

Impact of bilingualism on cognitive flexibility

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Abstract

This research examines the impact of bilingualism on cognitive flexibility, a crucial aspect of executive function that allows individuals to adapt their thinking and behavior in response to changing environments. Bilingual individuals often experience enhanced cognitive flexibility due to the constant practice of switching between languages, which may improve their ability to manage conflicting information and multitask effectively. This study reviews existing literature, including experimental studies and neuroimaging findings, to assess how bilingualism influences cognitive processes such as problem-solving, attention control, and mental shifting. Preliminary results indicate that bilingual individuals tend to perform better on tasks requiring cognitive flexibility compared to monolinguals, suggesting that the bilingual experience fosters mental agility. Additionally, the research explores age-related factors, noting that the cognitive benefits of bilingualism may be more pronounced in early childhood and can persist into older age. The implications of these findings highlight the importance of promoting bilingual education as a means to enhance cognitive skills and adaptability. This study advocates for further research to understand the underlying mechanisms and long-term benefits of bilingualism on cognitive flexibility across diverse populations.

Keywords: bilingualism, cognitive flexibility, executive function, language switching, problem-solving, attention control, neuroimaging, education.

1. Introduction

Cognitive psychology increasingly studies how bilingualism affects cognitive processes. Significantly changed attitudes towards bilingualism in recent years encourage research in this area because bilingualism is no longer considered a drawback, as it was in the previous century. Rather, people are nowadays positively disposed towards mastering more than one language. As was stated in an interesting recent study, compared to 65.6% of the population in 1995, in 2007 as many as

79.87% of the population perceives bilingualism as a skill that has to be learned (Ivica, 2018). In educational terms, mastering two languages in terms of coeducation with members of other nations is ground for the education system, that improves one's language capacity in two days through 24-hour instruction in two languages. Bilingualism has thus broadened its borders, focusing on communication, so as to manifest itself as a competence of understanding, perception, and accuracy in the use of a foreign language. Cognitively viewed, bilingual competence surpasses the borders of monolingualism by emphasizing economy, that is, the maximum effect with the least resource. Bilingualism has irreversibly proven that in terms of cognitive capacities, economy of production is far greater than within the confines of monolingualism. Recently even this thought suggests an upgrade towards multilingual competence. Bilingualism, not only enriches language skills thinking, especially along non-linguistic lines is enriched by bilingual practice of interpretation. It has been established that bilinguals manifest a larger capability to shift attention from one task to another without errors, quicker memory scanning for the purpose of reducing feelings of saturation, or in terms of inhibitory control, suppress responses that could interrupt with executing an individually adequate task according to rules. Preventing linguistic complexity is due to the fact that languages in translation do not overlap in terms of linguistic properties. The main emphasis is placed on interpreting word orientation in order to ignore false association, and the task is to select the real association that they have in common. Studies have also shown that the degree of predicting the hearing of a word is substantially less than when the word is seen in visual form. Studies reveal that children's second language enables them to exclusive thinking about a subject in a language that is not native to them. On the other hand developers of bilingual test of pragmatic competence show people who grew up with two languages significantly higher pragmatic competence, confronting monolingual participants with ambiguous sentences, unclear in terms of interpretation. (Blanco-Elorrieta & Caramazza, 2021)

2. Understanding Bilingualism

Bilingualism is complicated and multifaceted as the different parts of language must be coordinated in its production, and meaning must be extracted from the incoming language input. Bilingualism thus involves all the complexities of single-language

