HEALTH PSYCHOLOGY REPORT · 2024
ORIGINAL ARTICLE

Al-hanof M. Al-dabaibeh 1 · A,B,C
Muawiyah M. Abu Ghazal 2 · B,D,F
Thaer A. Ghbari 3 · E,F

The effect of a training program in executive functions based on Anderson's model in reducing cognitive test anxiety

BACKGROUND
The choice of specialization at the secondary level in Jordan depends on the average scores of the student in the previous stages, specifically the scores of the tenth-grade year. Therefore, students in this grade experience cognitive test anxiety (CTA) at elevated levels, and the presence of deficiencies or weaknesses in the skills of executive functions impacts subsequent career-related milestones for students. The current investigation aimed to assess the influence of an Anderson model-based training program on executive function as a means of alleviating CTA.

PARTICIPANTS AND PROCEDURE
Employing a quasi-experimental pre-post design, the study examined the effectiveness of the training intervention. 36 tenth-grade students were stratified into two groups: 19 in the experimental group and 17 in the control group. Both groups underwent administration of the Cognitive Test Anxiety Scale before and after the test. The experimental group participated in a 14-session training program conducted three times weekly.

RESULTS
The results exhibited a statistically significant difference in post-test means between the experimental and control groups, signifying the successful reduction of CTA levels among students in the experimental group.

CONCLUSIONS
The enduring significance of CTA in the ongoing assessment process, encompassing both historical and contemporary contexts, highlights the necessity for proactive intervention. Recognizing the inherent diversity among students, our study aimed to create a customized training program to alleviate CTA. This endeavor is especially crucial for adolescents navigating a developmental stage where educational materials become more intricate. The effectiveness of the intervention is elevated by its strategic foundation in executive functions, which directly and influentially affects CTA. Aligning the training program with these crucial cognitive processes enhances its ability to effectively reduce the underlying factors contributing to CTA, thereby providing a promising approach for meaningful and sustainable outcomes in addressing the challenges faced by students in this regard.

KEY WORDS
executive functions; cognitive test anxiety; Anderson model; adolescents

ORGANIZATION – 1: Department of Basic Sciences and Humanities, Faculty of Science and Arts, Jordan University of Science and Technology, Irbid, Jordan · 2: Department of Counseling and Educational Psychology, Yarmouk University, Irbid, Jordan · 3: Department of Educational Psychology, The Hashemite University, Zarqa, Jordan

AUTHORS' CONTRIBUTIONS – A: Study design · B: Data collection · C: Statistical analysis · D: Data interpretation · E: Manuscript preparation · F: Literature search · G: Funds collection

CORRESPONDING AUTHOR – Thaer A. Ghbari, Ph.D., Department of Educational Psychology, Faculty of Educational Sciences, The Hashemite University, P.O. Box 330127, Zarqa 13133, Jordan, e-mail: thaera@hu.edu.jo

TO CITE THIS ARTICLE – Al-dabaibeh, A. M., Abu Ghazal, M. M., & Ghbari, T. A. (2024). The effect of a training program in executive functions based on Anderson's model in reducing cognitive test anxiety. *Health Psychology Report*. https://doi.org/10.5114/hpr/191089

RECEIVED 29.01.2024 · REVIEWED 26.06.2024 · ACCEPTED 11.07.2024 · ONLINE PUBLICATION 07.10.2024

BACKGROUND

Students hold diverse cognitive beliefs that exert an impact on various facets of their lives, including their beliefs concerning exam performance. This gives rise to the emergence of cognitive test anxiety (CTA), denoting individuals' cognitive responses to evaluative situations and their internal dialogue surrounding such situations before, during, and after these assessments (Cassady & Johnson, 2002).

Since the 1970s, research has investigated executive functions (EFs), a term first introduced by Pribram in 1973, elucidating the functions of the brain and cerebral cortex. The development of EFs commences in early childhood, spanning through adolescence and beyond, encompassing aspects such as perception, decision-making, planning, problem-solving, and language processing (Grange & Houghton, 2014). Its influence extends to several variables crucial in an adolescent's life, particularly during the normative tenth-grade age, such as CTA (Leibert & Morris, 1967).

