Undergraduate Article

The Bilingual Advantage

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Abstract
The existence of a bilingual advantage in executive functions is widely debated in psychological research, with a body of research both supporting and contradicting the phenomenon. Recent reviews of the literature have advocated for a more robust framework to be employed to understand why the findings have been inconsistent. The present study contributed to this research gap by examining the effects of bilingualism through Bialystok and Craik's (2022) proposed attentional control framework. Specifically, the study investigated attention and working memory under greater attentional control demands, aimed to answer the research question; is there a difference in bilinguals and monolinguals attentional control and working memory?

The study hypothesised that bilingual participants would show an advantage over monolinguals. The criteria for the bilingual participants was a self-reported language proficiency of B2 or higher on a modified Common European Framework of Reference (CEFR) scale. The monolingual (N=29) and bilingual (N=34) participants were tested using the Eriksen Flanker task for attention and the N-back task for working memory. The study did not observe any significant advantage for bilingual participants. The generalisability of these results is limited due to a small sample size. This study contributes to previous research that opposes the effects of bilingualism on executive functions.

Introduction

Bilingualism is the ability to speak and understand two languages fluently. As language plays a fundamental role in human cognition, it is reasonable to assume that speaking multiple languages could influence cognitive functions.[1] Research into the cognitive effects of bilingualism has grown in popularity in the last decade,[2] as have bilingual populations. The 2022 Irish census reported that over 750,000 people spoke languages other than English or Irish in their household.[3] The census also reported a 6% resurgence in Irish speakers since 2016.[4] This is reflective of the current sociolinguistic climate in Ireland, which has shown increasing interest in the revival of the Irish language.[5] Other bilingualism research has focused on the social impacts of bilingualism and reported that bilingualism can foster empathy and tolerance in society.[6] The Irish state has long endeavoured towards promoting the Irish language.[7] In November of 2025, the Department of Education launched two Irish language policies: The Irish-Medium Education policy, which aims to provide more opportunities for children to receive their education through the Irish language, and the Action Plan for Irish in English-Medium Schools, which aims to incorporate Irish in all areas of school life, so that it can be "experienced as a living language, not just a school subject."[8]

The Irish government has also undertaken to promote the speaking and learning of foreign languages across Ireland. Languages Connect is an initiative that was founded by the Department of Education, as part of the Strategy for Foreign Languages in Education 2017-2026.[9] Its goal is to promote foreign languages across the country, in both schools and professional spaces. Continued research into the cognitive effects of bilingualism may strengthen the government's support for

1. Priscilla Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance of Older Adults," *Scientific Reports* 13, no. 1 (2023): 16912, https://doi.org/10.1038/s41598-023-43961-7
2. Ellen Bialystok and Fergus I.M Craik, "How Does Bilingualism Modify Cognitive Function? Attention to the Mechanism," *Psychonomic Bulletin & Review* 29 (2022): 1246–1269, https://doi.org/10.3758/s13423-022-02057-5
3. Central Statistics Office, "Press Statement Census 2022 Results Profile 5: Diversity, Migration, Ethnicity, Irish Travellers & Religion," 26 October 2023, https://www.cso.ie/en/csolatestnews/pressreleases/2023pressreleases/pressstatementcensus2022resultsprofile5-diversitymigrationethnicityirishtravellersreligion/
4. Central Statistics Office, "Irish Language and the Gaeltacht Census of Population 2022 Profile 8," 19 December 2023, https://www.cso.ie/en/releasesandpublications/ep/p-cpp8/censusofpopulation2022profile8-theirishlanguageandeducation/irishlanguageandthegaeltacht/
5. Jack McCarron, "Revival at Risk? Irish Speakers Say Policies Must Be Stepped Up," RTÉ Gaeilge, 13 March 2025, https://www.rte.ie/gaeilge/2025/0312/1501648-prime-time-irish-language-revival/
6. Kirsten Sutton, "Why First and Second Language Skills Are a Benefit to Learners and Society," Cambridge University Press & Assessment (2021), https://www.cambridge.org/news-and-insights/blogs/first-and-second-language-skills-are-a-benefit-to-learners-and-society
7. John Harris, "Bilingual Education and Bilingualism in Ireland North and South," *International Journal of Bilingual Education and Bilingualism* 10, no. 4 (2007): 359-368, https://doi.org/10.2167/beb449.0
8. "Minister McEntee Launches New Policy for Irish-Medium Education and Action Plan for Irish in English-Medium Schools," Department of Education and Youth, 6 November 2025, https://www.gov.ie/en/department-of-education/press-releases/minister-mcentee-launches-new-policy-for-irish-medium-education-and-action-plan-for-irish-in-english-medium-schools/
9. "About Us," Languages Connect, accessed 15 January 2025, https://languagesconnect.ie/

language learning policies.

