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NEUROPHYSIOLOGICAL INVESTIGATION INTO BILINGUALS' MENTAL ADVANTAGES

НЕЙРОФИЗИОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ ПСИХОЛОГИЧЕСКИХ ПРЕИМУЩЕСТВ БИЛИНГВОВ

Abstract:

Modern studies of bilingualism tend to focus on the neurophysiological processes related to changes in the structure and peculiarities in the functioning of the brains of bilingual people. Particular interest is shown towards studies related to the formation of the brain structures in young children who are raised in multilingual environments. Bilinguals display their advantages most clearly in early childhood when they can be more disciplined, much better at communicating, and more empathetic than their peers. Researchers have proven that communication with native speakers is the decisive factor which enables the successful acquisition of a foreign language. Such early experiences of bilingual communication form a special language zone in children's brains, which makes it much easier to learn foreign languages later on in life. Monitoring of adult bilinguals reveals that they tend to be adapted much better to their social and professional lives. Artificial bilingualism at a later age can reveal personal traits that are related to the acquisition of a particular foreign language. Senior bilinguals have more flexible mental processes, better memory and concentration ability as well as slowed dementia onset.

Keywords: bilingualism, polylingualism, cognitive development, personal qualities, natural early bilingualism, late artificial bilingualism

Introduction

Modern researches into the social and personal qualities of bilinguals show their apparent benefits in social and professional environments. Research into bilingual brain functions shows that special zones are formed by natural bilinguals in early childhood. Activity in these zones guarantees undeniable cognitive benefits for bilinguals in senior age. Researchers are increasingly focusing on

the study of the mechanisms that regulate the use of different languages and the effects of polylingualism on cognitive processes, socialisation, and inter-personal communications, as well as polylingualism's manifestations at different ages.

Theory

The first studies of childhood polylingualism showed that the simultaneous acquisition of two languages has negative impacts on children's cognitive and speech development (I. Epstein, 1916). Consequently, experts often recommended that children begin learning foreign languages aged seven or ten years. Soviet schools relied on this psychological and pedagogical approach. However, it is well known that children who started learning a foreign language at ten years of age often failed to acquire communication, reading, and writing skills in a foreign language, although they may have continued to study it for many years.

The shift in the understanding of the role of early learning of a second language happened after the publication of information related to the positive effects of early bilingualism on children's cognitive development and socialisation. Researchers of children's bilingualism note that infants up to six months old are "linguistic geniuses" because they can distinguish sounds in all human languages. By the end of their first twelve months, children learn to distinguish the sounds of their native language better and their ability to distinguish the sounds of foreign languages decreases (Kuhl et al., 2006).

Infants transfer from being "global citizens" to "native language experts", which is an important milestone in acquiring language, and which precedes the stage of acquiring the vocabulary and grammar of their native language. Furthermore, the better children can distinguish the sounds of their native language at the age of eleven months, the larger their vocabulary size in the later years (Kuhl et al., 2008). At the same time, the learning of their native language patterns reduces their sensitivity to non-native patterns and, to some extent, decreases their capacity for foreign language acquisition.

Research shows that bilingual children outperform their monolingual peers in cognitive development. The reason for this is that a bilingual child has more extensive and ample experience thanks to their straddling of two languages and cultures. They have to constantly switch from one language to another, changing pronunciation, grammar, and meanings (Cummins, 1976; Bialystock, 1987).

Analysis of bilinguals' psychological properties has shown that such advantages were especially apparent in young children in situation that required them to control their attention or when they were exposed to conflicting information (Bialystok et al., 2010).

In adult life, these differences become less evident, although they manifest themselves when there is a need to solve complex problems (Costa et al., 2008). The psychological analysis of cognitive characteristics of late artificial versus early natural bilinguals showed that the latter have cognitive advantages (Bekasova, Markemann, 2012).

Comparing bilingual groups raised in a "family language – society language" environment (monolingual families) and the "one parent – one language" environment (bilingual families) revealed the factors that affected language development in early natural bilinguals. The analysis of thinking patterns showed that bilinguals raised in bilingual families ("one parent – one language") were given to thinking in a mix of languages. On the other hand, bilinguals raised in monolingual families are not given to mix languages in their thinking when they are exposed to the opposition of their family language and the society language.

However, the languages of such bilinguals, although separated in their conscious mind, are nonetheless mixed in their subconscious mind. Most surveyed bilinguals from monolingual families see their dreams in a mix of languages, i.e. their subconsciousness uses more than one language as a single system regardless of the external situation.

Bilinguals raised in bilingual families and thinking in a mix of languages separate such languages in their subconsciousness depending on the external factors, such as environment and the language activity. Only one language is involved in their dreams. The language of their dreams

changes depending on the content or setting.

In terms of cultural identity, both groups show identical results: 63% of bilinguals associate themselves with one culture, 25% with two or more cultures and 12% have difficulties in determining their cultural identity.

The research revealed interesting differences in the cognitive preferences and academic success of different bilingual groups. Bilinguals raised in monolingual families showed interest in the humanities, while one fourth of the group members were successful learners in the social, mathematical, and natural sciences. Bilinguals raised in bilingual families showed capacity for mathematical and natural sciences along with higher than average academic success. Almost half bilinguals in this group have or are acquiring university degrees, with only one fifth in the other group. However, both groups showed similar high-performance levels in the humanities.