This investigation centers on variables integral to a student's academic experience, specifically EFs and CTA. The research involves the formulation and execution of a training program targeting EFs, drawing inspiration from Anderson's model. The primary aim is to evaluate the effectiveness of the program in alleviating CTA among students.

COGNITIVE TEST ANXIETY

Cognitive test anxiety is defined as the cognitive response and internal dialogue that takes place within the student before, during, or after the test (Cassady & Johnson, 2002). It also includes the beliefs that negatively affect the student's performance on a test, such as low study skills (Liebert & Morris, 1967). It includes the student's self-disparaging thoughts, fear of failure, guilt for not doing enough, the idea that he or she is unsuccessful and inadequate compared to others, distraction during study and testing, concerns about the test result, perception of the test as a threat to self-esteem, and avoidance of preparation and assessment situations (Cassady & Johnson, 2002; Sahin et al., 2006).

Several studies that examined the relationship between test anxiety and performance showed that the cognitive dimension has an impact that exceeds the emotional dimension (von der Embse et al., 2018). CTA is not limited to the student being in a test situation, but is also related to poor study skills, inability to retrieve information, and difficulty in encoding and organizing knowledge (Benjamin et al., 1981).

Theories and models have attempted to explain CTA, including the cognitive interference model, which states that anxiety during testing interferes with the ability to retrieve information and impairs recall of prior learning (Benjamin et al., 1981). As for the learning deficiency model, it indicates that CTA is not a cause but rather a consequence of the individual's poor abilities and ineffective study habits, which leads to learning deficiencies (Numan & Hasan, 2017). The information processing model also attributes the low achievement of students with CTA to having problems learning, organizing, or revising content before a test, or recalling it during a test (Benjamin et al., 1981).

EXECUTIVE FUNCTIONS (EFS)

The precise definition of executive functions (EFs) poses a notorious challenge. Sergeant et al. (2002) highlighted the existence of 33 distinct definitions of EFs. This multiplicity in definitions arises from various factors, including the absence of a clear elucidation of the interrelationships among these skills. Consequently, the term exhibits variability based on the specific model's perspective and the intended purpose of its utilization (McCloskey et al., 2008).

Executive functions have been defined as a set of abilities that enable goal-directed behavior, including behavioral regulation, working memory, planning and organizational skills, and self-monitoring (Stuss & Benson, 1986). According to Lezak (1995), EFs consist of the capabilities that enable a person to successfully engage in independent, purposeful, self-serving behavior, and consist of four components: will, planning, purposeful action, and effective performance. Each comprises a distinct set of activity-related behaviors that are necessary for appropriate, socially responsible, and effective self-serving behavior in adults.

Anderson (2002) stated that the processes associated with EFs are multiple, but the main elements include anticipation, goal selection, planning and activity initiation, self-regulation, mental flexibility, attention distribution, and the use of feedback. Barkley (1997) defined EFs as goal-directed behaviors that can include cognitive and behavioral skills, such as inhibition, working memory, problem-solving, task navigation, emotional control, planning, and monitoring. EFs are central to many cognitive abilities, as they are involved in retaining information, performing mental processing and representations, acting appropriately, avoiding impulsiveness, resisting inappropriate behaviors, and adapting behavior flexibly to changes in the situation (Davidson et al., 2006).

Executive functions develop sequentially, starting in early childhood. Interaction with caregivers plays a major role in influencing the development of executive functions through middle childhood, and these interactions become more complex with age due to

language and social development, attention, and impulse control. In addition, organization – as a mental process – increases the capacity and speed of working memory, as well as the development of inhibition, and cognitive flexibility (Goldstein & Naglieri, 2014).

Klenberg (2015) stated that these functions play an essential role in student's learning and their ability to carry out basic tasks in school settings.

