 2011; Stordal et al., 2005).

Delving into the subgroup with depression, there's a tendency towards negative self-assessment, suggesting a distorted perception of their actual capabilities. This tendency aligns with the well-documented predisposition of depressive individuals towards negative biases (Rude, Krantz, and Rosenhan, 1988; Beck, 1963; Orth, Robins, Meier, and Conger, 2016; Wisco, and Nolen-Hoeksema, 2010).

The literature provides separate insights into the EF impairments seen in depression and alcohol dependence. For instance, a 2021 meta-analysis confirmed individuals with depression showed decreased EF performance across tasks (Nuño, Gómez-Benito, Carmona, & Pino, 2021; Snyder et al., 2015). Factors like medication, depression subtype, age, and the number of episodes can influence EF (Hinkelmann et al., 2009; Tavares et al., 2007; Cataldo, Nobile, Lorusso, Battaglia, & Molteni, 2005; Matthews, Coghill, & Rhodes, 2008; McClintock, Husain, & Cullum, 2010; Porter, Bourke, & Gallagher, 2007; Lane and O'Hanlon, 1999).

For patients with alcohol dependence, cognitive deficits persist even after prolonged sobriety (Brion et al., 2017). These patients often show signs of denial, which is rooted more in cognitive failure than defensive mechanisms

(Rinn, Desai, Rosenblatt, & Gastfriend, 2002). Analogies have been drawn between alcoholic denial and the unawareness of deficits seen in anosognosia (Heilman, 1991; Levine, Calvanio, & Rinn, 1991).

In our research findings, individuals with alcohol dependence tended to report superior EF in self-assessment measures when contrasted with individuals diagnosed with depression. Nevertheless, this enhanced self-perceived EF did not correspondingly align with their performance outcomes in objective cognitive tasks.

In sum, our research underscores the diverse EF performances across clinical and non-clinical groups. Both patient subgroups— depression and alcohol dependence— exhibit unique cognitive characteristics. Future research needs to dive deeper into the underlying mechanisms of these EF deficits to better aid these patient groups. The complexities noted here emphasize the necessity for thorough and multi-faceted analyses of EF across different psychopathological conditions.

LIMITATIONS

One of the primary limitations of our study is the extensive age range of the participants (23-75 years). Given the shifts in EF across different age groups it's imperative to consider the inherent complexities and nuances associated with the evolution of EF across the lifespan (Zelazo, Craik, & Booth, 2004). The wide age range of participants in our study, the multifaceted nature of EF, combined with developmental intricacies, might introduce a degree of variability that could influence our findings. The changes in EF due to aging could potentially mask or amplify the observed effects of psychiatric conditions.

Conducting studies within inpatient settings poses inherent challenges. The controlled environments can introduce potential biases due to the institutionalized nature of care. Securing large sample sizes from inpatient populations presents substantial challenges. Individuals are often undergoing intensive treatment and may have acute symptoms, therefore recruitment for research purposes can be limited. Additionally, ethical considerations, and the temporary duration of inpatient stays further constrain the potential pool of participants. As a result, achieving expansive sample sizes in such settings is difficult, which may impact the generalizability of findings derived from inpatient-based studies.

REFERENCES

Barkley, R. A. (2014). The assessment of executive functioning using the Barkley Deficits in Executive Functioning Scales. In *Handbook of executive functioning* (pp. 245-263). Springer, New York, NY.

Barkley, R. A., Albu, M., Ciuca, A. M., Crișan, L. G., & Rogobete, D. (2022). *Scala Barkley pentru evaluarea deficitelor funcției executive (BDEFS): Adaptarea BDEFS pe populația din România*. Editura A.S.C.R.

Barry, D., & Petry, N. M. (2008). Predictors of decision-making on the Iowa Gambling Task: Independent effects of lifetime history of substance use disorders and performance on the Trail Making Test. *Brain and cognition*, *66*(3), 243-252.

Beck, A. T. (1963). Thinking and depression: I. Idiosyncratic content and cognitive distortions. *Archives of general psychiatry*, *9*(4), 324-333.

Berch, D. B., Krikorian, R., & Huha, E. M. (1998). The Corsi block-tapping task: Methodological and theoretical considerations. *Brain and cognition*, *38*(3), 317-338.

Bernardin, F., Maheut-Bosser, A., & Paille, F. (2014). Cognitive impairments in alcohol-dependent subjects. *Frontiers in psychiatry*, 5, 78.

