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Threshold Hypothesis and Executive Function: Insights from Saudi International School Bilinguals

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Abstract

The research examines the threshold hypothesis in Saudi Arabia, concentrating on the impact of bilingualism on executive function. This study looks at the differences in metalinguistic awareness, inhibitory control, attentional control, and working memory between male high school students who are balanced, dominant, or semi-broad bilingual. This study enhances the neglected field of bilingualism in Arabic-speaking areas, focusing specifically on cognitive function and multilingual proficiency. A quantitative, causal-comparative analysis was performed with male secondary school students in Saudi Arabia, classified as balanced, dominating, and semi-broad bilinguals. Participants undertook language competency evaluations utilizing the TOEFL for English and the GCSE for Arabic. We employed four cognitive tasks—grammatical judgment, Stroop test, semantic and phonemic fluency, and backward digit recall—to assess executive processes. The research employed statistical analyses to determine substantial disparities in cognitive function across the three bilingual cohorts. The results corroborate the threshold hypothesis, as balanced and dominant bilinguals surpassed semi-bilinguals in executive function tests. The absence of substantial differences between balanced and dominating bilinguals suggests that attaining a specific skill level in two languages may improve cognitive capabilities. These findings underscore the need for cultivating robust bilingual abilities to enhance cognitive performance and reinforce the threshold hypothesis in non-Western settings.

Keywords: Bilingualism, Executive Functions, Secondary students, Cognitive Tasks, Threshold hypothesis

Introduction

Thanks to globalization, people from all walks of life can now communicate and engage with one another more efficiently than ever before, drawing closer together in an increasingly interdependent globe (Hamers & Blanc, 2000). The phenomenon of bilingualism, however,

has emerged alongside this greater diversity. Researchers have focused on bilingualism for quite some time, primarily in two areas that Cummin (1979), suggested. The first issue is dependency, or how one language affects another's acquisition. In the second domain, the threshold theory discusses how bilingualism may promote the maturation of cognitive capacities, particularly executive processes. Cummin proposed both theories. Many theories and researchers have previously surfaced that cast doubt on the benefits of bilingualism and worried about its possible detrimental effects on children's brain development (Peal & Lambert, 1962). Parents back then were concerned that their children would experience adverse cognitive effects, linguistic disorientation, and even social and language difficulties because they were growing up bilingual (Diaz, 1983). In addition, Tsushima and Hogan (1975), stated that being bilingual could harm a child's academic performance and verbal competence. Some researchers have failed to show that being bilingual is beneficial, according to Cummins (1979), and this is because they used flawed methods in their studies.

These investigations ignored essential characteristics such as gender, parental socioeconomic status, and language competency. Research by Diaz (1985), revealed that these studies failed to account for the fact that children who speak one language and those who speak two languages are not cognitively equivalent. Consequently, linguistic competency should play a pivotal role in comparing these two categories. These results have led many researchers to advocate bilingualism as a viable option for people, even those born into monolingual households. According to current research, this has led to more people speaking two languages, which has overtaken the number of people speaking just one language (Hamers, 2004). Bilingualism may also cause people to have unrealistic views of the world, according to studies cited by Saunders, Romaine, Carrol, and Darcy (2020). Furthermore, they hypothesized that the mental gymnastics involved in learning a second language could impair students' capacity for reasoning and analysis. Griot et al. (2021), recently explored the possible link between multilingualism and cognitive development. The study found that bilingualism had minimal effects when accounting for disparities in language or memory abilities. Researchers found no good or bad effect on executive functions like phonological awareness. However, Giovannoli, Martella, and Casagrande's (2023), systematic review indicates few variations between language groups. The experimental investigations included in this study found no substantial variations in cognitive and motor inhibition abilities. Furthermore, the study found no benefits in executive functioning, even when accounting for verbal fluency test results.

Much prior research has focused on the potential role of bilingualism in the maturation of executive functions, which has been the subject of much prior research. According to Peal and Lambert (1969), research has shown that learning two languages, sometimes called bilingualism, helps with cognitive growth. To this day, researchers continue to look for evidence of this connection. Research in this area has shown that being able to speak more than one language is essential for maturing cognitive abilities like attention, cognitive agility, and executive function (Nguyen et al., 2024; Grote et al., 2021; Degirmenci et al., 2022). Considering all of this research, it is clear that being bilingual has a good effect on executive functioning. Researchers Kovyazina et al (2021), found that people who are fluent in two languages have an advantage in verbal working memory, which helps them overcome difficulties when learning new words and speaking clearly. Research on the effects of bilingualism on executive function development has shown mixed results; some research has

found a positive association between the two, while other studies have shown the opposite. Bilingualism and its effects on brain maturation are, as a result, a complicated and multifaceted subject.

The primary cause of these contentious findings is the failure to account for controlled and non-controlled variables that influence executive functions. These variables include, but are not limited to, the age of acquisition, proficiency level, and patterns of language use (Brito & Noble, 2021; Hackman et al., 2021). These language aspects impact one's cognitive capacities, especially on executive and attentional functioning tests. As a result, while assessing the cognitive advantages of being bilingual, it is crucial to consider these language factors. This study will examine five domains of executive functions: metalinguistic awareness, verbal and nonverbal memory, attention, and cognitive flexibility. The threshold hypothesis is a prominent theory in this area (Nadzir & Halim, 2022). Based on this theory, to fully benefit from being bilingual, one must reach a certain level of competence and proficiency in both their mother tongue and second language (Cummin, 1979). According to Lasagabaster (2001), the threshold hypothesis can be helpful in determining the correlation between a person's cognitive development and their ability to speak two languages fluently. The validity of this idea has led other researchers to adopt it in their recent investigations into the relationship between language acquisition and bilingualism (Weiss et al., 2020; Nadzir & Halim, 2022; Siame, 2022; Wei et al., 2022). This paper aims to address the following questions:

A) How does speaking two languages simultaneously improve one's cognitive abilities?
B) How can an international school in Riyadh, Saudi Arabia, make the threshold hypothesis work?