The 'Bilingual Advantage' (BA)[10] is the observed phenomenon where bilinguals have exhibited enhanced cognitive abilities in comparison to their monolingual counterparts. Research into the BA is conflicted as to whether bilingualism enhances overall cognitive functions, or just specific processes.[11] This has been reported in numerous studies, where bilinguals who acquired their second language at a young age were found to have greater attention and memory functions.[12] Other research into the onset of diseases such as dementia, similarly, proposed that the cognitive benefits of bilingualism could contribute to slower mental decline.[13] These cognitive advantages have been observed when testing and comparing bilinguals' and monolinguals' scores in nonverbal mental tasks. These tasks test mental processes such as memory and attention, which rely on higher-level cognitive processes known as Executive Functions (EF).[14] The BA describes bilinguals' ability to have heightened control of their EFs compared to monolinguals. It is theorised that the BA occurs due to bilinguals' enhanced ability to control the EFs that are required to mentally switch between two languages.[15]

Despite a large body of research supporting BA, ongoing debates and recent conflicting findings across the literature[16] have raised questions about the validity of these implied benefits.[17] A study conducted by Paap et al. strongly contested

10. J. Bruce Morton and Sarah N. Harper, "What Did Simon Say? Revisiting the Bilingual Advantage," *Developmental Science* 10, no. 6 (2007): 719–726, https://doi.org/10.1111/j.1467-7687.2007.00623.x
11. Mohammad N. Karimi and Zahra Hosseini Rad, "Bilingual Advantage Hypothesis: Testing the Fit among L1-Dominant Child and Adolescent Bilinguals," *Journal of Neurolinguistics* 60 (2021): 101017, https://doi.org/10.1016/j.jneuroling.2021.101017
12. Kayla Beaudin and Diane Poulin-Dubois, "Testing the Bilingual Cognitive Advantage in Toddlers Using the Early Executive Functions Questionnaire," *Languages* 7, no. 2 (2022): 122, https://doi.org/10.3390/languages7020122;

    Dana Byrd, "Cognitive Benefits of Being Bilingual," *Journal of the Washington Academy of Sciences* 98, no. 3 (2012): 19–30, https://www.jstor.org/stable/24536482;

    Catherine Monnier et al., "Is Bilingualism Associated with Better Working Memory Capacity? A Meta-Analysis," *International Journal of Bilingual Education and Bilingualism* 25, no. 6 (2021): 2229–2255, https://doi.org/10.1080/13670050.2021.1908220
13. Brini et al., "Bilingualism Is Associated with a Delayed Onset of Dementia but Not with a Lower Risk of Developing it: a Systematic Review with Meta Analyses," *Neuropsychology Review* 30, no. 1 (2020): 1–24, https://doi.org/10.1007/s11065-020-09426-8;

    Federico Gallo and Jubin Abutalebi, "The Unique Role of Bilingualism among Cognitive Reserve-Enhancing Factors," *Bilingualism: Language and Cognition* 27, no. 2 (2024): 287–294, https://doi.org/10.1017/S1366728923000317
14. "Executive Functions," APA Dictionary of Psychology, American Psychological Association, accessed 19 April 2018, https://dictionary.apa.org/executive-functions
15. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
16. Costa et al., "On the Bilingual Advantage in Conflict Processing: Now You See It, Now You Don't," *Cognition* 113, no. 2 (2009): 135–149, https://doi.org/10.1016/j.cognition.2009.08.001
17. Elisavet Chrysochoou, "The Bilingual Effect on Cognitive Development: Not an Executive Function Advantage, but a Differentiation of Mental Abilities," *Journal of Cognitive Psychology* 34, no. 4 (2021): 470-484, https://doi.org/10.1080/20445911.2021.2002875;

