Cognitive Flexibility in University Students: An Exploratory Study

https://doi.org/10.5281/zenodo.20972583

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Received: 10/03/2026 Accepted: 14/05/2026 Published: 30/06/2026

Abstract

This study aims to explore the performance of cognitive flexibility with its two components, alternative flexibility and control flexibility, for university students, by examining the correlation between cognitive flexibility and age, then the significant differences in cognitive flexibility in relation to the extent of language proficiency, and finally in relation to the gender variable. This study involved 60 participants, 44 females (M_{age}=27.43; SD=10.35) and 16 males (M_{age}=35.63; SD=9.22) from various faculties, universities, and disciplines, ranging in age from 18 to 54 years old. Participants were assessed using the Cognitive Flexibility Inventory (Dennis & Vander Wal, 2010), and Operating sheet that included questions about age, gender, and languages mastered. The results of this study showed a statistically significant relationship between age and cognitive flexibility ($r = 0.507$, $p < 0.01$) for alternative flexibility, and total flexibility ($r = 0.483$, $p < 0.01$), while the relationship between age and flexibility control ($r = -0.086$) was not statistically significant. There were also statistically significant differences in cognitive flexibility based on language proficiency. Alternative flexibility ($F = 16.687$, $p < 0.001$) and total cognitive flexibility ($F = 19.361$, $p < 0.001$) were significantly higher in multilingual individuals. Control flexibility ($F = 0.518$, $p = 0.598$) showed no significant differences indicating that language proficiency does not affect cognitive control abilities. Regarding the gender variable, the results showed statistically significant gender differences in cognitive flexibility. Females scored significantly higher in alternative flexibility ($t = -0.970$, $p = 0.016$), and males outperformed females in control flexibility ($t = 1.338$, $p = 0.012$), while no significant gender differences were found in overall cognitive flexibility ($t = -1.603$, $p = 0.083$. In general, this study confirmed that cognitive flexibility plays a fundamental role in the academic success and psychological adaptation of students. The results showed that older and multilingual students excelled in formulating cognitive alternatives, while males excelled in cognitive control and females in alternative flexibility. Despite these differences, the gender gap in overall cognitive flexibility remained limited and statistically insignificant.

Keywords: cognitive flexibility, control, alternative, language proficiency

Introduction

Cognitive flexibility (CF) refers to the ability to modify or switch between sets or strategies in response to changes in the environment, as it relates to the practice of meditation and mindfulness (Deák & Wiseheart, 2015; Moore & Malinowski, 2009). From a cognitive science perspective, cognitive flexibility is seen as an aspect of cognitive control (set shifting) or a manifestation of multiple cognitive control processes operating in sequence or in parallel. By characterizing the relationship between neuroplasticity and cognitive flexibility, and that individuals who experience a decrease in cognitive flexibility may require higher order neural resources in order to downregulate negative emotions, resilience is related to emotional reactivity during reappraisal (Dajani & Uddin, 2015; Zaehringer et al., 2018). cognitive flexibility is distributed across multiple neural structures, with frontal-parietal regions contributing to flexible switching, including high-level cortical connectivity areas (VlPFC, dlPFC, anteriour sigulate, rigth AI), inferior temporal cortex, occipital cortex, and subcortical structures of the caudate and thalamus (Cristofori et al., 2019; Kim et al., 2012; Niendam et al., 2012; Wager et al., 2004). Thus, the concept of cognitive flexibility is a complex and multidimensional mental capacity that enables individuals to effectively adapt to changes and demands in their environment (Gosling et al., 2025), and this capacity depends on the articulation of several low-level cognitive processes, such as shifting attention or modifying strategies in response to feedback from the environment.

Their importance extends to developmental stages across human life (Anderson, 2002; Chevalier, 2010; Diamond, 2013). In exploring the development of cognitive flexibility as an executive function, Best and Miller (2010) findings indicated that growth trends differed between working memory and switching, with working memory continuing to grow into adulthood, while switching reached maturity during adolescence (Best & Miller, 2010, p. 1651). In summary, measuring the growth of mental flexibility, following slightly different developmental trajectories, shows that information processing, cognitive flexibility, and objective setting are relatively mature by 12 years old. However, many executive functions are not well established until mid-adolescence or early adulthood (Anderson, 2002), as evidenced by research linking high-level cognitive resilience to a range of gains, including better school performance in children (Best et al., 2009; Jurado & Rosselli, 2007; Smith et al., 2004), lower levels of anxiety and depression in adults, and increased well-being in the elderly (Davis et al., 2010; Zheng et al., 2024). In the context of the above, the role of cognitive flexibility during the university process cannot be overlooked, as many studies emphasize that the ability of students to cope with these variables is closely related to their level of cognitive flexibility, which helps them return to difficult situations and deal constructively with failure and frustration (Genet & and Siemer, 2011).