This study builds on the existing body of research on the threshold hypothesis by examining the executive functions of male Saudi students in Riyadh, Saudi Arabia, who are bilingual in Arabic and English. Depending on their level of proficiency in both languages, researchers categorized the students as balanced bilinguals, dominant bilinguals, or semi-bilinguals. Researchers hope that teachers, students, and linguists will all benefit from the study's findings, which will address a vacuum in the literature.

Literature Review

Although there is a lot of research on how learning a second language affects one's intelligence, much of it has come from well-developed Western nations. Saudi Arabia is among the few Arabic-speaking Middle Eastern countries where research is scarce compared to China, Taiwan, and India (Elbedour et al., 2019). The Kingdom of Saudi Arabia is an excellent location for such research. Despite the relevance of examining the association between the degree of bilingual speakers and cognitive ability, most literature review studies compare the cognitive capacities between monolingualism and bilingualism. As a result, the participants in this study are all monolingual, and the focus is solely on bilingual speakers. Studies like Pathak et al. (2022) that have looked at the correlation between bilingualism and intelligence have only focused on a single cognitive activity. In contrast to their work, which solely used the Stroop Task to measure the association between bilingual speakers and the development of cognitive capacity, this study employs four cognitive tests for broad generalization and analysis of multiple areas of cognitive development. Executive functions on verbal and nonverbal abilities are the exclusive focus of Rosselli et al. (2019). The present study is even more thorough than previous ones that used comparable methods, such as the threshold

hypothesis and characteristics like socioeconomic status and age. For example, Lin (2009) investigated how being bilingual relates to performance on the working memory test and the grammatical judgment task. The effect of bilingualism on verbal and nonverbal skills was the subject of Andreou's (2015), research. This study fills a gap in the literature by examining several cognitive capacities, including inhibition, working memory, attentional control, and metalinguistic awareness.

This study's analysis of a wider variety of variables helps us better understand the relationship between bilingualism and cognitive development, including the various cognitive capacities it encompasses. The current study is like that of et al. (2023) in that it investigates the executive functions of bilinguals, such as their ability to solve problems, focus their attention, and have metalinguistic awareness. However, their study may have benefitted from additional diversity since it draws comparisons between monolinguals and bilinguals without considering proficiency. While many studies have explored executive functions, they have predominantly focused on Western nations (Ferjan & Kuhl, 2017; Craik & Bialystok, 2010; Kovács & Mehler, 2009; Graf & Hay, 2015; Parra et al., 2011; Conboy & Thal, 2006; Hoff et al., 2012; Conboy & Mills, 2006; Kuhl & Rivera-Gaxiola, 2008; Eilers et al., 2006; and Paradis et al., 2007; Marian and Shook (2013); and Prior MacWhinney, 2010).

In contrast, we hope to shed light on the topic worldwide by taking a more holistic look at the correlation between bilingualism and intelligence. Some scholars have looked at this, including Alshahrani (2017), Elbedour et al. (2019), Alhuqbani (2016), Sharaan et al. (2021), and Bawalsah et al. (2019); however, their research has only compared the abilities of bilinguals and monolinguals. Two studies examining how bilingualism affected kindergarteners' creative ability in Riyadh, Saudi Arabia, were Al Saud (2016) and Elbedour et al. (2019). In addition, the link with cognitive capacities was not considered in the study by Aldosari and Alsultan (2017), which examines the impact of early bilingual education on first language literacy skills in Saudi Arabian elementary school students in second grade. What distinguishes the present study is that it considers the effects of Arabic-English bilingualism on cognitive ability.

The Threshold Hypothesis

This one stands out among the many theories that have attempted to explain the link between bilingualism and mental capacity. This theory posits that being bilingual has cognitive benefits and that proficiency in two languages is necessary. The effects of being bilingual on cognitive development might vary depending on how proficient a person becomes in both languages, claims Cummins (Cummins 1976 in Cummins et al. 2009: p. 41). He suggests two different proficiency levels concerning the cognitive effects of being bilingual. He or she must reach certain thresholds of language proficiency in order to get the cognitive benefits of being bilingual. Somewhat differently, Hoffman presents an alternative illustration of a threshold theory (2001: p. 89). According to Baker (2011), there are three tiers of bilingualism, each associated with a different level of language competency and a particular cognitive consequence. Balanced bilinguals fluent in both languages make up the first threshold level. The cognitive benefits will accrue to such bilinguals. According to this theory, such bilinguals will reap cognitive benefits. A second criterion is used When most of the population is fluent in both languages. Bilingual people have honed one language but have room for improvement in the other. Because of this, it is highly improbable that bilinguals at this level enjoy any

unique cognitive benefits. Those who are only slightly bilingual and familiar with both languages make up the final cutoff. Bilingual people at this level may experience cognitive difficulties because they cannot effectively use both languages.