    Merve Gul Degirmenci et al. "The Role of Bilingualism in Executive Functions in Healthy Older Adults: A Systematic Review," *International Journal of Bilingualism* 26, no. 4 (2022): 426–449, https://doi.org/10.1177/13670069211051291

the phenomenon and reported that 80% of bilingual EF studies between 2011 and 2015 yielded insignificant results.[18] A recent meta-analysis by Degirmenci et al.[19] noted a similar lack of significant findings and advocated for future bilingualism research to implement more robust methodologies. Bialystok and Craik[20] proposed a methodological framework that attempts to explain the conflicting findings in the literature. Unlike a large proportion of bilingualism research, their framework focuses on the EF of Attentional Control (AC) as the central mechanism influenced by bilingualism. The present study aims to investigate this theory to see if a BA can be demonstrated through AC.

The Bilingual Advantage and the Attentional Control Mechanism – Literature Review

The Bilingual Advantage

Research has found evidence of the BA in tasks that require attentional control, inhibitory control, and working memory.[21] However, the results across the literature have been inconsistent, with some studies reporting no difference between bilingual and monolingual EFs,[22] Bialystok and Craik[23] suggested that this may stem from the frameworks applied, mainly the focus that previous studies placed on Inhibitory Control.

Inhibitory Control

Inhibitory Control (IC) is the process which ignores irrelevant information and controls one's actions and behaviours.[24] Neuropsychological research has widely reported that both languages spoken by bilinguals are concurrently active in the brain during

18. Kenneth R. Paap, Hunter A. Johnson and Oliver Sawi, "Bilingual Advantages in Executive Functioning Either Do Not Exist or Are Restricted to Very Specific and Undetermined Circumstances," *Cortex* 69 (2015): 265–278, https://doi.org/10.1016/j.cortex.2015.04.014
19. Degirmenci et al., "The Role of Bilingualism."
20. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
21. John. G. Grundy and Kalinka Timmer, "Bilingualism and Working Memory Capacity: A Comprehensive Meta-Analysis," Second Language Research 33, no. 3 (2017): 325–340, https://www.jstor.org/stable/26375888;

    Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";

    Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages."
22. Chrysochoou, "The Bilingual Effect on Cognitive Development.";

    Emily Nichols et al., "Bilingualism Affords No General Cognitive Advantages: A Population Study of Executive Function in 11,000 People," *Psychological Science* 31, no. 5 (2020): 548-567, https://doi.org/10.1177/0956797620903113;

    Paap et al., "Bilingual advantages Executive Functioning.";

    Asli Yoruk, Mevla Yahya and Banu Cangoz-Tavat, "Do Bilinguals Have an Advantage in Prospective Memory?" *Journal of Cognitive Psychology* 35, no. 3 (2023): 255–270, https://doi.org/10.1080/20445911.2022.2159964
23. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
24. Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance."

listening, reading and planning speech.[25] This requires IC functions to manage and inhibit the irrelevant language in the given context.

IC is a central mechanism across Executive Function (EF) research, mainly due to The Unity and Diversity model of EF,[26] which describes EF processes as sub-components unified under one common process, IC. It represents three EFs: Inhibition, shifting (switching between tasks), and updating (managing working memory). It has been a widely utilised framework across the BA literature.[27] The model was proposed to represent general EF processes, meaning the processes that support goal-oriented behaviour. Some researchers have argued that this model does not accurately describe the complexities of dual language processing,[28] and therefore cannot describe the processes behind the BA. Consequently, Green's EF model, known as the Inhibitory Control (IC) model, was proposed to describe the specific language processes involved in the bilingual experience; however, it also placed IC processes at the centre of the BA.[29] Green's model describes how the language processes that monitor word production selectively inhibit the non-target language.[30] From the perspective of these models, it is to be assumed that bilinguals would perform tasks involving inhibition better than monolinguals. This understanding of IC has emphasised it as the central mechanism behind BA.

