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The Relationship Between Bilingualism and Attention, Inhibition, Cognitive Flexibility, and Working Memory: A Systematic Review

İki Dillilik ile Dikkat, Ketleme, Bilişsel Esneklik ve Çalışma Belleği Arasındaki İlişki: Sistematik Bir İnceleme

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ABSTRACT

The aim of this study is to systematically examine the relationship between bilingualism and attention, inhibitory control, cognitive flexibility, and working memory. Accordingly, studies investigating the relationship between bilingualism and attention, inhibitory control, cognitive flexibility, and working memory were reviewed. The systematic review was conducted in accordance with the PRISMA guidelines. English-language studies published between 2006 and 2025 were identified through searches of the PubMed, PsycARTICLES, and ScienceDirect databases. Based on the inclusion and exclusion criteria, a total of 31 quantitative studies were included in the review. Most studies were conducted with infant and child samples, whereas a limited number involved adults and older individuals.

The findings indicate that the bilingual advantage is particularly evident in selective attention, attention-based inhibition, and cognitive flexibility. Bilingual individuals were found to demonstrate superior performance in suppressing distracting stimuli and switching between tasks. In contrast, findings related to response inhibition and simple working memory tasks were more inconsistent. In the domain of working memory, the bilingual advantage was found to emerge particularly in complex tasks requiring high levels of executive control. Furthermore, some studies suggested that early exposure to a second language and frequent active language switching may strengthen cognitive advantages.

In conclusion, the findings suggest that bilingualism does not confer a generalized superiority across all cognitive functions; rather, it appears to support specific executive function processes. To achieve a more comprehensive understanding of the cognitive effects of bilingualism, future studies are encouraged to examine variables such as age of language acquisition, language proficiency, frequency of language use, and language-switching experience in greater detail.

Keywords: Bilingualism, Executive Functions, Attention, Inhibition, Cognitive Flexibility, Working Memory

ÖZET

Bu çalışmanın amacı iki dillilik ile dikkat, ketleme, bilişsel esneklik ve çalışma belleği arasındaki ilişkiyi sistematik olarak incelemektir. Bu doğrultuda dikkat, inhibisyon kontrolü, bilişsel esneklik ve çalışma belleği ile iki dillilik arasındaki ilişkiyi ele alan çalışmalar değerlendirilmiştir. Sistematik derleme, PRISMA kriterlerine uygun olarak yürütülmüştür. PubMed, PsycARTICLES ve ScienceDirect veri tabanlarında 2006–2025 yılları arasında yayımlanan İngilizce çalışmalar taranmıştır. Dâhil edilme ve dışlama kriterleri doğrultusunda toplam 31 nicel çalışma incelemeye alınmıştır. Çalışmaların büyük bölümü bebek ve çocuk örneklemleriyle yürütülmüş, sınırlı sayıda çalışma yetişkin ve yaşlı bireyleri kapsamıştır.

Bulgular, iki dillilik avantajının özellikle seçici dikkat, dikkat temelli ketleme ve bilişsel esneklik alanlarında daha belirgin olduğunu göstermektedir. İki dilli bireylerin, dikkat dağıtıcı uyaranları baskılama ve görevler arasında geçiş yapma becerilerinde daha yüksek performans sergiledikleri görülmüştür. Buna karşın, tepki ketleme ve basit çalışma belleği görevlerinde bulguların daha tutarsız olduğu belirlenmiştir. Çalışma belleği alanında iki dillilik avantajının özellikle yüksek yürütücü kontrol gerektiren karmaşık görevlerde ortaya çıktığı bulunmuştur. Ayrıca bazı çalışmalar, erken yaşta ikinci dile maruz kalmanın ve aktif dil değiştirme sıklığının bilişsel avantajları güçlendirebileceğini göstermiştir.

Sonuç olarak, elde edilen bulgular iki dilliliğin tüm bilişsel işlevlerde genel bir üstünlük sağlamadığını, ancak belirli yürütücü işlev süreçlerini destekleyebildiğini göstermektedir. İki dilliliğin bilişsel etkilerinin daha iyi anlaşılabilmesi için gelecekteki çalışmalarda dil edinim yaşı, dil yeterliliği, dil kullanım sıklığı ve dil değiştirme deneyimi gibi değişkenlerin ayrıntılı biçimde incelenmesi önerilmektedir.

Anahtar Kelimeler: İki Dillilik, Yürütücü İşlevler, Dikkat, Ketleme, Bilişsel Esneklik, Çalışma Belleği

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INTRODUCTION

The literature offers various definitions of bilingualism. Some scholars define bilingualism as the ability to speak two languages with native-like proficiency and equal fluency (Bialystok, 2001; Bloomfield, 1933; Peal & Lambert, 1962). In contrast, Grosjean (1997) conceptualized bilingualism as the ability to communicate in two or more languages, regardless of whether individuals possess equivalent levels of proficiency in each language. According to this perspective, individuals who are not equally fluent in both languages may still be considered bilingual.

Bilingualism is commonly classified according to language proficiency, language balance, age of acquisition, and order of acquisition (Cummins, 1979). Based on age and order of acquisition, bilingualism can be categorized as simultaneous, sequential early, and sequential late bilingualism. Individuals exposed to two languages from birth are referred to as simultaneous bilinguals. Those who acquire a second language after establishing their first language but before the age of six are classified as sequential early bilinguals, whereas individuals who learn a second language after the age of six are considered sequential late bilinguals (Cummins, 1979; Tao et al., 2015). These different forms of bilingual experience may influence the cognitive and linguistic outcomes associated with bilingualism (Bialystok et al., 2009).

Individuals become bilingual for a variety of reasons. Some acquire two languages simultaneously by growing up in multilingual environments, whereas others learn a second language later in life due to migration, education, travel, or personal interest (Bialystok et al., 2009). It is estimated that more than half of the world's population is bilingual and that approximately two-thirds of children are raised in bilingual environments (Grosjean, 2010). Similarly, in Türkiye, cultural diversity and migration patterns contribute to increasing linguistic diversity. According to Ethnologue data, 45 languages other than Turkish were spoken in Türkiye as of 2026.

