

Psycholinguistics Study on the Interplay of Bilingualism on Selected Cognitive Functions Based on Threshold Hypotheses among Saudi International School Students

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Abstract

This study investigates the threshold hypothesis in Saudi international school students. While this hypothesis has been extensively researched in the West, its application in Arabic-speaking regions, particularly Saudi Arabia, remains unexplored. This paper compares the executive function (metalinguistic awareness, inhibitory control, attentional control, and working memory) differences between the three levels of bilinguals (balanced, dominant, and semi) in male secondary school students in Saudi Arabia. Participants took language tests (TOEFL for English, GCSE for Arabic) and four cognitive tasks (grammatical judgment task, Stroop Task, semantic and phonemic fluency task, and Backward-digit-recall task). A quantitative causal-comparative analysis concluded that there was no significant difference between the performance of balanced, dominant, and semi-bilinguals on executive function tasks, except for the phonemic task. However, the study showed that semi-bilinguals performed poorly in all cognitive tasks. Thus, balanced and dominant bilinguals perform equally in inhibitory control, mental flexibility, and metalinguistic and semantic tasks.

Keywords: Bilingualism, Executive Functions, Secondary students, Saudi International School, Threshold hypothesis.

INTRODUCTION

Globalization has brought diverse societies closer in today's interconnected world, facilitating frequent communication and interaction between different cultures (Hamers & Blanc, 2000). However, this increased diversity has also led to the phenomenon of bilingualism. Bilingualism has been studied for a long time, mainly in two areas proposed by Cummin (1979). The first area concerns how the first language impacts the development of the second language, known as interdependence. The second area concerns how being bilingual might enhance the development of cognitive functions, mainly executive functions, known as the threshold hypothesis. Cummin proposed both of these theories. Before these hypotheses, several theories and scholars emerged who were critical of bilingualism and its potential negative impact on cognitive development (Peal & Lambert, 1962). At this time, parents were not enthusiastic about raising bilingual children, fearing that it could result in adverse cognitive outcomes, linguistic confusion, and even language and social barriers (Diaz, 1983). Further, Tsushima and Hogan (1975) argued that bilingualism could negatively affect children's verbal proficiency and academic development.

Cummins (1979) argues that the failure of certain scholars to demonstrate the benefits of bilingualism can be attributed to inadequate research methodologies. Specifically, these studies did not consider essential variables such as language proficiency, parents' socio-economic factors, and gender. Diaz (1985) re-examined these studies and found they overlooked that bilingual and monolingual children are not linguistically equal. Therefore, language proficiency should be critical in comparing these two groups. In light of these findings, many scholars now encourage individuals to become bilingual, even from a monolingual background. As a result, the number of bilingual speakers has increased and surpassed the number of monolingual individuals, according to recent studies (Hamers, 2004). Moreover, research conducted by authors such as Saunders, Romaine, Carrol, and Darcy (2020) concluded that bilingualism could lead to inadequate conceptions of reality.

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They also suggested that learning a second language could confuse learners, leading to the understanding or production of erroneous messages and limiting the learner's ability for reasoning and analysis. Goriot et al. (2021) recently investigated the potential correlation between bilingualism and cognitive development. The study revealed minor effects of bilingualism, as the impact of bilingualism seemed to disappear when differences in language or memory skills were considered. It was observed that learning two languages simultaneously neither has a positive nor a negative impact on executive function, such as phonological awareness. On the other hand, a systematic review by Giovannoli, Martella, and Casagrande (2023) suggests very few differences between language groups. The experimental studies conducted in this review failed to identify any significant differences in cognitive and motor inhibition ability. Furthermore, no advantages were observed in executive functioning when considering the performance on the verbal fluency task.

Previously, many scholars investigated to what extent bilingualism might contribute to executive function development. These studies revealed that learning two languages (bilingualism) positively contributes to mental development (Peal & Lambert, 1969). Such studies extend even to the present time to validate such correlation. In this realm, Nguyen et al. (2024), Grote et al. (2021), and Degirmenci et al. (2022) found that bilingualism is the cornerstone of cognitive development in many aspects, including executive function, attention, and cognitive agility. Collectively, these studies offer persuasive proof that bilingualism positively influences executive functions. Kovyazina et al. (2021) discovered that bilingual individuals exhibit better verbal working memory, allowing them to overcome challenges in vocabulary acquisition and verbal fluency.

While some studies reveal positive correlations between learning two languages and the development of executive functions, many studies neglect such assumptions, showing that bilingualism might even lead to adverse outcomes. Thus, the topic of bilingualism and its contributions to cognitive development is complex, with many unanswered questions. The main reason for such controversial conclusions is the overlook of controlled factors, such as the age of acquisition, proficiency level, and language use patterns; in addition to non-controlled factors, such as socio-cultural status, video game practice, and music practice, have been shown to affect executive functions (Brito & Noble, 2021; Hackman et al., 2021). These linguistic factors influence a person's cognitive abilities, particularly when it comes to tasks that assess their attentional and executive functioning skills. Therefore, it is essential to consider these linguistic aspects when evaluating the cognitive benefits of bilingualism.

