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Research Article

Cognitive Performance in the Dominant Language: A Comparison of Bilingual and Monolingual Adults on Executive and Lexical Tasks

Egemen Dilde Bilişsel Performans: Yürütücü işlevsel ve Sözcüksel Görevlerde İki Dilli ve Tek Dilli Yetişkinlerin Karşılaştırılması

Yavuz Kurt*

* Marmara University, English Language Teaching Department, İstanbul, Türkiye. E-mail: yavuz.kurt@marmara.edu.tr
Marmara Üniversitesi, İngiliz Dili Eğitimi Ana Bilim Dalı, İstanbul, Türkiye. E-posta: yavuz.kurt@marmara.edu.tr

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Abstract

Purpose: *This study examines the effects of bilingual experience and age of acquisition on executive control and lexical performance in the dominant language. A total of 23 adults participated, including early bilinguals (Kurdish/Arabic–Turkish), late bilinguals (Turkish–English), and Turkish monolinguals.* ***Method:*** *Participants completed a color-naming Stroop task to assess inhibitory control and a vocabulary task in Turkish to measure lexical retrieval.* ***Findings:*** *Non-parametric analyses revealed that early bilinguals significantly outperformed both late bilinguals and monolinguals in the incongruent condition of the Stroop task, indicating enhanced executive control. In contrast, no significant differences were found among the three groups in vocabulary performance in Turkish.* ***Conclusion:*** *These findings suggest that early and sustained bilingual exposure may confer advantages in executive functioning, whereas lexical performance in the dominant language appears less sensitive to bilingual experience under conditions of similar language exposure. The study highlights the critical role of age of acquisition and language exposure in shaping cognitive outcomes of bilingualism, while also underscoring the need for further research with larger samples and multiple measures.*

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Öz

***Amaç**: Bu çalışma, iki dillilik deneyiminin ve edinim yaşının baskın dilde yürütücü kontrol ve sözcüksel performans üzerindeki etkilerini incelemektedir. Çalışmaya erken iki dilliler (Kürtçe/Arapça–Türkçe), geç iki dilliler (Türkçe–İngilizce) ve Türkçe tek dillilerden oluşan toplam 23 yetişkin katılmıştır. **Yöntem**: Katılımcılar, ketleyici kontrolü değerlendirmek için renk adlandırma Stroop görevini ve sözcüksel erişimi ölçmek için Türkçe bir kelime bilgisi görevini tamamlamıştır. **Bulgular**: Parametrik olmayan analizler, erken iki dillilerin Stroop görevinin uyumsuz koşulunda hem geç iki dillilerden hem de tek dillilerden anlamlı düzeyde daha iyi performans gösterdiğini ortaya koymuş, bu da gelişmiş yürütücü kontrole işaret etmiştir. Buna karşılık, Türkçedeki kelime bilgisi performansı açısından üç grup arasında anlamlı bir fark bulunmamıştır. **Sonuç**: Bu bulgular, erken ve sürekli iki dillilik maruziyetinin yürütücü işlevlerde avantaj sağlayabileceğini, buna karşın benzer dil girdisi koşullarında baskın dildeki sözcüksel performansın iki dillilik deneyimine daha az duyarlı olduğunu göstermektedir. Çalışma, iki dilliliğin bilişsel sonuçlarının şekillenmesinde edinim yaşı ve dil girdisinin kritik rolünü vurgulamakta ve daha büyük örneklemlerle ve çoklu ölçüm araçlarıyla yapılacak ileri araştırmalara ihtiyaç olduğunu ortaya koymaktadır.*

Introduction

A considerable body of research has found that bilinguals' and monolinguals' performance on various executive function and language tasks differs. The executive function tasks employed in studies usually measure attention (Bialystok, 2011; Carlson & Meltzoff, 2008), inhibiting distractions (Bialystok et al., 2008a), and task switching (Bialystok, 1999). The general tendency in these studies has been that bilingual subjects usually outperform monolinguals when required to ignore false cues, handle multidimensional tasks, and switch between tasks (Giovannoli et al., 2023). Such cognitive advantages have been linked to different levels of multilingual experience (but see also Paap, Johnson, & Sawi, 2015). Bialystok (2007) suggests that when competing or distracting information is present, bilingual children can better manipulate their knowledge to complete a task. The reason, as explained by Bialystok based on the present view in the area, is "the experience of controlling attention to the relevant language system in the face of competition from the other language, which is simultaneously active but irrelevant to the current language task" (p. 215). Such experience nurtures those control functions and makes them available for non-linguistic uses as well.

