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Research Article

The relation between different executive functions and depressive symptoms in young adults in Croatia

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ABSTRACT

The study aims to explore the specific relation of different executive functions with depressive symptoms in a non-clinical sample of young adults in Croatia. The online study included 290 young adults (aged 18-35). Participants completed a PHQ-9 questionnaire that assessed depressive symptoms, one measure of executive functions using self-report, and two behavioural tasks measuring working memory and inhibition. Partial correlation analysis indicated that better working memory (measured using both self-report and a behavioural task) is related to less depressive symptoms in young adults. Contrary to expectations, the relation between inhibition and depressive symptoms was not confirmed. Additionally, the regression analysis suggests that working memory task is an important predictor of depressive symptoms, even after controlling for participant's education level, financial status, and level of resilience. Research shows that certain executive functions are differentially related to mental health in young adults. Additional research is needed to explore the mechanism underlying these differences and aid the creation of more appropriate treatment plans.

Keywords: executive functions, working memory, inhibition, depressive symptoms, young adults

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Introduction

People are often exposed to stressors that can lead either to adaptation or to various adverse health, behavioural, or psychological consequences. For example, it is estimated that, during their lifetime, approximately 70% of people will experience at least one traumatic life event such as exposure to death or the threat of death, serious physical injury (actual or threatened), or sexual violence (experienced directly, witnessed first-hand or indirectly, or experienced in professional activity; Frewen et al., 2019). A particularly challenging period that may require good adaptation skills is young adulthood. The period of transition from adolescence to adulthood often involves people changing their environment and exploring new experiences and new social roles. Various tasks that can arise in young adulthood make this period particularly stressful, especially for individuals with lower levels of psychological resilience. Among others, a particularly common psychiatric disorder among young adults is depression. In the United States, between 2015 and 2020, levels of depression in the population under 35 years of age increased, and 17.2% of young people aged 18 to 25reported experiencing at least one major depressive episode (Goodwin et al., 2022). Younger adults were more likely to report depressive symptoms than any other age group. Additionally, Arias-de la Torre et al. (2023) noted that the point prevalence of clinically relevant depressive symptoms in Europe between 2013 and 2020 had high variability across countries, with the highest within-country prevalence increases being observed in Slovenia, Denmark, Lithuania, and Croatia.

In addition to dissatisfaction, extreme feelings of sadness and pessimism, symptoms of depression involve the occurrence of physical, social, and cognitive changes (i.e., changes in sleeping habits and appetite, lack of motivation and energy, difficulty concentrating and ability to make decisions, and withdrawal from social activities). In individuals with major depressive disorder, all of these symptoms cause clinically significant distress or impairment in work, social, or other areas of functioning (American Psychiatric Association, 2013). Severe forms of depression may involve suicidal thoughts that can lead to suicide attempts and, consequently, deaths by suicide. Finally, many individuals who have subsyndromal depression may later develop difficulties that will require

intervention (Goodwin et al., 2022); therefore, it is crucial to recognize the factors that are associated with symptoms of depression in young adults.

Successful adaptation models emphasize a combination of physiological, neurobehavioral, environmental, and psychological factors. These psychological factors include executive functions, which play an important role in understanding complex and abstract concepts, solving new problems, and planning and governing different situations. A large body of research shows that as part of the developmental process of adaptation, undifferentiated neutral systems in childhood become increasingly specialized with age. For example, a well-known "unity and diversity" theory of executive functions (Miyake et al., 2000) posits that interrelated but separate components of cognitive functioning include cognitive flexibility, working memory, and inhibition as basic components. In detail, cognitive flexibility refers to the ability to change perspective or approach a problem with new rules or priorities. Working memory involves the ability to hold and mentally manipulate information. Finally, inhibition refers to the ability to stop an automatic or dominant response in order for a person to achieve a certain goal or delay the satisfaction of certain needs. Executive functions are most often assessed using behavioural tasks and rating scales. Behavioural tasks typically measure accuracy and reaction time. On the other hand, rating scales have been developed to improve the ecological validity of executive function measures in complex everyday situations. Using scales to assess executive function, the participant reports cognitive difficulties performing everyday tasks. The use of both behavioural tasks and rating scales as part of executive function assessment is recommended, as different methods have been shown to measure different aspects of executive function (Toplak et al., 2013).

