



## THE IMPACT OF LEARNING A LANGUAGE ON THE BRAIN FUNCTION

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**Abstract:** *Cognitive sciences are discovering many things that educators have always intuitively known about language learning. However, the important point is actively using this new information to improve both student learning and current teaching practices. The implications of neuroscience for educational reform regarding second language (L2) learning can clearly be seen in the following categories: brain structures and the corpus callosum; neuronal development and the parts of the brain dedicated to language; memory and the Information Processing Model. This article provides information about Corpus Callosum and the effect of language learning on brain function.*

**Key words:** *brain structures, content-based language learning, corpus callosum, neuroscience.*

In today's globalized world, learning a new language has become more than just a communication skill; it is a powerful cognitive exercise that directly influences brain function. Recent studies in neuroscience and cognitive psychology show that acquiring a second language can reshape the brain's structure and improve its performance. When a person learns a language, multiple areas of the brain are activated, including those responsible for memory, attention, problem-solving, and decision-making. This continuous mental engagement strengthens neural connections and increases brain plasticity.

Moreover, bilingual or multilingual individuals often demonstrate enhanced cognitive abilities compared to monolinguals. They tend to switch tasks more efficiently, focus better, and delay the onset of age-related cognitive decline.

Therefore, exploring the impact of language learning on brain function is essential not only for understanding human cognition but also for improving educational approaches and lifelong learning strategies.

### Brain Structures and the Corpus Callosum

What is known about how the brain receives and processes information is quite complex. During the course of any given moment in time, sensory input travels through the brain by way of the thalamus on its way to the cerebral cortex. This sensory input is filtered by the brain stem and limbic system. It is affected, and sometimes altered, by its passage through the lower, limbic systems of the brain, totally in control of our physical and emotional needs. The limbic brain is made up of clumps of specialized cells rather than the modularities found in the cortex. The thalamus is especially important to second language (L2) learners, as is the amygdala, which controls the emotional response to learning the new language. Information that survives the passage described above, arrives at the frontal cerebral cortex, where information processing and learning begin to take place. It is at this point that the brain attempts to understand and make sense of the information registered via the senses. Information deemed meaningful and relevant is then stored in different localizations or modularities found in the cerebral cortex. The various parts of the brain communicate by way of neurochemicals. During the past 20 years, the chemical nature of nerve cell communication has been clarified significantly. Many neurochemicals, which serve as neurotransmitters, derive from dietary protein that must be included in daily consumption.

### The Effect of Language Learning on Aging

Recent evidence has suggested that there is a positive impact of bilingualism on cognition - with a later onset of dementia. Researchers from the University of Edinburgh used the Lothian Birth Cohort 1936 to address whether learning a second language can influence later cognitive performance. Discontinuing the

opportunity to address confounding variables such as ethnic and environmental differences. The researchers found that bilinguals performed significantly better on tests conducted between 2008 and 2010. The strongest effects were observed on general intelligence and reading. Overall results suggested a positive effect of bilingualism on cognition in older age and this included those who acquired a second language as adults. The bilingual executive advantage (BEA) hypothesis, that is, the improvement in cognitive functions, specifically executive functions, results from the ability to control more than one language system. This theory is controversial, and a recent systematic review, including 53 studies, does not apply to working memory. There is evidence to support the bilingual effect in relation to cognitive flexibility. However, the inconsistent results found across studies prevent clear conclusions from being drawn; further studies are still needed.

#### The Impact of an Additional Language on Working Memory

Working memory is defined as a dedicated, mental workspace for the storage, processing, and manipulation of information. One aspect of working memory includes the holding of information in a speech-based format, called the phonological loop. Bilinguals have been shown to outperform individuals who can only speak one language in tasks that require working memory. The response rate amongst those who can speak more than one language was more accurate in response to trials, which suggests that bilinguals have an advantage in executive functioning. Bilingual participants could also outperform monolinguals in tests that required areas of the brain unrelated to the processing of language. This included visual-spatial span, suggesting that language acquisition can improve working memory beyond language processing.

#### The Impact of an Additional Language on Verbal Intelligence

Peal and Lambert published a paper in 1962 that was considered a hallmark study highlighting the importance of controlling for several variables such as socioeconomic status, sex, and age, as well as underscoring the importance of

standardized measures for bilingualism when selecting populations to be studied. In this particular study, in a comparison between bilingual and monolingual participants, bilinguals performed better than monolingual counterparts in both verbal and nonverbal tests, however, the difference was more pronounced in non-verbal testing. The advantage conferred by bilingualism is thought to be a result of greater mental flexibility and the ability to form concepts.

#### The Impact of an Additional Language on Nonverbal Intelligence

Non-verbal intelligence is defined as a set of cognitive and problem-solving skills as applied to tasks that don't require the use of language. Examples of nonverbal tasks include reasoning, the recognition of visual sequences, the ability to understand visual information, the ability to conceive abstract ideas, and the ability to recognize visual cues in social contexts body language.

According to Maria Viorica, the pioneer of the notion of coactivation in those with bilingualism, bilingual spoken language understanding confers the ability to activate inhibitory regulation in the prefrontal cortex. This is because this area of the brain must select between 2 languages that are co-activated, that is, able to be spoken concurrently. As a result, the bilingual brain it's subject to continuous exercise and is, therefore, more capable of executing cognitive tasks as a result of having better control of this area of the brain.

However, a more recent study conducted in 2019 suggests that there are no major differences between bilingual and monolingual matched participants in nonverbal switching and suggests that bilinguals may not have better cognitive control than monolinguals.

The impact of speaking an additional language has several positive cognitive effects, with wide implications on a range of disciplines - including human brain health. Several studies have suggested bilingualism can improve their brain's cognitive function, producing great cognitive control abilities, increased nonverbal

and verbal capabilities, increased perceptual sensitivity, and confers some protection against aging, most notably delaying the onset of dementia.

In conclusion, learning a language has a profound and positive impact on brain function. It enhances cognitive flexibility, strengthens memory, and improves attention control by actively engaging multiple brain regions. Scientific evidence suggests that language learning contributes to long-term brain health by increasing neuroplasticity and potentially delaying cognitive aging.

Thus, learning a new language should not be seen merely as an academic or professional skill, but as a form of mental training that enriches brain capacity and overall cognitive development. Encouraging language learning at all ages can therefore play a significant role in building a more intelligent, adaptable, and mentally resilient society.

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