Given the widespread prevalence of bilingualism, its effects on cognitive processes have been extensively investigated in cognitive and developmental psychology. Early theorists such as Vygotsky emphasized the critical role of language in cognitive development. According to Vygotsky (1978), language plays a central role in the development of impulse control, inhibition, and planning abilities. This perspective supports the notion that bilingualism may positively contribute to cognitive development. In contrast, studies conducted prior to the 1960s suggested that bilingualism produced cognitive confusion and negatively affected children's language abilities and verbal intelligence (Goodenough, 1926; Jones & Stewart, 1951; Pintner, 1932; Saer, 1923). However, Peal and Lambert (1962) argued that these studies suffered from significant methodological limitations. Their findings demonstrated that when variables such as socioeconomic status, age, gender, language proficiency, and language experience were controlled, bilingual children outperformed monolingual children on both verbal and nonverbal intelligence measures. The replication of similar findings in subsequent research contributed to the emergence of the bilingual advantage hypothesis.

According to the bilingual advantage hypothesis, knowledge of more than one language enhances cognitive processes such as attention, cognitive flexibility, and executive control. Continuous language switching and the inhibition of the non-target language are thought to strengthen the ability to suppress distracting stimuli and shift efficiently between tasks (Bialystok et al., 2012). Consequently, recent research has increasingly focused on the relationship between bilingualism and executive functions. Several studies have reported that bilingual children outperform their monolingual peers on executive function tasks (Adesope et al., 2010; Arizmendi et al., 2018; Bialystok, 2007, 2017; Bialystok & Viswanathan, 2009). In contrast, other studies have found no significant effects of bilingualism on executive functioning (Anton et al., 2014; Duñabeitia et al., 2014; Nichols et al., 2020; Paap & Greenberg, 2013; Valian, 2015). Likewise, some meta-analyses have failed to provide sufficient evidence supporting the bilingual advantage hypothesis (Lehtonen et al., 2018; Lowe et al., 2021).

Executive functions refer to higher-order cognitive processes responsible for regulating thoughts and behaviors (Diamond, 2013). These functions comprise three core components: inhibitory control, cognitive flexibility, and working memory (Diamond, 2013; Miyake et al., 2000). Inhibitory control involves selectively attending to relevant information, maintaining attention, and suppressing distracting stimuli (Miyake et al., 2000). During language use, bilingual individuals continuously select the target language while inhibiting the non-target language, a process that may enhance selective attention abilities (Bialystok, 2001; Bialystok & Majumder, 1998). Cognitive flexibility refers to the ability to adapt and switch between tasks in response to changing environmental demands (Diamond, 2013). Bialystok (2011) argued that the regular practice of switching between languages may support the development of cognitive flexibility. Consistent with this view, several studies have reported evidence of a bilingual advantage, particularly in inhibitory control and cognitive flexibility (Bialystok et al., 2009; Costa et al., 2008; Green & Abutalebi, 2013; Mehrani & Zabihi, 2017).

Working memory refers to the capacity to temporarily store and manipulate information. Although differences between bilinguals and monolinguals are generally not observed in simple working memory tasks, bilingual individuals have been reported to perform better on more complex and attentionally demanding tasks (Baddeley, 2003). While some studies suggest that bilinguals possess greater working memory capacity (Lehtonen et al., 2018; Soliman, 2014), others have reported no significant differences between bilingual and monolingual groups (Bonifacci et al., 2011; Ratiu & Azuma, 2015).

The present systematic review aims to clarify the ongoing debate regarding the potential effects of bilingualism on executive functions. Specifically, the review synthesizes findings from studies examining the relationships between bilingualism and four executive function domains: attention, inhibitory control, cognitive flexibility, and working memory.

This systematic review is significant in that it provides a comprehensive evaluation of the relationship between bilingualism and executive functions within the framework of four core executive function domains: attention, inhibitory control, cognitive flexibility, and working memory. By synthesizing findings from studies encompassing diverse age groups, different bilingual experiences, and various measures of executive functioning, the review offers a comprehensive overview of the existing evidence. In doing so, it identifies the executive function domains in which bilingualism appears to confer more consistent advantages, as well as those in which the findings remain mixed or inconclusive. Furthermore, the limited number of systematic reviews examining the relationship between bilingualism and executive functions in Turkey further underscores the importance of the present study. By consolidating current evidence on the cognitive outcomes of bilingualism, this research is expected to serve as a valuable resource for researchers, educators, and practitioners.

METHOD

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). PRISMA is a guideline designed to assist authors in reporting systematic reviews. The process of including articles in the systematic review was presented using PRISMA's four-phase flow diagram.

Research Strategies

To identify articles published in international peer-reviewed journals, the databases PubMed, PsycARTICLES, and ScienceDirect were searched. The searches were conducted using the keywords "bilingualism," "executive function," "attention," "inhibition," "cognitive flexibility," and "working memory." The review was limited to English-language academic studies published between 2006 and 2025. In addition, the reference lists of the selected studies were also examined.

Inclusion and Exclusion Criteria

The following eligibility criteria were established for the systematic review:

(a) studies published in English,

(b) availability of full-text access,

(c) samples consisting of healthy individuals,

(d) quantitative research design,

(e) inclusion of at least one bilingual group and one monolingual group and

(f) assessment of at least one executive function.

The exclusion criteria were determined as follows:

(a) studies published before 2006,

(b) case reports, qualitative studies, reviews, and meta-analyses and

(c) inclusion of trilingual or multilingual groups.

Data Collection

From the studies included in the systematic review, the following information was extracted: author information, year of publication, the number of bilingual and monolingual participants, languages spoken, participants' age range, methods and tasks used, cognitive domains examined, and main findings.

RESULTS

Selection of Studies

The flow diagram of the systematic review process is presented in Figure 1. A total of 2,024 studies were identified through searches conducted across three databases, and two additional studies were identified through reference list screening. After duplicate studies were removed, titles and abstracts were screened, and 148 studies meeting the inclusion criteria were evaluated in detail. As a result, 31 studies that met the inclusion and exclusion criteria were included in the systematic review.