Moreover, cognitive flexibility plays an organizational role in reducing stress and negative emotions in the university context (Johnco et al., 2013). According to Ionescu (2012) there is a relationship between cognitive flexibility as a mental ability and the ability of individuals to modify their cognitive and emotional responses in ever-changing learning environments, which improves their academic performance and psychological well-being. In the same vein, individuals who are proficient in more than one language are also characterized by high cognitive flexibility (Bull & Scerif, 2001; Kaddouri et al., 2025; Spiegel et al., 2021). In light of the above, despite all the research and studies on the subject, few studies in Morocco are concerned with studying cognitive flexibility among university students, so the aim of our study is to explore the nature of the operation of cognitive flexibility in students in relation to language proficiency, age, and statistically significant differences in the level of performance in cognitive flexibility according to gender within the Moroccan context.

Study Problem

The problem of this study lies in the measurement of cognitive flexibility (CF) in students, according to its two dimensions: alternative flexibility and flexible control, as well as in the study of its relationship with age, academic level and language proficiency. CE is defined as the ability to adapt one's behavior in response to a changing environment (Armbruster et al., 2012; Scott, 1962). This ability enables the individual to disengage from a previous task, reconfigure a new set of responses, and then apply this new set to the current task. A high level of cognitive flexibility is associated with positive outcomes across different stages of life, such as better reading fluency in childhood (Engel de Abreu et al., 2014), greater flexibility in the face of stressful events in adulthood (Genet & and Siemer, 2011), higher levels of creativity in middle age (Chen et al., 2014), as well as better quality of life in old age (Davis et al., 2010).

In this context, (CE) emerges as an essential mental resource, reflecting the individual's ability to adapt effectively to new and complex situations, and to reorganize his or her thoughts and strategies according to the context. It is a fundamental element of adaptive thinking, promoting adjustment to changes in the environment, the resolution of everyday problems and the generation of new ideas that support innovation (Barbey et al., 2013). It is defined as the ability to mentally reconfigure oneself in response to contextual variations (Chieu, 2007), thus representing a major dimension of higher executive functions. It is closely linked to skills such as problem-solving, decision-making and emotional regulation.

In this framework, many studies emphasize that students' ability to cope with these variables is closely related to their level of cognitive flexibility, which helps them reframe difficult situations and deal constructively with failure and frustration (Genet & and Siemer, 2011). Furthermore, (CE) plays an important regulatory role in reducing stress and negative emotions in the academic context (Johnco et al., 2013). According to Ionescu (2012) it is closely linked to the ability of individuals to adjust their cognitive and emotional responses in ever-changing educational environments. According to Ionescu (2012) it is closely related to individuals' ability to adjust their cognitive and emotional responses in constantly changing educational environments, enhancing both their academic performance and psychological well-being.

Thus, the present research aims to answer the following central question:

How does cognitive flexibility, through its two components (alternative flexibility and flexibility control), influence university students' performance?

Study questions

- Is there a statistically significant correlation between cognitive flexibility and age in university students?
- Is there a significant difference between language proficiency and the cognitive flexibility scale in university students?
- Are there statistically significant differences in the level of cognitive flexibility among university students according to the gender variable?

Operational definition of concepts

Before turning to the methodology used in our dissertation, it is important to clarify the operational concepts we are referring to.

Certainly, it is important to understand the meaning and relevance of :

- Cognitive flexibility: In operational terms, this refers to the ability to switch from one process to another, in addition to transitioning effectively between several tasks, and to alternate between these tasks to achieve a given objective. It also includes adaptive selection among different representations, strategies or task registers.

- Alternative flexibility: Alternative flexibility refers to an individual's ability to switch quickly and efficiently from one cognitive strategy or way of thinking to another, in order to adapt to the changing demands of a task or environment. It is generally measured by performance on tasks requiring frequent changes of rules or criteria, such as mental flexibility tasks involving a change of classification or a switch between several sets of rules.

- Flexibility control: Flexibility control refers to an individual's ability to supervise, regulate and adjust cognitive processes when shifting attention or strategy, to ensure effective adaptation to task demands. It involves managing the inhibition of automatic or preceding responses and maintaining focus on the relevant objective, while facilitating controlled switching between different rules or modes of thinking.

- Language proficiency: For the purposes of this study, language proficiency is operationally defined as the level of linguistic competence an individual possesses in one or more languages, particularly the language(s) of instruction.