Hence, the primary aim of the present study is to examine the consequences of bilingualism on the progress of five areas of executive functions (metalinguistic awareness, verbal and nonverbal memory, attention, and cognitive flexibility). One of the most significant theories in this respect is the threshold hypothesis (Nadzir & Halim, 2022). This hypothesis states that a minimum competency and proficiency in either the mother tongue or the second language must be achieved to grasp any cognitive privilege of bilingualism (Cummin, 1979). Lasagabaster (2001) states that implementing the threshold hypothesis can be highly beneficial in accurately ascertaining the connection between an individual's cognitive growth and proficiency in speaking two languages. As a result of its validity, many scholars recently used this hypothesis in their studies to find the correlation between language development and bilingualism (Weiss et al., 2020; Nadzir & Halim, 2022; Siame, 2022; Wei et al., 2022). Therefore, This paper accordingly seeks to answer the following questions:

A) How does a correlation between the level of bilingualism and the performance of cognitive tasks develop language skills?

B) How can the threshold hypothesis be adequate at an International School in Riyadh, Saudi Arabia?

The significance of this study is that it extends the investigation of the threshold hypothesis by comparing the executive skills of three different categories of bilingualism, which are balanced bilinguals (proficient in both Arabic and English), dominant bilinguals (high command of one language, and a low command of the other), and semi-bilinguals (low command of Arabic and English) on bilingual male Saudi students in Grades 10-12 in Riyadh, Saudi Arabia. The study results are expected to fill a knowledge gap described in the literature review and be helpful to educators, students, and linguists.

LITERATURE REVIEW

While considerable research has been conducted on the correlation between second language acquisition and intellectual abilities in bilingualism, most of this research has been carried out in developed Western countries. Although some research has been conducted in China, Taiwan, and India, minimal research has been done in the Arabic-speaking Middle East, with only a few studies in Saudi Arabia (Elbedour et al., 2019). Saudi Arabia is an exciting place to conduct research in this area. Throughout the literature review, the vast majority of the studies stress comparing the cognitive abilities between bilingualism and monolingualism, ignoring the importance of studying the correlation between the level of bilingual speakers and cognitive ability. Therefore, this study concentrates only on bilingual speakers and excludes any monolingual speakers from its sample.

Existing studies investigating the relationship between the degree of bilingualism and the level of cognitive ability conclude based on one cognitive task, such as the study of Pathak et al. (2022). While their study only considers The Stroop Task to measure the relationship between bilingual speakers and the development of cognitive ability, this study takes four cognitive tasks to have comprehensive generalization and examine different areas of cognitive development. The study of Rosselli et al. (2019) is only restricted to measuring executive functions regarding verbal and nonverbal ability. Although some studies utilized similar procedures, such as the threshold hypothesis and variables like SES and age, the current study is yet more comprehensive. For instance, Lin (2009) examined the relationship between bilingualism, the working memory test, and the grammatical judgment task. Meanwhile, Andreou's (2015) study investigated the level of bilingualism and its impact on verbal and nonverbal abilities. Nonetheless, the present study narrows the literature gap by examining the relationship between bilingualism and multiple cognitive abilities, including metalinguistic awareness, attentional control, working memory, and inhibition. By studying a more extensive range of variables, this study nourishes a more in-depth interpretation of the connection between bilingualism and cognitive development and how it involves different cognitive abilities.

Like the present study, et al. (2023) examine executive functions, including the bilinguals' metalinguistic awareness, problem-solving, and attentional control. However, their study needed to be more varied as it compares bilinguals and monolinguals without considering the level of bilinguals. While some studies, such as those by Ferjan and Kuhl (2017), Craik and Bialystok (2010), Kovács and Mehler (2009), Graf and Hay (2015), Parra et al. (2011), Conboy and Thal (2006), Hoff et al. (2012), Conboy and Mills (2006), Kuhl and Rivera-Gaxiola (2008), Eilers et al. (2006), and Paradis et al. (2007), Marian and Shook (2013) and Prior MacWhinney (2010), have conducted comprehensive examinations of executive functions, these studies were primarily conducted in Western countries. Our study, on the other hand, aims to provide a global perspective by examining the relationship between bilingualism and cognitive abilities in a broader context.

Scholars such as Alshahrani (2017), Elbedour et al. (2019), Alhuqbani (2016), Sharaan et al. (2021), and Bawalsah et al. (2019) have all investigated this topic, yet their studies are comparative between bilinguals' performance with monolinguals. Al Saud (2016) and Elbedour et al. (2019) on *The Impact of Bilingualism on the Creative Capabilities of Kindergarten Children in Riyadh, Saudi Arabia*. Furthermore, while Aldosari and Alsultan (2017) studied *The Influence of Early Bilingual Education (English) on the First Language (Arabic) Literacy Skills in the Second Grade of Elementary School in Saudi Arabia*, their work did not take into account the correlation with cognitive abilities. The current study, however, considers Arabic-English bilingualism and its impact on cognitive abilities, which sets it apart from previous studies.

The Threshold Hypothesis

This hypothesis is considered one of the most significant theories investigating the relationship between bilingualism and cognition. This hypothesis points out that the required competence level in two languages gains the cognitive advantages from bilingualism. According to Cummins, the consequences of bilingualism on cognitive growth can be affected by the level of proficiency attained in the two languages (Cummins 1976 in Cummins et al. 2009: p. 41). He proposes two threshold levels for bilingual competency and cognitive consequences. Thresholds are levels of language competency he/she has to achieve to obtain cognitive benefits from bilingualism.