processing but also includes demands that are not present in monolingualism. The study of bilingualism is varied and multidisciplinary— encompassing sociology, linguistics, anthropology, psycholinguistics, neurolinguistics, and education, among others. Bilingualism can refer to even many different aspects: how the languages were learned (simultaneous bilingualism, sequential bilingualism), the cultural and social context in which the languages were learned, the societal status of the languages, and the degree of proficiency achieved in each language (from barely functional to equivalent to that of a monolingual with graduate education and professional training). The variety of possible bilingual experiences means that bilinguals can greatly differ in the relationship they have to each of their languages (the degree to which they are used to communicate with other people, their affective qualities). This variety of experience in turn means that the ways in which the languages come to be processed are incredibly diverse. This creates challenges for researchers who must sample as many of the possible types and experiences of bilinguals as possible, while still maintaining an adequate level of control of the linguistic and extra-linguistic material that is to be tested. On the one hand, these challenges make generalizations about how bilingualism affects cognitive processing difficult. On the other hand, the study of this diversity may lead to a deeper understanding of the cognitive consequences of bilingualism (Nicoladis et al., 2018).

2.1. Definition and Types of Bilingualism

What comes into your mind when you think of bilingualism? As a second language student in a foreign country, a couple of scenarios might come to you: activating different lexicons, adjusting syntax, or sporadic codeswitching between two languages. However, the textbook conversation you encountered on a daily basis was not all about bilingualism. Before diving into the effects of bilingualism on cognition, it is important to sketch a clearer picture and define bilingualism for a more precise understanding. One of the most widespread definitions characterizes bilingualism as the capability to use two languages. This definition, however, shelters a vast spectrum of bilingual experiences and identities. Two languages can be learned at the same time from birth or at different developmental stages. If at least one language exhibits native-like proficiency, then the bilingual will be perceived as having balanced proficiencies in both of her languages. Otherwise, the other language would be

perceived as the dominant language, tipping the balance toward one language. This would then label the bilingual with imbalanced proficiencies as having a more native proficiency in one language only. It could be the L1 or L2, depending on various situations and language use patterns (Nicoladis et al., 2018). Also, acquiring a language is an ongoing process and context plays a crucial part in modulating language proficiencies. Thus, a balanced bilingual may lose her L1 proficiency that had once been native-like and, over time, may lose balanced proficiencies altogether. Similarly, a dominant bilingual might acquire a proficient L2 over time and lose the dominance of a once-dominant L1. This demonstrates the ever-changing dynamics underlying bilingualism and bilingual proficiencies. The context such as giving a presentation or having a lighthearted conversation would prime one language over another, resulting in different performances in different situations. A simple conversation partner could determine the language choice as well. These astonishing grammar skills, language spectra, and adaptive control mechanisms are the result of a constant tug-of-war between two languages, eventually shaping one's bilingual identity. (Bialystok, 2021)

2.2. Cognitive Benefits of Bilingualism

An additional resource on bilingualism and cognitive flexibility is necessary to address current gaps in the literature. As such, an understanding of related theoretical background, findings, and implications is welcome. The review might consider discussing cognitive control, the role of language contexts, as well as potential future research directions. Bilingualism has become a notably popular domain of research in the cognitive field. The extensive amount of research has reported that the bilingual advantage is found mainly in a wide range of cognitive advantages, such as in executive functions. Executive functions are a group of higher cognitive domain of control functions that have been shown to be of considerable importance in the field of bilingual research. Moreover, discussing broader language and context factors would provide a more comprehensive picture of bilingualism and possible links with Cognitive Flexibility. Thus, Bilingual language, evaluated respectively by the type of bilingualism (simultaneous and sequential), and the measured language in experimental paradigms, has a key role in exercising language skills and directing the mind so as to foster cognitive control. In fact, this complex and stressful necessity is

believed to forge an efficient cognitive control mechanism in the brain (Boudros, 2017). Past related studies have suggested that many factors, such as different language experiences and practices or cognition demands contexts, may unfold the effect of bilingualism on executive functions that lead to cognitive flexibility (Barbu et al., 2018). Future research on bilingualism and cognitive flexibility would be of value to reveal the effect of language contexts on cognitive flexibility by enhancing the experimental control of the language contexts.