Many studies suggest that depression is associated with impaired executive functions. For example, individuals with depressive symptoms performed poorly on executive function tasks such as working memory (Semkovska et al., 2019) and inhibition (Yitzhak et al., 2023) compared to controls. According to the Resource Allocation Model (RAM; Ellis & Moore, 1999), it is assumed that there is a fixed amount of resources available for information processing. According to this model, depression increases cognitive load and consumes resources that would otherwise be devoted to

a task. In other words, a higher level of depression would reduce a person's ability to focus attention on cognitive tasks, especially in the case of complex tasks. In addition, some researchers believe that executive functions can serve as a protective factor that aids coping with depressive symptoms; that is, they believe executive function training can reduce the likelihood of depressive symptoms (Beloe & Derakshan, 2020). Studies suggest that better executive functions most likely "protect" an individual from preoccupation with negative thoughts and low mood. However, studies in this research field are not entirely consistent. In particular, some studies show no differences between depressed and non-depressed individuals on measures of executive functions (Murphy et al., 2019), except in late adulthood (Rosselli et al., 2019). Working memory and, particularly, inhibition seem to be the most frequently studied executive functions in depression-related research. Specifically, inhibition is mentioned in 68%, and working memory is mentioned in 35% of research studies, which makes them the most represented in the literature on executive functions (Baggetta & Alexander, 2016). Therefore, it is necessary to determine their separate contribution to the mental health of young adults. Additionally, the link between executive functions and depressive symptoms is well-documented in clinical and older adult samples; however, the relation between these constructs within non-clinical samples of young adults is less recognized. Exploring factors associated with depression in young adults in Eastern Europe is particularly important, given that this population was shown to be at increased risk of serious mental health problems.

The Present Study

The aim of the present study was to explore the association of working memory and inhibition with symptoms of depression in a non-clinical sample of young adults in Croatia using a cross-sectional design. Given that some previous research has used only subjective or only objective measures of executive functions (i.e., Nikolin et al., 2021), the strength of our research design is the parallel use of a subjective self-report questionnaire, as well as objective behavioural tasks to measure specific executive functions and their separate relations to depressive symptoms. In line with the Resource Allocation Model of Ellis & Moore (1999), it was hypothesized that better working memory and inhibitory ability, as measured by self-report and

behavioural tasks, would be associated with lower levels of depressive symptoms in young adults.

Method

Data and Participants

The data were collected online during August and September 2023 using a snowball method via social networks, portals, e-mail lists, and by directly sharing the link with acquaintances. To achieve representativeness, the sample was weighted by demographic characteristics (i.e., age, socioeconomic status) and device (computer and mobile). After excluding participants with neurological disorders (i.e., epilepsy, traumatic brain injury), the final sample consisted of 290 young adults (225 females, 64 males, and one non-binary individual) aged 18-35 (M_{age} = 24.35 years, SD_{age} = 3.87 years). The participant's level of education was as follows: 0.3% had finished primary school, 35.4% had finished high school (between 11 and 12 years of schooling), 63.6% had a college degree, and 0.7% had a postgraduate degree. Moreover, 73.7% reported an average financial status. With regard to their employment status, 2% were high school pupils, 54.8% were students, 35.3% were employed and 7.9% unemployed. The research was ethically approved by the University Institutional Review Board (IRB). To be allowed to participate in the study, all participants provided written informed consent.

Measures

Executive functions – self-report

Adult Executive Function Inventory (ADEXI; Štelcar, 2021)

The Croatian version of the ADEXI (Štelcar, 2021) was used to measure executive functions in young adults. The inventory consists of 14 items measuring working memory difficulties (9 items; e.g., "I have difficulties with tasks or activities that involve several steps") and inhibition difficulties (5 items; e.g., "I have a tendency to do things without first thinking about what could happen"). The participants used a five-point Likert-type scale to assess how well each statement describes them (1 = "definitely not true," 2 = "not

true," 3 = "partially true," 4 = "true," and 5 = "definitely true"). The score is calculated as a linear combination of answers to the associated statements, with higher scores indicating greater difficulties in executive functions. In our sample of young adults, the internal reliability coefficients of the subscales were α = .87 (working memory difficulties) and α = .66 (inhibition difficulties).

Executive functions – behavioural tasks

We used the free software package OpenSesame (Mathôt & March, 2022) to construct computerized behavioural tasks for executive function (working memory and inhibition) assessment.