Characteristics of the Selected Studies

The characteristics of the 31 studies included in the review are presented in Table 1. The studies were published between 2006 and 2025, and all employed quantitative research designs. Three of the studies used a longitudinal design (Castillo et al., 2022; Chamorro et al., 2025; Crivello et al., 2016), whereas the remaining studies were conducted using cross-sectional designs. Most of the samples consisted of infants and children, while six studies involved adults and two studies focused on older adults. All studies included one monolingual group and at least one bilingual group.

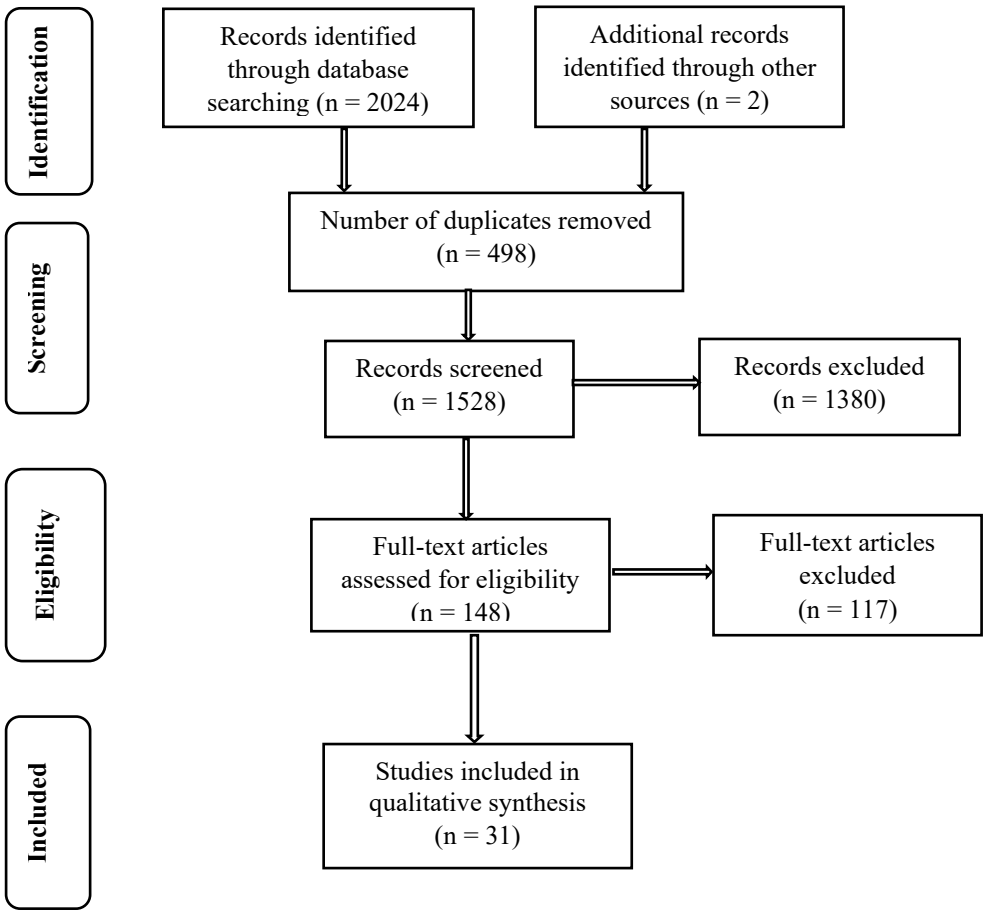

Figure 1: Flow Diagram of the Study Selection Process
Source: Adapted by the author based on the PRISMA flow diagram by Moher et al.

Table 1: Characteristics and Findings of the Studies

Author(S)	Year	Participants	Age Range	Method / Task	Cognitive Domain Examined	Main Findings
1. Ellen Bialystok	2006	62 Monolingual (English) 62 Bilingual (English+Another Language)	6-7 years	Simon Task	Inhibition	Bilingual children responded both faster and more accurately under incongruent conditions. Bilingualism provided an advantage in inhibitory control.
2. Stephanie M. Carlson & Andrew N. Meltzoff	2008	17 Monolingual (English) 12 Bilingual (Spanish+English) 21 Immersion Group (English+Spanish [13] / Japanese [8])	4-7 years	Attention Network Task Simon Task Statue Task Dimensional Change Card Sort (DCCS) Visually Cued Recall Task Delay of Gratification Task Gift DelayTask	Attention Inhibition Cognitive Flexibility Working Memory	Bilingual children demonstrated significantly higher performance in inhibition, attentional control, cognitive flexibility, and working memory tasks compared to both other groups.
3. Albert Costa et al.	2008	60 Monolinguals (Spanish) 60 Bilinguals (Spanish + Catalan)	18-35 years	Attention Network Test	Attention Control	Measurements across the three attentional networks (alerting, orienting, and executive control) revealed that bilingual adults performed the tasks more rapidly and demonstrated greater efficiency in the alerting and executive control networks. The findings suggest that bilingualism contributes positively to the development of attentional abilities in young adults.
4. Agnes Kovács & Jacques Mehler	2009	20 Monolingual (Italian) 20 Bilingual (Italian+Another Language)	7 months	Switch Task (Eye-tracking)	Cognitive Flexibility	Bilingual infants adapted more rapidly to task switching. The study demonstrated that cognitive flexibility may be influenced by bilingualism from an early age. The findings provide evidence that simultaneous exposure to two languages at a very early age confers cognitive advantages.
5. Diane Poulin-Dubois et al.	2011	30 Monolingual (12 French-speaking + 18 English-speaking) 33 Bilingual (French + English speakers)	2 years	Multilocation Task Shape Stroop Task Reverse Categorization Task Snack Delay Task Gift Delay Task	Inhibition Attention Control Cognitive Flexibility	The bilingual advantage was observed only in the Stroop task. Bilingual children performed significantly better than monolingual children on the Stroop task. No significant differences were found between the groups on the other tasks.
6. Ellen Bialystok	2011	32 Monolingual (English) 31 Bilingual (English + Another Language)"	8 years	Dual-Modality Classification Task (DMCT)	Inhibition Cognitive Flexibility Working Memory	No significant differences were found between monolingual and bilingual children under the single-task condition. However, under the dual-task condition, particularly in visual tasks, bilingual children demonstrated both higher accuracy and superior performance. The findings suggest that bilingual children have developed enhanced abilities to coordinate the executive function components required for performing complex tasks.