Material and methods

Participants

The participants for this study are composed of 60 individuals, aged between 18 and 54 years old. All of them are of Moroccan nationality and come from urban, rural, and semi-urban environments. 44 females (M_{age}=27.43; SD=10.35) and 16 males (M_{age}=35.63; SD=9.22). They were randomly selected from different Moroccan universities, studying in different majors and different university levels (Bachelor's, Master's, and PhD).

Inclusion criteria

Inclusion criteria included participants who were legally enrolled in an institution of higher education (Bachelor, master's or PhD), were adults (18 years and above), voluntarily agreed to participate after being fully informed of the research objectives and procedures, and were able to understand the instructions and answer the research instruments in French.

Exclusion criteria

Exclusion criteria included individuals with a prior diagnosis of cognitive or psychiatric disorders (e.g. ADHD, autism spectrum disorders, or severe depression and anxiety), regular consumption of substances that affect executive and cognitive abilities, and those with significant language difficulties that hinder comprehension of instructions.

Study Instruments

Measures of the Cognitive Flexibility

In this study, cognitive flexibility was assessed using the Cognitive Flexibility Inventory (CFI), a 20-item self-questionnaire designed to measure an individual's ability to cognitively adapt to stressful or difficult situations, by identifying different perspectives or possible solutions (Dennis & Vander Wal, 2010). The CFI comprises two main components, Flexibility Alternatives, this dimension assesses the ability to consider several alternative interpretations or solutions to a problem, the items (2-4-7-9-11-17). And Control Flexibility, this measures the individual's perceived control over difficult situations, i.e. his or her ability to actively manage challenges, items (1-3-5-6-8-10-12-13-14-15-16-18-19-20). Participants responded to the items on a 7-point Likert scale (from 1 = “disagree friction” to 7 = “agree friction”). The scoring procedures specified for the Cognitive Flexibility Inventory require reverse scoring of select items and then summing the numerical response values to obtain a total score. Higher scores on both scales are indicative of greater cognitive adaptability associated with greater Cognitive Flexibility when encountering stressful situations; lower scores are indicative of greater cognitive rigidity associated with less cognitive adaptability when encountering stressful situations (Dennis & Vander Wal, 2010).

Operating sheet

The Operating sheet used in this study was designed to collect a range of information that would enable a complete and accurate profile of the participants. The questionnaire included basic data such as age (in years) and gender (female or male). A section of the questionnaire was devoted to assessing the participants' degree of language proficiency (monolingual, bilingual, trilingual).

Procedures

Data were collected in several stages, in accordance with current methodological and ethical standards in psychological research. First, measurement instruments were prepared and validated, notably the French version of the Cognitive Flexibility Inventory (CFI) (Dennis & Vander Wal, 2010), as well as a sociodemographic form to collect personal information such as age, gender, marital status, level of education, and parental occupation. These instruments were combined into a single form that was distributed online through Google Forms, depending on students' accessibility. Participants were randomly selected among students enrolled in various university courses (humanities, social sciences, economics, law, biology, etc.) and at different levels of study (bachelor, master, and doctoral), according to inclusion criteria (being a student, 18 years old or older, and free consent) and exclusion criteria (All participants with severe mental or neurological disorders (such as ADHD, autism, depression or severe anxiety), regular consumption of substances that affect cognitive function, or significant language difficulties that impede comprehension of instructions will be excluded from the study). Finally, informed consent was obtained from all participants prior to their actual participation in the study.

Statistical Analyses

Statistical Methodology

In this study, we relied on a statistical methodology based on two axes, namely: Descriptive and analytical. This approach enabled us to comprehensively understand the characteristics of our data and the relationships between the various variables studied.

Descriptive. Descriptive statistics were used to summarize the main characteristics of the participants and the studied variables. Descriptive analyses characterized our data using means, standard deviations, medians, modes, patterns, and distributions (Baccini, 2010). For continuous quantitative variables, such as overall scores and scores on the Cognitive Resilience Lab subscales, means and standard deviations were calculated in order to assess central tendencies and dispersion of the data. For qualitative variables (gender, language proficiency), frequencies and percentages were determined to describe the socio-demographic composition of the participants.

Analytical. The statistical analysis in this study relied on a set of analytical tools appropriate to the nature of the variables. Pearson correlation analysis was used to examine the relationship between cognitive flexibility and continuous quantitative variables, especially the age variable. Analysis of (ANOVA) was also adopted to compare participants' performance in cognitive flexibility across different groups based on the level of language proficiency (monolingual, bilingual, and trilingual), in order to detect statistically significant differences. In addition, the Student's t-test was used to compare the means of two independent groups by gender (male and female) to determine whether there were differences in cognitive flexibility performance between men and women within the sample (Baccini, 2010).

