

Bilingual Children's Working Memory Development Research: The Inquiry of Effects between Early Childhood and Later Stages

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Abstract: To investigate whether bilingualism brings cognitive benefits on human's brain and development in lifetime, this paper explains the mechanism of working memory and bilingualism to explore how bilingualism affects children's working memory from early childhood to the later stage, whether there is greater effect on earlier childhood than later? Through interpreting some current research and literature, this journal article reviews that bilingualism may not directly affect the breadth of children's working memory. However, bilingualism enhances children's cognitive abilities in the process of language conversion in their brains. And bilingual children's cognitive advantages are also demonstrated at higher levels of cognitive processing from early childhood to later adulthood.

1. Introduction

Parents around the world are interested in raising children bilingually since being bilingualism could bring considerable cognitive and intellectual benefits to their life. For example, several research indicates that bilingualism has a positive effect on children's cognitive development, task performance on executive functions system (EF), inhibition, shifting, and updating ^[12] (Miyake et al., 2000); Working memory is the significant component of executive function, which plays a crucial role in the whole memory development and cognitive system, this paper will explain the mechanism of working memory and bilingualism to explore how bilingualism affects children's working memory from early childhood to the later stage, whether there is greater effect on earlier childhood than later?

2. Bilingualism and Working Memory

Children's working memory has been uniquely modified by bilingualism from early childhood to adulthood ^[13] (Morales et al., 2013). As Bailey and the colleges (2020) indicated in their research, bilingualism refers to an individualism who can use or speak two languages at the same time in language system ^[5], while monolingualism is to refer those people who can only use one language throughout lifetime. Furthermore, the early bilinguals are those children who are learning and using two languages before 6 years old ^[1] (Archila-Suerte et al., 2016). Bilingualism also affects working memory of bilingual human-being, and ^[2] "Working memory refers to the temporary storage of

information in connection with the performance of other cognitive tasks such as reading, problem-solving or learning” (Baddeley, 1983, p. 311). Since bilingualism requires to switch languages in the brain, bilinguals from early to later stages continuously work in the selection and switching of two languages, over time, it strengthens children’s memory development and cognitive system to suppress irrelevant information ^[3] in the current task which they need to deal with during that task (Bialystok et al., 2004). To be more specific, bilingualism brings the effects on spatial working memory tasks that bilinguals have better spatial memory than monolinguals, indicating that bilinguals are well process and organize information to obtain greater working memory capacity in their brain ^[9] (Feng, 2009). Bialystok and colleagues (2014) conducted on bilingual verbal and nonverbal working memory ^[4], found that bilinguals only had advantages in nonverbal tasks, while the differences between bilinguals and monolinguals in verbal tasks were not significant.

2.1 Bilingual Advantage Theory

The Bilingual Advantage theory has been first put forward by ^[10] Giovannoli et al. (2020) that Bilingual Advantage Theory is to maintain both languages active in the brain throughout the continuous need to control two known languages, and to use language that is suitable for each specific environment, thereby improving cognitive function, especially executive function. The ability of using two languages embarks bilingualism on extending cognitions to multiple tasks at the same time ^[4] (Bialystok et al., 2014). According to ^[2] Baddeley’s working memory model (1983), working memory includes three parts: phonological loop, visual spatial sketchpad and central executive system. Among them, the central executive system is considered to be the core component of working memory, also, the central executive system is mainly responsible for the control processing in working memory. That is, the central executive in working memory is very important for bilingualism processing in the brain^[2] (Baddeley, 1983).

2.2 Mechanisms of Development

Bilingual children show their advantages on cognitive outcomes based on the historical line. For toddler and adolescence group, research conducted by ^[11] Kormi-Nouri et al. (2003) explore the difference of bilingual children and monolingual children on explicit memory, and they selected children aged 3, 8, and 11 to complete episodic memory tasks. The results showed that bilingual children performed better in recognition and retelling than monolingual children (Kormi Nouri et al., 2003). In recent years, research has focused on bilingualism and learning in infancy. For example, ^[6] Brito and Barr (2014) found that infants with bilingual experience performed better in imitating behavior at 18 months of age than monolingual children.