The Stroop task (Mead et al., 2002)

During the Stroop task, participants were presented with stimuli in the form of colour names coloured in different colours on the screen. The presented stimulus was either congruent or incongruent. When the stimulus was congruent, word colour and word name were matched (i.e., the word “red” was presented in red colour), whereas, in the case of incongruent stimuli, the word and the colour of the word were not matched (i.e., the word "red" was presented in yellow colour). The participants' task was to determine the colour of each displayed word by pressing the correct key on the keyboard (i.e., if the word "red" was displayed in green colour, they were to press the "g" key, which indicates the colour green). The success rate was determined by the average difference in reaction speed to congruent and incongruent stimuli (expressed in milliseconds). A smaller difference in reaction speed reflects the participant’s better ability to inhibit dominant responses. The test-retest reliability of the Stroop task in earlier samples of young adults was high, ranging from 0.78 to 0.92 (Vora et al., 2016).

The N-back task (version used by Miller et al., 2009)

The N-back task was used to assess participants' working memory ability. Participants were presented with a sequence of three sets of 25 letters. Each letter was presented separately, and the task was to assess whether the presented letter had already been shown in two previous presentations of the letter. When a letter was presented in a predetermined order, the participant's task was to press the corresponding key on the keyboard (i.e., participants are first shown the letter "F," then the letter "B,"

then again the letter "F"). When a letter was not presented in a predetermined order, the participant was required not to respond. The indicator of success was the percentage of correctly recognized displays, with higher scores representing better working memory ability. The test-retest reliability of this task in earlier samples was .85 (Soveri et al., 2016).

Depressive symptoms

Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001)

The Croatian version of the PHQ (Bolić, 2024) was used to measure depressive symptoms in young adults. For each of the nine statements in the questionnaire, participants estimated how often they experienced certain symptoms in the last two weeks (e.g.," Feeling tired or having little energy"). Participants used a four-point Likert-type scale (0 = "Not at all," 3 = "Nearly every day"). The total score was calculated as a linear combination, with higher scores indicating a severity of depressive symptoms. The internal reliability coefficient of this questionnaire in our study was α = .79.

Control variables

Participants' education level and financial status, as well as the level of resilience measured by the Connor-Davidson Resilience Scale 10-CD-RISC-10 (Campbell-Sills & Stein, 2007), were used as control variables in this research. For a detailed description of the control variables, see Bolić (2024).

Results

Preliminary Analysis

The Kolmogorov-Smirnov (KS) test, skew index (SI), and kurtosis index (KI) were used to check the normality of the distributions. The Kolmogorov-Smirnov test suggested the distribution of all variables significantly differed from normal ($p < .05$). However, noting that even one extreme result can cause the distribution to deviate significantly from normal, Kline (2011) explains that the distribution can still be considered normal if the absolute values of SI < 3.0 and KI < 10.0. In our study, the SI of

all variables ranged from .02 to 2.15, while the KI values ranged from .08 to 5.36.

Partial correlation analyses were used to explore research hypotheses. As is shown in Table 1, when controlling for education level, financial status, and level of resilience, young adults with more working memory difficulties (measured with self-report or behavioural tasks) had higher levels of depressive symptoms. However, inhibition was not related to depressive symptoms when assessed via self-report or behavioural task. Thus, inhibition will not be included in further analyses. As for the relationship between different methods for assessing executive functions (i.e., self-report and behavioural measures), the correlations ranged from non-significant to low.

Table 1

Descriptive Statistics, Normality Tests, and Partial Correlations

Variables		*M (SD)*	*KS*	*SI*	*KI*	*2*	*3*	*4*	*5*
1	ADEXI working memory	20.92 (6.29)	.09	0.60	0.08	**.44****	.04	.02	**.12***
2	ADEXI inhibition	13.44 (3.79)	.08	0.02	-0.34	-	.03	**.17****	.08
3	N-back working memory	77.53 (20.25)	.07	-2.15	5.36		-	**.13****	**-.14***
4	Stroop inhibition	139.60 (159.11)	.22	-0.44	-1.39			-	.01
5	PHQ-9	7.17 (4.16)	.13	0.47	-0.50				-

Note. KS – Kolmogorov-Smirnov test; SI – Skew Index; KI – Kurtosis Index.

$^{*}p < .05$. $^{**}p < .01$.

The role of working memory in explaining depressive symptoms

Following partial correlation analyses, we wanted to examine whether self-report measure or behavioural task of working memory will have

greater contribution in explaining depressive symptoms. Therefore, hierarchical regression analysis was conducted. The first block of predictors consisted of control variables. The second block included measures of working memory difficulties.

