TARTAN ARTICLE

Research on causes of dyslexia

Sci/Tech | Cecilia Westbrook

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Research by psychology professor Marcel Just indicates that brain activity not only reflects a child's reading ability, but also sheds light on the effectiveness of reading instruction.

In this study, Just and collaborators Ann Meyler and Timothy Keller at Carnegie Mellon's Center for Cognitive Brain Imaging teamed up with researchers from Stanford University. Just and his team were interested in uncovering differences in brain activity between good and poor readers.

The sample of children in Just's study consisted of third- and fifth-graders from school districts all over Allegheny County. Children's reading abilities ranged from far below average to well above average.

In his study, Just's team gave children simple sentences to read while researchers scanned the children's brains with functional Magnetic Resonance Imaging (fMRI). fMRI tracks blood flow in the brain to show which areas of the brain are activated.

Researchers found differences in brain activity in several areas of the parietotemporal cortex.

The parietotemporal area of the brain is located above and behind the ear, and it serves as a bridge between the auditory (hearing) cortex and brain areas that do higher cognitive processing, such as those that are involved in reading and language comprehension.

According to Just's research, a strong correlation exists between a child's reading ability and the level of activation exhibited by the parietotemporal cortex. In particular, above average readers exhibit more brain activity than below average readers.

"It's unusual to get data as good as this," said Just.

Just's research supports current theories that the parietotemporal cortex's role in reading is phonological processing, which is the process of matching written letters and syllables to their sounds.

Phonological processing is part of the lower levels of reading processing, after visual processing has detected the written words but before higher cognitive functions have made sense of them.

“The parietotemporal cortex is thought to be critical to analyzing the written word,” Just's research group stated in an article that was recently published in the journal [ITAL]Cerebal Cortex[ITAL].

Prior investigations into the link between reading ability and brain activity in children have only looked at brain activity during lower-level reading comprehension, such as recognizing letters or deciding if words rhyme. These studies have consistently found that poor readers exhibit lower activation in the parietotemporal cortex.

Just’s research, on the other hand, is the first large-scale study to examine brain activity during children's processing of whole sentences, which is considered to reflect a higher level of reading comprehension.

Just's results demonstrate a link between the lower-level phonological processing that occurs in the parietotemporal cortex and higher-level reading processing, such as understanding sentences.

Just’s study was part of a larger study by psychology professor Joseph Torgeson of Florida State University on the effect of intensive reading instruction on children's reading abilities.

Students whose reading score fell below the 30th percentile were given 100 hours of intensive remedial reading instruction over the course of one year, while above average readers were given normal school instruction. The remedial instruction was mostly focused on lower-level reading skills, such as sounding out words.

Torgeson said, “About 40 percent of children in higher grade levels still struggle with reading.”

“The study was designed to see what it would take to close the gap [between good readers and poor readers],” he said.

Just's team scanned the children before and after the yearlong study. Researchers found that the intensive instruction changed the amount of activity in the childrens' parietotemporal cortices during reading tasks.

“Before treatment, the poor readers had much less activation,” said Just, “but after treatment, the under-activation went away.”

Data from brain scans also show that there are structural differences in the children's brains before and after instruction. “So we’re not just changing activation,” Just said, “we’re changing their brains.”

Results from professor Torgeson's study, however, show that students' scores on higher-level reading comprehension did not improve as much as they had expected.

“We’d hoped to see a generalization from the low-level reading instruction to higher-level reading ability, but we didn’t see that happen,” Torgeson said.

Torgeson thinks that in order to close the reading gap, more instruction in higher-level reading skills may be needed.

Nonetheless, this study lends tentative support to the idea that intensive instruction can improve a child’s reading ability.

“Everybody starts with a set of strengths and weaknesses,” said Just. “You just want to get to a point where your weaknesses don’t hold you back.”