Table 1
Cummins Threshold Hypothesis

Type of Bilingualism	Cognitive Effects	
Additive/ balanced bilingualism.	High levels in both languages	Positive cognitive effects
Dominant bilingualism. Native-like level in one of the language	Neither positive nor negative cognitive effects	Higher threshold level of bilingual competence
Sem bilingualism. Negative cognitive effects Low level in both languages (maybe balanced or dominant)	negative cognitive effects	Lower threshold level of bilingual competence

Methods of Research

This study uses the threshold theory as a framework to investigate how bilingualism affects cognitive development (Cummins, 1979). To characterize the unique components of L2 proficiency, the chosen technique also assists in determining whether there is a correlation between English and Arabic language proficiency. Thus, 212 bilingual kids from international Saudi schools will have their Arabic and English language abilities (reading, writing, listening, and speaking) and cognitive abilities assessed in the current methodology's initial stage. Our investigation is based on a solid quantitative causal-comparative design. This study is critical for elucidating and analyzing the relationships between independent and dependent variables, as Charles (1998) argues. In this instance, we are investigating the possibility that the two languages—English and Arabic—influence cognitive capacity. Taking this all-encompassing approach guarantees that our findings are genuine and reliable. The threshold hypothesis (Cummins, 1979) investigates cognitive growth, including metalinguistic awareness, attention, cognitive flexibility, and memory, and asks if the degree of Arabic/English proficiency contributes. According to Cummins's classifications, many bilingual pupils attending Saudi Arabian international schools fall into one of two categories. We do not randomly choose research participants. Hence, there are three requirements that every student must fulfill: The pupils must be in the secondary levels initially. Secondly, these topics should be a part of the international school curriculum right from the start. The third requirement is that irrespective of their country of origin, Arabic must be their mother tongue.

Findings and Discussion

A person's level of bilingualism influences their cognitive capacity. This section presents the link between bilingualism levels and executive function skills. The levels of bilingualism include balanced bilinguals, dominant bilinguals, and semi-bilinguals. The tasks that measure executive function include the Stroop task, verbal fluency, backward-digit memory, and the grammatical judgment task.

Table 2
Cognitive ability in Different Areas

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Backwards-digit-recall task	212	1.00	10.00	4.7453	1.47728
Stroop Task	212	9.00	104.00	66.5330	17.90395
Semantic	212	.00	22.00	13.6038	4.29863
Phonemic	212	.00	30.00	14.0094	7.51379
Grammatically judgment task	212	6.00	120.00	89.7783	22.81258
Valid N (listwise)	212				

The grammatical judgment task results range from a high of 120 to a low of 6, with a mean of 88.77 and a standard deviation of 21.714, as shown in the table above. This indicates that students' performance is diverse and dispersed. With a range from 0 to 30, the phonemic task has an average value of 13. Results are dispersed and diverse, as indicated by the high standard deviation (5.51). The semantic task has a mean value of 12.6 and a range of 0 to 22. A standard deviation of 4.2.99 indicates that the values are not uniform. The Stroop task's results range from 8 to 105, with a mean value of 65.53, as shown in the table above. Values vary, as evidenced by the standard deviation of 16.90. The final backward-digit recall task had a mean value of 4.74, a range of nine to one, and a minimum value of one. With a standard deviation of only 1.3, the results are quite close. Three degrees of performance (low, medium, and high) help us assess how well children are doing on these types of assignments.

Bilingualism and Metalinguistic Skills

This study used the grammaticality judgment (GJ) task to assess syntactic awareness, the initial skill. Verifying the correctness of a sentence's linguistic form is an essential part of GJ. Instead of focussing on the meaning of a phrase—the main target of attention in everyday language use—this test assesses children's level of analysis and control in selecting the optimal sentence structure. A considerable level of self-control is required for the participants to disregard the semantic mistake. On the other hand, analysis necessitates finding the faults and fixing the syntactic and semantic ones. Some strange sentences in this exercise make you check your grammar and silence your meaning (i.e., make sure you are simply processing the structure of the words). The grammatical judgment task is a positive indicator of metalinguistic awareness because it checks for the ability to decouple word meanings from their structural basis.

Table 3
The Correlation between the type of Bilingualism and a Grammatical Judgment Task

The correlation between the type of bilingualism and a grammatical judgment task					
		GRAMMAR LEVEL			
		Low	**med**	**high**	**Total**
type of bilingualism	Balanced	23	46	64	131
	Dominant	21	28	16	63
	semi-lingual	18	4	1	21
Total		63	78	81	215

Only 1.4% of the semi-bilingual individuals got a medium score on this specific activity, indicating that their performance was severely lacking. Semi-bilinguals know the basics of both languages but struggle to communicate fluently. In contrast, the top performers on this task were the balanced bilinguals, who are fluent in both languages equally. Their score was 50.9%.

The dominating bilinguals, who speak one language well and are proficient in another, came in at 19.5%, just behind the balanced bilinguals. According to these findings, the balanced bilingual group of students performed the best, followed by the dominant bilingual group and the semi-bilingual group. The results also support the threshold hypothesis, which states that balanced bilinguals (those who are fluent in both Arabic and English) have a higher score than semi-bilinguals (those who do not meet the criteria for language mastery), and bilinguals with a higher level of proficiency in both languages have a lower score. Metalinguistic activities are an area where balanced bilingual youngsters tend to thrive, which could explain this finding. Their ability to choose the proper grammatical structure and spot semantic mistakes is exceptional. Their innate ability to adapt to new linguistic environments is the driving force behind their exceptional proficiency. On top of that, they have a keen understanding of the traditional link between words and their assigned meanings, as well as a heightened awareness of language's arbitrary character. These results point to a link between being able to use language selectively and being multilingual.