Hoffman (2001: p. 89) offers another representation of a threshold hypothesis. The table illustrates three levels of bilingualism; each level represents the language proficiency levels and has a cognitive outcome (Baker, 2011). The first threshold level is the balanced bilinguals who have achieved competency in the two languages. Based on this hypothesis, those bilinguals will benefit from the cognitive advantages. The second threshold is the dominant bilinguals fully competent in the two languages. Hence, those bilinguals have improved their proficiency in one of the two languages, but their capability in the other still needs to be improved. This is why bilinguals at this level are unlikely to have cognitive advantages or disadvantages. The last threshold is the semi-bilinguals with limited or inadequate proficiency in the two languages. Bilinguals at this level may have negative cognitive consequences due to the inability to deal with either of the two 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

The methodology adopted in this study is designed to examine the consequences of bilingualism on cognitive development based on the threshold hypothesis (Cummins, 1979). Further, the adopted methodology helped point out whether English language proficiency is interrelated with Arabic language proficiency to describe the peculiar factors behind proficiency in L2. Therefore, the first step of the present methodology is to measure the Arabic and English language skills, including reading, writing, listening, and speaking, in addition to the cognitive level of 212 international Saudi school bilingual students.

This study is grounded in a robust quantitative causal-comparative design. As Charles (1998) asserts, this type of research is instrumental in clarifying and comparing the cause and effect between independent and dependent variables. In our case, we are examining how the two languages, Arabic and English, can potentially influence cognitive ability. This comprehensive approach ensures the validity and reliability of our findings. The threshold hypothesis (Cummins, 1979) examines whether the proficiency level of the Arabic/English Language contributes to cognitive development, including metalinguistic awareness, attention, cognitive flexibility, and memory. Cummins’s Classifications classify the most common type of bilingualism in international Saudi school bilingual students. The subjects of the study are not randomly selected. Therefore, each student should meet three criteria: First, the students must be in the secondary stages. Second, the subjects must be in the international school curriculum from their earliest educational life stages. Third, the Arabic language must be their mother-tongue language, regardless of their nationalities.

FINDINGS AND DISCUSSION

The Contributions of Level of Bilingual Proficiency Influences the Cognitive Level

This section presents the correlation between the level of bilingualism (balanced bilingual, dominant bilinguals, and semi-bilinguals) and the executive function skills (The grammatical judgment task, Stroop Task, Verbal Fluency Task, and Backward-digit-recall task).

Table 2. Cognitive Ability in Different Areas.

	Descriptive Statistics				
	N	Minimum	Maximum	Mean	Std. Deviation
Backwards-digit-recall task	212	1.00	9.00	4.7453	1.37728
Stroop Task	212	8.00	105.00	65.5330	16.90295
Semantic	212	0.00	22.00	12.6038	4.29963
Phonemic	212	0.00	30.00	13.0094	5.51258
Grammatically judgment task	212	6.00	120.00	88.7783	21.71253
Valid N (listwise)	212				

The grammatical judgment task is out of 120, and according to the above table, the highest point is 120, and the lowest is 6, while the mean value is 88.77, and std 21.714, which shows that students' results are varied and spread out. The phonemic task mean value is 13, while the highest is 30 and the lowest is 0. The std deviation is high (5.51), showing varied and spread-out results.

The semantic task mean value is (12.6), while the highest value is 22 and the lowest is 0. The std deviation value is (4.2.99), showing varied values. According to the results in the above table, the Stroop task mean value is 65.53, the highest value is 105, and the lowest is 8. The std deviation is 16.90, which shows varied values. The mean value of the last task of the Backward digit recall task is 4.74, while its highest value is nine and the lowest is 1. The std deviation is 1.3, showing close results. To better understand the performance of the students in such tasks, the level of performance is divided into three levels (low, medium, and high).

Bilingualism and Metalinguistic Skills

The first skill this study measured is syntactic awareness, which is evaluated by the grammaticality judgment (GJ) task. GJ requires distinguishing whether the sentence's linguistic form is written correctly. This task evaluates children's level of analysis and control in determining the correct sentence structure of everyday language use rather than its meaning (i.e., the primary object of focus in everyday language use). Participants need a high degree of control in ignoring the semantic error. In contrast, analysis requires figuring out the mistakes and correcting the syntactic and semantic errors. This task contains anomalous sentences that evoke participants to judge grammaticality and to quell the meaning (i.e., to ensure that only the sentences' structure is processed). The grammatical judgment task also measures metalinguistic awareness as it measures whether the participant can separate the structure of language from the meaning – the awareness of the arbitrariness of words.

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			Total
		Low	Med	High	
type of bilingualism	Balanced	22	45	63	130
	Dominant	20	27	15	62
	Semi-lingual	17	3	0	20
Total		59	75	78	212

In this particular task, the results showed that the semi-bilingual participants performed poorly, with only 1.4 % of participants achieving a medium score. Semi-bilingual individuals have some knowledge of a second language but are not fully proficient. On the other hand, the balanced bilingual participants, who are equally proficient in both languages, achieved an outstanding score of 50.9%, marking the highest performance in this task. Following the balanced bilingual group, the dominant bilinguals, who have a primary language but are proficient in a second language, scored 19.5%. These results suggest that the best performance was shown by the students of balanced bilingualism, followed by the dominant bilingual group and then the semi-bilinguals. Furthermore, the findings confirm the threshold hypothesis, which suggests that bilingual individuals who are proficient in Arabic and English, such as the balanced bilinguals in this study, tend to achieve a higher score, while those who do not meet the requirements of language mastery such as semi-bilinguals, show the lowest score. One justification for this result is that balanced bilingual children excel in metalinguistic tasks. They have remarkable skills in selecting the correct grammatical structure and identifying semantic errors. This superior proficiency is due to their constant adaptation to different language contexts. Additionally, they exhibit heightened awareness of the arbitrary nature of language and understand the conventional relationship between words and their designated meanings. These findings suggest a correlation between selective skills and bilingualism.