As can be seen in Table 2, after controlling for sociodemographic variables, self-reported working memory difficulties were not a significant predictor of depressive symptoms in our sample of young adults. However, the behavioural task of working memory (N-back task) explains 2% ($p < .05$) of the variance of depressive symptoms. In line with the results of the correlation analysis, a higher number of correct results on the N-back task, which indicates better working memory ability, independently predicts lower scores on the depression symptoms questionnaire.

Partially in line with our hypothesis, only the N-back task was a significant predictor of depressive symptoms. In other words, better working memory, as measured by a behavioural task, predicted lower levels of self-reported depressive symptoms in young adults.

Table 2

The Contribution of Working Memory to the Explanation of Depressive Symptoms

Variables	ß
1. step	
Education level	-.05
Financial status	-.07
Resilience	-.09
F	2.14
df_1	3
df_2	286
ΔR^2	.01
2. step	
Education level	-.05
Financial status	-.07
Resilience	-.09

	ADEXI working memory difficulities	.07
	N-back task	-.13*
F		3.04
df_1		5
df_2		284
ΔR^2		.02*

* $p < .05$.

Discussion

In a sample of young adults, we wanted to investigate the association of working memory and inhibitory ability with symptoms of depression. Specifically, we wanted to test whether better working memory and inhibition would be associated with lower levels of depressive symptoms.

This study extends earlier research on the link between executive functions and depressive symptoms by examining specific relations between working memory and inhibition and depressive symptoms in a non-clinical sample of young adults using parallel versions of self-report and behavioural tasks that measure executive functions. Consistent with the work of Ellis & Moore (1999), our study showed that executive functions may be associated with symptoms of depression in a sample of young adults. However, there were certain unexpected findings that we will elaborate in the following paragraphs.

Partially in line with our hypothesis and similar to previous research, people with difficulties in working memory, as measured by self-assessments (Hoorelbeke et al., 2022) and behavioural measures (Nikolin et al., 2021), reported more pronounced symptoms of depression. Many studies suggest that depressed individuals have dysfunctions in the activities of parts of the brain responsible for cognitive processes involved in working memory, such as selective attention, updating and information manipulation (Wang et al., 2021). These results are consistent with the Resource Allocation Model (Ellis & Moore, 1999), according to which depression increases cognitive load and reduces the ability to focus attention on cognitive tasks, especially in the case of complex tasks. Overall, in our study, it appeared that participants with higher levels of depressive symptoms had

working memory difficulties, as reflected in their poorer performance on the N-back task. Besides, they seemed to be aware of the difficulties working memory deficits cause in their daily lives, as reflected in their self-reports. Given that the research used neutral, non-emotional stimuli, it can be assumed that the general ability to process information, regardless of the type of stimulus, predicts symptoms of depression. In addition, there is evidence of a neurobiological basis for this association. Precisely, depressive symptoms are associated with structural abnormalities in the prefrontal lobe and posterior cortical regions (i.e., Walsh et al., 2007), which lead to less activation of these brain areas and lower levels of glutamate - the neurotransmitter associated with memory, cognition and emotion regulation (i.e., Pehrson & Sanchez, 2014). On the other hand, unlike the research of Hoorelbeke et al. (2022), in our study the ADEXI working memory difficulties subscale was not a significant predictor of depressive symptoms. This can be attributed to the somewhat low correlation between the ADEXI working memory difficulties subscale and depressive symptoms subscale, compared to the working memory behavioural task.

It is worth pointing out that the low correlations between executive functions and depressive symptoms are not surprising given that our study was conducted on a non-clinical sample of young adults, compared to stronger correlations in the research conducted on the same age groups with diagnosed clinical disorders, such as major depressive disorder (i.e., Liu et al., 2019). Additionally, similar to the results of our study, results from previous research (e.g., Toplak et al., 2013) show non-significant to low correlations between behavioural measures of executive function and executive function rating scales. This indicates that behavioural tasks and executive function rating scales measure different aspects of the same construct. Toplak et al. (2013) believe that different executive function measures capture different levels of cognitive analysis. Specifically, behavioural tasks are thought to provide information about the efficiency of information processing, while rating scales provide an understanding of an individual's success in achieving certain goals. In addition, Toplak et al. (2013) state that differences in the understanding of behavioural tasks and rating scales also arise from the assumptions of measurement theory in psychology. Namely, in psychometrics, there are two types of performance, that is, reactions expected from participants in a certain situation, namely:

(1) typical or usual and (2) optimal or maximal performance of a certain activity or task. In rating scales, the participant's reaction is not completely defined by the examiner's instructions, and the participant is not expected to provide their best possible performance. Instead, the participant has the freedom to interpret the situation in their own way. Conversely, in behavioural tasks, there is a clearly defined situation in which participants are expected to perform optimally, with their task being to achieve as much success as possible. Given the above, future research should focus on a more detailed exploration of various behavioural correlates of rating scales and behavioural tasks for assessing executive functions.