7. Pascale M J Engel de Abreu et al.	2012	40 Monolingual (Portuguese-speaking) 40 Bilingual (Portuguese+ Luxembourgish-speaking	8 years	Dot Matrix Odd-One-Out Test of Everyday Attention for Children Flanker Task	Working Memory Attention Control	No significant differences were found between bilingual and monolingual children in visuospatial working memory performance. However, in the Flanker task, bilingual children demonstrated better attentional control despite the presence of distracting stimuli.
8. Julia Morales et al.	2013	63 Monolingual 62 Bilingual	5-7 years	Frogs Matrices Task (FMT)	Working Memory	Bilinguals performed more successfully on demanding working memory tasks. Five-year-old bilingual children demonstrated performance comparable to that of seven-year-old monolingual children on easier tasks.
9. Ellen Bialystok et al.	2014	**Study 1** 27 Young Adult Monolingual (English) 44 Young Adult Bilingual (English + Another Language) 25 Older Adult Monolingual (English) 34 Older Adult Bilingual (English + Another Language	20 years 67-71 years	Stroop Task	Attention Inhibition	Both younger and older bilingual individuals demonstrated superior performance on tasks requiring attentional control and inhibition. However, the effect was more pronounced among older adults. This finding supports the view that bilingualism may contribute to cognitive reserve against cognitive aging.
		Study 2 36 Young Adult Monolingual (English) 36 Young Adult Bilingual (English + Another Language) 18 Older Adult Monolingual (English) 18 Older Adult Bilingual (English + Another Language)	20-21 years 69-72 years	The Recent Probes Tasks ✓ Letter Task ✓ Figure Task	Working Memory	The findings provide evidence of a bilingual advantage in older participants on the nonverbal design fluency task. Bilingualism appears to exert greater effects on complex tasks in older adults compared to younger adults.
10. Elma Blom et al.	2014	52 Monolingual (Dutch) 68 Bilingual (Turkish + Dutch)	5-6 years	Dot Matrix Odd-One-Out Forward Digit Recall Backward Digit Recall	Visuospatial Working Memory, Verbal Working Memory	Bilingual children demonstrated superior performance, particularly on complex working memory tasks. However, no significant differences were found between monolingual and bilingual children on simple storage tasks.
11. Alejandra Calvo & Ellen Bialystok	2014	66 Monolingual 109 Bilingual	6-7 years	Woodcock Johnson Tests of Cognitive Abilities-III, Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV), Flanker Task, Frogs Matrices Task (FMT)	Nonverbal Visual Attention, Verbal Visual Attention, Inhibition, Working Memory	When vocabulary knowledge was controlled for, no significant differences were found between the language groups in verbal and nonverbal attentional performance. In the Flanker task, bilinguals were found to be more successful in cognitive control and inhibition tasks. In working memory tasks, bilinguals demonstrated superior

						performance on tasks requiring high levels of cognitive control.
12. Cristina Crivello et al.	2016	43 Monolingual (English) 39 Bilingual (English + French)	24 months 31 months	Executive Function Tasks ✓ Conflict Tasks ✓ Reverse Categorization Task ✓ Shape Stroop Task ✓ Gift Delay Task ✓ Multilocation Task	Inhibition Cognitive Flexibility Working Memory	In the longitudinal study, children were assessed at 24 and 31 months of age. The findings indicate that the bilingual advantage increased with age. Bilingual children outperformed monolinguals in tasks measuring cognitive flexibility and attentional inhibition. However, no significant differences were found in response inhibition tasks. This suggests that bilingualism does not confer advantages across all types of inhibition. Additionally, no advantage was observed in working memory tasks.
13. Melody Wiseheart et al.	2016	37 Monolingual 31 Bilingual	19 years	The Task-Switching Paradigm	Cognitive Flexibility	It was observed that bilinguals demonstrated faster response times, higher accuracy rates, and less performance decline during task-switching activities. Bilinguals were found to exhibit superior performance particularly in attentional control, task switching, and cognitive adaptability skills.
14. Mehdi B. Mehrani & Reza Zabihi	2017	31 Monolingual (Persian) 36 Bilingual (Persian + Turkish)	4-5 years	Dimensional Change Card Sort (DCCS) Simon Tasks Digit Recall Tasks ✓ Forward Digit Recall ✓ Backward Digit Recall	Cognitive Flexibility Inhibition Working Memory	Bilingual children demonstrated superior performance in both cognitive flexibility and inhibitory control tasks. In contrast, no significant differences were found between the two groups in working memory tasks.
15. Josephine Ross & Alissa Melinger	2017	**Study 1** 45 Monolingual 54 Bilingual 48 Monolingual / Bidialectal Individuals	6-9 years	Simon Task Flanker Task	Inhibition Cognitive Flexibility	In the Simon task, bilinguals were found to make fewer errors than both monolingual and bidialectal children. However, no bilingual advantage was observed in response times on either the Simon or Flanker tasks.
		Study 2 21 Monolingual 49 Bilingual 20 Monolingual / Bidialectal Individuals	6-9 years	Berg Card Sorting Task (BCST)	Cognitive Flexibility	No evidence was found that bilingual or bidialectal individuals have an advantage over monolingual individuals in cognitive flexibility.
16. Genesis D. Arizmendi et al.	2018	167 Monolingual (English) 80 Bilingual (Spanish + English)	7-9 years	Two Stroop Tasks ✓ Classic Stroop Task ✓ Stroop Cross-Modal Task Stop-Signal Task Pirate Sorting Task Global Local Task Number Updating Task N-Back Auditory Task N-Back Visual Task	Inhibition Cognitive Flexibility Working Memory	No significant differences were found between monolingual and bilingual children on any of the executive function tasks. The bilingual advantage hypothesis was not supported.