This study's balanced bilinguals demonstrate a remarkable talent for correcting incorrect phrases associated with their cognitive and linguistic flexibility. Because they become balanced bilinguals in Arabic and English and develop higher-level language abilities and cognitive flexibility, the people taking part in this study can fix incorrect phrases. They can do this because they are fluent in both languages, understand the connection between input and linguistic and metalinguistic development, and follow the rules without considering context (Bialystok & Craik, 2022). Lastly, the results are consistent with previous research showing that balanced bilinguals acquire metacognitive reading domains (Abu et al., 2022). Because the test in the study by Galambos and Goldin-Meadow (2014), was so easy, most participants scored above 80%, indicating that bilingualism does not affect metalinguistic skills. Importantly, the research used a different testing technique, having kids explain the statement before they could fix it. There are two possible interpretations of bilingualism's task effect. One possible explanation is that multilingual youngsters do not necessarily have better language skills. However, they are better at figuring out how to use their skills when asked to explain something. Melike Ünal Gezer, Yu-Min Ku, and Zhuo Chen (2020), investigated how bilingual children's literacy and metalinguistic abilities developed alongside their language

capabilities. According to the study, higher levels of language proficiency were associated with more substantial linguistic and metalinguistic development. Nevertheless, a more well-rounded multilingual experience resulted in greater metalinguistic awareness. Research supports this study's findings, demonstrating that balanced bilingual children exhibit superior metalinguistic awareness and skill mastery than dominant and semi-bilingual children.

Bilingualism and Working Memory

The researcher uses the backward digit task to determine if there is a connection between working memory and bilingualism. The current study used the same task as Thomas, Milner, and Haberlandt (2003), and participants demonstrated an advantage in the backward span task but not the forward task. Since these activities necessitate precise processing, they back up their claim that bilinguals could be better able to take advantage of the benefits of multilingual on working memory (WM) tasks that call for precise processing, such as attentional control. Conversely, these benefits can vanish when the WM job requires less regulated processing. The table below shows a correlation between the type of bilingualism and working memory activities that involve the backward digit task.

Table 4
The Correlation between type of Bilingualism and Backward Digit Task

The correlation between type of bilingualism and backward digit task

		Low	**med**	**high**	**Total**
type of bilingualism	Balanced	55	73	4	131
	Dominant	36	28	0	63
	semi-lingual	17	5	0	21
Total		108	106	4	215

Based on their 9.4% working memory (WM) test score, the semi-bilingualism group did not perform up to par. In contrast, the balanced and dominant bilingual groups outperformed the semi-bilinguals. However, they still fell short of the expected results even though they were at the first and second threshold levels, respectively. For example, out of the total participants, 61.3% were in the balanced bilingual group, and more than 25% had poor scores. This finding contradicts the threshold hypothesis, which held that bilinguals with a favourable cognitive balance would not negatively impact their brain function. Similarly, when testing the dominant bilingual group, which was predicted to show no positive or negative mental impacts, over 29% of individuals (or 16.5% of the total) scored poorly, which goes against the threshold hypothesis. Namazi and Thordardottir (2010), also found no advantages to bilingualism in verbal or visual working memory tests among children aged four and five; thus, our findings align with theirs. Like the present study, Engel de Abreu (2011), utilized the identical backward digit-span task to assess six-year-old children and found no evidence of bilingual differentiation. Bialystok and Feng (2009), found that bilingual children did not demonstrate proficiency in the forward digit-span and sequencing-span tasks. Finally, Bonifacci et al (2011), used minors and adults in their studies. When testing participants' recall of a sequence of previously displayed numbers to identify the target symbol, researchers found no benefit to being bilingual. There is only weak evidence that bilingual people in both languages do better on working memory tests than other bilinguals.

Their performance may also be subpar (Bialystok, 2010; Barac et al., 2016). Some experimental tasks may have peculiarities that explain why they did not provide statistically significant results (Ladas et al., 2015). It is challenging to compare results due to the large number of tests used to evaluate executive functioning. Paap et al. (2015), recommend including at least two working memory evaluation activities to validate results. Research shows that using a complex task version is the only way to achieve the bilingual effect. Therefore, it is crucial to determine if this effect is exclusive to tasks with specific complexity levels. Bilinguals performed better on more challenging tasks (the flanker task and the Go/No-Go test); according to research by Barac et al. (2016), they were not different on more manageable tasks. However, studies that used a more user-friendly Corsi test only demonstrated the bilingual effect. When tested against dominant and semi-bilingual individuals, balanced bilinguals performed surprisingly well. This aligns with earlier research that found that bilinguals with a proficient grasp of both languages performed exceptionally well on verbal and visual working memory tests. The advantages of bilingualism in working memory are thus only noticeable under conditions of solid demand for inhibition processing. Therefore, balanced bilinguals performed better than other varieties in the backward digit test, which calls for high inhibition and control. In other words, tasks that need much cognitive power seem to be where bilinguals shine. Bialystok et al. (2008), reached the same conclusion as the previous assumption, highlighting the more significant impact of multilingual advantage on activities involving higher processing power levels. Consistent with Bialystok et al. (2014), who verified that bilinguals show their benefits in more complex tasks due to the high processing demands of such tasks, our finding also supports that theory. Research has shown that speaking two languages fluently improves working memory (WM).