Contrary to expectations, no association was found between any of the two measures of inhibition (i.e., subjective and objective) and depressive symptoms. Such findings are not in accordance with many previous studies (i.e., Yitzhak et al., 2023). However, some researchers (e.g., Rosselli et al., 2019) argue that inconsistent findings on the executive functions-depression link can be found in a sample of adolescents, as deficits in executive functions in individuals with depressive disorders are more common in late adulthood. Moreover, the lack of consistency across studies may be explained by participants' level of depressive symptoms. That is, the effect size of this association increases as the level of depressive symptoms increases (Liu et al., 2019), and in our study, participants reported mild depressive symptoms on average. In addition, a longitudinal study by Yitzhak et al. (2023) suggested there are intra-individual fluctuations in inhibitory capacity measured by the Go-NoGo behavioural task; specifically, inhibitory capacity may fluctuate at a daily level. In their study, poor performance on the inhibition-related task was not observed during the initial measurement but only after five consecutive days of measurement. Therefore, it is possible that our study did not find a statistically significant association between inhibition and depressive symptoms due to intra-individual daily fluctuations in inhibition. Also, it would be useful to test the relationship between inhibition and depressive symptoms using another behavioural task measuring inhibition ability, such as the Go-NoGo task. The participant's task is to react or perform a motor action during the *go* state and to resist the impulsive urge to do so during the *no-go* state. A higher proportion of incorrect responses in the task is considered a direct measure of inhibition-related difficulties. Therefore, this type of task is recommended for future research.

All the above points to the importance of studying each executive function individually and determining their separate contribution when it comes to different difficulties.

Our study points to several factors that should be considered in future research. For example, the nature of its implementation. Given that the study was conducted online, it was not possible to control for some systematic variable factors such as previous exposure to similar behavioural tasks. Given that executive function tasks cannot be paused once the participant has begun to solve them, various distractions may have led to poorer performance. Furthermore, due to the age of the participants, it is possible that at least some of them play video games, and people who regularly play video games perform better on many measures of executive functions (i.e., Alho et al., 2022); thus, future research would benefit from data on the frequency of playing video games in daily life. Furthermore, self-assessment measures are prone to subjectivity; participants may have provided socially desirable responses, and their responses may have been influenced by their current mood, their understanding of the research concepts, and their ability to accurately rate their difficulties. In addition, due to the lower reliability of the ADEXI inhibition difficulties subscale, results related to this subscale should be interpreted with caution. However, it should be noted that, according to some authors (e.g., Taber, 2017), an acceptable level of reliability may be lower than $\alpha = .70$, depending on the constructs being measured. Earlier interpretations by Gardner (1995) emphasized that a rating scale must be unidimensional in order to produce interpretable results. It is possible that other self-report measures, such as the Behavior Rating Inventory of Executive Function-Adult Version (Roth et al., 2005), which has excellent psychometric properties, may provide better insight into the relationship between executive functions and depression in youth. Given the low percentage of explained variance of the criterion variable of depressive symptoms, future research may include tasks that measure cognitive flexibility and some higher-order executive functions such as reasoning, problem-solving, and planning. For example, future research could use the Wisconsin Card Sorting Task (Stuss et al., 2000), in which the participant has to adapt their behaviour or thoughts to the new demands of the situation, as well as the Tower of London (Kaller et al., 2012), which was designed to measure planning ability. The inclusion of different measures of executive