It is suggested in executive function research that there are two processes underpinning IC: Interference Suppression (IS) and Response Inhibition (RI), and some bilingualism research has examined these processes specifically.[31] IS, which is the process of disregarding irrelevant stimuli, is activated during Stroop, Simon and Flanker tasks. Response Inhibition is the process that suppresses inappropriate actions and is activated during Go/No-Go (GNG) tasks. The Stroop, Flanker and Simon tasks are commonly used in BA research and are described as IC tasks. The Stroop task requires participants to correctly identify the name of a colour when it is printed in a different colour ink, for example, the word blue, printed in yellow ink. Similarly, the Simon task shows that participants will respond faster and with more accuracy when

25. Judith F. Kroll et al., "Bilingualism, Mind and Brain," *Annual Review of Linguistics* 1, no. 1 (2015): 377–394, https://doi.org/10.1146/annurev-linguist-030514-124937;

    Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";

    Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance."

26. Akira Miyake et al., "The Unity and Diversity of Executive Functions and Their Contributions to Complex 'Frontal Lobe' Tasks: A Latent Variable Analysis," *Cognitive Psychology* 41, no. 1 (2000): 49–100, https://doi.org/10.1006/cogp.1999.0734

27. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"

    Ashley Chung-Fat-Yim, Geoff Sorge and Ellen Bialystok, "The Relationship between Bilingualism and Selective Attention in Young Adults: Evidence from an Ambiguous Figures Task," *Quarterly Journal of Experimental Psychology 70*, no. 3 (2017): 366–372, https://doi.org/10.1080/17470218.2016.1221435

28. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"

29. David W. Green, "Mental Control of the Bilingual Lexico-Semantic System," *Bilingualism: Language and Cognition* 1, no. 2 (1998): 67–81, https://doi.org/10.1017/s1366728998000133

30. Ibid.

31. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"

the stimulus and response are related, for example, when the stimulus and response keys are both to the participant's right side.

In the Flanker task, the participant must respond to the stimulus, which is 'flanked' by irrelevant stimuli, which could either correlate, or contrast with the correct response to the stimulus. During GNG tasks, participants are told to respond to the target stimulus (e.g. X) and not to respond if the non-target stimulus appears (e.g. Y). Previous research has revealed that bilinguals outperform monolinguals by scoring higher in Simon,[32] Stroop, and Flanker tasks,[33] but not in GNG tasks.[34]

Luk et al.'s study examined this difference among young adult bilinguals and monolinguals who performed the Flanker task with fMRI.[35] During a Flanker task, the participants responded to the direction of a target cue, a red chevron, while ignoring any conflicting chevrons. There were three sets of trials, practice, neutral and experimental. During the practice trials, only the red chevron was displayed on screen and the neutral trials displayed chevrons that did not create a conflict with the direction of the target. The experimental trials were congruent, where the target was flanked by symbols pointing in the same direction, and incongruent trials, where the flanking symbols pointed in the opposite direction. The incongruent trails required IS responses. The experimental trials also included a GNG trials, and participants were told not to respond if the on-screen stimuli were all Xs. This no-response reaction required the participant's RI. The scores from the inhibition tasks were analysed in contrast with the neutral trials.

The fMRI results showed both groups had the same patterns of brain activation and performed similarly in the RI task. These findings are supported by other BA literature, which also found no difference between bilingual and monolingual inhibitory control abilities.[36] However, the bilingual groups averaged higher scores than the monolingual participants during the IS response trials. The bilinguals showed different brain activity during the IS tasks. This differentiation in brain activity could have helped the bilingual group to better inhibit interference. The researchers inferred from these results that IC comprises two distinct processes, and BA is only evident in IS. The absence of a BA in the RI indicates that IC cannot be the underpinning process

32. Ellen Bialystok et al., "Bilingualism, Ageing and Cognitive Control: Evidence from the Simon Task," *Psychology and Ageing* 19, no. 2 (2004): 290–303, https://doi.org/10.1037/0882-7974.19.2.290
33. Kroll et al., "Bilingualism, Mind and Brain."
34. Lu Jiao et al., "Working Memory Demand of a Task Modulates Bilingual Advantage in Executive Functions," *International Journal of Bilingualism* 23, no. 1 (2017): 102–117, https://doi.org/10.1177/1367006917709097
35. Gigi Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals: Response Inhibition versus Interference Suppression," *Brain and Cognition* 74, no. 3 (2010): 347–357, https://doi.org/10.1016/j.bandc.2010.09.004
36. Chrysochoou, "The Bilingual Effect on Cognitive Development.";

    Emily Nichols et al.," Bilingualism Affords No General Cognitive Advantages."

of BA.[37] The study instead proposed that BA influenced IC at an attentional level.

