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BILINGUAL COGNITIVE AND LANGUAGE DEVELOPMENT IN THE EARLY YEARS

EL DESARROLLO COGNITIVO Y LINGÜÍSTICO BILINGÜE EN EDADES TEMPRANAS

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Resumen:

Este artículo muestra cómo aprender dos idiomas desde una edad temprana puede ser una ventaja para el desarrollo de los niños. Aunque los estudios sobre el desarrollo del aprendizaje lingüístico no son nuevos, es crucial comprender las ventajas de ser bilingüe desde una edad muy temprana. En el contexto de estas aportaciones sobre el desarrollo bilingüe, este artículo proporciona un estado de la cuestión acerca de los efectos del proceso de adquisición del lenguaje en el desarrollo cognitivo infantil. Los resultados de esta revisión sugieren que los niños bilingües tienen beneficios cognitivos que redundan en su éxito como estudiantes. Sin embargo, hay algunos desafíos que aun pueden abordarse para que los niños bilingües mejoren aún más su capacidad de aprendizaje. Ser bilingüe, lejos de provocar problemas, mejora las habilidades cognitivas. En este sentido, es preciso fomentar más investigaciones sobre el bilingüismo en la primera infancia.

Palabras clave: Cerebro bilingüe; bilingüismo temprano; desarrollo bilingüe; primera infancia; adquisición del lenguaje

Abstract:

This article offers an examination of how learning two languages from an early age may be an asset to children's development. Although discourses on language learning development are not new, it is crucial to understand the benefits of being bilingual from a very early age. At the interface of bilingual development, the present review article provides a summary of the knowledge gained by science into the effects on children's cognitive development during the language acquisition process. Results from this review suggest that bilingual children enjoy cognitive gains which are critical for students' success but there are some challenges that can be addressed to further enhance bilingual children's learning. Rather than causing any kind of delay, being bilingual improves cognitive skills and more research on early childhood bilingualism must be further developed.

Keywords: Bilingual brain; early bilingualism; bilingual development; early childhood; language acquisition

1. Introduction

Babies and young children have early learning skills which equip them in a such a way that they learn any language with apparent ease (Garcia-Sierra et al., 2011; Petitto et al., 2012; Costa & Sebastián-Gallés, 2014; Ferjan, Ramirez, Clarke, Taulu, & Kuhl, 2017). In fact, early childhood (0 to 6 years) is considered a critical period for language learning development (Johnson & Newport, 1989; Newport, 1990). All babies are born around the world with the potential to become bilinguals, however as Ferjan and Kuhl (2017a) suggest the optimal period for second language learning is at an early age through high-quality real-life interactions.

The first moments, months and years of life, especially the first three years, are the most important years of a child's life since they are very determining in the configuration of the brain. After birth, the brain is in constant activity that depends largely on its relationship with the world around it (Mora, 2017). Moreover, this relationship is fundamental for the development of many brain functions since the main neural networks are established (Mora, 2017).

The brain is the most complex organ of the body and it does have the potential to change physically. This capacity is called plasticity because the brain is a mouldable plastic organ in constant change throughout life. However, these physical changes are different in each human being as they depend on everything that is learned, the education received and the culture and environment in which one lives (Mora, 2017). In fact, this plasticity differs depending on whether a child learns either one or two languages in early childhood, producing consequently some cognitive differences in the brain.

Previous studies suggest that monolingual or bilingual language input during early childhood predicts later performance and learning (Deniz, Richards, & Kuhl, 2013). However, much of the research which examines language development focuses on monolingual children. Yet humans do not know too much about the effects of language input in bilinguals (Ramírez-Esparza, García-Sierra, & Kuhl, 2016) which might lead to the further propagation of misconceptions. Some of these widespread beliefs state that children who learn two languages at the same time are at a disadvantage regarding linguistic development (King & Fogle, 2006; Petitto, 2009; Petitto et al., 2001). Therefore, the purpose of this review article is to explore and better understand how being monolingual or bilingual from birth might determine future cognitive skills and language development. This article adopts an evidence-based methodology and reviews empirical studies on young bilingual children to gain insight into the possible benefits of being bilingual at an early stage and their implications for later language and cognitive development.