17. Karolina M. Lukasik et al.	2018	220 Monolingual 115 Early Bilingual 150 Late Bilingual	32-35 years	Visuospatial WM Tasks Verbal WM Tasks N-Back Tasks	Visuospatial Working Memory, Verbal Working Memory	No significant differences were found between the groups in verbal working memory performance. The highest performance in visuospatial working memory and the N-back task was observed among late bilinguals; however, a significant group difference was found only for N-back performance. Overall, insufficient evidence was found to support the bilingual advantage hypothesis.
18. Ashley Chung-Fat-Yim et al.	2019	33 Monolingual 32 Bilingual	15-16 years	Flanker Task	Inhibition Attention Control	Bilingual participants responded more quickly under incongruent conditions; however, this difference was not significant under congruent conditions. In complex tasks, the effect of language group was found to be marginally significant. Overall, the bilingual advantage was found to be weak and inconsistent.
19. Ahmed Benaissa & Mohammed Boudouh	2020	50 Monolingual (Arabic) 50 Bilingual (Arabic + French)	8-11 years	Digit Span Tasks Rey Complex Figure Test Sub-test Visual Attention The Wisconsin Card Sorting Test (WCST)	Working Memory Attention Inhibition Cognitive Flexibility	The findings demonstrated that bilingual children performed significantly better than monolingual children on tasks measuring working memory, attention, inhibition, and cognitive flexibility. The study provides evidence supporting the bilingual advantage.
20. Cristina-Anca Barbu et al.	2020	28 Monolingual (French) 30 Bilingual (HFLS) (German + French) 21 Bilingual (LFLS) (German + French)	18-44 years	Test of Attentional Performance Battery (TAP) ✓ Go/No-Go Subtest of theTAP ✓ Cognitive Flexibility Subtest of the TAP	Inhibition Cognitive Flexibility	High Frequency Language Switchers (HFLS) demonstrated superior cognitive flexibility performance compared to Low Frequency Language Switchers (LFLS) and monolingual. However, no significant differences were observed between the groups in response inhibition tasks.
21. Athanasia Papastergiou et al.	2021	38 Monolingual (Greek) 32 Bilingual (Greek + English)	9 years	Attentional Network Task (ANT) Counting Recall Task Backward Digit Span Task Nonverbal Stroop Task Shifting Task (Colour-Shape Task)	Attention Control Inhibition Cognitive Flexibility Working Memory	Bilinguals demonstrated higher efficiency scores in terms of accuracy and response times across five executive function tasks assessing working memory, inhibitory control, and cognitive flexibility. The bilingual advantage emerged not in individual tasks, but in analyses evaluating multi-task performance, reflecting the integration of multiple cognitive processes.

22. John A. E. Anderson et al.	2021	34 Monolingual (English) 37 Bilingual (English + Another Language)	65-80 years	N-Back Tasks Item and Associative Tasks Structural MRI (T1) (Brain Structure) fMRI Scans (Brain Activation During Tasks) Diffusion Weighted Imaging (DWI) (White Matter Connectivity)	Working Memory	Bilinguals were found to demonstrate superior performance compared to monolinguals on working memory tasks, particularly under demanding conditions. Moreover, they produced faster and more accurate responses in working memory tasks. Neuroimaging findings revealed that bilinguals exhibited lower levels of brain activation during the same tasks and showed more efficient functional connectivity between certain brain regions.
23. Anabel Castillo et al.	2022	7095 Monolingual (English) 522 Bilingual (Another Primary Language + English) 229 Bilingual (Another Primary Language + English Learners)	4-5 years	Dimensional Change Card Sort (DCCS) Numbers Reversed Task Teacher Report on Attention Level Teacher Report on Inhibitory Control	Cognitive Flexibility Working Memory Attention Inhibition	In the longitudinal study, significant overall improvements in executive functions were observed. According to teacher evaluations, bilingual children demonstrated higher levels of inhibitory control and attentional skills at the beginning of kindergarten compared to monolingual children and children learning English. However, this difference was reported to diminish over time. Working memory performance improved across all groups, although no significant differences were found between the groups. Similarly, while no initial group differences were identified in cognitive control, bilingual children and children learning English as a second language were found to exhibit more rapid development in cognitive control over time.
24. Gloria Chamorro & Vikki Janke	2022	16 Monolingual Education (Spanish) 26 Bilingual Education (40% English + 60% Spanish) 17 Bilingual Education (30% English + 70% Spanish)	6-7 years	Test of Everyday Attention for Children ✓ Selective Attention Task ✓ Sustained Attention Task	Inhibition Attention	Significant differences between the groups were found in only two of the seven tasks measuring selective and sustained attention. In the selective attention task associated with inhibitory control, both bilingual groups outperformed the monolingual group. In a task measuring sustained attention, the group with greater second-language exposure (receiving 40% instruction in English) demonstrated higher performance than the monolingual group.