Bialystok[38] reviewed Luk et al.'s and other behavioural and neuroimaging bilingual studies to understand the discrepancies across the literature. Bialystok concluded that bilingualism influences various processes collectively categorised as executive attention, and testing IC alone could be why there are mixed findings. Similarly to Luk et al., Bialystok proposed that the EF processes in which a BA has been observed can be influenced by AC. This is corroborated by other literature that has tested and supported the role of attentional mechanisms.[39]

Attentional Control

Attentional Control (AC) is the ability to attend to the relevant stimuli in the environment.[40] AC has been the focus of multiple research studies that have argued against IC as the central mechanism, instead proposing that bilingualism influences IC at an attentional level.[41] For example, Kroll et al., reported on neuroimaging studies where heightened activation in the anterior cingulate cortex was observed in bilingual participants during a Flanker task.[42] This brain activation is associated with attentional control, suggesting that bilingual brains are more efficient at focusing their attention due to the ongoing language competition in the brain.

Other neuroimaging studies have also supported this, reporting on bilinguals showing less brain activity and better or equal performances to monolinguals during working memory tasks[43] as well as showing overall more efficient and coherent activation of brain networks.[44] Furthermore, authors such as Papastergiou et al., also found evidence for the attentional control mechanism among Greek-English

37. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";
    Costa et al., "On the Bilingual Advantage in Conflict Processing.";
    Jiao et al., "Working Memory Demand."
    Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals."
38. Ellen Bialystok, "The Bilingual Adaptation: How Minds Accommodate Experience," *Psychological Bulletin* 143, no. 3 (2017): 233–262, https://doi.org/10.1037/bul0000099
39. Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance.";
    Diane Poulin-Dubois et al., "The Effects of Bilingualism on Toddlers' Executive Functioning," *Journal of Experimental Child Psychology* 108, no. 3 (2011): 567–579, https://doi.org/10.1016/j.jecp.2010.10.009;
    Athanasia Papastergiou et al., "A Study on the Executive Functioning Skills of Greek–English Bilingual Children: A Nearest Neighbour Approach," *Bilingualism: Language and Cognition* 26, no. 1 (2022): 78–94, https://doi.org/10.1017/s1366728922000335
40. Joseph B. Hopfinger and Scott D. Slotnick, "Attentional Control and Executive Function," *Cognitive Neuroscience: Current Debates, Research and Reports* 11, no. 1–2 (2019): 1–4, https://doi.org/10.1080/17588928.2019.1682985
41. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";
    Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals."
42. Kroll et al., "Bilingualism, Mind and Brain."
43. Kyle J. Comishenand Ellen Bialystok, "Increases in Attentional Demands Are Associated with Language Group Differences in Working Memory Performance," *Brain and Cognition* 147 (2021): 105658, https://doi.org/10.1016/j.bandc.2020.105658
44. Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals."

bilingual and monolingual children aged 63-108 months.[45] They aimed to investigate a range of confounding variables, such as socioeconomic status and intelligence, that could explain the inconsistencies in identifying the mechanism behind the BA. In this study, children were assessed on their nonverbal intelligence and their level of Greek and/or English. Afterwards, they completed the Attentional Network Task (ANT), which measured attentional control. The ANT is similar to the Flanker task, requiring participants to react to the direction of a target stimulus. They completed two working memory tasks, the Counting Recall task (CRT) and the Backward Digit Span Task (BDST).

During the BDST, the children were asked to recall the reverse order of the numbers they heard being called. A nonverbal Stroop task was also administered, which required the children to select the direction of the arrow regardless of its position on the screen. The final task was the Colour Shape Task (CST), which assessed their shifting. The researchers used K-nearest neighbour methods to control for confounding variables. They closely matched two groups of Greek and English Monolinguals with the bilinguals based on their fluency, intelligence and SES. The bilingual children had faster Response Times (RT) in the Stroop task on incongruent trials and were faster overall in the BDST. Significant differences were only shown in one of two inhibition tasks and one of two working memory tasks. These findings indicate a bilingual advantage in IS and domain-specific working memory. The greater attentional demands required during complex tasks could support this.