By uniting descriptive and analytical approaches, we came to a more in-depth understanding of the characteristics of the data and the relationships between the variables studied in our research. These analyses allowed us to identify significant patterns, correlations, and differences, contributing to a more comprehensive understanding of cognitive resilience among university students.

Results

Socio-demographic and academic profile of Participants studied

This study involved 60 students studying at Moroccan universities. The mean age of the participants was 29.62±10.63 years, with a maximum age of 54 years and a minimum age of 18 years. The gender ratio in this study was unbalanced (26.7% males and 73.3% females). The learners in the sample were selected from different universities in Morocco and from multiple disciplines (56.7% bachelor's, 28.3% master's, and 15% PhD) (Table 1).

Table 1

Socio-demographic and academic profile of Participants studied

		Size	Percentage
Genre	Males	16	26.7%
	Females	44	73.3%
Niveau universitaire	bachelor's	34	56.7%
	master's	17	28.3%
	PhD	9	15%
Age = 29.62±10.63 years (maximum=54 years, a minimum= 18 years)			

Descriptive statistical analyses of the data revealed that study participants scored (M=28.22, SD=8.24) on alternative flexibility and (M=65.32, SD=27.99) on flexibility control tasks (Table 2). In addition to scores (M=92.03, SD=22.43) on the overall cognitive flexibility tasks.

Table 2

Descriptive statistical analysis of the students' cognitive flexibility scale

	N	Mean	SD
Alternative flexibility	60	28.22	8.24
Flexibility control		65.32	27.99
Totale cognitive flexibility		92.03	22.43

In this study, a significant correlation between age and performance in cognitive flexibility is found. First, age shows a moderate and significant positive correlation with alternative flexibility ($r = 0.507$, $p < 0.01$) and with overall cognitive flexibility ($r = 0.483$, $p <$

0.01). This suggests that older individuals in the sample tend to exhibit a better ability to generate better cognitive alternatives, which also contributes to a higher overall cognitive flexibility score. In contrast, age was not significantly related to flexibility control ($r = -0.086$) (table 3), suggesting that the ability to voluntarily organize and modify one's cognitive processing in response to situations does not differ significantly with age. Furthermore, a very strong positive correlation was observed between alternative flexibility and total cognitive flexibility ($r = 0.970$, $p < 0.01$), which is expected given that the former is a major sub-dimension of the latter. Moreover, the significant negative correlation between alternative flexibility and flexibility control ($r = -0.566$, $p < 0.01$), as well as between flexibility control and overall cognitive flexibility ($r = -0.455$, $p < 0.01$), may reflect a reverse dynamic: As alternative generation increases, the tendency toward rigid cognitive control could decrease.

Table 3

Pearson's correlation between cognitive flexibility and age in university students

	Age	Alternative Flexibility	Flexibility control	Total cognitive flexibility
Age	--			
Alternative Flexibility	0,507**	--		
Flexibility control	-0,086	-0,566**	--	
Total cognitive flexibility	0,483**	0,970**	-0,455**	--

**. Correlation is significant at the 0.01 level (2-tailed).

Differences between language proficiency and cognitive flexibility performance

In a study of statistically significant differences by language fluency (monolingual, bilingual, trilingual) (table 4), the results revealed statistically significant differences for “alternative flexibility” ($F = 16.687$, $p < 0.001$) and “overall cognitive flexibility” ($F = 19.361$, $p < 0.001$), suggesting that multilingual fluency is associated with a greater ability to generate alternatives and higher overall cognitive flexibility. On the other hand, no significant difference was observed for “control flexibility” ($F = 0.518$, $p = 0.598$), suggesting that this specific dimension of flexibility is not affected by the number of languages mastered.

Table 4

ANOVA tests between language proficiency and cognitive flexibility performance

Variable	Language	Mean	SD	N	df	F	Sig. (2-tailed)
Alternative Flexibility	Monolingual	58,57	29,703	34	59	16,687	0,000**
	Bilingual	48,12	30,098	17			
	Trilingual	83,63	6,817	9			
Control Flexibility	Monolingual	28,57	8,121	34	59	0,518	0,598
	Bilingual	29,35	9,703	17			
	Trilingual	27,04	6,762	9			
Total Cognitive Flexibility	Monolingual	87,14	21,775	34	59	19,361	0,000**
	Bilingual	77,46	22,769	17			
	Trilingual	107,33	8,485	9			

Note: df = degrees of freedom, **F** = ANOVA F-statistic, **Sig. (2-tailed)** = p-value. **p < 0.01**, marked by **0.000**, indicates a statistically significant difference at the 0.01 level (**).