functions and related cognitive abilities, such as cognitive reserve (e.g., Volarov et al., 2020), could provide more detailed information on the association of specific cognitive functions with depressive symptoms. Moreover, future research could include other variables related to depressive symptoms, such as personality traits, emotion regulation strategies, sleep habits, and physical activity (e.g., Schuch et al., 2017). Additionally, our sample predominantly consisted of females, so caution is needed when interpreting the results, given that gender is a well-known covariate of the studied variables (i.e., Gaillard et al., 2021; Hyde & Mezulis, 2020). Although the level of education was included as a control variable, since the number of years of education is associated with better cognitive functions throughout adulthood (Lövdén et al., 2020), it is important to note that our sample predominately consisted of young, highly educated people Also, higher education is considered a protective factor in the development of mental health problems such as depression in youth (Bauldry, 2015). Another limitation of the present study is its correlational design, making it impossible to establish a causal relationship between the variables of interest. The strengths of the present study are worth noting, too. This research focuses on the relatively unexplored associations between specific dimensions of executive functions and depression in young adults. Moreover, the present study used both objective (i.e., computerized behavioural tasks) and subjective (i.e., self-reported) measures of executive functions. By using different methods for assessing executive functions, a more valid prediction of depressive symptoms in early adulthood is possible. Such a practice takes into account that some high correlations may be attributable to common method variance. Furthermore, this research places executive function in the context of common problems of modern life. A large number of young adults have experienced at least one major depressive episode during their lifetime, so it is important to discover mechanisms that can help them cope with these mental health problems. The conducted research showed that working memory has a relevant role in explaining the symptoms of depression. The results can help in designing strategies aimed at reducing the symptoms of depression through executive functions, especially working memory training for young adults, both computerized and noncomputerized. Moreover, as pointed out by Novick et al. (2020), the way in which a certain activity is performed as part of the executive function training, the characteristics of the

mentor or trainer, as well as the perception of the importance and relevance of the activity for the participant will likely have a more significant effect on the participant than the activity itself. Together, the results of the conducted study can serve as a basis for further research in different age groups and in the context of different life challenges.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data used in this paper are available upon a reasonable request.

References

Alho, K., Moisala, M., & Salmela-Aro, K. (2022). Effects of media multitasking and video gaming on cognitive functions and their neural bases in adolescents and young adults. *European Psychologist*, *27*(2), 131–140. https://doi.org/10.1027/1016-9040/a000477

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. https://doi.org/10.1176/appi.books.9780890425596

Arias-de la Torre, J., Vilagut, G., Ronaldson, A., Bakolis, I., Dregan, A., Martín, V., Martinez-Alés, G., Molina, A. J., Serrano-Blanco, A., Valderas, J. M., Viana, M. C., Alonso, J. (2023). Prevalence and variability of depressive symptoms in Europe: update using representative data from the second and third waves of the European Health Interview Survey (EHIS-2 and EHIS-3). *Lancet Public Health*, *8*(11), e889-e898. https://doi.org/10.1016/S2468-2667(23)00220-7

Baggetta, P., & Alexander, P. A. (2016). Conceptualization and operationalization of executive function. *Mind, Brain, and Education*, *10*(1), 10–33. https://doi.org/10.1111/mbe.12100

Bauldry, S. (2015). Variation in the protective effect of higher education against depression. *Society and Mental Health*, *5*(2), 145–161. https://doi.org/10.1177/2156869314564399

Beloe, P., & Derakshan, N. (2020). Adaptive working memory training can reduce anxiety and depression vulnerability in adolescents. *Developmental Science*, *23*(4) e12831. https://doi.org/10.1111/desc.12831

Bolić, T. (2024). Odnos izvršnih funkcija i otpornosti s depresivnim simptomima kod mladih odraslih osoba [Neobjavljeni diplomski rad, Sveučilište Josip Juraj Strossmayera u Osijeku]. Filozofski fakultet.

Campbell-Sills, L. & Stein, M. B. (2007). Psychometric analysis and refinement of the Connor-Davidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. *Journal of Traumatic Stress*, *20*(6), 1019–1028. https://doi.org/10.1002/jts.20271

Ellis, H. C. & Moore, B. A. (1999). Mood and memory. In T. Dalgleish & M. J. Power (Eds.), *Handbook of cognition and emotion* (pp. 193–210). John Wiley & Sons Ltd. https://doi.org/10.1002/0470013494.ch10

Frewen, P., Zhu, J., & Lanius, R. (2019). Lifetime traumatic stressors and adverse childhood experiences uniquely predict concurrent PTSD, complex PTSD, and dissociative subtype of PTSD symptoms whereas recent adult non-traumatic stressors do not: results from an online survey study. *European Journal of Psychotraumatology*, *10*(1), 1606625. https://doi.org/10.1080/20008198.2019.1606625