Their findings build on research by Nichols et al.,[46] who used similar methods to closely match 11,041 adult participants' scores and found no significant results supporting the BA. Similarly, research by Chrysochoou et al.[47] found no BA during the attentional network task. However, Papastergiou et al. did find that the bilingual participants responded faster than monolinguals during the backward digit span task, and the incongruent trials in the Stroop task. Papastergiou et al. attributed this to the enhanced attentional abilities of bilinguals. These results, contribute to a plethora of literature supporting this mechanism .[48]

45. Papastergiou et al., "Study on Executive Functioning."
46. Nichols et al., "Bilingualism Affords No General Cognitive Advantages."
47. Chrysochoou, "The Bilingual Effect on Cognitive Development."
48. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";

    Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance.";

    Grundy and Timmer, "Bilingualism and Working Memory Capacity."

    Luk et al., "Distinct Neural Correlates.";

    Poulin-Dubois et al., "The Effects of Bilingualism on Toddlers' Executive Functioning.";

    Kefi Mohamed Zied et al., "Bilingualism and Adult Differences in Inhibitory Mechanisms: Evidence from a Bilingual Stroop Task," *Brain and Cognition* 54, no. 3 (2004): 254–256, https://doi.org/10.1016/j.bandc.2004.02.036

Considering these findings, Bialystok and Craik proposed their theory that the inconsistencies across BA research,[49] were due to emphasis across the literature on IC as the central mechanism of BA. They instead offered their argument that studying AC produces more accurate and consistent findings in support of the BA.[50] Their framework suggests that AC monitors and organises the EF of processing, selection (engagement/ disengagement), WM, and inhibition (IS and RI). They suggested that managing multiple languages does not strengthen attentional abilities but rather trains attention in a way that allows bilinguals to control cognitive resources more efficiently than monolinguals. To test Bialystok and Craik's AC theory, the EF tasks employed should demand higher attentional control from the participants. Researchers such as Costa et al.[51] examined this by using two different Flanker tasks and only identified a BA in the task with higher attentional demands. Similarly, a BA has been observed during Working Memory tasks when the difficulty level increases.[52]

Attentional Control and Working Memory

Working Memory (WM) is the temporary holding of information for manipulation and processing.[53] It is a key process in language comprehension and learning and an area where bilinguals are more practised. The Bilingual Advantage (BA) has been observed across multiple WM studies, suggesting that bilinguals have larger WM capacities.[54] A larger working memory capacity may enhance participants' ability to recall how to play psychometric tests. To address this possible advantage, Bialystok et al., increased the working memory demand in a Simon task to account for this so that the skill for ignoring irrelevant stimuli could be more accurately recorded.[55] The study reported on the participants' WM costs, which showed how effectively participants coped with the task's difficulty level. They found that bilinguals had lower inhibition and WM costs. Bilinguals also had faster response times.

A study by Jiao et al. also explored how monolingual and bilingual participants differed when there was a higher WM demand in a Flanker task, which included a

49. Chrysochoou, "The Bilingual Effect on Cognitive Development.";
Emily Nichols et al.," Bilingualism Affords No General Cognitive Advantages."
Paap et al., "Bilingual advantages Executive Functioning.";
Yoruk et al., "Do Bilinguals Have an Advantage in Prospective Memory?"
50. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
51. Costa et al., "On the Bilingual Advantage in Conflict Processing."
52. Bialystok et al., "Bilingualism, Ageing and Cognitive Control."
Comishen and Bialystok, "Increases in Attentional Demands."
53. "Working Memory," APA Dictionary of Psychology, American Psychological Association, accessed 19 April 2018, https://dictionary.apa.org/working-memory
54. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";
Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance.";
Grundy and Timmer, "Bilingualism and Working Memory Capacity.";
Monnier et al., "Is Bilingualism Associated with Better Working Memory Capacity?"
55. Bialystok et al., "Bilingualism, Ageing and Cognitive Control.";

Go/No-Go (GNG) trial, similar to the Luk et al. study, and a conditional GNG task.[56] These were tested against normal Flanker and GNG tasks. Bilinguals displayed an advantage in the modified Flanker task (IS) and, in contrast to other literature also saw an advantage during the conditional GNG tasks, which typically require RI.[57] Bialystok and Craik[58] theorised that BAs have been observed in these studies because the tasks required more attentional resources due to increased task difficulty, and WM demands.