The balanced bilinguals in this study demonstrate a unique ability to correct erroneous sentences, a skill attributed to their linguistic and cognitive flexibility. Since the participants of this study are proficient in both Arabic and English (balanced bilinguals) and gain higher-level linguistic skills and cognitive flexibility, they can correct erroneous sentences. Such capability is due to their rapid interchange between the two languages, the comprehensive knowledge of the relationship between input and linguistic/metalinguistic development, and

their compass on formal instructions while disregarding meaning (Bialystok & Craik, 2022). Finally, the study's outcomes are similar to those of Abu Rabia and Fedar (2022), which indicate that balanced bilinguals gain metacognitive reading domains. However, due to the simplicity of the given task in the study conducted by Galambos and Goldin-Meadow (2014), bilingualism does not impact metalinguistic skills, as most participants scored more than 80%. It is worth noting that the study followed a different testing protocol, where children were asked to explain first and correct the sentence later. The task effect of bilingualism can be interpreted in two ways. One interpretation is that bilingual children may not possess superior linguistic ability but may be more proficient in utilizing their linguistic abilities to correct errors when prompted to explain.

Yu-Min Ku, Zhuo Chen, and Melike Ünal Gezer (2020) examined the connection between language development and literacy/metalinguistic skills in bilingual children. The study found that the higher the language skills, the more significant the linguistic and metalinguistic development. However, a more balanced bilingual experience resulted in better metalinguistic awareness. The research confirms the result of this study, as balanced bilingual children have an advantage in metalinguistic awareness and better skill mastery than dominant and semi-bilinguals

Bilingualism and Working Memory

In the realm of finding the correlation between bilingualism and working memory, the researcher utilizes the backward digit task. Thomas, Milner, and Haberlandt (2003) used the same task in the current study, and the participants showed an advantage in the task (backward span) but not in the forward task. Given that these tasks require highly controlled processing, They justify their conclusion by stating that bilinguals may be more effective in capturing the advantages of bilingualism in the working memory (WM) task that demands greater controlled processing, such as attentional control. Conversely, these benefits may disappear when the WM task demands less controlled processing. The table below illustrates the correlation between type of bilingualism and working memory tasks using 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	54	72	4	130
	Dominant	35	27	0	62
	Semi-lingual	16	4	0	20
Total		105	103	4	212

The working memory (WM) task results suggest that the group with semi-bilingualism skills performed inadequately, scoring only 9.4%. Conversely, the balanced and dominant bilingual groups performed better than the semi-bilinguals but failed to achieve the anticipated outcomes despite belonging to the first and second threshold levels. For instance, more than a quarter of the participants in the balanced bilingual group, which comprised 61.3% of the total, scored low marks. This result contrasts the threshold hypothesis, which suggests that balanced bilinguals will exhibit positive cognitive effects. Similarly, the dominant bilingual group, expected to exhibit neither positive nor negative mental effects, had over 16.5% of participants (29%) score low marks, which contradicts the threshold hypothesis. This aligns with Namazi and Thordardottir (2010), who failed to notice any bilingual benefits in either verbal or visual WM tasks among four- and five-year-old children. Likewise, Engel de Abreu (2011) tested six-year-old children and encountered no proof of bilingual distinction in the backward digit-span task, which was the same task used in the present study. Meanwhile, Bialystok and Feng (2009) concluded in their research that bilingual children did not master the forward digit-span and sequencing-span tasks. Lastly, Bonifacci et al. (2011) experimented with both children and youths. They discovered no bilingual advantages in working memory tasks that demanded participants to notice the target symbol in a series of digits that had appeared formerly.

Limited evidence supports that balanced bilingual individuals perform better than the other bilingual groups in working memory tasks. Moreover, they might even perform poorly (Bialystok, 2010; Barac et al., 2016). Ladas et al. (2015) suggest that the absence of significant results in some experimental tasks could be due to the

characteristics of the tasks. The wide variety of tests for assessing executive functions makes comparing results difficult. Paap et al. (2015) recommend including at least two tasks to evaluate the working memory to confirm results. Studies show that the bilingual effect only occurs when a complex task version is used. As a result, it is essential to determine whether this effect arises only when the task requires certain complexities. Barac et al.'s (2016) study found that bilinguals showed an advantage in more complex tasks, such as the flanker task and Go/No-Go task), while no differences were observed in the more manageable tasks. Conversely, in other studies that used the Corsi test, the bilingual effect only emerged when a more accessible version of the task was used.

Balanced bilinguals performed unexpectedly well in a task compared to dominant and semi-bilinguals. This is consistent with previous studies showing balanced bilinguals' ability to excel in verbal and visuospatial working memory tasks. Additionally, bilinguals' working memory benefits are only evident when there is a high demand for inhibition processing. Hence, balanced bilinguals achieved a higher score than other types of bilinguals in the backward digit task that requires high control demand of inhibition. This suggests that bilinguals' advantages are more evident in tasks requiring high processing demands. Bialystok et al. (2008) agree with the previous assumption, concluding that bilingual privilege is more salient in tasks requiring higher processing demands.

This result also agrees with Bialystok et al. (2014), who confirmed that the advantages for bilinguals appear in additionally demanding tasks because they involve highly demanding processing. Studies confirm that bilingualism positively contributes to working memory (WM). Being proficient in two languages can enhance WM speed and accuracy. Bilingual children perform better in WM tasks, particularly demanding ones like the Backward Digit Recall. Other studies have also confirmed that bilingualism improves WM. Meltzoff (2008), Engel De Abreu et al. (2012), and Calvo and Bialystok (2014) assure that bilingualism is accountable for improving WM.