Analysis of sex differences in cognitive flexibility using Student's t-test for independent samples. Statistically significant differences were found in two of the three dimensions assessed. For alternative flexibility, a significant difference was observed ($t = -0.970$; $p = 0.016$) (table 5), with higher scores for females ($M = 67.43$; $SD = 26.02$) compared to males ($M = 59.50$; $SD = 33.02$). This suggests that female participants demonstrated a greater ability to generate alternative solutions to complex or novel situations. Similarly, a significant difference was found in control flexibility (t = 1.338; p = 0.012), this time in favor of males (M = 30.56; SD = 9.75) compared to females (M = 27.36; SD = 7.57). This result suggests that the men in the sample have better cognitive control, i.e., a greater ability to voluntarily control or regulate their thinking. On the other hand, the overall cognitive flexibility scores showed no significant difference between genders (t = -1.603; p = 0.083), although females had a slightly higher mean (M = 94.80) than males (M = 84.44).

Table 5
Comparison of the average scores in the alternative flexibility and controlled flexibility tasks between the female and male groups

Variable	Gender	Mean	SD	N	df	t	Sig. (2-tailed)
Alternative Flexibility	Masculin	59,50	33,021	16	58	-0,970	0,016*
	Féminin	67,43	26,024	44			
Control Flexibility	Masculin	30,56	9,750	16	58	1,338	0,012*
	Féminin	27,36	7,570	44			
Total Cognitive Flexibility	Masculin	84,44	24,284	16	58	-1,603	0,083
	Féminin	94,80	21,340	44			

Note: df = degrees of freedom, **F** = ANOVA F-statistic, **Sig. (2-tailed)** = p-value
p < 0.01, indicates a statistically significant difference at the 0.01 level (**).

Discussion

This study aims to explore the performance in cognitive flexibility among university students in Morocco, due to the interest in cognitive flexibility and in line with the pressures that many students face during their university career. Indeed, most academic learning depends on this ability, which can have a positive or negative impact on the success or failure of knowledge acquisition. Thus, it seeks to examine gender and age differences, language proficiency, and performance in alternative and controlled resilience. Within this framework, one of our propositions is that there are statistically significant differences in students' cognitive flexibility performance depending on gender, age, and language proficiency. Statistical analysis of the results revealed significant differences in cognitive resilience in relation to several variables such as age, language proficiency, and gender. Overall, these findings suggest that cognitive resilience is not a homogeneous ability within the university community, but is influenced by a variety of personal and contextual factors. In this context, a positive relationship was observed between age and both alternative resilience and overall cognitive resilience.

This suggests that advancing age may enhance the ability to produce more effective mental alternatives and cognitive adaptation to different situations. The results of this study are consistent with previous studies that have emphasized this gradual development of cognitive flexibility across developmental stages. Zelazo et al. (2024) showed that cognitive flexibility, as a key component of executive functions, develops significantly during childhood and adolescence, peaks in early adulthood and then gradually declines with age, due to neurobiological changes. They highlight the importance of prefrontal cortex maturation in improving the ability to switch between different cognitive strategies and effectively adapt to new contexts (Diamond, 2013). On the other hand, Ionescu (2012) proposes a more integrative perspective in which cognitive flexibility is not only dependent on biological factors, but is also fueled by the accumulation of social, emotional, and cognitive experiences over time, enhancing the ability to flexibly restructure mental representations. Some recent research suggests that older adults compensate for reduced neurocognitive performance with more elaborate metacognitive strategies acquired with experience (Diamond, 2013; Ionescu, 2012).

Regarding the relationship of cognitive flexibility (alternative flexibility and controlled flexibility) to language proficiency, the results confirm statistically significant differences between groups, and show a marked cognitive advantage for multilingual individuals, especially trilingual, who show significantly higher scores in cognitive flexibility. These results are partially consistent with the results of Wiseheart (2016) study at the University of Cambridge, which showed that monolingual and bilingual individuals perform similarly on single-cost switching tasks, confirming the current study. However, the second part of Wiseheart results contradicts these findings, revealing that bilinguals show less linguistic interference than monolinguals, indicating a better ability to reconstruct stimulus-response associations. A study by Wisehart (2016) reveals that repeated engagement with multiple languages strengthens executive function and increases cognitive flexibility while switching between tasks. In contrast, Luke (2001) findings are quite contrasting, indicating that there is no statistically significant difference associated with bilingualism in performance on cognitive flexibility tasks. It is important to note that the benefits of bilingualism in executive functions have been observed in both children (Adesope et al., 2010; Barac et al., 2014) and adults (Bialystok et al., 2008; Colzato et al., 2008; Costa et al., 2008).

