Neuroscience and the Bilingual Brain

13
By Judy Willis MD
3/22/12

Dr. Judy Willis (@judywillis on Twitter) is an authority on brain research as it relates to learning. She is a regular blogger at Edutopia. You can also find her online at RADteach.

A selective attentive focus and the ability to block out distraction are seminal executive functions that are minimally developed in youngsters. These functions gradually become stronger throughout the years of prefrontal cortex maturation, which last into the twenties. It is with regard to these executive functions that research about the "bilingual brain" is particularly exciting.

The research refers to children raised with a language at home that differs from the dominant language outside the home, such as in school. Compared to monolinguals, the bilingual children develop greater attention focus, distraction resistance, decision-making judgment and responsiveness to feedback. The correlated fMRI scans of these children reveal more activity in the prefrontal cortex networks that control these executive functions.

Exercising Their *Thinking* Brains Early and Often

The leading explanation for this correlation is the need of bilinguals to frequently "select" which language is needed, what words fit the linguistic criteria and how to convey their intended meaning each time they communicate. To do this, the brain must actively evaluate between the competing language systems and deliberately focus attention on the chosen language.

The research interpretation of the fMRI and cognitive tests is that the ongoing evaluation and selection process in bilingual children exercises brain circuits which regulate attention control and block distraction. This neural network activation of the

executive functions is one suggested explanation for the higher performance in cognitive tests by children who have had five to ten years of bilingual exposure (Bialystok, 2009; Kaushanskaya & Marian, 2007). Further studies are investigating whether similar benefits are found in children who have exposure to a second language later in life.

Better Memory and Attention

The implications of the bilingual research also relate to the influence of the higher brain's executive functions on working (short-term) memory strength down in the hippocampus. The hippocampus is the relay station where new information is first encoded into memory before moving up to the prefrontal cortex for further processing into long-term memory. In the mature brain, the amount of information that can be "held" in mind for active processing in working memory is limited to somewhere between five and nine chunks of data.

"Holding" is what happens in your working memory when you perform the separate steps of mentally multiplying 11 x 15. Most people calculate the product of 10 x 15 and hold that 150 in mind while they calculate 1 x 15. The 150 is then reactivated and added to the 15. The limitation of holding data while simultaneously processing data is why you can't multiply 2417 x 429 mentally. There is simply too much information to store in the hippocampus while you carry out all those separate multiplications.

In the bilingual children, the higher performance in nonverbal cognition suggests that "holding" information in their working memory also benefits their early and frequent executive function exercise of paying attention to and evaluating language.

Implications for Brighter Starts

The incoming research supports encouraging parents to retain use of their native language in the home. The implications also raise considerations of what other early exposures and in-school experiences can be designed to promote these executive function activations in all children. What other planned learning activities can be so engaging as to promote the activation and strengthening of young children's developing networks of attentive focus? Should second language instruction begin earlier in elementary school?

I'll keep you posted as further research becomes available, and I look forward to your contributions to this dialogue.