In other words, the study found that different levels of bilingualism significantly affected controlled processing in WM. Balanced and dominant bilinguals outperformed semi-bilinguals. The study suggests that bilingualism provides an advantage in controlled processing, a vital element of WM and other executive functions. Therefore, attentional control in the WM experiment plays a vital role in mediating the outcomes of bilingualism in WM. Sampedro and Peña (2019) researched the correlation between bilingualism and working memory. Participants were grouped into low, medium, and high proficiency levels. The present study found that high and medium participants performed similarly and better than low participants in working memory tasks. Sampedro and Peña's study found that medium-level proficiency is associated with worse working memory performance. The present study confirms their threshold hypothesis, indicating that bilingualism contributes to better performance in executive functions such as working memory. The current study also highlights the difference in working memory task performance between high and medium-level participants compared to low-level participants. Meanwhile, Yang et al. (2016) categorized bilingual participants into dominant and balanced bilinguals based on English proficiency. They found that different levels of bilingual proficiency improved working memory, with no significant difference between dominant and balanced bilinguals except under a high memory load. These findings align with our current study. One reason for such a correlation is that bilingualism improves working memory (WM) tasks. Studies show bilingual children inhibit one language while using another, resulting in better WM performance. Bilinguals also have faster and more accurate WM responses. Bilingualism improves the ability to store and control information in WM and is a critical factor in cognitive development (Mehrani & Zabihi, 2017; Engel de Abreu 2002; Kane et al., 2001).

Half of the balanced (72 out of 130) and dominant bilinguals (27 out of 62) perform medially in the working memory task. However, these findings contradict the hypothesis put forward by Cummin, which suggests that balanced bilinguals exhibit superior cognitive abilities and dominant bilinguals will neither have positive nor negative cognitive development. Ongun (2018) provides a possible explanation for the results of this study by pointing out that differences in linguistic abilities between bilinguals might be absent once the groups have the same vocabulary size, and the low performance in working memory tasks might be due to the small vocabulary size. This means the current study's balanced and dominant bilinguals share a similar vocabulary size, leading to similar results in the working memory task. Moreover, Patra et al. (2020) justify why balanced and dominant

bilinguals might share the same outcomes in the same task as the current study because of the similar exposure period to the second language. Meanwhile, since the participants of the current study have equal exposure to the English language, they have similar performance in the English language, proving why two bilingual groups out of three have similar results in the WM task that can be summed up by two points: the first one is they have similar vocabulary level and secondly their similar exposure period to the second language. Similarly, Kudo and Swanson (2014) conducted a study on bilingual children to investigate the link between vocabulary and working memory (WM) performance. They used Baddeley's (1998) measures to measure WM and classified the children as balanced and additive bilinguals. The study found that vocabulary plays a significant role in EF tasks, such as the working memory task. Researchers suggest (e.g., Daneman and Carpenter 1980; Just and Carpenter 1992) studying advancements in WM once vocabulary mastery in both languages reaches a later developmental stage. This study aligns with the processing efficiency view of working memory, which suggests a trade-off regarding WM resources during language processing. Thus, young bilinguals may struggle with verbal working memory tests due to their lower vocabulary proficiency and delayed exposure to their second language. However, as they mature, bilingual individuals can experience linguistic advantages. These findings highlight the complex relationship between language and cognition in bilinguals, indicating that while balanced bilinguals may have an advantage over dominant bilinguals, linguistic abilities still play a crucial role in cognitive performance.

Another justification postulated by Soliman (2014) is that the distinct linguistic features of two languages explain why bilinguals achieve similar and low results in this task. Moreover, because both Arabic and English are not distinctively different when the two languages are similar, it is easier for the participants to transfer literacy skills, which results in reduced cognitive demand. Conversely, when two languages are distinct, executive function improves.

Bilingualism and Inhibitory Control

Bilingual speakers' frequent code-switching creates a strong relationship between inhibitory and executive control, measured by the Stroop task, and their linguistic skills. Faster response times and correct answers in the Stroop task indicate higher inhibitory and executive control capacities. Participants performed the task in two conditions - one with incongruent words and another with congruent words. Evaluation takes into account the reaction time (RT) and correct answers. Quick and accurate responses reflect better inhibitory and executive control capacities. Students with low scores are slower and make more mistakes when naming a printed word's ink color.

Table 5. The correlation between type of bilingualism and stroop level.

The correlation between type of bilingualism and Stroop level		Stoop level			Total
		Low	Med	High	
Type of bilingualism	Balanced	46	74	10	130
	Dominant	28	31	3	62
	Semi-Lingual	16	4	0	20
Total		90	109	13	212

The results of the Stroop task reveal exciting insights into the cognitive abilities of bilingual individuals. The semi-bilingual group performed inadequately, scoring only 7.5%, indicating their skills were not up to par. Meanwhile, the balanced and dominant bilingual groups performed better than the semi-bilinguals but were unable to achieve the anticipated outcomes despite belonging to the first and second threshold levels. In the balanced bilingual group, which comprised most participants (61.3%), more than 39.6 individuals scored between medium and high levels. However, the number of participants who scored high was only 5%, while 21.6% achieved low performance, a result that contradicts the threshold hypothesis, which suggests that balanced bilinguals will demonstrate positive cognitive effects. Similarly, the dominant bilingual group, expected to show neither positive nor negative effects on mental function, had more than 13.2% of participants (29%) score low marks. In comparison, more than 16% scored between high and medium levels. These findings suggest that the relationship between bilingualism and cognitive function is complex and requires further investigation.