Finally, in a study of gender differences, the results showed statistically significant differences, with females having superior alternative flexibility, while males performed better in flexibility control. The literature on this topic is contradictory; some studies indicate male superiority in some executive functions, including cognitive flexibility (Farrant et al., 2012; Kim et al., 2012; Qasim & Abdullat, 2018), while other studies found female superiority (Algharaibeh, 2020; Schopp et al., 2001), or no significant difference (Cartwright et al., 2010). Thus, the male advantage observed in Arab societies can be explained by the greater social freedom that allows them to experience different situations, which promotes the development of resilience (Qasim & Abdullat, 2018). Conversely, women are often constrained by customs and traditions and encouraged to be cautious and restrained, which can lead to cognitive rigidity and limit their flexibility-enhancing experiences. In addition, Eastern culture is more protective of women, which reduces their freedom to experiment and learn from their mistakes, making them more cautious and less flexible than men who have more autonomy and the ability to modify their responses to situations. In addition, the characteristics of male adolescence studied here, such as challenge, persistence, and perseverance, encourage greater social engagement and favor the acquisition of a higher level of cognitive flexibility compared to women (Algharaibeh, 2020b).

Conclusion

This study highlights the central role of cognitive flexibility in the academic success and mental adjustment of students. The results showed that cognitive flexibility is a key factor in students' psychological adjustment and academic success. Significant relationships were found between cognitive flexibility and some individual and academic variables. Older students showed a higher ability to generate cognitive alternatives, with no apparent effect of age on cognitive control skills. Multilingualism, especially among trilingual, was correlated with a higher level of cognitive flexibility on the alternatives side, with no effect on cognitive control. In terms of gender, females excelled in creating alternatives, while males showed better cognitive control, with overall differences in overall flexibility between genders remaining small.

Strengths and limitations

It should be noted that the study focused exclusively on students in general and randomly selected students and did not include a comparison group of high-achieving students. In addition, the experimental sample was relatively small, comprising 60 students. These considerations open up avenues for future research that takes into account a wider range of variables.

Author contributions

All authors contributed significantly to the production of this article and approved thefinal manuscript.

References

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A Systematic Review and Meta-Analysis of the Cognitive Correlates of Bilingualism. *Review of Educational Research, 80*(2), 207-245. https://doi.org/10.3102/0034654310368803

Algharaibeh, S. A. S. (2020). Cognitive flexibility as a predictor of subjective vitality among university students. *Kıbrıslı Eğitim Bilimleri Dergisi, 15*(5), 923-936.

Anderson, P. (2002). Assessment and Development of Executive Function (EF) During Childhood. *Child Neuropsychology, 8*(2), 71-82. https://doi.org/10.1076/chin.8.2.71.8724

Armbruster, D. J. N., Ueltzhöffer, K., Basten, U., & Fiebach, C. J. (2012). Prefrontal cortical mechanisms underlying individual differences in cognitive flexibility and stability. *Journal of Cognitive Neuroscience*, *24*(12), 2385–2399. https://doi.org/10.1162/jocn_a_00286

Baccini, A. (2010). *Statistique descriptive multidimensionnelle (pour les nuls)* [Notes de cours]. Institut de Mathématiques de Toulouse (UMR CNRS 5219). https://www.math.univ-toulouse.fr/~baccini/zpedago/asdm.pdf

Barac, R., Bialystok, E., Castro, D. C., & Sanchez, M. (2014). The cognitive development of young dual language learners: A critical review. *Early Childhood Research Quarterly*, *29*(4), 699–714. https://doi.org/10.1016/j.ecresq.2014.02.003

Barbey, A. K., Colom, R., & Grafman, J. (2013). Architecture of cognitive flexibility revealed by lesion mapping. *NeuroImage*, *82*, 547–554. https://doi.org/10.1016/j.neuroimage.2013.05.087

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development*, *81*(6), 1641–1660. https://doi.org/10.1111/j.1467-8624.2010.01499.x

Best, J. R., Miller, P. H., & Jones, L. L. (2009). Executive functions after age 5: Changes and correlates. *Developmental Review*, *29*(3), 180–200. https://doi.org/10.1016/j.dr.2009.05.002

Bialystok, E., Craik, F., & Luk, G. (2008). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(4), 859–873. https://doi.org/10.1037/0278-7393.34.4.859

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology*, *19*(3), 273–293. https://doi.org/10.1207/S15326942DN1903_3

Cartwright, K. B., Marshall, T. R., Dandy, K. L., & Isaac, M. C. (2010). The development of graphophonological-semantic cognitive flexibility and its contribution to reading comprehension in beginning readers. *Journal of Cognition and Development*, *11*(1), 61–85. https://doi.org/10.1080/15248370903453584