25. Alexandra Perovic et al.	2023	71 Monolingual (Serbian) 21 Bilingual (Hungarian + Serbian) 19 Bilingual (Slovak + Serbian)	18-33 years	Spatial Working Memory (SWM) Stockings of Cambridge (SOC) Attention Shifting Task (AST)	Working Memory Cognitive Flexibility Attention Control	No significant differences were found between the groups in working memory tasks. However, in the SOC and AST tasks measuring executive functions, Hungarian–Serbian bilingual speakers demonstrated superior performance compared to both Slovak–Serbian bilinguals and monolingual speakers.
26. Rong Huang et al.	2023	39 Monolingual (English) 35 Bilingual (Spanish + English)	3-5 years	Animal Go/No-Go Task Corsi Block Tapping Test Dimensional Change Card Sort (DCCS)	Inhibition Working Memory Cognitive Flexibility	Bilingual children were more successful than monolinguals in learning new words. Additionally, bilinguals demonstrated superior performance compared to monolinguals in tasks measuring inhibition, working memory and cognitive flexibility.
27. My V. H. Nguyen et al.	2024	33 Monolingual (English) 46 Bilingual (Spanish + English)	5-7 years	Dimensional Change Card Sort (DCCS) Simon Task Go or No-Go (GNG) Task The Head–Toes–Knees–Shoulders Task (HTKS), The Behavior Rating Inventory of Executive Function (BRIEF)	Cognitive Flexibility Inhibition	No significant differences were found between the groups in the GNG task, which measures simple inhibitory control. In contrast, bilinguals demonstrated superior performance compared to monolinguals in the HTKS, Simon effect, and DCCS tasks.
28. Linghui Chu & Gail Joseph	2024	70 Monolingual 52 Bilingual	3-5 years	Peg Tapping Test Dimensional Change Card Sort Task (DCSS)	Inhibition Cognitive Flexibility	Bilingual children made fewer errors and demonstrated greater success in applying rules in the Peg Tapping test assessing inhibitory control. Furthermore, in the DCCS task evaluating cognitive flexibility, they showed superior performance in rule switching and obtained lower perseveration scores.
29. Sally Sade et al.	2024	30 Monolingual 18 Bilingual	3-5 years	The Reverse Categorization Task Pictorial Stroop Task The Grass-Snow Task Dimensional Change Card Sort (DCCS) Backward Digit Span Task	Inhibition Cognitive Flexibility Working Memory	The study found that bilingual four-year-old children outperformed their monolingual peers only on the standard version of the DCCS task. This difference was not observed in the three- and five-year-old groups. No significant differences were identified between the groups in inhibitory control and working memory tasks.
30. Jiejia Chen et al.	2025	28 Monolingual (Chinese) 28 Bilingual (Chinese + English)	20 years	Visual Stroop Task Auditory Stroop Task Visual N-Back Task Auditory N-Back Task Visual Task-Switching Paradigm Auditory Task-Switching Paradigm	Inhibitory Working Memory Cognitive Flexibility	The findings demonstrated that bilingualism enhanced visual and auditory working memory performance. In addition, a bilingual advantage was identified in working memory. However, no bilingual-related superiority was found in inhibitory control or cognitive flexibility.

31. Gloria Chamorro et al.	2025	66 Monolingual (Spanish) 140 Bilingual (Spanish + 32%–41% English exposure) 25 Bilingual (Spanish + 82% English exposure)	6-7 years	Test of Everyday Attention for Children ✓ SkySearch (selective attention) ✓ SkySearchDT (divided attention) ✓ CreatureCounting (switching) ✓ Walk/Don'tWalk (response inhibition) ✓ OppositeWorlds (switching)	Attention Inhibition Cognitive Flexibility	The findings revealed that children with greater exposure to a second language at school demonstrated superior performance in tasks measuring selective attention, switching, and response inhibition. However, no significant advantage was identified in divided attention measures. Longitudinal findings further showed that these children exhibited marked improvements in performance on repeated tasks after one year.

Bilingualism and Attention

The relationship between bilingualism and attention was examined in 13 studies. The Attentional Network Task (ANT) was used in three studies to assess attention (Carlson & Meltzoff, 2008; Costa et al., 2008; Papastergiou et al., 2021). These studies demonstrated that bilingualism positively influenced attentional performance across the alerting, orienting, and executive control networks. The Stroop Task was used in two studies to measure attention (Bialystok et al., 2014; Poulin-Dubois et al., 2011). The findings indicated that bilingual children and adults demonstrated superior performance compared to monolinguals on tasks requiring attentional control. Among the three studies using the Flanker Task, two found that bilingual children exhibited better attentional control under incongruent conditions (Chung-Fat-Yim et al., 2019; Engel de Abreu et al., 2012). However, one study reported no significant group differences after controlling for vocabulary knowledge (Calvo & Bialystok, 2014). Two studies using the Test of Everyday Attention for Children found that children with greater second-language exposure demonstrated higher selective and sustained attention performance (Chamorro et al., 2025; Chamorro & Janke, 2022). In addition, studies using the AST, Teacher Report on Attention Level, and the Visual Attention subtest also reported higher attentional performance among bilingual participants (Benaissa & Boudouh, 2020; Castillo et al., 2022; Perovic et al., 2023).

Bilingualism and Inhibition

The relationship between bilingualism and inhibitory control was examined in 22 studies. Different tasks were used across studies to assess cognitive inhibition. The Simon Task was used in five studies (Bialystok, 2006; Carlson & Meltzoff, 2008; Mehrani & Zabihi, 2017; Ross & Melinger, 2017; Nguyen et al., 2024). Most studies reported that bilingual children demonstrated superior performance in inhibitory control tasks. However, some studies found no significant differences in response time. Nguyen et al. (2024) reported no group differences in the simple Go/No-Go Task (GNG) task, whereas bilingual children outperformed monolinguals in the Head-Toes-Knees-Shoulders Task (HTKS) and Simon tasks.

Seven studies used different versions of the Stroop Task (Arizmendi et al., 2018; Bialystok et al., 2014; Chen et al., 2025; Crivello et al., 2016; Poulin-Dubois et al., 2011; Papastergiou et al., 2021; Sade et al., 2024). While bilingual children demonstrated superior performance in the Shape Stroop task, no group differences were found in the Gift Delay task. A study involving younger and older adults also reported superior Stroop performance among bilinguals, with the effect being more pronounced in older adults (Bialystok et al., 2014). In contrast, the bilingual advantage was not supported in other Stroop task variants. Studies using the Flanker Task provided limited evidence for a bilingual advantage (Calvo & Bialystok, 2014; Chung-Fat-Yim et al., 2019). Some studies found that bilingual children performed more quickly and accurately under incongruent conditions. However, the advantage was described as weak and inconsistent. Findings from studies using the Go/No-Go Task, Walk/Don't Walk Task, and Peg Tapping Task were inconsistent. Studies involving children indicated that bilinguals performed better on response inhibition tasks (Chamorro et al., 2025; Chu & Joseph, 2024; Huang et al., 2013), whereas a study conducted with adults found no group differences (Barbu et al., 2020). Finally, two studies using Visual Attention Task and Selective Attention Task reported that bilingual children demonstrated superior performance in inhibitory control tasks related to selective attention (Benaissa & Boudouh, 2020; Chamorro & Janke, 2022).