Prior, Noa Goldwasser, Rotem Ravet-Hirsh, and Mila Schwarz found that balanced bilingualism may result in better executive function abilities than other types of bilingualism, especially in inhibition. In a similar study, Hernández et al. (2013) conducted a study on English-Mandarin bilinguals between 18 and 25 who completed four computerized executive function tasks, which showed that the age at which the second language was acquired positively influenced the interference cost in the Stroop task. Likewise, the mean score for the current task in this study was the highest (65.53), indicating that early exposure to a second language may be the reason for better performance. Moreover, the current study agrees with Blumenfeld and Marian's (2011) conclusions, which documented that bilingual children portrayed a better performance on tasks demanding inhibitory control. Mehrani and Zabihi (2017) justify this in their theoretical accounts, which propose that bilinguals undergo a unique 'command of attention' in daily life; this refers to their ability to focus on the relevant language and disregard labels from the language they are not using actively, a skill that is constantly exercised in their bilingual environment. This conclusion agrees with Vygotsky's hypothesis (1978), Green (1998), and Bialystok et al. (2004) on the role of bilingualism in self-control manners such as inhibition and attention. Prior et al. (2014) investigate the distinctions in executive functioning capabilities between balanced bilinguals, meaning equal proficiency in both languages and unbalanced bilinguals, meaning higher proficiency in one language. The study outcomes reveal that balanced bilingualism may be advantageous regarding cognitive capabilities, while unbalanced bilingualism may have some drawbacks. Therefore, this study and the findings of Prior, Goldwasser, Ravet-Hirsh, and Schwarz support the idea that bilingualism can provide advantages in several aspects of executive function, such as inhibition and shifting.

To delve further into this matter, Ghafouri and Rezaei (2023) conducted a study where the participants underwent a computerized version of the Stroop Color and Word Task to measure inhibition. The study's results are essential, indicating no significant correlation between bilingualism and cognitive control. This finding challenges the results of the present study. It suggests that other factors, such as intellectual, physical, and social activities, may play a pivotal role in the relationship between bilingualism and cognitive control. Unlike the current study, Kousaie and Phillips (2012) have asserted that earlier studies indicating a bilingual advantage have considered relevant variables such as socioeconomic status and language proficiency. They reveal that the bilingual advantage ceased to exist when the groups were matched for native/second language status and socioeconomic variables on a verbal inhibition task (the Stroop task). Their assumption proves why the current study participants show an advantage of being bilinguals in the Stroop Task. That is because of the homogeneity among the participants in terms of native/second language status and socioeconomic status. The novelty of the current study stems from the fact that dominant bilinguals who are not competent with two languages as much as the balanced bilinguals show an equal level of proficiency in the Stroop task that measures inhibitory control. Studies suggest that an unbalanced bilingual group may have an advantage in inhibitory control (Heidlmayr et al., 2014). Also, unbalanced bilinguals (dominant) performed well on the Stroop Colour Word Task and the Simon Task. It is commonly believed that children who learn a second language early have an advantage in inhibitory control, working memory, and task-switching (Bialystok et al., 2010). Therefore, recent research conducted by Sabourin and Vinerte (2015) and Ratiu and Azuma (2015) speculated that bilingual individuals have an advantage, stating that the optimal period of acquiring the second language has a more positive influence on cognitive ability. Likewise, the current study examined the age of the participants, taking into account the "critical period" for language learning. Most current study participants acquire a second language at the earliest stages of their lives, proving why most achieved high scores in this task.

Recently, Langley et al. (2022) conducted a study to investigate whether highly proficient Spanish-English late bilingual adults had an advantage in inhibition control. The study utilized the Victoria version of the Stroop Task to evaluate the participants' inhibitory control abilities and other measures to assess their second language proficiency levels. The findings revealed that bilingualism did not significantly correlate with the Stroop task performance. The study's implications, limitations, and recommended changes for future research, which may potentially demonstrate a bilingual advantage, are discussed. It is commonly believed that children who learn a second language early have an advantage in inhibitory control, working memory, and task-switching (Bialystok et al., 2010). Therefore, recent research conducted by Sabourin and Vinerte (2015) and Ratiu and Azuma (2015) speculated that bilingual individuals have an advantage, stating that the optimal period of acquiring the second

language has a more positive influence on cognitive ability. Likewise, the current study examined the age of the participants, taking into account the "critical period" for language learning. Most current study participants acquire a second language at the earliest stages of their lives, proving why most achieved high scores in this task.

The research on bilingualism and its impact on executive function has yielded mixed findings. The study suggests that only balanced bilingualism, where both languages are in intense competition with each other, may result in certain advantages in executive function. However, it is essential to note that further research is required to examine the language profiles of bilingual individuals. Clarifying these findings and providing a more comprehensive understanding of the relationship between bilingualism and executive function is crucial. While not definitively supporting one side of the debate, the study's results provide valuable insights.

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	
type of bilingualism	Balanced	40	74	16	130
	Dominant	30	27	5	62
	semi-lingual	17	3	0	20
Total		87	104	21	212

Verbal fluency is the ability to generate words and comprehend relationships between them semantically and phonemically. Bilingualism improves cognitive abilities, such as switching languages, which demands switching between languages and making connections between them. In this realm, this study primarily analyzes the impact of bilingualism on verbal fluency by examining the bilingual participants with two verbal fluency tasks, one semantic and one phonemic, each with a 60-second time limit. These tasks show the effect of the participants' bilingual experience on their linguistic processing and cognitive capabilities (Salmon et al., 1999). The study categorized participants into semi-bilingual, balanced bilingual, and dominant bilingual. The semi-bilingual group, consisting of individuals with some knowledge of a second language, performed poorly, with the vast majority scoring low. This suggests that their language skills were not adequate to perform well in the task. In contrast, the balanced and dominant bilingual groups performed better than the semi-bilingual groups. However, the balanced bilinguals confirmed the threshold hypothesis in this task since 69.2% out of 130 achieved scores between high and medium. On the other hand, a considerable percentage of balanced bilinguals scored low, with 30.7 out of 130. According to the threshold hypothesis, dominant bilinguals neither gain positive nor negative consequences. In this task, those at the low level performed just as well as those at the medium and high levels. Therefore, the theory does not support this hypothesis. Overall, the findings suggest that bilingualism can significantly impact cognitive abilities, and the level of proficiency in the second language plays a crucial role in determining performance.