3. Cognitive Flexibility: Definition and Importance

Cognitive flexibility is the ability to switch between thinking about different concepts, or think about multiple concepts simultaneously (Nicoladis et al., 2018). It is a crucial mental process for problem-solving. Additionally, since many aspects of people's environment, including social institutions and technology, keep changing at an increasingly rapid pace, cognitive flexibility will become more and more vital to successfully adapting to new situations. Cognitive flexibility is one of the three critical components of executive function according to the model developed by Miyake et al. It is defined in this model as the ability to switch back and forth between multiple tasks or mental sets. When bilinguals engage with one of their languages, they learn to inhibit the nontarget language to reduce crosslinguistic interference. This process of suppression, in turn, sharpens skills that are required to rapidly switch between mental sets, or cognitive flexibility, leading to better performance on cognitive control tasks. This bilingual advantage has further been found to extend to individuals without an immigrant background and to non-executive control tasks. ADHD children often suffer from language imbalance and fail to develop language separation skills compared to TD children, thus reducing the training effect of bilingualism on cognitive flexibility. Indeed, children with greater language separation demonstrated better EF performance compared to their peers with no language separation. Results show that better performance in reading was predicted by higher levels of cognitive flexibility, and better performance in math was predicted by both cognitive flexibility and working memory. These findings suggest that cognitive flexibility is particularly important for academic success in all subjects even when controlling for FSIQ. In this sense, fostering children's cognitive flexibility may facilitate a significant improvement across various academic disciplines well beyond

executive control tasks. Recent studies have further demonstrated that cognitive flexibility is a significant predictor of social and emotional well-being in children and adults, including in regulated learning, emotion regulation, and social competence. Compared to other executive functions, cognitive flexibility is expected to show the strongest relationship with personal decision-making development. Because cognitive flexibility is the ability to rapidly switch focus among stimuli, it can affect a person's ability to identify, comprehend, and respond to ambiguity in decision-making situations. This is in line with previous research showing that bilingualism can enhance cognitive flexibility. (Köder et al., 2022)

4. Research Studies on Bilingualism and Cognitive Flexibility

A hotly debated topic in the literature is whether bilingual individuals exhibit superior flexibility in thinking. There have been diverging claims in light of the most well-established cognitive benefits known for bilinguals. The present article reviewed research studies that examined the relationship between bilingualism and cognitive flexibility in the hope of identifying factors that might have contributed to the differences in reported results. Bilinguals have been reported to outperform their monolingual counterparts in overarching cognitive benefits. These cognitive benefits, however, have not always been consistently observed. Several studies have shown that bilinguals and monolinguals perform comparably on different cognitive tasks. Such discrepancies have prompted researchers to conduct studies that attempt to explain why earlier evidence of a cognitive advantage for bilinguals is sometimes not observed.

One compelling explanation for the inconsistencies is the existence of a modifying parameter or a constellation of various internal and external factors. For instance, age of acquisition and level of proficiency in a given language play a crucial role in the magnitude of the benefits. These two principal factors lay a theoretical groundwork for examining other potential influencing variables. Furthermore, other factors, such as the level of executive control involved in bilingual tasks and quantity of daily switching, have been well-documented in recent literature. Alternatively, researchers have stressed the need to account for an aspect of bilingualism that is intrinsic to the individuals, such as the traits of the bilinguals. Most of the above-mentioned studies showed that even though bilinguals outperformed monolinguals in global cognitive

processing, no flexibility advantage was demonstrated. On the other hand, several studies have indicated an evidence for flexibility in thinking benefit for bilinguals. However, the bilingual advantage was not demonstrated in both aspects of trail-making tasks (N Boudros, 2017).

4.1. Key Findings

The subsection distills and analyzes the key findings from recent studies, roles and ages of bilingual speakers, cognitive and linguistic effects of bilingualism, professional benefits and cognitive advantages of bilingual speakers, literacy and the role of demographics and linguistic variables in achieving the full benefits of bilingualism. The subsection then offers a critical analysis of the reviewed, a theoretical model of the relationship between speaking and reading in matrix-spanish-to-english late bilinguals, the ability to neglect irrelevant information may facilitate bilingual sentential, and the primary benefit of bilingual experience is enhanced dorsolateral prefrontal cortex plasticity. The subsection concludes with a summary of the potential influence of environmental and language dominance factors on developmental and non-developmental bilingual speakers.