Also, an individual with impaired EFs often makes decisions impulsively and incorrectly. This is due to the increased pressure on working memory, which causes the control mechanisms to malfunction. An individual with cognitive control has an increased ability to organize information and reduce cognitive pressure, enabling him/her to choose effective strategies for better and more appropriate decision-making (Getz, 2013). Thus, EF skills improve academic outcomes, and support social and emotional learning, self-confidence, and self-efficacy (Culclasure et al., 2019; Durlak et al., 2011; Richardson et al., 2012).

Although the beginnings of EFs and their theoretical basis came from clinical neuropsychology, many cognitive psychologists developed models for EFs that contributed to enriching and clarifying this concept to include many cognitive tasks (Goldstein & Naglieri, 2014).

Anderson developed his model in which EFs are portrayed as a comprehensive control system consisting of four factors (Anderson, 2002; Anderson et al., 2004, 2008). The first is attention control, including organization and control of actions and impulse control, such as the ability to delay gratification. The next is information processing, which includes fluency, efficiency, and speed of output, which are components that can be enhanced by using effective organizational strategies. Third, cognitive flexibility includes shifting responses, learning from mistakes, developing alternative strategies, distributing attention, and processing multiple sources of information simultaneously. If the individual does not have cognitive flexibility, he will become easily irritated if the activity changes, he will fail to adapt to new demands, and he will avoid any cognitive processing such as mental arithmetic and will tend to make the same mistakes. Finally, goal setting includes the ability to take the initiative, plan actions, and deal with tasks effectively and strategically. Anderson's model was adopted in the current study as a basis for building the training program.

PURPOSE OF THE STUDY

The choice of specialization at the secondary level in Jordan depends on the average scores of the student in the previous stages, specifically the scores of the tenth-grade year. Therefore, students in this grade experience CTA at elevated levels, and the presence of deficiencies or weaknesses in the skills of EFs impacts subsequent career-related milestones for students.

In the test anxiety experiment (O'Donnell, 2017), while attention training helps students with test anxiety (Emadi Far & Gorji, 2017), increased students' negative thoughts about themselves and negative assessments about failing their exams decrease test performance (Yüksel et al., 2018). Therefore, the current research is based on examining the effectiveness of a training program based on the Anderson model in reducing CTA, as this program will increase cognitive flexibility. It involves learning from mistakes, developing alternatives, strategies for distributing attention, and other dimensions of the Anderson model on which the training program is based. Thus, students in this age group are ready to receive help that contributes to reducing CTA. The effect of CTA increases at this stage due to the relationship of test results with subsequent career-related milestones (Elliot & McGregor, 1999). Accordingly, the current study attempts to test the following hypothesis:

There is no statistically significant difference at $\alpha \leq .05$ between the mean scores of the experimental group and the control group on the post-test anxiety scale due to the training program based on the Anderson model in executive functions.

PARTICIPANTS AND PROCEDURE

METHODOLOGY AND DESIGN

The study employed a quasi-experimental method, with the CTA being the dependent variable and the training on EFs being the independent variable, as shown below:

G1 R	O1	X	O1
G2 R	O1	—	O1

PARTICIPANTS

The participants consisted of 36 tenth-grade students in Amman, Jordan, who were enrolled in the first semester of the academic year 2022-2023, aged 15-16 years old, who were divided into two groups: the experimental group (19 male and female), and the control group (17 male and female) (see Table 1). The study's ethical standards were meticulously upheld at all participating institutions before commencing data collection. The study was conducted in accordance with the principles outlined in the Helsinki Declaration of 1989, and the research protocol received approval from the Ethics Committee of the Department of Educational Psychology and Counseling at Yarmouk University in Jordan.

Table 1

Participants across experimental and control group conditions

	Experimental group	Control group	Total
Female	13	10	23
Male	6	7	13
Total	19	17	36

Table 2

Means and standard deviations of CTA dimensions' pre-test and post-test scores for the experimental and control group

Group	Pre-test		Post-test	
	M	*SD*	*M*	*SD*
Experimental (n = 19)	3.55	0.58	2.20	0.51
Control (n = 17)	3.61	0.61	3.53	0.53

Note. CTA – cognitive test anxiety.