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	63	63	4	130
	Dominant	46	16	0	62
	Semi-Lingual	19	1	0	20
Total		128	80	4	212

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

The results of the Stroop task reveal exciting insights into the cognitive abilities of bilingual individuals. The semi-bilingual group performed inadequately, scoring only 9.4%, indicating their skills were not up to par. Meanwhile, the balanced and dominant bilingual groups performed better than the semi-bilinguals but were unable to achieve the anticipated outcomes despite belonging to the first and second threshold levels. In the balanced bilingual group comprising most participants (51.5%), 130 individuals scored between medium and high levels. However, half of those participants scored low performance, which contradicts the threshold hypothesis and suggests that balanced bilinguals will demonstrate positive cognitive effects. Similarly, the dominant bilingual group, expected to show neither positive nor negative effects on mental function, had more than 75.2 % out of 62 score low marks. Moreover, only 25.8% scored between medium levels. These findings indicate that the relationship between bilingualism and cognitive function is intricate and necessitates further investigation.

The study thrives on investigating how participants performed in phonemic fluency (generating words starting with certain letters) and semantic fluency (generating words from specific categories). The outcomes of the present study show better performance in semantics than phonemics. The result aligns with Hazim Alkhrisheh (2019) and Friesen et al. (2016), who pointed out that phonetic tasks demand higher cognitive abilities than semantic tasks due to the non-alphabetical listing of lexical entries, making retrieval more challenging.

Another justification is proposed by Bennet and Verney (2019) and Gollan et al. (2002) along with Michael, who proposed that having more cognates, which are words that share similar sounds in two languages (e.g., 'flower' and 'flor'), can improve one's capacity to generate letters fluently. Studies have confirmed that cognates are more likely to be semantic than phonemic (Blumenfeld et al., 2016; Sadat et al., 2016). It has also been proposed that cognates can enhance lexical access (Sandoval et al., 2010), which is more likely to occur in languages with similar phonology (Sadat et al., 2016). These facts agree with the facts presented in the current study. For instance, the cognates between Arabic and English are high; therefore, the participants can perform good results in the semantic fluency test and even higher than phonemic (Blumenfeld et al., 2016; Sadat et al., 2016). Thus, it is evident that the choice of language used during testing plays a crucial role in determining the performance of bilingual individuals. This factor is an additional consideration when evaluating the linguistic abilities of bilinguals. Moreover, Escobar et al. (2018) and Friesen et al. (2016) also justify the previous results, stating that phonemic is less common in everyday speech production and requires different cognitive skills, including interference suppression and unusual retrieval strategies.

The current study compares balanced dominant and semi-bilinguals. The findings show that the level of bilingualism positively correlates with the task's linguistic and executive control domains. As a result, balanced bilinguals exhibited better fluency in cluster size and the number of correct answers. These results indicate that bilingualism improves executive control. However, the study found no significant distinction in working memory between balanced and dominant bilinguals. The study's outcome reveals that the type of executive function task is a determinant variable in the correlation between bilingualism and cognitive development. Therefore, any study in this realm must use various tasks to come up with accurate results (Paap et al., 2019).

The study's second finding reveals a considerable distinction between the semantic and phonemic tasks. This result goes in line with Gollan et al. (2007), Kormi-Nouri et al. (2015), and Friesen et al. (2016), who state that participants would generate fewer lexical items in phonemic tasks than in semantic tasks. Similarly, these findings were reported by Feisal Aziez, Hazim Alkhrisheh, Furqanul Aziez, and Maulana Mualim in 2020. Luo et al. (2010), Paap et al. (2019), Sandoval et al. (2010), and Shao et al. (2014) add that phonemic task requires great demands on executive control techniques. Semantic fluency accentuated great demands on linguistic skills. In order to accomplish phonemic fluency tasks, participants must devise techniques to inhibit the activation of related semantic words (e.g., Friesen et al., 2015; Luo et al., 2010).

In the current study, the students in the semantic fluency task are asked to retrieve words based on semantic category (here: fruit and vegetables), whereas, in the phonemic fluency task, students are asked to generate words that begin with the letter S. Most of the group (semi-bilingualism) performed poorly in the task, while the groups (Balanced and dominant) bilingualism had medium performance (better than semi-bilingualism). Based on the given data, the students are in the first threshold hypothesis, indicating that they mastered the two

languages but did not perform outstandingly in the two tasks. Therefore, the given data does not conform to the threshold hypothesis. This distinction between balanced and dominant bilinguals is crucial because it can help us understand the extent of the advantages of being bilingual. Thus, the threshold hypothesis, which suggests that bilingualism provides cognitive advantages only when individuals reach a certain level of proficiency in the second language, needs to consider the skills that differentiate between balanced and dominant bilinguals.