Bogod, N. M., Mateer, C. A., & MacDonald, S. W. (2003). Self-awareness after traumatic brain injury: A comparison of measures and their relationship to executive functions. *Journal of the International Neuropsychological Society*, 9, 450-458.

Brion, M., D'Hondt, F., Pitel, A. L., Lecomte, B., Ferauge, M., de Timary, P., & Maurage, P. (2017). Executive functions in alcohol-dependence: A theoretically grounded and integrative exploration. *Drug and alcohol dependence*, *177*, 39-47.

Burgess PW, Alderman N, Evans J, Emslie H, Wilson BA. (1998), The ecological validity of tests of executive function. *Journal of Int Neuropsychol Soc*. 1998 Nov; 4(6):547-58. doi: 10.1017/s1355617798466037.

Cataldo, M. G., Nobile, M., Lorusso, M. L., Battaglia, M., & Molteni, M. (2005). Impulsivity in depressed children and adolescents: a comparison between behavioral and neuropsychological data. *Psychiatry research*, 136(2-3), 123-133.

Field, A. (2017). *Discovering Statistics Using Ibm Spss Statistics + Webassign*. Sage Publications.

Fischer, M. H. (2001). Probing spatial working memory with the Corsi blocks task. *Brain and cognition*, *45*(2), 143-154.

Godard, J., Grondin, S., Baruch, P., & Lafleur, M. F. (2011). Psychosocial and neurocognitive profiles in depressed patients with major depressive disorder and bipolar disorder. *Psychiatry research*, 190(2-3), 244-252.

Goldberg, E. (Ed.). (2017). *Executive functions in health and disease*.

Gustavson, K. A., Alexopoulos, G. S., Niu, G. C., McCulloch, C., Meade, T., & Areán, P. A. (2016). Problem-solving therapy reduces suicidal ideation in depressed older adults with executive dysfunction. *The American Journal of Geriatric Psychiatry*, 24(1), 11-17.

Heilman, K. M. (1991). Anosognosia: possible neuropsychological mechanisms. *Awareness of deficit after brain injury: Clinical and theoretical issues*, 53-62.

Hinkelmann, K., Moritz, S., Botzenhardt, J., Riedesel, K., Wiedemann, K., Kellner, M., & Otte, C. (2009). Cognitive impairment in major depression: association with salivary cortisol. *Biological psychiatry*, 66(9), 879-885.

Johnson, W., & Deary, I. J. (2011). Placing inspection time, reaction time, and perceptual speed in the broader context of cognitive ability: The VPR model in the Lothian Birth Cohort 1936. *Intelligence*, *39*(5), 405-417.

Kosinski, R. J. (2013). A literature review on reaction time. *Clemson University*, *10*(1), 337-344.

Labudda, K., Frigge, K., Horstmann, S., Aengenendt, J., Woermann, F. G., Ebner, A., ... & Brand, M. (2009). Decision making in patients with temporal lobe epilepsy. *Neuropsychologia*, *47*(1), 50-58.

Lane, R. M., & O'Hanlon, J. F. (1999). Cognitive and psychomotor effects of antidepressants with emphasis on selective serotonin reuptake inhibitors and the depressed elderly patient. *German Journal of Psychiatry*.

Lawrence, N. S., Wooderson, S., Mataix-Cols, D., David, R., Speckens, A., & Phillips, M. L. (2006). Decision making and set shifting impairments are associated with distinct symptom dimensions in obsessive-compulsive disorder. *Neuropsychology*, *20*(4), 409.

Levine, D. N., Calvanio, R., & Rinn, W. E. (1991). The pathogenesis of anosognosia for hemiplegia. *Neurology*, *41*(11), 1770-1770.

Mahmut, M. K., Homewood, J., & Stevenson, R. J. (2008). The characteristics of non-criminals with high psychopathy traits: Are they similar to criminal psychopaths?. *Journal of Research in Personality*, *42*(3), 679-692.

Matthews, K., Coghill, D., & Rhodes, S. (2008). Neuropsychological functioning in depressed adolescent girls. *Journal of Affective Disorders*, 111(1), 113-118.

McClintock, S. M., Husain, M. M., Greer, T. L., & Cullum, C. M. (2010). Association between depression severity and neurocognitive function in major depressive disorder: a review and synthesis. *Neuropsychology*, 24(1), 9.