INSTRUMENTS

Cognitive Test Anxiety Scale (CTAS). The research data were collected with the short version of the CTAS without the reverse-coded items (Cassady & Finch, 2014). The short version has been reported as a conceptually preferable version to the original full-length version and was able to validly assess CTA within a variety of cultural contexts (Bozkurt et al., 2017). The scale comprises 17 items, each rated on a 4-point Likert scale. An illustrative item is "While preparing for a test, I often think that I am likely to fail," with responses ranging from 1 (*not at all typical of me*) to 4 (*very typical of me*).

Construct validity was established by distributing the scale to a sample of 127 students and correlations between item scores and scale scores were calculated. These correlations ranged between .40 and .83, which indicates a good construct validity of the scale. To ensure the scale's reliability, data from the validity sample were used and the test was repeated after 2 weeks, then Pearson's correlation equation for stability reliability was calculated (r = .84, p < .001). Cronbach's α was calculated for internal consistency (.93). Both reliability criteria are considered good indicators of reliability of this scale.

Executive function training program. A training program was developed based on Anderson's model of executive functions, which includes four basic functions: attentional control, cognitive flexibility, goal setting, and information processing. The training program includes fourteen 45-minute sessions and is presented three times weekly. The program included a set of general guidelines for students, such as respect for other opinions and avoiding direct criticism, and adopted strategies such as discussion, sharing, feedback, cooperative learning, opening questions, and brainstorming.

The validity of the program was verified by presenting it to 5 university professors specializing in counseling and educational psychology, and their observations and amendments had an 80% agreement rate.

PROCEDURE

The research endeavor commenced with the dissemination of an advertisement tailored for tenth-grade students grappling with test anxiety. This outreach aimed to enlist participants for a specialized training program explicitly designed to mitigate the aforementioned condition, contingent upon obtaining informed consent from both the students and their parents. Upon enrollment, participants underwent an initial assessment to gauge the level of CTA. Individuals with low test anxiety were subsequently excluded, while those exhibiting a moderate to high degree were included.

Subsequently, the selected students were randomly assigned to either the experimental or control group. Participants in the experimental group were then contacted to confirm their willingness to attend the training sessions and were required to sign a participation form. Upon confirmation of their commitment, they received the prescribed training program and were expected to attend sessions regularly, actively engage in the training, and complete assigned tasks. Following the completion of the training program, both groups underwent a post-test assessment to measure CTA levels.

RESULTS

The study hypothesis is that there is no statistically significant difference ($\alpha \leq .05$) between CTA means of the experimental group and the control group on the post-test anxiety scale.

To test this hypothesis means and standard deviations for CTA (pre-test and post-test scores) for the experimental and control groups were calculated and are shown in Table 2.

Table 2 shows that there are apparent differences between the mean CTA scores before and after the test based on the assigned group. To detect the statistical significance of these differences, ANOVA was used, as shown in Table 3.

Table 3 presents findings indicating a statistically significant difference in the post-test scores of CTA

Table 3

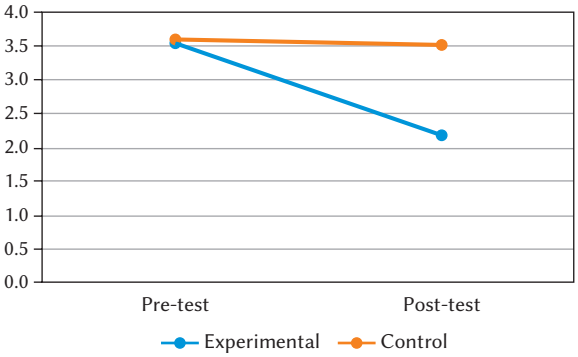
ANOVA on the scores of cognitive test anxiety based on group

Source	Type III sum of squares	*df*	Mean square	*F*	*p*
Pre1	0.56	1	0.56	2.15	.152
Group	15.54	1	15.54	59.98	.001
Error	8.55	33	0.26		
Total	313.36	36			

($F(1, 33) = 59.98$, $p < .001$). The observed difference favored the control group, with a mean of 3.53, compared to the experimental group's mean of 2.20. This difference signifies a reduction in students' scores within the experimental group attributed to the training program. Moreover, Figure 1 visually depicts the disparities in scores within the Cognitive Test Anxiety Scale (CTAS) after the training intervention, further underscoring a discernible decrease in CTA levels within the experimental group.