Chen, Q., Yang, W., Li, W., Wei, D., Li, H., Lei, Q., Zhang, Q., & Qiu, J. (2014). Association of creative achievement with cognitive flexibility by a combined voxel-based morphometry and resting-state functional connectivity study. *NeuroImage*, *102*, 474–483. https://doi.org/10.1016/j.neuroimage.2014.08.008

Chevalier, N. (2010). Les fonctions exécutives chez l'enfant: Concepts et développement. *Canadian Psychology/Psychologie Canadienne*, *51*(3), 149–163. https://doi.org/10.1037/a0020031

Chieu, V. M. (2007). An operational approach for building learning environments supporting cognitive flexibility. *Journal of Educational Technology & Society*, *10*(3), 32–46.

Colzato, L. S., Bajo, M. T., van den Wildenberg, W., Paolieri, D., Nieuwenhuis, S., La Heij, W., & Hommel, B. (2008). How does bilingualism improve executive control? A comparison of active and reactive inhibition mechanisms. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(2), 302–312. https://doi.org/10.1037/0278-7393.34.2.302

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition*, *106*(1), 59–86. https://doi.org/10.1016/j.cognition.2006.12.013

Cristofori, I., Cohen-Zimerman, S., & Grafman, J. (2019). Executive functions. In M. D'Esposito & J. H. Grafman (Eds.), *Handbook of clinical neurology* (Vol. 163, pp. 197–219). Elsevier. https://doi.org/10.1016/B978-0-12-804281-6.00011-2

Dajani, D. R., & Uddin, L. Q. (2015). Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience. *Trends in Neurosciences*, *38*(9), 571–578. https://doi.org/10.1016/j.tins.2015.07.003

Davis, J. C., Marra, C. A., Najafzadeh, M., & Liu-Ambrose, T. (2010). The independent contribution of executive functions to health-related quality of life in older women. *BMC Geriatrics*, *10*(1), Article 16. https://doi.org/10.1186/1471-2318-10-16

Deák, G. O., & Wiseheart, M. (2015). Cognitive flexibility in young children: General or task-specific capacity? *Journal of Experimental Child Psychology*, *138*, 31–53. https://doi.org/10.1016/j.jecp.2015.04.003

Dennis, J. P., & Vander Wal, J. S. (2010). The Cognitive Flexibility Inventory: Instrument development and estimates of reliability and validity. *Cognitive Therapy and Research*, *34*(3), 241–253. https://doi.org/10.1007/s10608-009-9276-4

Diamond, A. (2013). Want to optimize executive functions and academic outcomes? Simple, just nourish the human spirit. In P. D. Zelazo & M. D. Sera (Eds.), *Minnesota symposia on child psychology: Vol. 37. Developing cognitive control processes: Mechanisms, implications, and interventions* (pp. 203–230). John Wiley & Sons. https://doi.org/10.1002/9781118732373.ch7

Engel de Abreu, P. M. J., Abreu, N., Nikaedo, C. C., Puglisi, M. L., Tourinho, C. J., Miranda, M. C., Befi-Lopes, D. M., Bueno, O. F. A., & Martin, R. (2014). Executive functioning and reading achievement in school: A study of Brazilian children assessed by their teachers as “poor readers.” *Frontiers in Psychology*, *5*, Article 550. https://doi.org/10.3389/fpsyg.2014.00550

Farrant, B. M., Maybery, M. T., & Fletcher, J. (2012). Language, cognitive flexibility, and explicit false belief understanding: Longitudinal analysis in typical development and specific language impairment. *Child Development*, *83*(1), 223–235. https://doi.org/10.1111/j.1467-8624.2011.01681.x

Genet, J. J., & Siemer, M. (2011). Flexible control in processing affective and non-affective material predicts individual differences in trait resilience. *Cognition and Emotion*, *25*(2), 380–388. https://doi.org/10.1080/02699931.2010.491647

Gosling, C. J., Cartigny, A., Scoriels, L., Portalier, C., Laidi, C., & Mallet, J. (2025). La flexibilité cognitive: Une dimension cognitive clé. *médecine/sciences*, *41*(5), 443–450. https://doi.org/10.1051/medsci/2025075

Ionescu, T. (2012). Exploring the nature of cognitive flexibility. *New Ideas in Psychology*, *30*(2), 190–200. https://doi.org/10.1016/j.newideapsych.2011.11.001