Proficiency in two languages can enhance the speed and accuracy of working memory (WM). Bilingual youngsters excel at particularly challenging WM tasks like the backward Digit Recall. According to other research, bilingualism enhances WM. Evidence from studies by Meltzoff (2008), Engel De Abreu et al. (2012), and Calvo and Bialystok (2014) support the idea that bilingualism contributes to better WM. The study found that varying levels of bilingualism significantly influenced regulated processing in WM. Bilinguals who were balanced and dominant outperformed semi-bilinguals. Controlled processing is an essential component of working memory (WM) and other executive functions; the study implies that being bilingual gives an advantage in this area. Consequently, attentional control in the experiment moderates the outcome of bilingualism in working memory. Sampedro and Pea (2019) investigated the relationship between working memory and bilingualism. They categorized individuals into low, medium, and high proficiency levels. In this study, participants with high or medium levels of working memory performed as well as or better than those with low levels of memory. Working memory performance is poorer when proficiency is at a medium level, according to Sampedro and Peña's study. The current research backs up their threshold hypothesis, showing that being multilingual helps with executive processes like working memory. Participants' performance on working memory tasks varied across levels, with high and middle performers outperforming those with lower levels. On the other hand, Yang et al. (2016) used participants' levels of English proficiency to classify them as either balanced or dominant migrants. They found no significant difference between balanced and dominant bilinguals, except when faced with a heavy memory load, and discovered that varying degrees of bilingual proficiency enhanced working memory. Our recent investigation confirms these findings. Bilingualism may enhance working memory (WM) tasks, which could explain this

association. Multilingual children perform better on WM tasks because they can inhibit one language while using the other. Additionally, WM responses are quicker and more accurate for bilinguals.

A crucial component of cognitive development, bilingualism enhances the capacity to store and manipulate information in working memory (WM) (Mehrani & Zabihi, 2017; Engel de Abreu, 2002; Kane et al., 2001).. Half of the balanced language learners (72 out of 130) and dominant language learners (27 out of 62) perform medially on the working memory test. These results, however, go counter to Cummin's theory, which holds that dominant bilinguals will have neutral cognitive growth while balanced bilinguals will display superior cognitive ability. Ongun (2018) offers a plausible explanation for the study's findings by suggesting that once both groups have the same vocabulary size, differences in linguistic abilities between bilinguals may disappear and that poor performance on working memory tasks might result. The results of the working memory task were comparable for the balanced and dominant bilinguals in this study, suggesting that their vocabulary sizes are comparable. Furthermore, the exact duration of exposure to the second language could account for the similar performance of balanced and dominant bilinguals in the current study's task (Patra et al., 2020). The participants in the current study have had equal exposure to English, so they perform similarly regarding the language. Two factors explain the comparable results of two of the three bilingual groups on the WM task: first, their vocabulary levels are similar, and second, the amount of time they have spent exposed to the second language is also similar. Kudo and Swanson (2014), also conducted a study on bilingual youngsters to investigate the relationship between vocabulary and WM performance. To determine whether the kids were balanced or additive bilinguals, they used Baddeley's (1998) WM measurements. According to the study, vocabulary is critical in executive functions (EF) tests, such as working memory. Once vocabulary competence in both languages reaches a later developmental stage, researchers propose investigating improvements in WM (e.g., Daneman and Carpenter 1980; Just and Carpenter 1992). This research aligns with the processing efficiency perspective on working memory, posing a compromise to WM resources when processing language. Young bilinguals may find verbal working memory tests challenging because of their limited vocabulary and delayed exposure to the second language.

However, bilinguals can benefit linguistically as they age. Although balanced bilinguals may have an edge over dominant bilinguals, linguistic talents are still crucial for cognitive function since these results show that language and cognition in bilinguals are intricately related. Another reason cited by Soliman (2014), is that the unique characteristics of each language account for the similarity and low performance of bilinguals on this test. In addition, participants have less cognitive load due to the ease with which they may transfer literacy skills between Arabic and English since the two languages are not significantly different when they are similar. On the other hand, when two languages are distinct, executive function improves.

Bilingualism and Inhibitory Control

Bilingual speakers are highly competent because of the close association between code-switching, inhibitory and executive control, as tested by the Stroop task, and language abilities. Faster reaction times and correct answers on the Stroop test demonstrate a higher level of inhibitory and executive control. Participants received incongruent words in one

scenario, while they received congruent terms in the other. The evaluation considers the RT and the number of correct responses. Rapid and precise reactions enhance the ability to block and exert executive control. Students who perform poorly take longer and make more mistakes when asked to identify the ink colour used to print a word.

Table 5
The Correlation between type of Bilingualism and Stroop Level

The correlation between type of bilingualism and Stroop level					
		STOOP LEVEL			
		Low	**Med**	**high**	**Total**
type of bilingualism	Balanced	47	75	11	131
	dominant	29	32	4	63
	semi-lingual	17	5	1	21
Total		93	109	13	215

The Stroop task findings taught us some fascinating things about bilinguals' cognitive capacities. With a score of just 7.5%, the semi-bilingual group did not possess the necessary proficiency. The balanced and dominant bilingual groups outperformed the semilinguals but still fell short of the expected results, even though they were at the first and second threshold levels, respectively. More than 39.6% of the participants in the balanced bilingual group—the largest subset at 61.3%—scored at medium or high levels. Contrary to the threshold theory, which states that balanced bilinguals will show favourable cognitive effects, just 5% of subjects scored high, and 21.6% rated low. Similarly, despite the predicted minimal influence on cognitive performance, over a third of the participants in the dominant bilingual group received failing grades. In contrast, over sixteen percent received scores ranging from high to medium. These results indicate the complexity of the link between multilingual and cognitive performance, which calls for additional research. Compared to other forms of bilingualism, particularly inhibition, Prior, Noa Goldwasser, Rotem Ravet-Hirsh, and Mila Schwarz discovered that balanced bilingualism may lead to higher executive function abilities. Hernández et al. (2013), conducted a similar study, administering four computerized executive function tasks to English-Mandarin bilinguals aged 18–25. The results indicated that the age at which the second language acquisition occurred positively affected the interference cost in the Stroop task. Similarly, this study's highest mean score (65.53) for the current task suggests that exposure to a second language at a young age may explain the improved performance. Additionally, the results of the present study agree with those of Blumenfeld and Marian (2011), who found that bilingual children demonstrated superior performance on tasks requiring inhibitory control.