Figure 1

Difference between the scores of the two groups in the CTAS after the training program



Note. CTAS – Cognitive Test Anxiety Scale.

DISCUSSION

This study showed that there was a statistically significant difference ($\alpha \leq .05$) in CTA, where the mean post-test score of the experimental group was lower than the mean post-test score of the control group, which indicates a decrease in students' scores in the experimental group due to the training program.

This result can be attributed to the fact that the objectives, strategies, and training program based on Anderson's model of EFs has an influential effect on reducing the level of CTA, as it worked on training students on study strategies, alternative strategies, and how to choose the strategy appropriate to the subject.

The participants' attention improved because one of the program's procedures aided them in focusing their attention on specific stimuli in the program, such as the use of dark colors and unusual shapes. Consequently, they were able to maintain their attention throughout the experiment sessions. It is well established that the use of unusual shapes or attention-grabbing colors enhances selective attention (Tulving et al., 1996; Ranganath & Rainer, 2003). Additionally, considering that the participants were adolescents, Banich (2009) pointed out that younger individuals demonstrate an increased ability to benefit from attentional control compared to adults.

In addition, the program helped students in recognizing feelings and how to control them, and training in cognitive flexibility to identify mistakes and learn from them. As there is an inverse relationship between cognitive flexibility and test anxiety (Kuloglu & Orhan, 2021), students with low cognitive flexibility do not think of alternative strategies to reduce their anxiety, and they have a negative perception of the obstacles they face and what may result from them. Therefore, if the student can search for ways to deal with the situation and has the belief that he can deal with it, this will help in reducing his anxiety.

This applies to test anxiety (Beck & Burns, 1979), where the low level of cognitive flexibility makes the student exaggerate the problem and makes the problem more complex, focusing on the problem itself rather than looking for solutions (Bedel & Ulubey, 2015).

As participants contributed to setting their own goals, Schunk (1985) emphasized that learners who articulate their personal goals experience improvements in their self-efficacy, academic achievement, and commitment to achieving those goals. Moreover, the training program included activities that make students familiarize themselves with the tasks they must perform, identify those that require high attention, and learn how to divide them into parts and focus on each part, all of which contribute to reducing test anxiety, as high test anxiety is associated with low levels of selective attention (Gass & Curiel, 2011).

Cognitive interference theory indicates that CTA arises due to poor coding and storage skills (Benja-

min et al., 1981), and the learning deficiency model indicates that it originates from poor abilities and ineffective study habits (Culler & Holahan, 1980). The models and theories justify that the cause of test anxiety is the presence of a defect in one or more of the four basic EFs that have been trained according to the Anderson model of executive functions, and training on the four functions was effective in reducing CTA among the study sample.

This result is consistent with the results of studies conducted by Fergus and Limbers (2019) and Emadi Far and Gorji (2017), which indicated the effectiveness of attention training in reducing test anxiety. The results of the current study are also in line with the findings from the study conducted by Sabzi et al. (2022), which showed evidence of the effectiveness of training on EFs in reducing test anxiety in the experimental group compared to the control group after the test.

CONCLUSIONS

The enduring significance of CTA in the ongoing assessment process, encompassing both historical and contemporary contexts, highlights the necessity for proactive intervention. Recognizing the inherent diversity among students and the varying degrees to which this issue presents itself, our study aimed to create a customized training program to alleviate CTA. This endeavor is especially crucial for adolescents navigating a developmental stage where educational materials become more intricate. The effectiveness of the intervention is elevated by its strategic foundation in EFs, which directly and influentially affects CTA. Aligning the training program with these crucial cognitive processes enhances its ability to effectively tackle and reduce the underlying factors contributing to CTA, thereby providing a promising approach for meaningful and sustainable outcomes in addressing the challenges faced by students in this regard.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The generalization of the results of this study is influenced by several factors, such as the sample size. The sample in this study is relatively small, but this is due to administrative constraints. Additionally, the generalization of results is constrained by the study's duration, as many educational institutions do not permit experiments to be conducted on their students for a long period.