The language tasks, on the other hand, usually compare the performance of bilinguals and monolinguals on lexical access tasks (Ivanova & Costa, 2008), grammatical judgment tasks (Davidson, Raschke, & Pervez, 2010), and semantic judgment tasks (Preverbio, Roberta, & Alberto, 2007). Cross-language influence has been observed in bilinguals at different levels in various tasks. For example, Van Heuven et al. (1998) suggest that target lexical items in one language can be influenced by orthographic neighbors in the other language of a bilingual person. Parallel activation of different

lexicons belonging to different languages (Bilingual Interaction Activation) can interfere with each other, resulting in delayed responses on vocabulary tasks (Van Heuven, Dijkstra, & Grainger, 1998). In the following part, specific studies regarding executive control benefits and lexical access limitations of bilingual experience are presented.

Literature review

In 2010, Adesope, Lavin, Thompson, and Ungerleider conducted a meta-analysis of 63 studies examining the cognitive consequences of bilingual experience. The researchers concluded that various cognitive outcomes, such as enhanced attentional control, working memory, and metalinguistic awareness, are associated with bilingualism. However, based on data from four groups of students at San Francisco State University who completed a set of executive processing tasks (e.g., Simon, flanker, and color-shape switching), Paap and Greenberg (2013) questioned whether bilingual experience leads to improved executive processing. They found no consistent cross-task correlation between bilingualism and executive processing advantages. The researchers further argued that studies relying on a single indicator of executive processing may not provide valid measures of domain-general abilities.

An aspect of executive processing related to resisting misleading cues was investigated by Bialystok and Codd (1997). In their study, children were shown two Lego towers: one contained fewer blocks but appeared taller because it used larger blocks. The children were then asked which tower could accommodate more families. Bilingual children significantly outperformed monolingual children, as they were less influenced by the misleading size cue. In a second study, the same researchers asked children to divide candies evenly between two dolls (Bialystok & Codd, 1997). After counting the candies placed in front of one doll, the children were asked to determine how many candies the other doll had. In this case, bilingual and monolingual children performed similarly. Since this task required only basic mathematical skills, unlike the previous task that required resisting a misleading cue, the researchers concluded that bilingual children tend to perform better on tasks that involve executive control.

Bialystok and Viswanathan (2009) employed three task conditions (Faces Task) originally developed by Bialystok et al. (2006) to target response suppression, inhibitory control, and cognitive flexibility. The participants were 90 eight-year-old children divided into three groups: monolinguals in Canada, bilinguals in Canada, and bilinguals in India. All bilingual children were educated in English while using another language at home, and their families confirmed exposure to both languages from birth. Both bilingual groups performed faster than monolinguals in tasks requiring inhibitory control and cognitive flexibility. However, no significant group differences were observed in the response suppression task or in the control condition that did not require executive control. Importantly, bilinguals in Canada and India performed similarly to each other but differently from monolinguals, suggesting that these findings generalize across cultures and languages. The researchers concluded that bilingualism enhances executive control.

Similar findings were reported by Bialystok et al. (2008a), who studied 96 younger (20) and older (68) bilinguals and monolinguals. Participants completed several tasks, including a color-naming Stroop task as a measure of executive control. The results revealed significantly better performance among both younger and older bilinguals compared to monolinguals, indicating that bilinguals handle incongruent stimuli more efficiently. Pelham and Abrams (2014) also found that both early bilinguals (exposed to Spanish and English before childhood) and late bilinguals (exposed after childhood) outperformed English monolinguals on the attentional network task. Their results further suggested that executive processing benefits and lexical access disadvantages were comparable across early and late bilinguals.