2. Discovering the bilingual brain

Studying the human brain is a very complex task and a very controversial issue. Until very recently, there was not enough information about the brain's machinery, but thanks to different non-invasive techniques, such as electroencephalography, magnetoencephalography and functional magnetic resonance imaging, a large quantity of experiments has been carried out with monolingual and bilingual children. In fact, as Kuhl (2011) notes we are getting more and more information about the cognitive effects associated to bilingualism. For the purpose of this review, the term bilingualism refers to the ability to express oneself in two languages (Byers-Heinlein & Lew-Williams, 2013). However, it is essential to understand also the linguistic aspects in order to comprehend the differences and variations among monolingual and bilingual learners. To this end, it is necessary first to study the language input and language outcomes in monolingual children to later understand the bilingual brain (Ramírez-Esparza et al., 2016).

2.1. Early language acquisition

Babies are born with the ability to detect not only the sounds which make up the words in their native language (Kuhl et al., 2006), but also the sounds of other world languages (Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Streeter, 1976). Moreover, up to 6 months of life, babies are good at discerning both native and foreign sounds; they are characterized as citizens of the world (Kuhl et al., 2006). However, between 6 and 12 months of life, infants' monolingual brains, as a result of listening predominantly to their native language, start losing the ability to spot the differences between the sounds in their mother tongue and the sounds of a foreign language. Thereby, infants become native language specialists by the end of the first year of life (Kuhl et al., 2006), i.e. the infant brain is no longer prepared for all languages, but instead it is primed to the mother tongue (Kuhl & Rivera-Gaxiola, 2008). It is about this point in life that two major changes occur: native phonic abilities considerably increase whereas the ability for discriminating other non-native language sounds declines (Cheour et al., 1998; Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Kuhl et al., 2006; Rivera-Gaxiola, Silva-Pereyra, & Kuhl, 2005; Sundara, Polka, & Genessee 2006).

The fact of being specialized in recognizing just the native sounds implies a series of consequences for monolingual infants. For instance, being good at discerning the native sounds sustains the detection of high-ordered language patterns. Therefore, the more the infants discern the sounds of their mother tongue, the larger their vocabulary will be for when they become adults (Kuhl et al., 2008). Nevertheless, native language specialists, as they are committed with native sounds, exhibit a reduction in recognizing foreign patterns. Their brains have learned to recognize, during a very critical period of lifespan, only native patterns. As a consequence, when it comes time for them to recognize non-native sounds, monolingual children present difficulties for tagging them (Zhang et al., 2009; Kuhl et al., 2006).

2.2. Early language acquisition in bilingual children

Research suggest that children acquire a second language with more ease than adults do because the commitment to native sounds and patterns are still incomplete during the first years of life. In fact, children who are exposed to two languages from birth typically become native language specialists in both languages (Ramírez-Esparza, García-Sierra, & Kuhl, 2014). According to Ferjan et al. (2017) babies' brains become specialized in processing whatever language or languages present in the environment. Consequently, part of the brain configuration depends on the child's language experiences (Ramírez-Esparza et al., 2016).

Other studies have also suggested that the brain responses depend on social interaction. In a study with 9-month-old infants, it was registered that these infants showed a phonetic reaction from live exposure, but not from recorded audios (Kuhl, 2011). As Ramírez-Esparza et al. (2016) suggest this is due to the fact that both monolinguals and bilinguals respond better to one-on-one interactions when there is a high exposure of child-directed speech; hence language experience at home is vital and fundamental for language acquisition (Ramírez-Esparza et al., 2014). But how is language mapped in the bilingual brain?

This question has been a major and intriguing issue to brain scientists. Contemporary research (see Kuhl & Rivera-Gaxiola, 2008) has significantly advanced in understanding how neural networks in bilingual infants are established in such a way they can respond in a native-like manner to two different languages. Language growth in bilingual infants depends on the quantity and quality of the speech in each language (Ramírez-Esparza et al., 2016). However, there are some factors which directly affect these quality and quantity elements. For instance, one-on-one interactions are much more favourable since learning does not occur in the same

way when it is presented through audiotapes than with real human interaction (Kuhl, Tsao, & Liu, 2003).