McLennan, S. N., & Mathias, J. L. (2010). The depression-executive dysfunction (DED) syndrome and response to antidepressants: a meta-analytic review. *International journal of geriatric psychiatry*, 25(10), 933-944.

Nakamura, M., Nestor, P. G., Levitt, J. J., Cohen, A. S., Kawashima, T., Shenton, M. E., & McCarley, R. W. (2008). Orbitofrontal volume deficit in schizophrenia and thought disorder. *Brain*, *131*(1), 180-195.

Nęcka, E., Lech, B., Sobczyk, N., & Śmieja, M. (2012). How much do we know about our own cognitive control?. *European Journal of Psychological Assessment*.

Nuño, L., Gómez-Benito, J., Carmona, V. R., & Pino, O. (2021). A systematic review of executive function and information processing speed in major depression disorder. *Brain Sciences*, 11(2), 147.

Orth, U., Robins, R. W., Meier, L. L., & Conger, R. D. (2016). Refining the vulnerability model of low self-esteem and depression: Disentangling the effects of genuine self-esteem and narcissism. *Journal of personality and social psychology*, *110*(1), 133.

Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of child psychology and psychiatry*, 37(1), 51-87.

Pickard, H. (2016). Denial in addiction. *Mind & Language*, *31*(3), 277-299.

Pimontel, M. A., Rindskopf, D., Rutherford, B. R., Brown, P. J., Roose, S. P., & Sneed, J. R. (2016). A meta-analysis of executive dysfunction and antidepressant treatment response in late-life depression. *The American Journal of Geriatric Psychiatry*, 24(1), 31-41.

Porter, R. J., Bourke, C., & Gallagher, P. (2007). Neuropsychological impairment in major depression: its nature, origin and clinical significance. Australian & New Zealand *Journal of Psychiatry*, 41(2), 115-128.

Rinn, W., Desai, N., Rosenblatt, H., & Gastfriend, D. R. (2002). Addiction denial and cognitive dysfunction: a preliminary investigation. *The Journal of neuropsychiatry and clinical neurosciences*, *14*(1), 52-57.

Roth, R. M., Gioia, G. A., & Isquith, P. K. (2005). *BRIEF-A: Behavior rating inventory of executive function--adult version*. Psychological Assessment Resources.

Rude, S. S., Krantz, S. E., & Rosenhan, D. L. (1988). Distinguishing the dimensions of valence and belief consistency in depressive and nondepressive information processing. *Cognitive Therapy and Research*, *12*, 391-407.

Scarpina, F., & Tagini, S. (2017). The stroop color and word test. *Frontiers in psychology*, 8, 557.

Snyder, H. R., Miyake, A., & Hankin, B. L. (2015). Advancing understanding of executive function impairments and psychopathology: bridging the gap between clinical and cognitive approaches. *Frontiers in psychology*, *6*, 328.

Tavares, J. V. T., Clark, L., Cannon, D. M., Erickson, K., Drevets, W. C., & Sahakian, B. J. (2007). Distinct profiles of neurocognitive function in unmedicated unipolar depression and bipolar II depression. *Biological psychiatry*, 62(8), 917-924.

Toplak, M. E., Jain, U., & Tannock, R. (2005). Executive and motivational processes in adolescents with Attention-Deficit-Hyperactivity Disorder (ADHD). *Behavioral and brain Functions*, *1*, 1-12.

Toplak, M. E., Liu, E., MacPherson, R., Toneatto, T., & Stanovich, K. E. (2007). The reasoning skills and thinking dispositions of problem gamblers: A dual-process taxonomy. *Journal of Behavioral Decision Making*, *20*(2), 103-124.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2013). Practitioner review: Do performance-based measures and ratings of executive function assess the same construct? *Journal of child psychology and psychiatry*, *54*(2), 131-143.

Wingo, J., Kalkut, E., Tuminello, E., Asconape, J., & Han, S. D. (2013). Executive functions, depressive symptoms, and college adjustment in women. *Applied Neuropsychology: Adult*, 20(2), 136-144.

Wisco, B. E., & Nolen-Hoeksema, S. (2010). Interpretation bias and depressive symptoms: The role of self-relevance. *Behaviour research and therapy*, *48*(11), 1113-1122.

Zelazo, P. D., Craik, F. I., & Booth, L. (2004). Executive function across the life span. *Acta psychologica*, 115(2-3), 167-183.