Bilingualism and Cognitive Flexibility

The relationship between bilingualism and cognitive flexibility was examined in 20 studies. In most of these studies, cognitive flexibility was assessed using the Dimensional Change Card Sort (DCCS) task. The DCCS measures mental set shifting and the ability to adapt to changing rules. Across seven studies using the DCCS task, bilingual children between the ages of 3 and 7 demonstrated superior performance compared to monolinguals (Carlson & Meltzoff, 2008; Castillo et al., 2022; Chu & Joseph, 2024; Huang et al., 2023; Mehrani & Zabihi, 2017; Nguyen et al., 2024; Sade et al., 2024). In two studies, cognitive flexibility was assessed using the Reverse Categorization Task (Crivello et al., 2016; Poulin-Dubois et al., 2011). In the longitudinal study conducted by Crivello et al. (2016), bilingual children were found to perform better on cognitive flexibility tasks, and the bilingual advantage increased with age. In contrast, Poulin-Dubois et al. (2011) reported no significant differences between the groups.

In five studies, cognitive flexibility was assessed using Task Switching Task and Set-Shifting Task paradigms (Chen et al., 2025; Kovács & Mehler, 2009; Papastergiou et al., 2021; Perovic et al., 2023; Wiseheart et al., 2016). Kovács and Mehler (2009), using a Switch Task with seven-month-old infants, demonstrated that bilingual infants adapted more rapidly to task changes. The findings indicated that cognitive flexibility may be influenced by bilingualism from a very early age. In the study by Papastergiou et al. (2021), bilingual children demonstrated superior performance in terms of both accuracy and response time on the Shifting Task. Similarly, Wiseheart et al. (2016) found that bilinguals performed task-switching activities both more quickly and more accurately. Perovic et al. (2023) reported that individuals speaking two typologically different languages performed better on cognitive flexibility tasks than both individuals speaking typologically similar languages and monolinguals. In contrast, Chen et al. (2025) found no bilingual advantage in visual and auditory task-switching tests.

Bialystok (2011) used the Dual-Modality Classification Task (DMCT) to assess cognitive flexibility in eight-year-old children. The findings revealed that bilingual children demonstrated superior performance, particularly under dual-task and visual-task conditions. Benaissa and Boudouh (2020) evaluated cognitive flexibility using the Wisconsin Card Sorting Test (WCST). The results indicated that bilingual children performed significantly better than monolinguals. In the study by Barbu et al. (2020), bilinguals who frequently switched languages in daily life demonstrated superior performance on cognitive flexibility tasks compared to both low-frequency language switchers and monolinguals. Similarly, Chamorro et al. (2025) reported that bilingual children with greater exposure to a second language at school exhibited higher cognitive flexibility performance. In contrast, some studies did not find significant evidence supporting a bilingual advantage in cognitive flexibility (Arizmendi et al., 2018; Ross & Melinger, 2017).

Bilingualism and Working Memory

The relationship between bilingualism and working memory was examined in 19 studies. Working memory was most commonly assessed using N-Back Task, Digit Span Task, and Digit Recall Task paradigms. Four studies employed N-Back tasks (Anderson et al., 2021; Arizmendi et al., 2018; Chen et al., 2025; Lukasik et al., 2018). Some findings indicated that bilingualism enhanced working memory performance. Chen et al. (2025) and Lukasik et al. (2018) reported superior performance among bilingual young adults. However, Lukasik et al. (2018) found no group differences in other working memory tasks. Similarly, Arizmendi et al. (2018) did not identify a bilingual advantage among children. Anderson et al. (2021), in a study conducted with older adults, demonstrated that bilinguals performed better under demanding working memory conditions. Furthermore, bilinguals exhibited lower levels of brain activation for the same level of performance and showed more efficient connectivity in certain brain regions. Findings from studies using Digit Recall Task were inconsistent (Blom et al., 2014; Mehrani & Zabihi, 2017). Blom et al. (2014) reported that bilinguals performed better on complex working memory tasks, whereas no group differences were observed in simple storage tasks. In contrast, Mehrani and Zabihi (2017) found no bilingual advantage in working memory tasks. Similar findings emerged in studies using the Digit Span Task. While two studies reported a bilingual advantage (Benaissa & Boudouh, 2020; Papastergiou et al., 2021), one study found no significant differences between groups (Sade et al., 2024).

In two studies conducted with children aged 5–7 years, working memory was assessed using the Frogs Matrices Task (FMT) (Calvo & Bialystok, 2014; Morales et al., 2013). Both studies found that bilingual children demonstrated superior performance on demanding working memory tasks. Carlson and Meltzoff (2008) used the Visually Cued Recall Task to assess the ability to recall and update visual information. Bilingual children performed significantly better on this task. Similarly, Huang et al. (2023) used the Corsi Block Tapping Test and reported superior performance among bilingual children. Bialystok et al. (2014) used the Recent Probes Task in a study involving younger and older adults. The findings indicated that bilingualism provided advantages particularly

in complex tasks among older adults. In contrast, several studies examining working memory found no significant differences between groups (Castillo et al., 2022; Crivello et al., 2016; Engel de Abreu et al., 2012; Perovic et al., 2023). These findings suggest that evidence for a bilingual advantage in working memory remains inconsistent.

DISCUSSION

In this systematic review, 31 studies published between 2006 and 2025 examining the relationship between bilingualism and the subcomponents of executive functions (attention, inhibitory control, cognitive flexibility, and working memory) were evaluated. The studies covered a wide range of age groups, with participants ranging from seven-month-old infants to adults aged 65–80 years. Studies conducted with infants and young children indicate that early exposure to two languages may confer cognitive advantages (Castillo et al., 2022; Chu & Joseph, 2024; Crivello et al., 2016; Kovács & Mehler, 2009; Poulin-Dubois et al., 2011). Longitudinal studies further demonstrated that the bilingual advantage may increase with age (Castillo et al., 2022; Chamorro et al., 2025; Crivello et al., 2016). Studies involving older adults suggest that bilingualism may reduce age-related cognitive decline and contribute to cognitive reserve (Anderson et al., 2021; Bialystok et al., 2014).