Comishen and Bialystok explored this theory further with young adult monolinguals and bilinguals using the n-back WM task and gradually heightened the task difficulty using the -1, 2-, and 3-back conditions, requiring participants to recall multiple items.[59] The demand for participants' attentional control increased with each condition, and the results identified a significant BA. The combined findings from these studies suggest that a WM advantage is reflected in bilinguals' strengthened AC during the processes of storing memories. This body of WM and AC research builds on Bialystok and Craik's theory that tasks that require more attentional resources highlight BAs.[60] These findings contribute to a more robust framework for BA research that could produce more reliable and replicable results.

The Rationale Underpinning the Present Study

The motivation of this study is to investigate the inconsistencies,[61] across the literature around which Executive Function (EF) is the central mechanism behind the Bilingual Advantage (BA). This will be investigated through the lens of Bialystok and Craik's proposed theory of Attentional Control (AC).[62] The present study aims to test this proposed theory, which suggests that AC is the central EF that is affected by bilingualism and the mechanism behind the BA. This study will answer the research questions:

1. Is there a difference in young adult bilinguals' and monolinguals' attentional control?
2. Is there a difference in young adult bilinguals' and monolinguals' working memory based on greater attentional control demands?

56. Jiao et al., "Working Memory Demand."
    Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals."
57. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";
    Luk et al., "Distinct Neural Correlates for Two Types of Inhibition in Bilinguals."
58. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
59. Comishen and Bialystok, "Increases in Attentional Demands."
60. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"
61. Chrysochoou, "The Bilingual Effect on Cognitive Development.";
    Emily Nichols et al.," Bilingualism Affords No General Cognitive Advantages.";
    Paap et al., "Bilingual advantages Executive Functioning.";
    Yoruk et al., "Do Bilinguals Have an Advantage in Prospective Memory?"
62. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?"

This study will employ a between-groups quasi-experimental design. The independent variable is the language grouping: Monolinguals and Bilinguals. The dependent variables are AC and WM. The present study will investigate this theory by testing 63 participants, 34 bilingual students and 29 monolingual students on their AC and WM, using the Eriksen Flanker attention task and the N-back working memory task, using the 2-back trial implementation. This increases the difficulty level of the N-back task, which will place higher demands on participants' AC.[63]

The participants of this study will be recruited from the IADT Dun Laoghaire college campus, using random sampling methods. The two participant groups will consist of adults in higher education in Ireland, between the ages of 18 and 34. The bilingual cohort will include a plethora of languages to diversify the sample. These languages will include Albanian, English, French, German, Greek, Gaeilge/Irish, Latvian, Lithuanian, Malayalam, Polish, Portuguese, Romanian, Russian, Spanish, and Turkish. The participant criteria for the bilingual group are a language proficiency of B2 (upper intermediate) or higher on the Common European Framework of Reference (CEFR) scale in their second language. This will be based on self-assessment. This scale is used across educational institutes as the international standard for describing language ability.[64] Any participants who indicate they are below this level of fluency in their second language will not be considered bilingual in this study. As suggested by previous research, the study will exclude multilingual participants.[65] Participants will be considered multilingual by the study if they indicate that they are a B2 or higher, in three or more languages. Both the monolingual and bilingual participants will be required to speak English to participate, this is to ensure they can understand the demographic survey and the EF task instructions, which will be written in English.

