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Reading Practice Can Strengthen Brain 'Highways'

by Jon Hamilton

Intensive reading programs can produce measurable changes in the structure of a child's brain, according to a study in the journal *Neuron.* The study found that several different programs improved the integrity of fibers that carry information from one part of the brain to another.

"That helped areas of the brain work together," says Marcel Just, director of the Center for Cognitive Brain Imaging at Carnegie Mellon University in Pittsburgh. Coordination is important because reading involves a lot of different parts of the brain, Just says.

Some parts recognize letters, others apply knowledge about vocabulary and syntax, and still others decide what it all means. To synchronize all these operations, the brain relies on high speed "highways" that carry information back and forth, he says. If those information highways can't handle the traffic, the brain won't be able to make sense of the text on a page or a screen. Just and his colleague Timothy Keller wondered whether that might be part of the problem for a lot of children struggling to read.

They used a special type of MRI to look at the brains of several dozen children from 8 to 12 years old, including poor readers and those with typical reading skills. The MRI scans allowed the scientists to study the network of fibers that carries information around the brain, which lives in the brain's so-called white matter. Children with poor reading skills had white matter with "lower structural quality" than typical children, Just says.

Building Up The Brain

So during the next school year, Just and Keller enrolled some of the poor readers in programs that provided a total of 100 hours of intensive remedial instruction. The programs had the kids practice reading words and sentences over and over again.

When they were done, a second set of MRI scans showed that the training changed "not just their reading ability, but the tissues in their brain," Just says. The integrity of their white matter improved, while it was unchanged for children in standard classes. Equally striking, Just says: "The amount of improvement in the white matter in an individual was correlated with that individual's improvement in his reading ability."

The finding adds to the evidence that learning involves more than just gray matter — the brain tissues that process and store information. It's becoming clear that white matter is also critical for learning, says Doug Fields, a researcher in the Child Health and Human Development section at the National Institutes of Health. That realization has led to a shift in the way many scientists view the brain, Fields says.

"By analogy, we were looking at a transistor, and now we're looking at the whole network," he says. Other studies have shown that white matter changes when people learn to juggle or play a musical instrument, Fields says.

And, he says, white matter also seems to be involved in everything from psychiatric illness to mathematical ability to autism. "Really, the more we look, the more we find," Fields says.