In addition to one-on-one interactions, the amount of child-directed speech is an important factor that influences language development. When children are exposed to two languages from an early age, they "develop each of their languages as a function of relative exposure" (Ramírez-Esparza et al., 2016, p. 16). Furthermore, bilingual children's language development of both languages depends on the quantity and quality of utterances they are exposed to in each language (Garcia-Sierra et al., 2011). Additionally, it appears that this early bilingual experience alters the way this information is processed, influencing bilinguals' cognitive growth (see Baker & Hornberger, 2001; Cummins, 1976).

3. Cognitive benefits of being bilingual

Studies have shown that bilingual children enjoy advantages that affects cognitive abilities that also extend into adulthood (Marian & Shook, 2012). In the last decade, researchers (Barac & Bialystok, 2012; Bialystok & Feng, 2011) have uncovered multiple bilingual brain advantages. In fact, a number of studies (see Vásquez, 2009) point toward important cognitive benefits of being bilingual such as (1) strengthened executive functions and cognitive flexibility, (2) fostered metalinguistic skills, (3) co-activation, (4) enhanced attentiveness, and (5) better performance on conflict tasks.

(1) Strengthened executive functions and cognitive flexibility

Developmentally speaking, the bilingual experience boosts both executive functions and cognitive flexibility. The executive functions refer to a series of cognitive processes, such as the attentional and inhibitory control skills, whereas cognitive flexibility is linked with problem solving and planning skills (Ferjan & Kuhl, 2017a). Bilingualism is responsible for driving these brain functions (Ferjan et al., 2017), shaping the activity and the structure of the brain (Marian & Shook, 2012). These cognitive abilities are reinforced when there is a big exposure to both languages, i.e. the more a bilingual person is dealing equally with two languages, the more these cognitive skills will be developed (Craik, Bialystok, & Freedman, 2010).

(2) Fostered metalinguistic skills

Interestingly, reading is a complex cognitive process that requires the brain to balance the attention given to the text, structure and other factors in order to decode and construct meaning. Bilingualism, as it affects the brain plasticity, is responsible for greater flexibility when learning language patterns. In fact, bilingual children about 7-12 years old understand and acquire better and faster language patterns than monolinguals do (Kovács & Mehler, 2009b; Graf & Hay, 2015).

Ferjan and Kuhl (2016) investigated the acquisition of vocabulary and grammar in bilingual infants and found that they start producing their first words at the same age as monolingual children do. Furthermore, research shows that the process of acquiring and incorporating new vocabulary and grammar in bilingual children looks very much like monolingual children's trajectory (Parra, Hoff, & Core, 2011), and the acquisition of vocabulary and grammar in each language replicates the monolingual pattern (Conboy & Thal, 2006; Parra et al., 2011). However, the bilingual language experience has often been reported as a lag in vocabulary and grammatical acquisition (Ferjan & Kuhl, 2016). While some studies (see Hoff, Core, Place, Rumiche, Señor, & Parra, 2012) have attested that early bilingual language development is within monolingual norms for the age at which they attain basic vocabulary and grammar, other studies (see Hoff et al., 2012) have reported that bilinguals, as they handle with less vocabulary

in each language, lag behind on grammatical standards when one language is considered. Moreover, as Ferjan and Kuhl (2016) noted this does not turn out to be surprising considering that children language experience depends on the quantity of language they hear and the fact that bilinguals need to split their time between two languages.

Nevertheless, Ferjan and Kuhl (2016) found that bilingual infants do not lag behind monolingual peers when only one or both languages are considered. As it happens in monolingual development, the rate of vocabulary and grammar in bilinguals correlates with the quality and quantity of their dual language exposure (Conboy & Mills, 2006; Place & Hoff, 2011; Ramírez-Esparza et al., 2016). Thus, hearing fewer words in one of the languages does not make bilingual children to lag when they are compared with their monolingual peers (Ferjan & Kuhl, 2016). Actually, the quantity and quality factors, as they depend on the experience with each language, are revealed in the brain activity. As research suggests the dominant language in bilingual children exhibits more mature brain activation compared to the less dominant language (Conboy & Mills, 2006).