The reviewed studies generally indicate that bilingualism had associated with better performance in some attention tasks. Most studies reported that bilingual individuals demonstrated superior performance on attention tasks. However, Calvo and Bialystok (2014) found that the group differences disappeared when vocabulary knowledge was controlled for. This finding suggests that the bilingual advantage in attention may be context-sensitive and that cognitive performance should be evaluated in interaction with language proficiency. In particular, studies employing the Stroop Task and Flanker Task demonstrated that bilingual individuals were more successful in focusing on target stimuli despite the presence of distracting information. This may be related to bilinguals' continuous need to select the target language while suppressing the non-target language during language use (Green, 1998). Furthermore, Chamorro et al. (2025) and Chamorro and Janke (2022) showed that children with greater exposure to a second language demonstrated higher selective and sustained attention performance. Therefore, it is important to evaluate the frequency of second-language use within home, school, and social environments

In contrast to the existing literature, findings related to inhibitory control demonstrate a more heterogeneous pattern. While some studies using the Simon Task and Stroop Task reported advantages in favor of bilinguals (Bialystok, 2006; Mehrani & Zabihi, 2017), other studies found no significant differences (Arizmendi et al., 2018; Papastergiou et al., 2021). This inconsistency may stem from the different subcomponents of inhibitory control. In particular, bilinguals appear to perform better on tasks requiring attention-based inhibition. In contrast, the bilingual advantage has not been consistently supported in response inhibition tasks (Crivello et al., 2016; Poulin-Dubois et al., 2011). These findings suggest that bilingualism may strengthen attention-based inhibitory processes, but that this advantage may not generalize to motor response suppression processes. It is also noteworthy that most studies examining response inhibition were conducted with participants in early childhood (Crivello et al., 2016; Nguyen et al., 2024; Poulin-Dubois et al., 2011). This may indicate that motor inhibition skills are not yet fully developed during early childhood. Therefore, age may be a determining factor in the bilingual advantage.

The most consistent findings regarding the bilingual advantage have been obtained in the domain of cognitive flexibility. The majority of the 20 studies examining cognitive flexibility reported results favoring bilinguals. In particular, studies using the Dimensional Change Card Sort (DCCS) task systematically found that bilingual children outperformed monolinguals (Carlson & Meltzoff, 2008; Castillo et al., 2022; Chu & Joseph, 2024; Huang et al., 2023; Mehrani & Zabihi, 2017; Nguyen et al., 2024; Sade et al., 2024). These findings support the view that bilinguals' continuous switching between two language systems strengthens mental set-shifting abilities (Bialystok, 2011). Nevertheless, some studies failed to confirm a bilingual advantage in cognitive flexibility (Arizmendi et al., 2018; Chen et al., 2025; Poulin-Dubois et al., 2011; Ross & Melinger, 2017). These contradictory findings may be related to differences in task complexity, age, and language experience. In particular, early exposure to a second language is thought to strengthen the effects of bilingualism on cognitive flexibility (Carlson & Meltzoff, 2008). Furthermore, language proficiency, balance between languages, and frequency of language switching appear to be important determinants of bilingual experience. Indeed, Barbu et al. (2020) demonstrated that bilinguals who switched languages more frequently in daily life exhibited superior cognitive flexibility performance.

The studies reviewed in this systematic review indicate that the relationship between bilingualism and working memory varies depending on task type, cognitive load, and participant characteristics. Overall, the findings suggest that bilingualism provides advantages particularly in complex working memory tasks requiring high levels of executive control, whereas this advantage appears to be more limited in simple storage and short-term recall tasks. These results are consistent with theoretical approaches proposing that working memory is a multidimensional

construct involving not only information storage, but also updating, processing, and attentional control (Baddeley, 2003; Miyake et al., 2000). The frequently used N-Back Task assesses the ability to maintain, update, and reorganize information. Although the findings are inconsistent, some studies have reported advantages in favor of bilinguals. In particular, Chen et al. (2025) and Lukasik et al. (2018) demonstrated that bilingual young adults achieved superior N-Back performance. Findings obtained from Digit Recall Task and Digit Span Task paradigms are similarly heterogeneous. Blom et al. (2014) found a bilingual advantage in complex working memory tasks but observed no significant differences in simple storage tasks. In contrast, Mehrani and Zabihi (2017) did not support a bilingual advantage in forward and backward digit recall tasks. Likewise, studies using Digit Span tasks have yielded inconsistent results (Benaissa & Boudouh, 2020; Papastergiou et al., 2021; Sade et al., 2024). These findings suggest that the bilingual advantage emerges more prominently in tasks involving high executive control demands rather than in short-term storage capacity alone. Stronger bilingual advantages related to working memory have been observed in complex visuospatial tasks. Studies using the Frogs Matrices Task found that bilingual children performed better under demanding working memory conditions (Calvo & Bialystok, 2014; Morales et al., 2013). Similarly, studies using the Visually Cued Recall Task and the Corsi Block Tapping Test also produced findings favoring bilinguals (Carlson & Meltzoff, 2008; Huang et al., 2023). A common characteristic of these tasks is that they involve not only information storage, but also updating information, maintaining attentional focus, and suppressing distracting stimuli. Therefore, the findings suggest that bilingualism particularly supports working memory processes associated with executive attention and cognitive control.

Overall, the findings indicate that the bilingual advantage emerges particularly in the domains of selective attention, attention-based inhibition, and cognitive flexibility. In contrast, this advantage appears to be more limited and inconsistent in response inhibition and simple working memory tasks. These results suggest that the cognitive effects of bilingualism are domain-specific. In other words, bilingualism does not provide a generalized advantage across all cognitive functions; rather, it appears to exert stronger effects on specific cognitive processes and executive control mechanisms. To better understand the conditions under which these effects emerge, future research should examine variables such as the age of second-language acquisition, language proficiency, degree of bilingualism, frequency of language use, and frequency of active language switching in greater detail.

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