Mehrani and Zabihi (2017), support this with their theoretical accounts, suggesting that bilinguals experience a distinct "command of attention" daily. Bilinguals constantly practice this ability to concentrate on the relevant language and ignore labels from the non-active language. This finding is in line with the theories put forth by Bialystok et al. (2004), Green (1998), and Vygotsky (1978), regarding the function of bilingualism in inhibition and attention management. Executive functioning abilities are studied by Prior et al. (2014), about balanced bilinguals (those who are equally proficient in both languages) and unbalanced bilinguals (those who are more competent in one language). Findings suggest that balanced bilingualism may improve cognitive capacities, whereas unbalanced bilingualism may have adverse effects.

Thus, with Prior, Goldwasser, Ravet-Hirsh, and Schwarz's results, our work lends credence to the hypothesis that being bilingual may benefit various executive function areas, including shifting and inhibition. Ghafouri and Rezai (2023), measured inhibition using a computerized version of the Stroop Colour and Word Task in their work. This allowed them to delve deeper into the issue. The study found no statistically significant relationship between bilingualism and executive function. This discovery calls the conclusions of the current study into question. Other variables, such as intellectual, physical, and social pursuits, may influence the correlation between cognitive control and bilingualism. Kousaie and Phillips (2012), argued that previous research showing a bilingual advantage had taken important factors like socioeconomic position and linguistic competency into account, which differs from the present study. They demonstrate that matching the groups for socioeconomic position and native/second language status on a verbal inhibition challenge (the Stroop task) eliminated the bilingual advantage. Their presumption supports the present research subjects' demonstration of benefits from bilingualism on the Stroop Task. All participants shared similar economic circumstances and spoke English as their primary or secondary language. The unique thing about this study is that it shows that balanced and dominant bilinguals, who are not very good with both languages, perform equally well on the Stroop test, which evaluates inhibitory control. According to research (Heidlmayr et al., 2014), an imbalanced multilingual group may be better able to modulate inhibitory processes.

Additionally, dominantly imbalanced bilinguals completed the Stroop Colour Word Task and the Simon Task. A popular belief is that inhibitory control, working memory, and task-switching are all areas where children who acquire a second language at a young age tend to excel (Bialystok et al., 2010). Recent studies by Sabourin and Vinerte (2015), and Ratiu and Azuma (2015) suggest that being bilingual may positively impact cognitive performance, suggesting an optimal period for second language acquisition. As previous research considered the "critical period" for language acquisition, the present study also looked at the participants' ages. Many present-day research participants learned a second language from a young age, which explains why most performed so well on this assessment. Langley et al. (2022), recently conducted a study investigating the potential for an inhibitory control advantage among highly fluent Spanish English late bilinguals. The Stroop Task (Victoria version) evaluated the participants' inhibitory control abilities and other markers of second language competence levels. This study found no correlation between multilingualism and Stroop test performance. We address the study's shortcomings and consequences and suggest modifications for future studies that could show a multilingual advantage. A popular belief is that inhibitory control, working memory, and task-switching are all areas where children who acquire a second language at a young age tend to excel (Bialystok et al., 2010). Recent studies by Sabourin and Vinerte (2015), and Ratiu and Azuma (2015), suggest that being bilingual may positively impact cognitive performance, suggesting an optimal period for second language acquisition. As previous research considered the "critical period" for language acquisition, the present study also looked at the participants' ages. Many present-day research participants learned a second language from a young age, which explains why most performed so well on this assessment. The effects of bilingualism on executive function have been the subject of conflicting research.

According to research, only balanced bilingualism, where the languages are competitive, may improve executive function. However, further research is required to explore the

linguistic traits of bilinguals. It is critical to shed light on these results and provide a more thorough comprehension of the connection between bilingualism and executive function. The study's findings do not lend credence to any particular argument, but they do provide light on the topic.

Bilingualism and Lexical Retrieval Skills

Table 6

The Correlation between type of Bilingualism and Semantic Level

The correlation between type of bilingualism and Semantic level

		low	med	high	Total
type of bilingualism	Balanced	41	75	17	131
	Dominant	31	28	6	63
	semi-lingual	18	4	1	21
Total		90	107	24	215

To be verbally fluent, one must be able to generate words both phonologically and semantically, as well as understand their links. Bilingualism enhances cognitive abilities such as flipping, which involves moving between languages and establishing connections. The study's focus is determining how bilingualism affects verbal fluency. We administered two verbal fluency tests to the bilingual participants, one measuring phonemic fluency and the other measuring semantic fluency, each with a 60-second time limit. According to Salmon et al. (1999), these tests demonstrate how participants' bilingual experience impacts their cognitive ability and linguistic processing. The study identified three levels of bilingualism: balanced bilingual, dominant bilingual, and semi-bilingual. Semi-bilingual people, meaning they know a second language to a lesser extent, fared the worst of all the groups. It appears that their language abilities were insufficient for the task at hand. Those whose first language is not English fared worse than those whose second language is balanced or dominant. On the other hand, with 69.2% of 130 participants scoring in the high to medium range, the balanced bilinguals provided evidence in favor of the threshold theory. Conversely, out of the total 130 balanced bilinguals, 30.7% performed poorly. The threshold hypothesis states that being a dominant bilingual has no benefits or drawbacks. Participants at the low, medium, and high levels all did equally well on this exercise. As a result, the theory disproves this hypothesis. In sum, the results show that being bilingual can majorly affect cognitive ability, with the degree of second language proficiency being the most important factor in deciding how well one does.