Carlson and Meltzoff (2008) investigated the bilingual advantage in tasks designed to tap executive functions. Their participants included Spanish-English early bilingual children, English monolingual children, and children enrolled in a trilingual immersion program (Spanish, Japanese, and English as L1). Using a comprehensive set of measures targeting attention and inhibition under conditions of distraction, the researchers found that native bilingual children significantly outperformed the other two groups. However, no significant difference was observed between second language learners and monolinguals.

Frenk-Mestre and Vaid (1993) demonstrated that bilinguals solved mathematical problems more quickly when presented as digits, but more slowly when the same problems were presented in their L1, and even more slowly in their L2. Similarly, Geary et al. (1993) showed that bilinguals were slower than monolinguals in solving complex mathematical problems, although both groups performed similarly when judging the correctness of solutions. These findings suggest that bilingual disadvantages in such tasks stem from language-related factors rather than deficits in mathematical ability (e.g., Cerda & Wicha, 2024).

Although bilinguals often outperform monolinguals in executive processing tasks, this advantage appears to diminish in linguistic tasks. Managing multiple languages has been shown to influence bilinguals' performance in each language, including vocabulary tasks. Research findings on lexical development are mixed. Some studies report similarities, while others indicate differences between bilingual and monolingual children. For example, bilingual children exhibit similar rates of vocabulary acquisition when both languages are considered (Patterson, 2004). Additionally, bilingual and monolingual infants reach major language milestones on a similar timetable to monolingual children (Byers-Heinlein & Lew-Williams, 2013). Although bilingual children may engage in code-mixing before the age of two due to lexical gaps, they can still demonstrate early knowledge of translation equivalents (Nicoladis & Secco, 2000).

Bialystok et al. (2008b) provided evidence that bilinguals outperform monolinguals when vocabulary tasks involve executive control. Using a letter fluency task that imposed high executive demands, the researchers found that the typical bilingual disadvantage disappeared among highly proficient bilinguals. Neuroimaging studies

further support the involvement of executive control in bilingual language processing. For example, Luk et al. (2011), in a meta-analysis of bilingual brain studies, reported that brain regions activated during bilingual language use overlap with those associated with executive functions. Similarly, Luk et al. (2010) showed that bilinguals not only rely more on executive control regions but also recruit additional neural areas during tasks such as the flanker task.

In contrast, when executive control demands are minimized, the pattern of results changes. Bialystok and Craik (2010) reported that early bilinguals often have smaller vocabulary sizes in each language compared to monolinguals. Pearson, Fernandez, and Oller (1993) found that although bilingual children may appear to have smaller vocabularies in each language, their combined vocabulary across both languages is comparable to that of monolingual children. Similarly, Ivanova and Costa (2007) demonstrated that monolinguals were faster than bilinguals at Picture-naming tasks in both dominant and non-dominant languages.

Allman (2005) also reported that bilingual preschool children show comparable receptive and productive vocabulary knowledge to monolinguals when both languages are assessed. However, when only one language is measured, bilinguals may appear disadvantaged. Bialystok et al. (2010), using the Peabody Picture Vocabulary Test III (PPVT III), found that bilingual children scored significantly lower than monolinguals in receptive vocabulary across all age groups.

Conflicting findings have also been reported in studies with younger children. De Houwer, Bornstein, and Putnick (2012) found that bilingual children had an advantage in overall lexical comprehension at 13 months when both languages were considered, but monolinguals outperformed bilinguals at 20 months when only one language was assessed. Young bilingual children may show advantages or disadvantages depending on whether one or both languages are considered (De Houwer, 2021).

The age of acquisition may play a crucial role in shaping bilingual cognitive outcomes. Ullman (2001) proposed that early and late-acquired languages rely on distinct neural systems, with early language processing linked to the basal ganglia and later language learning associated with the temporal lobe. These differences may reflect critical period effects and influence both lexical access and executive functioning.