With growing evidence of bilingual cognitive advantages a critical review is needed. The evidence for cognitive benefits is far from definitive and several issues must be addressed for this body of work to mature and for the integration of findings across studies to be possible. Advocacy for the potential impact of bilingual media uses on unofficial language development research, and school read-aloud practices of emergent bilingual youths may want to consider leveraging the joint cognitive and linguistic advantages that are associated with a lifelong habit of media use. Introducing a clear and accessible point that fosters multicultural support and appreciation, the research suggests a beneficial approach to media use for minoritized-language youth.

With globalization on the rise, and with ever-more rapidly changing societies, the multiplied linguistic potential offered by bilingualism is an asset of significant magnitude. Bilinguals report that through the acquisition and use of two languages they are better enabled to work their way around scenarios where global diversity is a key strength. The positive impact of bilingualism on society has been alluded to in policy documents which indicate that bilingualism has cognitive, cultural, socio-

economic and educational benefits as it involves new opportunities opening up to young people at a global level and the enhanced competitiveness of businesses, research centres and universities at the European level. The research question up to this point in time has been to discern whether and how an early start in life-long bilingual conduct affects a wide array of cognitive and language related activities. (Cheng, 2022; van Hell, 2021)

5. Practical Implications and Recommendations

Bilingualism, the regular daily use of two or more languages, has been shown to impact cognition in ways that benefit cognitive flexibility (N Boudros, 2017). Cognitive flexibility in turn has broader impact on the ability to solve problems that require thinking “outside the box”. One important implication of the findings for educators is the necessity to include bilingual education as a part of the curriculum. In light of the advantages of bilingual education described here, strict constraints on curriculum planning that exclude bilingual education are inconsistent with goals of promoting academic achievement in students. Another, equally important implication is that teachers need not require a specific aptitude in the two languages. In contrast, what is vital is the extent to which the two languages are used in daily life. This suggests that teachers may foster good use of two languages by developing lessons that naturally incorporate both languages and encouraging bilingual students to continue developing both languages.

Recommendations for school districts and policymakers revolve around the practicality of maintaining and developing bilingual language acquisition once it has been initiated. In addition to fostering good use of the languages as described above, school districts and policymakers can capitalize by providing ample support and education to parents of bilingual children. Additionally, given that cognitive benefits of bilingualism can emerge when the two languages are used in dual language conditions throughout life, school districts may consider the value of rolling out similar dual language curriculums even at the high school level. Parents of bilingual children should be aware that it is indeed beneficial to encourage bilingual language acquisition in children, as cognitive benefits may then emerge throughout development. For these parents, when they are of the lower (SES), there might be initiatives to disseminate through GP clinics or public channels. Community centers

might also be used as a venue to host events on bilingual language acquisition, where both parents and teachers could benefit more broadly. With relatively few changes to the existing system, considerable benefits in student cognitive development might be reaped.

One important consideration is that these findings have important implications for societies at large; further support by communities can thus help foster cognitive development in individuals as they develop. In turn, this might promote additional support and resources to encourage further bilingual development across schools, communities and societal attitudes in general. This would be of great advantage not only at the level of cognitive effects, but also in fostering communication across cultures, and appreciation of others. Moreover, continued community support will likely ensure that bilingual individuals will continue to flourish cognitively across the lifespan. Ensured that historical separatism between Quebec and English Canada has apprehended – bilinguals were affectionate towards each other, arrived to consensus sooner than monolinguals, made better joint decisions. Furthermore, especially in an increasingly globalized society, fostering bilingualism could thus be a means of promoting social harmony by deepening understanding and respect of others. An increasing effort at the level of schools, parents and more broadly in the societal attitude is thus called for to recognize and implement practices that support bilingual acquisition, to everyone's advantage. (Bialystok & Shorbagi, 2021)

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