Johnco, C., Wuthrich, V. M., & Rapee, R. M. (2013). The role of cognitive flexibility in cognitive restructuring skill acquisition among older adults. *Journal of Anxiety Disorders*, *27*(6), 576–584. https://doi.org/10.1016/j.janxdis.2012.10.004

Jurado, M. B., & Rosselli, M. (2007). The elusive nature of executive functions: A review of our current understanding. *Neuropsychology Review*, *17*(3), 213–233. https://doi.org/10.1007/s11065-007-9040-z

Kaddouri, H., Amrani, A., & El-Mir, M. (2025). Inhibitory control and academic performance in Arabic-speaking primary school students. *International Journal of Research and Innovation in Social Science*, *9*(17), 400–407. https://doi.org/10.47772/IJRISS.2025.917PSY0036

Kim, C., Cilles, S. E., Johnson, N. F., & Gold, B. T. (2012). Domain general and domain preferential brain regions associated with different types of task switching: A meta-analysis. *Human Brain Mapping*, *33*(1), 130–142. https://doi.org/10.1002/hbm.21199

Luke, M. A. (2001). *Effects of bilingualism on mental flexibility* [Honors thesis, Louisiana State University]. LSU Scholarly Repository. https://repository.lsu.edu/cgi/viewcontent.cgi?article=1902&context=honors_etd

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition*, *18*(1), 176–186. https://doi.org/10.1016/j.concog.2008.12.008

Niendam, T. A., Laird, A. R., Ray, K. L., Dean, Y. M., Glahn, D. C., & Carter, C. S. (2012). Meta-analytic evidence for a superordinate cognitive control network subserving diverse executive functions. *Cognitive, Affective, & Behavioral Neuroscience*, *12*(2), 241–268. https://doi.org/10.3758/s13415-011-0083-5

Qasim, A., & Abdullat, S. (2018). Psychological happiness in its relationship with cognitive flexibility and selfconfidence among a sample of graduate students at Sohag University. *Educational Journal-Sohag University*, *53*, 79–145.

Schopp, L. H., Shigaki, C. L., Johnstone, B., & Kirkpatrick, H. A. (2001). Gender differences in cognitive and emotional adjustment to traumatic brain injury. *Journal of Clinical Psychology in Medical Settings*, *8*(3), 181–188. https://doi.org/10.1023/A:1011369620254

Scott, W. A. (1962). Cognitive complexity and cognitive flexibility. *Sociometry*, *25*(4), 405–414. https://doi.org/10.2307/2785779

Smith, A. B., Taylor, E., Brammer, M., & Rubia, K. (2004). Neural correlates of switching set as measured in fast, event-related functional magnetic resonance imaging. *Human Brain Mapping*, *21*(4), 247–256. https://doi.org/10.1002/hbm.20007

Spiegel, J. A., Goodrich, J. M., Morris, B. M., Osborne, C. M., & Lonigan, C. J. (2021). Relations between executive functions and academic outcomes in elementary school children: A meta-analysis. *Psychological Bulletin*, *147*(4), 329–351. https://doi.org/10.1037/bul0000322

Wager, T. D., Jonides, J., & Reading, S. (2004). Neuroimaging studies of shifting attention : A meta-analysis. NeuroImage, 22(4), 1679-1693. https://doi.org/10.1016/j.neuroimage.2004.03.052

Wager, T. D., Jonides, J., & Reading, S. (2004). Neuroimaging studies of shifting attention: A meta-analysis. *NeuroImage*, *22*(4), 1679–1693. https://doi.org/10.1016/j.neuroimage.2004.03.052

Wiseheart, M., Viswanathan, M., & Bialystok, E. (2016). Flexibility in task switching by monolinguals and bilinguals. *Bilingualism: Language and Cognition*, *19*(1), 141–146. https://doi.org/10.1017/S1366728914000273

Zaehringer, J., Falquez, R., Schubert, A.-L., Nees, F., & Barnow, S. (2018). Neural correlates of reappraisal considering working memory capacity and cognitive flexibility. *Brain Imaging and Behavior*, *12*(6), 1529–1543. https://doi.org/10.1007/s11682-017-9788-6

Zelazo, P. D., Morris, I. F., Qu, L., & Kesek, A. C. (2024). Hot executive function: Emotion and the development of cognitive control. In M. A. Bell (Ed.), *Child development at the intersection of emotion and cognition* (2nd ed., pp. 51–73). American Psychological Association. https://doi.org/10.1037/0000406-004

Zheng, W., Akaliyski, P., Ma, C., & Xu, Y. (2024). Cognitive flexibility and academic performance: Individual and cross-national patterns among adolescents in 57 countries. *Personality and Individual Differences*, *217*, Article 112455. https://doi.org/10.1016/j.paid.2023.112455