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### Children's Reading Disability Attributed To Brain Impairment

Children who are poor readers appear to have a disruption in the part of their brain involved in reading phonetically, according to a sophisticated brain imaging study funded by the National Institute of Child Health and Human Development (NICHD).

The study also found that children who read poorly but who do not receive any extra help or training eventually compensate for their disability by using other parts of the brain as backup systems for the impaired brain regions. Although most of these children eventually do learn to read, they never do so with the same fluency as do good readers. This is probably because the "backup" brain systems they use when reading apparently cannot process printed information as easily as can the brain systems primarily involved in reading.

The researchers, led by Bennett Shaywitz, M.D., of the Yale University School of Medicine, published their results in the July *Biological Psychiatry*.

"This study shows us the physical basis of why some children have difficulty reading," said Duane Alexander, M.D., Director of the NICHD. "We are now in a position to observe the brain changes that take place when poor readers receive the training that allows them to become proficient readers. In turn, this knowledge may allow us to design even more effective therapies to help poor readers overcome their disability."

In the study, the researchers used a technology known as functional magnetic resonance imaging (fMRI), which produced computer-generated images of the brain while the children were reading. With fMRI, the team demonstrated differences in brain images between children with dyslexia and non-reading impaired control children. The disruption in the brain systems for reading was evident when the children performed phonologic tasks, that is, tasks that required knowing the sound structure of words. Written English is a kind of code — letters or combinations of letters stand for the individual sounds within words. The reading impaired children had difficulty with tasks that required interpretation of this code.

Dr. Shaywitz noted that the current study with children confirmed the researchers' earlier finding with adults that people with dyslexia have an impairment in the brain regions involved with reading words phonetically. And like adults with dyslexia, they use an alternate brain region as a backup system when reading. [The earlier study is described at: <http://www.nichd.nih.gov/new/releases/dyslexianews.cfm>.]

"The study shows some very important findings," Dr. Shaywitz said. "First it identifies neural pathways for

reading in good readers while showing a disruption of these pathways in children who are dyslexic (Fig 1). "Second, Dr. Shaywitz explained, the study identifies a region for skilled reading in the the brain area known as the left occipito-temporal region (Fig. 2). Better readers are more likely to activate this region than are poor readers. Third, the study shows areas of compensatory systems in the front and the right side of the brain in dyslexic children who are older (Fig.3).

These three images can be found at [http://www.nichd.nih.gov/new/releases/reading\\_disability.htm](http://www.nichd.nih.gov/new/releases/reading_disability.htm).

The researchers tested the ability of children to rhyme nonsense words, for example, asking them: "Do [LEAT] and [JETE] rhyme?" The children were also asked to determine the category of real words-- "Are [CORN] and [RICE] in the same category?" These tasks require children to use phonology, that is, their knowledge of the sound structure of words, which is very difficult for dyslexic readers. Shaywitz and his collaborators used fMRI to study 144 children ranging in age from 7 to 18 years, 70 dyslexic readers (21 girls, 49 boys) and 74 nonimpaired readers (31 girls, 43 boys ).

"Our findings show that the impairment in the brains of children with reading disability persists into adulthood," said another author of the study, G. Reid Lyon, Chief of NICHD's Child Development and Behavior Branch. "The findings provide compelling evidence that children with reading disabilities need to receive educational services to help them overcome their disabilities."

Dr. Lyon added that NICHD-funded research has shown that such services should have a firm foundation in phonological awareness. Before most poor readers can learn to read successfully, he said, they need to learn that spoken words can be broken apart into smaller segments called phonemes. Next, they usually require training in phonics — "mapping" phonemes to the printed words on a page. Once children have mastered these steps, they can then receive training to help them read fluently, and to comprehend what they read.

*The NICHD is part of the National Institutes of Health, the biomedical research arm of the federal government. The Institute sponsors research on development, before and after birth; maternal, child, and family health; reproductive biology and population issues; and medical rehabilitation. NICHD publications, as well as information about the Institute, are available from the NICHD Web site, <http://www.nichd.nih.gov>, or from the NICHD Clearinghouse, 1-800-370-2943; e-mail [NICHDClearinghouse@mail.nih.gov](mailto:NICHDClearinghouse@mail.nih.gov).*

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