Table 7

The Correlation between type of Bilingualism and Phonemic Level

The correlation between type of bilingualism and phonemic level

		Low	med	high	Total
type of bilingualism	balanced	64	64	5	131
	dominant	47	17	1	63
	semi-lingual	20	2	1	21
Total		131	83	7	215

Almost all of the group (semi-bilingualism) performed poorly in the task, while the groups.

The Stroop task findings taught us some fascinating things about bilinguals' cognitive capacities. With a score of just 9.4%, the semi-bilingual group clearly did not possess the necessary proficiency. The balanced and dominant bilingual groups outperformed the semilinguals but still fell short of the expected results, even though they were at the first and second threshold levels, respectively. Most participants (51.5%) were part of a balanced bilingual group, and 130 had scores ranging from medium to high. In contrast to the threshold hypothesis, which predicts that balanced bilinguals will show adverse cognitive effects, 50% of the participants performed poorly. Moreover, 75.2% of the 62 groups exhibited poor scores despite expecting no effects on mental function. On top of that, just 25.8% achieved scores in the middle range. These results highlight the complexity of the link between bilingualism and cognitive performance, which calls for additional study in the field. The research focuses on determining how well participants performed on phonemic fluency tests, which involves generating words starting with specific letters, and semantic fluency, which involves generating words from specific categories. In the current investigation, semantics outperformed phonematics. The findings align with previous research by Hazim Alkhrisheh (2019) and Friesen et al. (2016), which emphasized that phonetic tasks require stronger cognitive capacities than semantic ones due to the non-alphabetical listing of lexical elements, which makes retrieval more difficult. More cognates, or words with similar sounds in two languages (such as "flower" and "flor"), can enhance one's ability to create letters fluently, according to Michael, Bennet, and Verney (2019), and Gollan et al. (2002). Lumpenfeld et al. (2016) and Sadat et al. (2016) found that cognates are more likely to be semantic than phonemic. Cognates are more common in languages that share phonological features, which has suggested that they improve lexical access (Sandoval et al., 2010; Sadat et al., 2016).

These observations are consistent with the results of the present investigation. Participants, for example, can achieve excellent scores on the semantic fluency test, even higher than phonemic (Blumenfeld et al., 2016; Sadat et al., 2016), because there are many cognates between Arabic and English. Since this is true, the test language significantly affects bilinguals' performance. This is an extra criterion when judging a bilingual's language skills. According to Escobar et al. (2018), and Friesen et al. (2016), phonemic production is less common in everyday speech. It requires different cognitive skills, like being able to cut down on interference and use creative retrieval strategies. In this research, we look at balanced dominant and semi-bilingual people. The results demonstrate a favorable correlation between the degree of bilingualism and the language and executive control domains tested in the task. As a result, balanced bilinguals demonstrated more fluency in terms of cluster size and the number of correct answers.

These findings indicate that bilingualism enhances executive control. However, according to the research, there was no discernible difference in working memory performance between balanced and dominant bilinguals. Findings indicate that the nature of the executive function task has a significant role in the association between bilingualism and cognitive maturation. As a result, several procedures are required for reliable findings in this field (Paap et al., 2019). The study's second finding shows that the semantic and phonemic tasks differ significantly. This finding fits with other studies: people would produce fewer lexical items in phonemic tasks compared to semantic tasks (Gollan et al., 2007; Kormi-Nouri et al., 2015; Friesen et al., 2016). Feisal Aziez, Hazim Alkhrisheh, Furqanul Aziez, and Maulana Mualim published these results in 2020. The phonemic task places heavy demands on executive

control skills, as noted by Luo et al. (2010), Paap et al. (2019), Sandoval et al. (2010), and Shao et al. (2014). The authors highlighted the high level of language proficiency required for semantic fluency. People need to think of ways to stop themselves from thinking about related semantic words so they can do phonemic fluency tasks (e.g., Friesen et al., 2015; Luo et al., 2010). In this study, we tested students on two types of fluency: phonemic fluency, which involves coming up with words starting with the letter S, and semantic fluency, which involves retrieving terms based on a specific semantic category, such as fruits and vegetables. Bilingualism, in its balanced and dominant forms, had a medium performance, outperforming semi-bilingualism, which was the most common form of bilingualism. The data shows that the students fell into the first threshold hypothesis, which states they could master the two languages but did not excel in either assignment.

Therefore, the provided data does not support the null hypothesis. It is essential to differentiate between balanced and dominating bilinguals to grasp the full scope of bilingualism's benefits. Therefore, the threshold hypothesis states that the cognitive benefits of being multilingual are contingent upon reaching a specific degree of second-language ability, and the abilities that distinguish balanced from dominating bilinguals should be considered.