(3) Co-activation

The co-activation or joint activation of a bilingual's two languages happens regardless of the intention to use one language (Kroll, Bobb, & Hoshino, 2014). As Bialystok, Craik, and Luk (2012) pointed out there is a constant activation of both languages at the same time in the bilingual brain, even when the bilingual child is exposed to an entire context driven by one of the languages. Thus, when a bilingual child is using one language in a specific moment, the other language is also active, i.e. when the child hears a word belonging to one of the two languages, both languages systems are simultaneously and equally activated regardless of the language the words belong to (Marian & Spivey, 2003).

According to Bialystok et al. (2012), co-activation seems to have a direct relation with both linguistic and non-linguistic processing in bilingual children. For linguistic processing, this joint activation produces an attention problem in which the bilingual brain is evaluating the two competing languages, focusing on the language being used. This is referred as a global inhibition, i.e. when the child has to "respond in one language, suppressing the other one" (Bialystok et al., 2012, p. 9). On the other hand, local inhibition happens when the child has only to inhibit a specific competing distractor by processing constantly the stimuli coming from the language being used (Bialystok et al., 2012). Further, both these types of inhibition are responsible for the linguistic performance (de Groot & Christoffels, 2006). However, for non-linguistic processing, co-activation might be driven by competition and attention processes occurring during the linguistic processing, i.e. linguistic processing affects cognitive processes such as executive functions. Therefore, the co-activation of both languages seems to explain the enhancement of control mechanisms in bilinguals, such as cognitive processes (Bialystok et al., 2012).

(4) Enhanced attentiveness

Following with the fourth cognitive benefit, it seems that "bilingualism enhances general perceptual attentiveness through the experience of attending to two sets of visual cues" (Bialystok et al., 2012, p. 12). In fact, Weikum et al. (2007) conducted a study to examine whether monolingual and bilingual 4-, 6- and 8-month-old infants could discriminate languages. In their study, infants were shown video clips of the same speaker in two languages; however, results indicated that only bilingual 8-month-old infants showed renewed attention when the language switched, noticing the language change while monolinguals did not. Therefore, as Bartolotti and Marian (2012) among others (see Bialystok et al., 2012) concluded bilingualism enhances perceptual attentiveness facilitating bilingual children's early development.

(5) Better performance on conflict tasks

In terms of performance on tasks that require conflict management, evidence indicates that bilinguals outperform monolinguals (Bialystok et al., 2012; Marian & Shook, 2012). For example, in the classic Stroop Task monolinguals and bilinguals were presented with a series of colour words appearing in different colours and asked to name the font colour, instead of reading the word. When the colour and the word matched both monolinguals and bilinguals performed equally, but when the colour did not match the font, bilinguals performed better (see Bialystok et al., 2012) as they might ignore perceptual information and focus on the relevant data (inhibitory control). As Colzato et al. (2008) suggest bilingualism can enhance inhibitory control since bilinguals have a better ability to discern goal-relevant information, outperforming monolinguals (Marian & Shook, 2012).

Two other studies (see Prior & MacWhinney, 2010) conducted with children also provide evidence for early bilingual advantages in the performance to shift mental sets. Bilingual children were much faster and more efficient than monolinguals on the sorting tasks based on colour and shape, requiring children to coordinate simultaneous performance (multitasking). Further, as Health (2012) pointed out, bilinguals seem to perform better at multitasking because their cognitive development is more strengthened than in monolinguals.

3.1. Enhancing bilingual children cognitive abilities

It is well established that bilingual children enjoy cognitive gains compared with monolingual children (Bialystok et al., 2012; Kovács & Mehler, 2009a) that are critical for students' success later in life. However, there are some challenges faced by bilingual children such as (1) splitting time between two languages or (2) code switching that need to be addressed in order to further enhance bilinguals cognitive skills instead of potentially causing a "damaging effect upon children's educational outcomes" (Eilers, 2005, p. 2).