The research of personal qualities of late adapted bilinguals showed that the learning of foreign languages at school and later caused changes in personal traits. The formation of professional bilingualism develops efficient communication and social skills. Learners are also observed to acquire the traits and culture of foreign native speakers (Bekasova, 2017).

In late adulthood, the advantages of bilingualism become increasingly apparent in the decreasing the degradation of cognitive skills in seniors (Bartzokis et al., 2004). This may be explained by the fact that the acquisition of two language systems consistently activates analytical and comparative functions and give rise to interest in languages, history, traditions, and culture.

Data and Methodology

Magnetoencephalography (MEG) is a modern and effective method of brain activity visualisation. This method allowed researchers to obtain data related to differences in the brain activity levels of bilingual and monolingual development.

Experiments made by F. Ramirez compared brain reactions to language sound in eleven-month children from Spanish-English bilingual families and in their peers from English-speaking families (Ramirez, 2017a). The resulting data showed that the brain of a monolingual child responded only to the sounds of the English language and ignored sounds from the Spanish language. The brain of a bilingual kid responded to the sounds of the two languages that were native to them. This proves that children's brains "specialise" in those languages that are present in their language environment and reflect their language experience. Interestingly, responses to the sounds of the English language were equally strong both in bilingual and monolingual infants.

Bilingual learning in early childhood is becoming increasingly popular. Research shows that young children can acquire foreign languages faster, albeit subject to certain conditions.

Firstly, the language should be taught by a real teacher. In this case, nine-month old children can learn to distinguish the sounds of a new language at the level of an infant born into a bilingual family in just six hours, which is impossible by using video or audio lessons (Kuhl et al., 2003).

Furthermore, the development of language skills in the bilingual environment depends on the quality and quantity of speech to which a child is exposed in each language. Words addressed to a baby must have a higher tone of voice and be expressive and melodious (e.g. "Hiiii, babyyyyy") (Ramirez et al., 2017b).

Acquiring wider language skills in early childhood have specific effects in terms of children's socialisation and communication skills. According to proponents of the idea that children develop a "Theory of Mind" (ToM), children under a certain age are incapable of understanding that other people can think differently (Farhadian et al., 2010). Jean Piaget called this phenomenon "childhood egocentrism".

For example, a child without ToM can watch TV and think: "I'm watching this cartoon and all people are watching this cartoon now. If I switch my TV off, other people will not see the cartoon to the end." A child with ToM understands that other people can not only think differently about the world, but also that they may have a different opinion or attitude.

A ToM development test may be undertaken according to the following method: a pre-school child is shown a box of blackboard chalk and asked what is inside. The child answers: chalk.

Then they are shown that the box in fact contains ribbons. A new person enters the room whom the child has never met before and the researcher asks the child what this person thinks about the contents of this box.

If the child understands that other person's opinion can be different from their own, they will decide that a new person will judge the chalk box in the same way they did. This means that the child has the well-established ToM. If the child has no ToM, they will think that a new person will have the same knowledge as they do. Therefore, they will answer, "ribbons".

Experiments have shown that 3-year olds usually failed the ToM tests and 5-year olds usually succeed. When the same tests are conducted on 3-year-old bilinguals, they succeed regardless of the language of the researcher or the new person. Researchers have concluded from these experiments that young bilinguals learn to understand the minds of other people earlier and more successfully than their monolingual peers. These advantages do not depend on the specific languages spoken by the child.

Scientists are looking to discover the nature of such abilities by researching the processes of children's brain growth, development, and ageing. They focus on the frontal lobe functions that are responsible for attention. One reason why children "fall behind" in their attention development is that the frontal lobe develops as a result of the myelination (growing glial cells) of neurons.

Glial cells cause neurons to react in synch. They are white; therefore, the myelinated areas are called "white matter" as opposed to the grey matter of non-myelinated areas of the brain cortex (Fuster, 2008). The process of attention control and activation or blocking cognitive functions is one of the functions of the frontal lobe. Thus, children with incomplete myelination of frontal neurons are unable to quickly respond to an adult's request to "pay attention" or "stop doing that".

But multiple tests show that bilingual pre-school children are much better in managing their attention and reactions, i.e. those processes that are caused by frontal cortex, than their monolingual peers (Baddeley, 1996).

Neurophysiological studies of children raised in polylingual families show that language localisation zones in bilingual children's brain cortex intersect to form a general linguistic zone. All languages that are acquired later on join this zone to expand it. In late adopted bilinguals, languages are localised in different zones and such late bilinguals fall short in terms of the speed in processing linguistic information and their capacity to immediately switch languages (Popova M, 2014).

MRT studies of seniors showed that the brains of bilingual group members contained more myelinated white matter than those of monolinguals, and that they joined both hemispheres and the frontal lobe with other brain zones (Luk et al., 2011).

Conclusions

The importance of poly-language skills cannot be overestimated in the modern world. Neurolinguistic studies of children's brains allow us to contend that all children can be bilingual. Research shows that optimal performance in language learning is achieved when children learn languages in their early years via intensive communication with real people rather than through television or any other media. Therefore, it is important to use any opportunity for live language learning and to encourage people caring for children to use the language they speak fluently and comfortably. According to researchers, early bilingualism creates a specific language zone in children's brains that facilitates the formation of polylingualism.

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