

Brain Plasticity, Language Processing and Reading

Society for Neuroscience Publication

Many scientists once believed that as we aged the brain's networks cemented in place. But now an enormous amount of evidence uncovered in the past two decades finds that the brain never stops changing and adjusting. One line of research is showing that this flexibility can help maintain language processing even in the face of severe obstacles. Furthermore, some research suggests that special brain exercises can tap into the brain's adaptive capacities and help people overcome certain language and reading problems.

People who lose their eye-sight do not have to rely on audio novels to fulfill a book obsession. They can learn to read compositions in Braille, a writing composed of raised dots arranged in specific patterns, with their fingertips.

It's one of the benefits of having a plastic brain. That doesn't mean your brain is molded from a high-molecular-weight polymer similar to your toothbrush. It means that the brain is flexible. It compensates for obstacles. It adapts. It adjusts.

Once, researchers believed that only young brains were plastic. They thought that the connections between the brain's neurons developed in the first few years of childhood. Then they became fixed and very hard to change. An enormous amount of animal and human data uncovered in the past two decades, however, confirms that the brain retains its plasticity throughout life.

One line of research provides evidence that older brains can adapt in order to overcome a number of barriers and aid language processing and reading. The new findings are leading to:

- * A better understanding of the many different ways that the brain can process language.
- * Clearer ideas on how children and adults naturally can overcome language-processing obstacles.
- * Insights into how strategies may reroute brain networks and help those with reading, speech or hearing disabilities.
- * Ways to help second-language learners recognize new language sounds and to eliminate accents.

An increasing number of studies detail how the brain naturally reorganizes to overcome language and reading obstacles. For example, one new experiment shows how young and old brain networks modify to handle a loss of sight and process Braille. Researchers photographed the brain activity of individuals who lost their sight either as infants or after age 10 while they thought of a verb that related to a Braille-embossed noun. Like sighted people, the blind activated three brain areas thought to relate to language processing. Those who had been blind since infancy also received some help from the brain areas that normally process visual information in sighted people. Those who had been blinded later in life snagged some extra help from a few of the brain's visual areas as well as the brain's touch areas. The study shows the brain's ability to readjust its circuits to process language -- at any age. It also backs the idea that special brain exercises could tap into the brain's adaptive capacities when it can't do it on its own and could help people regain language functions despite various deficits.

Individuals with the reading disability, dyslexia, are one group that may benefit from these exercises. Studies show that different types of training techniques sometimes can improve dyslexics' poor reading skills. Many scientists believe that these techniques rework failing language processing networks.

Researchers now are photographing brains before and after intervention trainings to see if this is the case. Once they catalog the changes, they may be able to pair certain interventions with certain forms of dyslexia.

Adults who learn second languages also may benefit from interventions that are thought to take advantage of brain plasticity. Often, adults have trouble hearing and pronouncing certain non-native sounds. Japanese individuals, for example, can't hear or pronounce the difference between the "r" and "l" English sounds. The words "read" and "lead" sound the same to Japanese individuals. Studies have found, however, that special training techniques can help them overcome this setback. A recent study found that one training approach resulted in improvements in Japanese adults' perception and production of English words with "r" and "l" sounds. The improvements lasted for at least three months.

Many researchers think that training techniques sometimes can help those with the reading disability, dyslexia, because they modify brain networks. The images above hint that this is the case. The top images show the brain activity (lit-up areas) of a 10 year-old boy while he completes a task that requires the ability to identify the sounds of words. His reading level equaled that of an eight-year-old child. The bottom images show his brain activity while he completes the same task after receiving eight weeks of a type of special training. Following the intervention training, his reading level increased by three years and the images indicate that his brain activity changed as well. Researchers are conducting a very large, ongoing study to confirm this one example