The study is also constrained by its exclusive reliance on the Anderson model of executive functions, encompassing a specific subset of these cognitive processes. This limitation emphasizes the need for cautious interpretation of findings within the defined scope of the chosen model, prompting future research to consider alternative models or a broader spectrum of executive functions for a more comprehensive understanding.

Disclosures

This research received no external funding.
The research protocol was approved by the Ethics Committee of the Department of Educational Psychology and Counseling at Yarmouk University in Jordan (Approval No. ED/15/2022).
The authors declare no conflict of interest.

References

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology, 8*, 71–82. https://doi.org/10.1076/chin.8.2.71.8724

Anderson, V., Anderson, P., Grimwood, K., & Nolan, T. (2004). Cognitive and executive function 12 years after childhood bacterial meningitis: Effect of acute neurologic complications and age of onset. *Journal of Pediatric Psychology, 29*, 67–81. https://doi.org/10.1093/jpepsy/jsh011

Anderson, V., Anderson, P. J., Jacobs, R., & Smith, M. S. (2008). Development and assessment of executive function: From preschool to adolescence. In V. Anderson, R. Jacobs, & P. J. Anderson (Eds.), *Executive functions and the frontal lobes: a lifespan perspective* (pp. 123–154). Taylor & Francis.

Banich, M. T. (2009). Executive function: The search for an integrated account. *Current Directions in Psychological Science, 18*, 89–94. https://doi.org/10.1111/j.1467-8721.2009.01615.x

Barkley, R. A. (1997). Behavioral inhibition sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*, 65–94. https://doi.org/10.1037/0033-2909.121.1.65

Beck, P. W., & Burns, D. (1979). Anxiety and depression in law students: Cognitive intervention. *Journal of Legal Education, 30*, 270–290.

Bedel, A., & Ulubey, E. (2015). The role of cognitive flexibility coping in explaining coping strategies in adolescents. *Electronic Journal of Social Sciences, 14*, 291–300. https://doi.org/10.17755/esosder.91623

Benjamin, M., McKeachie, W. J., Lin, Y. G., & Holinger, D. P. (1981). Test anxiety: Deficits in information processing. *Journal of Educational Psychology, 73*, 816–824. https://doi.org/10.1037/0022-0663.73.6.816

Bozkurt, S., Ekitli, G. B., Thomas, C. L., & Cassady, J. C. (2017). Validation of the Turkish version of the Cognitive Test Anxiety Scale-Revised. *Sage Open, 7*. https://doi.org/10.1177/2158244016669549

Cassady, J. C., & Finch, W. H. (2014). Using factor mixture modeling to identify dimensions of cognitive test anxiety. *Learning and Individual Differences, 41*, 14–20. https://doi.org/10.1016/j.lindif.2015.06.002

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology, 27*, 270–295. https://doi.org/10.1006/ceps.2001.1094

Culclasure, B. T., Longest, K. C., & Terry, T. M. (2019). Project-based learning (Pjbl) in three southeastern public schools: Academic, behavioral, and social-emotional outcomes. *Interdisciplinary Journal of Problem-Based Learning, 13*, 5. https://doi.org/10.7771/1541-5015.1842

Culler, R. E., & Holahan, C. J. (1980). Test anxiety and academic performance: The effects of study-related behaviors. *Journal of Educational Psychology, 72*, 16–20. https://doi.org/10.1037/0022-0663.72.1.16

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia, 44*, 2037–2078. https://doi.org/10.1016/j.neuropsychologia.2006.02.006

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: a meta-analysis of school-based universal interventions. *Child Development, 82*, 405–432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Elliot, A. J., & McGregor, H. A. (1999). Test anxiety and the hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 76*, 628–644. https://doi.org/10.1037//0022-3514.76.4.628

Emadi Far, F., & Gorji, Y. (2017). Effectiveness of attention training on attention control, focused attention and dispersed attention in girl students with test anxiety. *Quarterly Journal of Child Mental Health, 4*, 67–77.