Luk, De Sa, and Bialystok (2011) examined the relationship between age of acquisition and cognitive control, finding that early bilinguals outperformed both late bilinguals and monolinguals on a flanker task. In contrast, Linck, Hoshino, and Kroll (2008) also reported executive function advantages among late bilinguals. Pelham and Abrams (2014) found that while monolinguals were faster and more accurate in lexical retrieval tasks, there was no significant difference between early and late bilinguals.

Investigating executive processing and lexical production in the dominant language among monolinguals, late bilinguals, and early bilinguals can provide valuable insights into the effects of bilingual experience. Based on previous research, bilingualism is generally associated with executive function advantages and potential disadvantages in

lexical access. Accordingly, the present study addresses the following research questions based on the data from three different groups of speakers: 1- early bilinguals (Kurdish or Arabic and Turkish), 2- late bilinguals (L1 Turkish, L2 English), and 3- monolingual speakers of Turkish:

1. Are there significant differences between the three groups in terms of their performance on a color-naming Stroop task?
2. Are there significant differences between the three groups in terms of their performance on a vocabulary task in their L1?

Methodology

Participants

The participants were 23 adults aged between 20 and 37. The sampling was based on convenience. All had either completed an undergraduate degree or were in their final year of undergraduate study. In addition, all participants had been educated within the same educational system. They were divided into three groups.

The first group consisted of five early bilinguals. Four were born into Kurdish-speaking families and one into an Arabic-speaking family. Although they were raised in households where Kurdish or Arabic was spoken, all five individuals were exposed to both their home language and Turkish from early childhood. All participants in this group reported Turkish as their most dominant language, as they were raised in a predominantly Turkish monolingual society. While they also reported proficiency in Kurdish or Arabic, they indicated that their proficiency in Turkish was higher. In addition, all participants in this group had advanced English proficiency, which they had acquired as a foreign language in a school setting.

The second group consisted of 13 late bilinguals. This group was relatively homogeneous, as all participants were native speakers of Turkish who had learned English as a second language in school, beginning at the primary or secondary level. All were proficient users of English, having passed a university proficiency examination required for admission to their faculty, and were senior students in a department of English language teaching. Some participants in this group also had basic knowledge of a third language (French or Spanish).

The third group consisted of monolingual participants who were native Turkish speakers and had little or no exposure to other languages throughout their lives. They took compulsory language courses during primary and secondary levels, but they did not show interest in learning the language afterward. They completed Turkish-medium programs at university, and they did not take elective language courses.

Table 1: *Information About Participants*

Participants	N	Mean age	Mean years of education	L1	L2
Group 1	5	25	16.4	Kurdish/Arabic and Turkish	English
Group 2	13	21	15.4	Turkish	English
Group 3	5	26	15.6	Turkish	-

Tools and Procedures

All participants completed a Stroop task and a vocabulary task in Turkish. The Stroop task was an adaptation of the Turkish version developed by Karakaş and Başar (1993). The vocabulary task was part of the Turkish-adapted version of the Woodcock-Johnson III Test of Achievement (WJ III ACH) (Haznedar et al., forthcoming). The WJ III Tests are widely used internationally for assessing various abilities, including reading and oral language proficiency.

The adapted test is currently in beta. For the present study, three components related to reading vocabulary were employed to assess participants' lexical retrieval abilities:

1. Synonyms**:** Participants were asked to provide synonyms for the words presented verbally.

2. Antonyms**:** Participants were asked to provide antonyms for the words.

3. Analogies**:** Participants were asked to complete word analogies.

For all three vocabulary tasks, participants were instructed to respond within a few seconds; however, response time was not recorded. Items were presented in order of increasing difficulty. Typically, a starting point is suggested in these tasks based on participants' age, assuming that all preceding items have been answered correctly. In this study, however, all items in the three components were administered to ensure comprehensive assessment, given that the adapted version is still under development and may contain deficiencies.

The Stroop task included three conditions: reading color names printed in black ink, naming colors presented as large dots, and the Stroop condition, in which color names were printed in incongruent font colors. Completion time for each prompt set was recorded. Both the Stroop and vocabulary tasks were administered individually in a quiet room.