Gaillard, A., Fehring, D. J., & Rossell, S. L. (2021). A systematic review and meta-analysis of behavioural sex differences in executive control. *European Journal of Neuroscience*, *53*(2), 519-542. https://doi.org/10.1111/ejn.14946

Gardner, P. L. (1995). Measuring attitudes to science: Unidimensionality and internal consistency revisited. *Research in Science Education*, *25*(3), 283–289. https://doi.org/10.1007/bf02357402

Goodwin, R. D., Dierker, L., Wu, M., Galea, S., Hoven, C. W., & Weinberger, A. H. (2022). Trends in U.S. depression prevalence from 2015 to 2020: The widening treatment gap. *American Journal of Preventive Medicine*, *63*(5), 726–733. https://doi.org/10.1016/j.amepre.2022.05.014

Hoorelbeke, K., Zwalmen, Y. V., Hagen, B. I., Stubberud, J., Koster, E. H.W. (2022). Connecting residual depressive symptoms to self-reported executive functioning: A network analytical approach, *Journal of Psychiatric Research*, *155*, 75-84, https://doi.org/10.1016/j.jpsychires.2022.08.007

Hyde, J. S., & Mezulis, A. H. (2020). Gender differences in depression. *Harvard Review of Psychiatry*, *28*(1), 4–13. https://doi.org/10.1097/hrp.0000000000000230

Kaller, C. P., Unterrainer, J. M., & Stahl, C. (2012). Assessing planning ability with the Tower of London task: Psychometric properties of a structurally balanced problem set. *Psychological Assessment*, *24*(1), 46–53. https://doi.org/10.1037/a0025174

Kline, R. B. (2011). *Principles and practice of structural equation modeling (3rd ed.)*. Guilford Press.

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Liu, T., Zhong, S., Wang, B., Liao, X., Lai, S., & Jia, Y. (2019). Similar profiles of cognitive domain deficits between medication-naive patients with bipolar II depression and those with major depressive disorder. *Journal of Affective Disorders*, *243*, 55–61. https://doi.org/10.1016/j.jad.2018.05.040

Lövdén, M., Fratiglioni, L., Glymour, M. M., Lindenberger, U., & Tucker-Drob, E. M. (2020). Education and cognitive functioning across the life span. *Psychological Science in the Public Interest*, *21*(1), 6–41. https://doi.org/10.1177/1529100620920576

Mathôt, S. & March, J. (2022). Conducting linguistic experiments online with OpenSesame and OSWeb. *Language Learning*, *72*, 1017-1048. https://doi.org/10.1111/lang.12509

Mead, L. A., Mayer, A. R., Bobholz, J. A., Woodley, S. J., Cunningham, J. M., Hammeke, T. A., & Rao, S. M. (2002). Neural basis of the Stroop interference task: response competition or selective attention? *Journal of the International Neuropsychological Society*, *8*(6), 735-742. http://doi.org/10.1017/s1355617702860015

Miller, K. M., Price, C. C., Okun, M. S., Montijo, H., & Bowers, D. (2009). Is the N-Back task a valid neuropsychological measure for assessing working memory? *Archives of Clinical Neuropsychology*, *24*(7), 711–717. https://doi.org/10.1093/arclin/acp063

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Murphy, O. W., Hoy, K. E., Wong, D., Bailey, N. W., Fitzgerald, P. B., & Segrave, R. A. (2019). Individuals with depression display abnormal modulation of neural oscillatory activity during working memory encoding and maintenance.

Biological Psychology, *148*, 107766. https://doi.org/10.1016/j.biopsycho.2019.107766

Nikolin, S., Tan, Y. Y., Schwaab, A., Moffa, A., Loo, C. K.; & Martin, D. (2021). An investigation of working memory deficits in depression using the n-back task: A systematic review and meta-analysis. *Journal of Affective Disorders*, *284*, 1–8. https://doi.org/10.1016/j.jad.2021.01.084

Novick, J. M., Bunting, M. F., Dougherty, M. R., & Engle, R. W. (Eds.). (2020). *Cognitive and working memory training: Perspectives from psychology, neuroscience, and human development*. Oxford University Press.