Fergus, T. A., & Limbers, C. A. (2019). Reducing test anxiety in school settings: a controlled pilot study examining a group format delivery of the attention training technique among adolescent students. *Behavior Therapy, 50*, 803–816. https://doi.org/10.1016/j.beth.2018.12.001

Gass, C. S., & Curiel, R. E. (2011). Test anxiety in relation to measures of cognitive and intellectual functioning. *Archives of Clinical Neuropsychology, 26*, 396–404. https://doi.org/10.1093/arclin/acr034

Getz, S. J. (2013). *Cognitive control and intertemporal choice: The role of cognitive control in impulsive decision making* [Unpublished doctoral dissertation]. Princeton University.

Goldstein, S., & Naglieri, J. (2014). *Handbook of executive functioning*. Springer.

Grange, J., & Houghton, G. (Eds.) (2014). *Task switching and cognitive control*. Oxford University Press.

Klenberg, L. (2015). *Assessment and development of executive functions in school-age children* [Unpublished doctoral dissertation]. University of Helsinki.

Kuloglu, A., & Orhan, F. G. (2021). Examination of test anxiety and cognitive flexibility levels of students preparing for the university exam. *International Online Journal of Educational Sciences, 13*, 996–1009. https://doi.org/10.15345/iojes.2021.04.004

Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed.). Oxford University Press.

Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: a distinction and some initial data. *Psychological Reports, 20*, 975–978. https://doi.org/10.2466/pr0.1967.20.3.975

McCloskey, G., Perkins, L. A., & Van Diviner, B. (2008). *Assessment and intervention for executive function difficulties*. Taylor & Francis.

Numan, A., & Hasan, S. (2017). Effect of study habits on test anxiety and academic achievement of undergraduate students. *Journal of Research and Reflections in Education, 11*, 1–14. https://www.ue.edu.pk/jrre/articles/1101001.pdf

O'Donnell, P. S. (2017). Executive functioning profiles and test anxiety in college students. *Journal of Psychoeducational Assessment, 35*, 447–459. https://doi.org/10.1177/073428291664155

Ranganath, C., & Rainer, G. (2003). Neural mechanisms for detecting and remembering novel events. *Nature Reviews. Neuroscience, 4*, 193–202. https://doi.org/10.1038/nrn1052

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: a systematic review and meta-analysis. *Psychological Bulletin, 138*, 353–387. https://doi.org/10.1037/a0026838

Sabzi, R., Mihandoost, Z., Nademi, A., & Parandin, S. (2022). The effectiveness of executive function training on emotional self-regulation and test anxiety of female students with writing disorders. *Journal of Health Promotion Management, 11*, 68–80.

Sahin, H., Gunay, T., & Bati, H. (2006). University entrance exam anxiety of senior high school students in the province of Izmir, district of Bornova. *STED, 5*, 107–113.

Schunk, D. H. (1985). Self-efficacy and classroom learning. *Psychology in the Schools, 22*, 208–223. https://doi.org/10.1002/1520-6807(198504)22:2<208::AID-PITS2310220215>3.0.CO;2-7

Sergeant, J. A., Geurts, H., & Oosterlaan, J. (2002). How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder?

Behavioural Brain Research, 130, 3–28. https://doi.org/10.1016/s0166-4328(01)00430-2

Stuss, D. T., & Benson, D. F. (1986). *The frontal lobes*. Raven Press.

Tulving, E., Markowitsch. J., Craik, F. I. M., Habib, R., & Houle, S. (1996). Novelty and familiarity activations in PET studies of memory encoding and retrieval. *Cerebral Cortex, 6*, 71–79. https://doi.org/10.1093/cercor/6.1.71

von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: a 30-year meta-analytic review. *Journal of Affective Disorders, 227*, 483–493. https://doi.org/10.1016/j.jad.2017.11.048

Yüksel, M. Y., Sevim, E., & Çelimli, Ç. (2018). Examination of the relationship between test anxiety and selective attention among adolescents. *Elementary Education Online, 17*, 864–873. https://doi.org/10.17051/ilkonline.2018.419331