Limitations

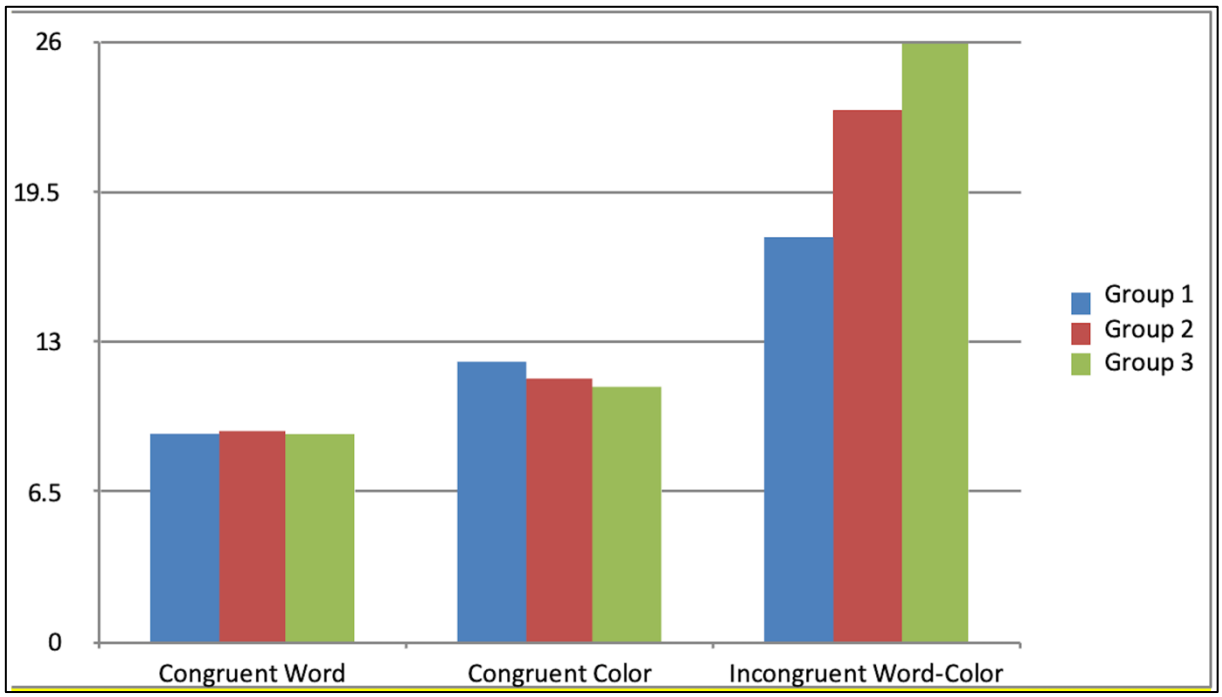
The current study was limited by a relatively small sample size per group and a limited number of measures, which may have affected the reliability of the results. Additionally, the small and uneven group sizes constrain the generalizability of the findings; therefore,

the study should be considered exploratory. Furthermore, because the Stroop task was the sole measure of executive functioning, any interpretations should be restricted to this specific task rather than generalized to executive control more broadly.

Findings

The participants' scores on each measure were analyzed using SPSS 20.0. When the number of subjects is below 30 and is not equal across groups, the Kruskal-Wallis Test is usually used to compare scores on a single measure or multiple measures. Therefore, a Kruskal-Wallis H Test was conducted to compare participants' reaction times across the three conditions of the Stroop Task. The mean reaction times across the three groups in the three conditions are presented in Figure 1 below.