Conclusion

Many studies on bilingualism focus on its possible benefits since it is a topic of significant interest in cognitive research. This is where the threshold hypothesis comes into play; according to it, the relationship between bilingualism and executive processes heavily depends on the degree of linguistic proficiency (MacSwan, 2000; Takakuwa, 2000; Cummins, 1983). There were no differences in EF between bilingual people found by Arizmendi et al. (2018), Duñabeitia et al. (2014), and Lehtonen et al. (2018), even though Woumans et al. (2015) and Vega and Fernández (2011), found evidence to support Cummins' threshold hypothesis (1983). These conflicting results highlight the necessity for additional research in this field. The present investigation focuses on offering conclusive evidence to establish a clear judgment. At the same time, research found that being bilingual might significantly affect executive processes like working memory, inhibitory control, metalinguistic abilities, and lexical retrieval. According to the findings, at least certain levels of executive processes may be unaffected by bilingualism. Both balanced bilinguals (those proficient in both languages) and dominant bilinguals (those more competent in one language) have an equal degree of EF, which indicates that. The research indicated no statistically significant difference between balanced and dominating bilinguals on many EF tasks. This could be due to difficulties caused by various factors, including the participants' age, socioeconomic level, and experimental tasks (Paap et al., 2015). Variations in the tests used to measure these abilities may explain the contradictory findings in research on the bilingual effect on executive functions.

Doing well on one executive function test does not guarantee success on subsequent tasks in the same domain, and even little adjustments to the experimental design can have a noticeable impact on the final tally. In addition, studies have shown that being bilingual improves performance in some cognitive processes. If linked to creativity, bilingualism could potentially enhance creative capacity by improving cognitive functioning (Ghonsooly & Showqi, 2012; Kharkhurin, 2011). Understanding whether the bilingual impact is task- or

multi-executive function-specific is critical for expanding our understanding of this phenomenon. Researchers Barac et al. (2016) found no difference between the two groups of participants regarding the easier of the two activities. It is possible to detect and validate the benefits of high-quality bilinguals by considering their age, exposure, and usage frequency. Just because two people are multilingual does not imply they have had the same bilingual experience. Contexts influence language competency levels (Antoniou, 2019). According to our findings on the inhibitory control measure, balanced bilinguals perform better than dominant and semi-bilingual individuals (as evidenced by a decreased Stroop ratio). However, when testing working memory (backward digit span), both sets of participants do about the same. This confirms previous research: multilingual people have an edge regarding inhibitory control (Bialystok et al., 2004; Emmorey et al., 2008). In conclusion, the study results provide credence to the threshold hypothesis, which postulates that being fluent in two languages has advantages for bilinguals. Other parts of the hypothesis do not match the findings. According to the theory, being bilingual only helps one's brain function optimally if one possesses a balanced command of both languages. Except for one item, the study indicated that dominant bilinguals fared equally.

Based on these results, dominant bilinguals may get the same cognitive benefits as balanced bilinguals from being bilingual. Executive control encompasses a variety of cognitive processes, including problem-solving, decision-making, and attentional control. Conversely, multilingual people tend to excel in these tasks. The benefit becomes more apparent while doing activities like language switching or comprehending linguistic subtleties that call for inhibitory control, cognitive flexibility, and metalinguistic ability. However, when it comes to activities that require lexical retrieval skills, such as swiftly recollecting words from memory, being balanced multilingual offers a distinct benefit. To grasp the magnitude of this benefit, it is essential to differentiate between balanced and dominating bilinguals. To get more accurate results, future studies on bilingualism in KSA international schools should involve students from diverse socioeconomic origins and study the effects of different amounts of time spent learning the second language.

Theoretical and Contextual Contributions

This research provides a comprehensive theoretical contribution to the understanding of bilingualism by proposing an expanded interpretation of the threshold hypothesis. While affirming that cognitive benefits are contingent upon proficiency levels, it also posits that contextual variable—such as the social and educational environment—moderate this relationship. This perspective encourages a rethinking of existing theoretical frameworks, leading to the hypothesis that cognitive benefits may not solely arise from balanced bilingualism but also the cultural and experiential richness associated with different bilingual identities. By investigating the cognitive profiles of individuals from various socioeconomic backgrounds in the context of international schools in Saudi Arabia, this study underlines the necessity of incorporating socio-cultural dimensions into scholarly discussions surrounding bilingualism.

Furthermore, this research explores the differential impact of bilingualism on specific executive functions, such as inhibitory control, working memory, and cognitive flexibility. Delineating the cognitive advantages possessed by both balanced and dominant bilinguals enriches our understanding of the embodied cognitive processes inherent in bilingualism. This

invites further scholarly inquiry into the specific tasks that may benefit from bilingual experiences, encouraging future studies to adopt a targeted approach to examine how distinct cognitive functions interact with varying types and levels of bilingual proficiency.
In terms of contextual contributions, this study emphasizes the significance of educational settings that foster multilingualism, particularly in culturally diverse environments. It illustrates how bilingual education can serve as a mechanism for language acquisition and an avenue for cognitive enhancement. The findings indicate that diverse language exposure within a structured educational framework can promote advanced executive functioning, a crucial consideration for policymakers and educators. By advocating for pedagogical strategies tailored to leverage the cognitive strengths of bilingual students, the research highlights the role of educational practices in optimizing cognitive outcomes.

Additionally, this investigation sheds light on the intersectionality of bilingualism with other factors such as age and exposure duration. By accounting for these variables, the study contributes to a broader understanding of how shifts in one's language environment can influence cognitive development, prompting the need for longitudinal studies that track these changes. The contextual aspect also resonates with the global dialogue on bilingualism's role in shaping identity, suggesting that cognitive advantages may be intrinsically linked to the personal and cultural significance of being bilingual.

Finally, this research invites a critical examination of the implications of bilingualism in a globalized world. It proposes that language diversity and proficiency not only enhance cognitive capacities but also foster intercultural communication and understanding. This contribution aligns with contemporary discussions on the importance of multilingualism in an increasingly interconnected society, suggesting that educational frameworks should prioritize bilingual education as a pivotal aspect of cognitive and social development.

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