Due to limited resources and time restraints, this research will not be able to control for confounding language variables in the bilingual participants. This includes the effect of the age of language acquisition and the effects of language pairings. Previous research on bilingual and monolingual children has suggested that acquiring a second language at a young age can enhance proposed BAs,[66] which

63. Ibid;
    Comishen and Bialystok, "Increases in Attentional Demands";
    Albert Costa et al., "Bilingualism Aids Conflict Resolution: Evidence from the ANT Task," *Cognition* 106, no. 1 (2008): 59–86, https://doi.org/10.1016/j.cognition.2006.12.013;
    Jiao et al., "Working Memory Demand."
64. Cambridge University Press & Assessment, "International Language Standards," 2019, https://www.cambridgeenglish.org/exams-and-tests/cefr/
65. Papastergiou et al., "Study on Executive Functioning."
66. Monnier et al., "Is Bilingualism Associated with Better Working Memory Capacity.";
    Byrd, "Cognitive Benefits of Being Bilingual.";
    Beaudin and Poulin-Dubois, "Testing the Bilingual Cognitive Advantage.";
    Papastergiou et al., "A Study on the Executive Functioning Skills.";
    Poulin-Dubois et al., "The Effects of Bilingualism on Toddlers' Executive Functioning."

could have confounding impacts on this study's results. Similarly, the present study cannot control for the potential effect of bilinguals speaking two languages from the same language family or two languages from different language families. For example, English and German are both from the Germanic language family, but English and Polish are from separate families, as Polish is a Slavic language. The participant population this research has access to is adults in higher education, with varying ages of second language acquisition; this participant population will not form large enough participant groups for effective statistical analysis. All confounding language variables will be discussed post-statistical analysis.

Four participants will be tested at a time in the IADT psychology lab. Each participant will be in front of an HP computer, and desk dividers will separate them. The researcher will provide each participant with verbal instructions on how to complete the experiment. They will be advised to raise their hands if they have questions, so as not to disrupt the other participants. The experiment will take approximately 20 minutes to complete. They will first complete a demographic survey, through Microsoft Forms, which includes an information sheet and consent form. They will then be asked to provide demographic information on their age, gender, languages spoken and language fluency. Next, they will open and then complete the N-back task for WM. The N-back task consists of two training rounds, with 25 trials each, and one recorded round, with 25 recorded trials.

This study will employ the 2-back task, which increases the task difficulty and requires higher levels of attentional control. The 2-back task presents the participants with a series of letters, shown individually on screen. Each letter is shown for 760 milliseconds, with an interval of 2000 milliseconds between each. If the current letter is the same letter that was shown two trials ago, the participants respond by clicking the "M" key. This task will take approximately five minutes to complete. The participants will receive a score out of 25 for how many correct responses they made.

They will then complete the Eriksen Flanker Task for AC. The task consists of one recorded round, with 50 trials and no training rounds. The Flanker task displays a row of five letters in each trial. The participants will be instructed to only respond to the central letter. If the centre letter is an X or C, they press the 'A' key. If the letter is a V or B, they respond with the 'L' key. The surrounding letters are either congruent (elicited the same response as the central letter), incongruent (elicited the opposite response to the central letter), or neutral (elicited no response). Each letter is shown for 3000 milliseconds. The rapid pace at which the stimuli are shown will heighten the task difficulty level and increase the AC demands. The task will take approximately 3.5 minutes to complete. Each trial carries a score of 1 (correct), 2 (incorrect), or 3 (did not react in time). During data analysis, the 2 and 3 scores will be transformed to a value of 0 (incorrect). Each participant will receive a final score out of 50.

Two one-way analyses of variances (ANOVAs) will be conducted to analyse the participants' scores and determine the effects of bilingualism on the variables, AC and WM. The analysis of results will be computed using IBM SPSS Statistics 29.
The current study will investigate and report on the differences, if any, between young adult bilinguals' and monolinguals' AC and WM based on high AC demands. The research hypothesizes that there will be an advantage for bilinguals in their AC, based on a body of literature that supports the AC theory.[67] The results of the study will contribute to the BA literature and either add support to Bialystok and Craik's AC theory or add further questions as to which EF acts as the central mechanism behind the BA. This research will also play a role in highlighting the need for continued exploration of BA, which could have both scientific and sociolinguistic implications.

67. Bialystok and Craik, "How Does Bilingualism Modify Cognitive Function?";
Comishen and Bialystok, "Increases in Attentional Demands."
Costa et al., "On the Bilingual Advantage in Conflict Processing.";
Achaa-Amankwaa et al., "Multilingualism and Task-Specific Advantages in Cognitive Performance.";
Jiao et al., "Working Memory Demand."
Papastergiou et al., "Study on Executive Functioning."
Luk et al., "Distinct Neural Correlates."

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