Figure 1: *Mean Reaction Times of the Three Groups in Congruent and Incongruent Conditions*



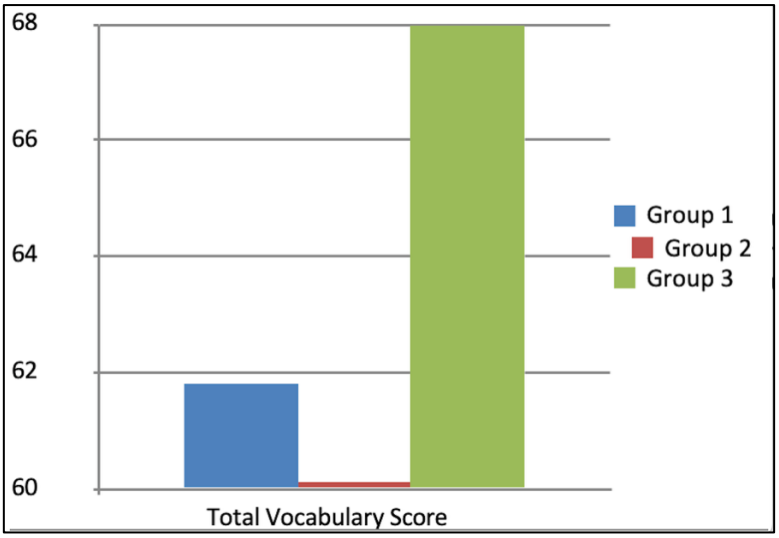
Note: Mean reaction times are reflected in seconds. Group 1 = early bilinguals, Group 2 = late bilinguals, Group 3 = monolinguals.

The test indicated that there was no significant difference among the three groups in the congruent word condition (H(2) = 0.023, p = 0.988), with mean reaction times of 12.20 for Group 1, 12.08 for Group 2, and 11.60 for Group 3. The difference between the three groups was not significant in the congruent color condition either, H(2) = 0.632, p = 0.729, with mean reaction times of 13.80 for Group 1, 11.92 for Group 2, and 10.40 for Group 3. The results showed that the three groups performed similarly in the first two control conditions, with similar reaction times to the prompts. However, there was a significant difference between the groups in the incongruent word-color condition H(2) = 8.739, p = 0.013, with a mean rank reaction time of 4.60 for Group 1, 13.0 for Group 2, and 16.80 for Group 3.

Since a significant difference was found between the groups in the third condition, a post hoc Mann-Whitney U test was conducted to make pairwise comparisons. The Bonferroni adjustment was used in order to control the risk of Type 1 error. The results indicated that the reaction time of Group 1 was significantly shorter than that of Group 2 (U = 8, p = .016) and Group 3 (U = 0, p = .009). However, there was not a significant difference between Group 2 and Group 3 (U = 21, p = .257). The U value of 0 in the comparison between Group 1 and Group 3 indicates that all the scores from sample 1 were smaller than those in the other sample.

The lexical retrieval performance of the three groups was compared based on their total vocabulary score, obtained by adding the scores from the three vocabulary measures: finding synonyms or antonyms and making analogies. The mean vocabulary raw scores are presented in Figure 2 below.

Figure 2: *Mean Raw Scores of the Groups on the Vocabulary Tasks*



Note: The maximum possible score is 87. The figure shows the mean raw scores, i.e., the total correct responses, for each group. Group 1 = early bilinguals, Group 2 = late bilinguals, Group 3 = monolinguals.

Because of the small and unequal sample sizes, a nonparametric test, the Kruskal-Wallis H test, was used to compare the groups. No significant difference was found between the three groups, H(2) = 2.443, p = 0.295, with a mean rank score of 13.20 for Group 1, 10.19 for Group 2, and 15.50 for Group 3. The results showed that the three groups performed similarly on the vocabulary measure with close total scores.

Discussion and Conclusion

In line with previous literature (Carlson & Meltzoff, 2008; Bialystok, 2011; Luk, De Sa, & Bialystok, 2011), the current study observed a significant difference between the early bilingual group and the monolingual group on the executive control measure, despite the small sample size. Similar results have also been reported by Bialystok et al. (2008a) with larger samples of younger and older adults. The enhanced performance of bilinguals in

executive processing tasks supports the view that exposure to multiple languages requires the bilingual mind to select between competing options while simultaneously inhibiting irrelevant ones (Bialystok, 2007). This continuous practice from an early age may strengthen executive functions and/or optimize neural mechanisms for dealing with distracting information, as observed in the early bilingual group in the present study.