(1) Splitting time between two languages

There is a debate over the advantages of bilingualism and whether bilingual children acquire each language at the same rate that children in monolingual environments do (Kuhl & Rivera-Gaxiola, 2008) and whether they lag behind their monolingual peers since bilingual children have to split their time between two languages. However, language development might influence in bilinguals' experience not because the learning process is different from monolinguals, but rather due to the fact that acquiring two languages at the same time require more time for getting equally experienced in both languages (Kuhl & Rivera-Gaxiola, 2008). In fact, compared to monolingual peers, bilinguals generally hear fewer words and sentences in each language (Ferjan & Kuhl, 2017a).

In contrast, bilingual children often reach language-specific listening later than monolinguals do (Kuhl & Rivera-Gaxiola, 2008). This delay could be due to the amount of people in the child's environment producing both languages and the quantity of input that is provided from those languages. Depending on these two factors, the language development in bilingual children might change (Kuhl & Rivera-Gaxiola, 2008), and thus the language-specific listening can be reached at either earlier or later stages of growth. Along these lines, there might be some initial cognitive costs such as lower oral proficiency and slow vocabulary development, which generally disappear over time (Eilers, 2005). Nevertheless, research shows that this does not necessarily imply that bilingual children lag behind monolinguals when both languages are considered. In fact, bilingual children reach the same monolingual norms when adequate support is provided (McCabe et al., 2013) and their vocabulary size is equal to or greater than monolinguals (Hoff et al., 2012; Hoff & Core, 2013).

(2) Code-switching

Another important challenge for bilingual children is code-switching which is "the surface manifestation of bilingual co-activation" (López, 2018, p. 3). In fact, going back-and-forth from one language to the other is a natural behaviour for bilinguals since they often know words or expressions better in one of both languages. This switching, also referred as language or code mixing, is the ability to integrate and separate two languages during the communication process (Ferjan & Kuhl, 2017a).

Switching from one code to the other and the constant effort for driving the attention to the target language enhances and enriches the brain networks (Ferjan & Kuhl, 2017a). In addition, this language mixing is used by bilinguals to facilitate communication (Ferjan & Kuhl, 2017a). Surprisingly, when code-switching occurs, children adhere to grammatical rules in the mixed-language they produce when they communicate. Bilinguals' brains still adhere to grammatical rules, adhering to predictable rules (Paradis, Nicoladis, & Genesee, 2000) showing that code switching is not a random mix of words but a strategic tool for bilinguals (Ferjan & Kuhl, 2017a).

Interestingly, bilinguals also need to keep a constant balance between the two languages so that one of them does not interfere with the other. To do so, the bilingual brain launches the executive functions. In bilingual children, as language systems are always active and competing, their brains need to use the attention and inhibition mechanisms (executive functions) every time the child is listening or speaking. This unceasing practice strengthens the executive functions as well as it changes the correspondent brain regions underlying these mechanisms (Bialystok et al., 2012).

4. Conclusion

In recent years, all these well-known benefits of bilingualism and the communicative, social and economic advantages that it promotes have made of bilingualism a very desirable goal (Ferjan & Kuhl, 2017b). As a result, a growing demand for bilingual education programs is being requested (Garcia, 2015; Williams, Garcia, Connally, Cook, & Dancy, 2016). Moreover, bilingual children have the necessity for developing both languages and get prepared for school, but they sometimes find a restricted and limited access to either one or both languages. However, Ferjan & Kuhl (2017a) and Genesee (2015) suggest bilingual children should be provided with a full range of opportunities and favourable conditions to succeed in school, and extensive research on early childhood bilingualism must be carried out.

The evidence reviewed indicates that bilingual children enjoy cognitive gains which are critical for students' success. As a result, when it comes to raising and educating a child bilingually, parents, educators and policymakers must work together to further explore into the underlying knowledge about the benefits of a bilingual brain. Moreover, being bilingual benefits children and addressing their individual bilingual needs is essential for being successful in learning both languages. However, further research is required to fully understand early childhood bilingualism in home and school environments.

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