2.2.1 Biological

With the widespread application of biology, the mechanism by which bilingualism affects working memory is gradually explored. Completing bilingual switching needs different parts of brain to work together, the higher intensity bilingual practices can enhance individual executive function ^[7] (Barac & Bialystok, 2012). As indicated by Barac and Bialystock (2012), the ^[7] prefrontal lobe is the core brain area for working memory. Individuals who complete tasks and switch and control two languages would activate the prefrontal lobe in the brain. Therefore, in the daily language switching process, bilingual children’s neural networks which are closely related to working memory are continuously practiced, thereby enhancing their executive function as well.

2.2.2 Cultural and contextual influences on change

The outcome of bilingual children's working memory may change based on parenting rearing and language policy used in different environments, and it is necessary to consider how they manage two languages and the language environment they are in ^[16] (Yang 2017). As the research about the difference of working memory between Korean near-monolingual, Korean-English intermediate, and ^[16] Korean-English high bilingual groups conducted by Yang (2017), it indicates that the acquisition of two languages does not guarantee the working memory advantage of bilinguals over monolinguals. More importantly, the advantages of bilinguals mostly depend on the environment of their language growth, which requires them to use the certain cognitive functions, and to some extent depends on the cognitive skills recruited by bilinguals to manipulate both languages at the same time.

2.3 Scholarly Argument

However, whether bilingualism has an effect on working memory is still controversial. Some studies on examining working memory in bilingual children have provided conflicting results that they found bilingualism enhanced working memory does not exist ^[14] ^[8] ^[16] (Namazi & Thordardottir, 2010; Engel, 2011; & Yang, 2017). Research from Engel (2011) selected ^[8] 44 bilingual and monolingual children to investigate whether early bilingualism would affect the performance of working memory of children aged 6 to 8 years. The data of the study shows that monolinguals perform significantly better in language measurement, while these children have no language group effect in working memory and mobile intelligence tasks. The results showed that bilingualism has an impact on children's language skills while little effects on children's working memory from 6 to 8 years. ^[16] Yang (2017) indicate that being bilinguals does not assert the enhanced working memory with comparison to the monolinguals, but the benefits show in their cognitive trainings when bilinguals are engaged in using two languages. More specifically, ^[14] Namazi and Thordardottir (2010) conducted an experiment on 15 French-English bilinguals, 15 French monolinguals and 15 English monolinguals through comparing their differences in verbal working memory and visual working memory. With comparison of the study results, bilingual children did not show benefits on the Simon Task and visual working memory test, bilinguals and monolinguals have similar results in both Simon Task and visual working memory task scores. Both bilinguals and monolinguals who show their advancement in accurate visual working memory also show better skills in Simon Task and there was no significant difference in task scores between bilinguals and monolinguals.

Additionally, bilingual children live in the diverse language environment than monolingual children, which affect their performance on linguistic tasks since they have less time in experiencing the particular language especially on language exposure frequency in the daily conversation.

3. Application and Conclusion

On the other hand, combining the topic of raising children bilingually throughout the world, there are few parents who are able to raise their children bilingually with consideration of linguistics, bilingual education and their brains. Therefore, based on the existing theory of bilingual benefits, it is particularly important to focus on the impact of children's memory system, cognitive development, and the systematical bilingual education on raising children bilingually.

Therefore, in the debate about whether bilingualism affects children's working memory, the existing research generally supports the view that bilingualism may not directly affect the breadth and capacity of children's working memory. From early childhood to the later adulthood, bilingualism enhance children's cognitive abilities during the time when they process language switching in their brain, thereby demonstrating bilingual cognitive advantages in more higher-level

cognitive processing ^[15] (Schroeder & Marian, 2012).

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