CONCLUSION

Bilingualism, a subject of considerable interest in cognitive investigation, is often studied for its potential advantages. In this respect, the threshold hypothesis (Cummins, 1983) suggests that the level of language mastery is crucial in determining the relationship between bilingualism and executive functions (MacSwan, 2000; Takakuwa 2000). While Vega and Fernández (2011) and Woumans et al. (2015) found proof to support Cummins' threshold hypothesis (1983), Arizmendi et al. (2018), Duñabeitia et al. (2014), Lehtonen et al. (2018) noted no differences in EF between bilinguals. These contradictory findings underscore the need for further research in this area.

The present study thrives on providing conclusive evidence to draw a definitive conclusion. Meanwhile, it uncovered that bilingualism might significantly impact executive functions, namely working memory, inhibitory control, metalinguistic skills, and lexical retrieval skills. The results show that bilingualism might not significantly impact executive functions at a certain level. This can be noticed from the equal level of EF between balanced bilinguals (master the two languages proficiently) and dominant bilinguals (master one language more than the other). In other words, the study found no significant difference between the performance of balanced and dominant bilinguals on most EF tasks. This might be due to challenges arising from various factors, such as participants' age, socioeconomic status, and experimental tasks (Paap et al., 2015). The mixed results found in studies about the bilingual effect in executive functions may be due to differences in the types of tasks used to assess such functions. It is important to note that good performance on one executive function task does not necessarily translate into good performance on other executive function tasks, and small changes in experiment format can affect the results. Furthermore, research suggests that bilingualism enhances performance in certain cognitive functions, and if these functions are associated with creativity, then bilingualism can potentially improve creative ability by enhancing cognitive functioning (Ghonsooly & Showqi, 2012; Kharkhurin, 2011). To shed more light on the bilingual effect, it is crucial to understand if it occurs only when the task demands a specific level of complexity or involves the coordination of multiple executive functions. The study by Barac et al. (2016) included tasks of varying difficulty levels, observing that bilinguals did not demonstrate any difference in the more straightforward task. Age, exposure, and frequency of use can identify high-quality bilinguals and verify their effects. Knowing the same languages does not mean individuals share the same bilingual experience. Contexts where languages are used impact proficiency levels (Antoniou, 2019).

Our research indicates that balanced bilinguals outperform the dominant and semi-bilinguals in the inhibitory control measure (with a smaller percentage stroop ratio). Both groups, however, perform similarly on the working memory measure (backward digit span). This finding is consistent with earlier studies suggesting an advantage in inhibitory control for bilingual participants (Bialystok et al., 2004; Emmorey et al., 2008).

To conclude, the study's findings support the threshold hypothesis, suggesting that bilingual individuals benefit from proficiency in both languages—however, some aspects of the hypothesis conflict with the results. The hypothesis proposes that only individuals with a balanced ability in both languages reap the cognitive benefits of bilingualism. The study found that dominant bilinguals performed similarly well in most tasks except for one. This finding implies that the cognitive advantages of bilingualism may not be exclusive to balanced bilinguals and that dominant bilinguals may also enjoy similar benefits. Meanwhile, individuals who speak more than one language are generally better at tasks that require executive control, which involves different cognitive functions, such as problem-solving, decision-making, and attentional control. However, this advantage is especially noticeable in tasks requiring inhibitory control, cognitive flexibility, and metalinguistic abilities, such

as switching between languages or understanding the nuances of language. However, being balanced bilingual provides an advantage in tasks requiring lexical retrieval skills, such as quickly recalling words from memory. This distinction between balanced and dominant bilinguals is crucial because it can help us understand the extent of this advantage.

Future studies on bilingualism in KSA international schools should include diverse SES variables and backgrounds and vary the duration and exposure to the second language for more accurate results.

دراسة في علم النفس اللغوي حول تأثير ثنائية اللغة على وظائف إدراكية محددة بناءً على فرضيات الحد الأدنى بين

طلاب المدارس الدولية السعودية

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هذه الدراسة تحقق فرضية الحد الأدنى في طلاب المدارس الدولية السعودية. بينما تم بحث هذه الفرضية بشكل واسع في الغرب، إلا أن تطبيقها في المناطق الناطقة بالعربية، خاصة في المملكة العربية السعودية، لم يتم استكشافه بعد. تقارن هذه الورقة بين الفروق في الوظائف التنفيذية (الوعي اللغوي، والتحكم التثبيطي، والتحكم التركيبي، والذاكرة العاملة) بين الثلاثة مستويات من اللغويين ثنائيي اللغة (متوازن، TOEFL سائد، ونصف) لدى طلاب المدارس الثانوية الذكور في المملكة العربية السعودية. شارك المشاركون في اختبارات اللغة وأربع مهام عقلية (مهمة تقييم قواعد اللغة، ومهمة ستروب، ومهمة التدفق الدلالي والصوتي، ومهمة GCSE للإنجليزية، والاستنكار الخلفي للأرقام). خلص التحليل الكمي التجريبي-المقارن إلى أنه لا يوجد فرق كبير بين أداء اللغويين ثنائيي اللغة متوازنين وسادة ونصف في المهام ذات الوظائف التنفيذية، باستثناء مهمة الصوتيات. ومع ذلك، أظهرت الدراسة أن اللغويين ثنائيي اللغة نصفيون قد قاموا بأداء سيئ في جميع المهام العقلية. وبالتالي، يؤدون اللغويين ثنائيي اللغة المتوازنون والسادة بنفس القدر في التحكم التثبيطي، والمرونة العقلية، والمهام اللغوية والدلالية.

الكلمات المفتاحية: ثنائية اللغة، الوظائف التنفيذية، طلاب المدارس الثانوية، المدرسة الدولية السعودية، فرضية الحد الأدنى

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