

NICHD-Funded Researchers Map Physical Basis Of Dyslexia

ScienceDaily (Mar. 4, 1998) — A Yale research team funded by the National Institute of Child Health and Human Development (NICHD) has used sophisticated brain imaging technology to show that there is decreased functioning while performing reading tasks in certain brain regions of individuals with the most common form of dyslexia. The study appears in the March 3 issue of the Proceedings of the National Academy of Sciences.

In their study, the researchers used a technology known as functional magnetic resonance imaging (fMRI), which produces computer-generated images of the brain while it is performing intellectual tasks. With fMRI, the team produced images of an impairment in the brains of dyslexic readers that became apparent when they tried to perform tasks which would require a firm command of the ability to decipher words phonetically.

"If you have a broken arm, we can see that on an X-ray," said the study's first author, Sally E. Shaywitz, MD, of the Yale University School of Medicine. "These brain activation patterns now provide us with hard evidence of a disruption in the brain regions responsible for reading--evidence for what has previously been a hidden disability."

Dr. Shaywitz explained that the words we speak are made up of individual sounds called phonemes. In spoken language, the brain automatically combines these sounds to form words. To make normal conversation possible, such sound pieces are strung together rapidly--about 8 to 10 per second--and blended so thoroughly that it's often impossible to separate them.

For people with dyslexia, the problem arises in converting this natural process to print. Written English is a kind of code: The 26 letters of the alphabet, either singly or in combination with other letters, stand for the 44 letter phonemes in spoken English. Dyslexic readers have extreme difficulty with phonological awareness (breaking spoken words into their component sounds) and with phonetics (the ability to match these letter sounds to the letters that represent them).

In their study, Dr. Shaywitz and her coworkers presented 29 dyslexic readers (14 men and 15 women, ages 16-54) and 32 normal readers (16 men and 16 women, ages 18-63) with a battery of reading tasks while observing their brain functioning with the fMRI scanner. Most of these tasks required the readers to manipulate and understand phonologic principals--the skills needed to consciously manipulate the letter sounds in words.

The dyslexic readers found it difficult to read nonsense rhyming words, such as "lete" and "jeat." This task is designed to measure the phonologic principals underlying reading and is far more difficult for dyslexic readers to complete than rhyming actual words, which they may have previously memorized.

When performing such tasks, the dyslexic readers in the study showed less activation in a brain region linking print skills to the brain's language areas, in comparison to normal readers. Specifically, dyslexic readers showed reduced activity in a large brain region that links the visual cortex and visual association areas

(angular gyrus) to the language regions in the superior temporal gyrus (Wernike's area).

In the article, the authors noted that their findings are consistent with those of earlier studies of acquired inability to read (alexia). In both alexia and dyslexia, the same brain regions appear to be affected; however, in people with dyslexia, the study shows the impairment is a functional one, whereas in alexia, it has been attributed to a tumor or brain injury due to a stroke.

When they performed phonologic tasks, the dyslexic readers also showed activation in the brain region known as Broca's area, which has been associated with spoken language. In contrast, the normal readers did not show any increased activity in Broca's area when reading. Dr. Shaywitz explained that the dyslexic readers may have used this brain region in an attempt to compensate for impairments in the brain regions normally used for phonological skills.

"In summary, for dyslexic readers, these brain activation patterns provide evidence of an imperfectly functioning system for segmenting words into their phonologic constituents; accordingly, this disruption is evident when dyslexic readers are asked to respond to increasing demands on phonologic analysis," the authors wrote. "The pattern of relative underactivation in posterior brain regions contrasted with relative overactivation in the anterior regions may provide a neural signature for the phonologic difficulties characterizing dyslexia."

Dr. Shaywitz explained that it is too early to use fMRI as a method for diagnosing dyslexia. Nonetheless, the findings have important implications. First, they provide neurologic evidence for the critical role that lack of phonological awareness plays in dyslexia. They also confirm the fundamental neurobiologic nature of dyslexia and provide a neural signature for the phonologic difficulties accompanying the disorder.

Adapted from materials provided by [NIH-National Institute Of Child Health And Human Development](http://www.nih.gov).

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NIH-National Institute Of Child Health And Human Development (1998, March 4). NICHD-Funded Researchers Map Physical Basis Of Dyslexia. *ScienceDaily*. Retrieved March 19, 2009, from <http://www.sciencedaily.com/releases/1998/03/980304073929.htm>