However, the benefits of enhanced executive processing were not observed for late bilinguals, despite their high proficiency in English. The late bilinguals' performance on the executive control measure was similar to that of monolinguals, as reflected by larger Stroop effects for both groups compared to early bilinguals. These findings align with those of Luk, De Sa, and Bialystok (2011) but contrast with the findings of Linck, Hoshino, and Kroll (2008) and Pelham and Abrams (2014), who reported executive processing advantages for both early and late bilinguals. Several factors may explain why no difference was observed between late bilinguals and monolinguals in this study. First, the small sample size and the use of a single measure for executive processing may have limited the sensitivity of the findings. Paap and Greenberg (2013) have emphasized that relying on a single indicator of executive processing may not adequately capture domain-general cognitive abilities. Second, the Stroop task itself may be an overly simplistic measure of executive processing, as it primarily reflects saliency, automaticity, and parallel processing rather than the full spectrum of executive functions (Kroll & Bialystok, 2013).

Another factor may relate to the age of L2 acquisition in the early bilingual group. Similar to Carlson and Meltzoff (2008), this study suggests that early and intensive exposure to multiple languages may be necessary for executive processing benefits to emerge. The late bilinguals learned English later in life and had limited opportunities to use it outside the classroom. In contrast, the early bilingual group had extensive exposure to both their home language and Turkish from a young age. Moreover, the early bilinguals also had advanced proficiency in a third language (English), which may have further contributed to their superior performance. However, the cognitive advantages of managing three languages versus two have not been extensively studied.

In contrast to executive control, the current study did not find differences among groups in lexical retrieval performance in their dominant language. This finding contrasts with previous research that reported bilingual disadvantages in lexical access and vocabulary performance (Ivanova & Costa, 2007; Bialystok et al., 2010; Pelham & Abrams, 2014). One possible explanation is that all three groups were immersed in a Turkish-dominant environment from an early age, resulting in comparable exposure and practice in Turkish. Extensive exposure to the dominant language facilitated lexical retrieval for early bilinguals, bringing their performance in line with that of monolinguals. Additionally, the early bilinguals had limited opportunities to use their home languages, which likely reduced cross-language interference and supported their Turkish vocabulary performance. The slightly higher mean scores of monolinguals on the vocabulary task suggest a minor advantage, although this difference was not statistically significant. A

more comprehensive measure incorporating the participants' home languages could provide a fuller picture of their total lexical knowledge.

The findings of this study have several important implications for language teaching and learning. First, early exposure to multiple languages appears to enhance executive functions (Bialystok, 2015), which are essential for attention control, task switching, and cognitive flexibility. This suggests that integrating second language instruction from an early age could benefit broader cognitive development beyond language proficiency (Crivello et al., 2016). Second, since lexical performance in the dominant language was comparable across groups, educators should recognize that bilingual students may not necessarily lag in vocabulary acquisition when they receive adequate exposure to each language. Third, awareness of the interplay between language exposure, age of acquisition, and cognitive outcomes can inform curriculum design and individualized instruction, particularly in multilingual classrooms (Diaz, 2025). Finally, assessment of bilingual learners should consider their total language experience rather than evaluating performance in a single language, as this provides a more accurate picture of their linguistic competence and cognitive abilities. Overall, these insights underscore the value of early and sustained bilingual education in both cognitive and linguistic domains.

Ethical Approval

This research was conducted with the permission of the Marmara University Institute of Educational Sciences Research and Publication Ethics Committee decision dated 04/08/2025 and numbered 08-21. Participants were informed about the research and informed consent was obtained.

Author Contributions

Yavuz Kurt: Conceptualisation, Theoretical Background, Methodology, Data Analysis, Data Visualisation, Writing, Review and Editing, Funding Acquisition

Conflict of Interest

None.

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The article was reviewed using the relevant tools and met the BUEFAD similarity standards.

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