Pehrson, A.L. & Sanchez, C. (2014). Serotonergic modulation of glutamate neurotransmission as a strategy for treating depression and cognitive dysfunction. *CNS Spectrums*, *19*(2), 121-133. https://doi.org/10.1017/S1092852913000540

Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). *Behavior Rating Inventory of Executive Function®--Adult Version (BRIEF-A)* [Database record]. APA PsycTests. https://doi.org/10.1037/t86244-000

Rosselli, M., Lang, M.K., & Arruda, F. (2019). Executive dysfunction in depressive disorders. In A. Ardila, A., S. Fatima & M. Rosselli (Eds.), *Dysexecutive syndromes: Clinical and experimental perspectives* (pp. 241-259). Springer Nature Switzerland AG.

Schuch, F., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P., Reichert, T., Carvalho Bagatini, N., Bgeginski, R., & Stubbs, B. (2017). Physical activity and sedentary behavior in people with major depressive disorder: A systematic review and meta-analysis. *Journal of Affective Disorders*, *210*, 139–150. https://doi.org/10.1016/j.jad.2016.10.050

Semkovska, M., Quinlivan, L., O'Grady, T., Johnson, R., Collins, A., O'Connor, J., Knittle, H., Ahern, E., Gload, T. (2019). Cognitive function following a major depressive episode: a systematic review and meta-analysis. *The Lancet Psychiatry*, *6*(10), 851-861. https://doi.org/10.1016/S2215-0366(19)30291-3

Soveri, A., Lehtonen, M., Karlsson, L. C., Lukasik, K., Antfolk, J., & Laine, M. (2016). Test–retest reliability of five frequently used executive tasks in healthy adults. *Applied Neuropsychology: Adult*, *25*(2), 155–165. https://doi.org/10.1080/23279095.2016.1263795

Stuss, D. T., Levine, B., Alexander, M. P., Hong, J., Palumbo, C., Hamer, L., Murphy, K. J., & Izukawa, D. (2000). Wisconsin Card Sorting Test performance in patients with focal frontal and posterior brain damage: effects of lesion

location and test structure on separable cognitive processes. *Neuropsychologia*, *38*(4), 388-402. https://doi.org/10.1016/S0028-3932(99)00093-7

Štelcar, M. (2021). *Odnos izvršnih funkcija i stilova rukovođenja* [Diplomski rad, Sveučilište Josip Juraj Strossmayera u Osijeku]. Filozofski fakultet. https://urn.nsk.hr/urn:nbn:hr:142:250644

Taber, K. S. (2017). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

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. https://doi.org/10.1111/jcpp.12001

Volarov, M., Miladinović, P., Gligorijević, A., Poznanović, M., Obradović, J., Nikolić, N., & Bugarski-Ignjatović, V. (2020). Serbian cognitive reserve index questionnaire: Adaptation and validation. In G. Nedović, & F. Eminović (Eds.), *Approaches and Models in Special Education and Rehabilitation* (pp. 11-24). University of Belgrade – Faculty of Special Education and Rehabilitation. https://www.icf.fasper.bg.ac.rs/zbornici/20200825_1-Thematic-Collection-2020.pdf

Vora, J.P., Varghese, R., Weisenbach, S.L., Bhatt, T. (2016). Test-retest reliability and validity of a custom-designed computerized neuropsychological cognitive test battery in young healthy adults. *Journal of Psychology and Cognition*, *1*(1), 11-19. https://pubmed.ncbi.nlm.nih.gov/28286883/

Walsh, N. D., Williams, S. C. R., Brammer, M. J., Bullmore, E. T., Kim, J., Suckling, J., Mitterschiffthaler, M. T., Cleare, A. J., Pich, E. M., Mehta, M. A., & Fu, C. H. Y. (2007). A longitudinal functional magnetic resonance imaging study of verbal working memory in depression after antidepressant therapy. *Biological Psychiatry*, *62*(11), 1236–1243. https://doi.org/10.1016/j.biopsych.2006.12.022

Wang, X., Cheng, B., Roberts, N., Wang, S., Luo, Y., Tian, F., & Yue, S. (2021). Shared and distinct brain fMRI response during performance of working memory tasks in adult patients with schizophrenia and major depressive disorder. *Human Brain Mapping*, *42*(16), 5458–5476. https://doi.org/10.1002/hbm.25618

Yitzhak, N., Shimony, O., Oved, N., Bonne, O., & Nahum, M. (2023). Less inhibited and more depressed? The puzzling association between mood, inhibitory control and depressive symptoms. *Comprehensive Psychiatry*, *12*, Article 152386. https://doi.org/10.1016/j.comppsych.2023.152386