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New brain findings on dyslexic children

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The vast majority of school-aged children can focus on the voice of a teacher amid the cacophony of the typical classroom thanks to a brain that automatically focuses on relevant, predictable and repeating auditory information, according to new research from Northwestern University.

But for children with developmental dyslexia, the teacher's voice may get lost in the background noise of banging lockers, whispering children, playground screams and scraping chairs, the researchers say. Their study appears in the Nov. 12 issue of *Neuron*.

Recent scientific studies suggest that children with developmental dyslexia -- a neurological disorder affecting reading and spelling skills in 5 to 10 percent of school aged children -- have difficulties separating relevant auditory information from competing noise.

The research from Northwestern University's Auditory Neuroscience Laboratory not only confirms those findings but presents biological evidence that children who report problems hearing speech in noise also suffer from a measurable neural impairment that adversely affects their ability to make use of regularities in the sound environment.

"The ability to sharpen or fine-tune repeating elements is crucial to hearing speech in noise because it allows for superior 'tagging' of voice pitch, an important cue in picking out a particular voice within background noise," said Nina Kraus, Hugh Knowles Professor of Communication Sciences and Neurobiology and director of the Auditory

Neuroscience Laboratory.

In the article "Context-dependent encoding in the human auditory brainstem relates to hearing speech-in-noise: Implications for developmental dyslexia," Kraus and co-investigators Bharath Chandrasekaran, Jane Hornickel, Erika Skoe and Trent Nicol demonstrate that the remarkable ability of the brain to tune into relevant aspects in the soundscape is carried out by an adaptive auditory system that continuously changes its activity based on the demands of context.

Good and poor readers were asked to watch a video while the speech sound "da" was presented to them through an earphone in two different sessions during which the brain's response to these sounds was continuously measured.

In the first session, "da" was repeated over and over and over again (in what the researchers call a repetitive context). In the second, "da" was presented randomly amid other speech sounds (in what the researchers call a variable context). In an additional session, the researchers performed behavioral tests in which the children were asked to repeat sentences that were presented to them amid increasing degrees of noise.

"Even though the children's attention was focused on a movie, the auditory system of the good readers 'tuned in' to the repeatedly presented speech sound context and sharpened the sound's encoding. In contrast, poor readers did not show an improvement in encoding with repetition," said Chandrasekaran, lead author of the study. "We also found that children who had an adaptive auditory system performed better on the behavioral tests that required them to perceive speech in noisy backgrounds."

The study suggests that in addition to conventional reading and spelling based interventions, poor readers who have difficulties processing

information in noisy backgrounds could benefit from the employment of relatively simple strategies, such as placing the child in front of the teacher or using wireless technologies to enhance the sound of a teacher's voice for an individual student.

Interestingly, the researchers found that dyslexic children showed enhanced brain activity in the variable condition. This may enable dyslexic children to represent their sensory environment in a broader and arguably more creative manner, although at the cost of the ability to exclude irrelevant signals (e.g. noise).

"The study brings us closer to understanding sensory processing in children who experience difficulty excluding irrelevant noise. It provides an objective index that can help in the assessment of children with reading problems," Kraus says.

For nearly two decades, Kraus has been trying to determine why some children with good hearing have difficulties learning to read and spell while others do not. Early in her work, because the deficits she was exploring related to the complex processes of reading and writing, Kraus studied how the cortex -- the part of the brain responsible for thinking --encoded sounds. She and her colleagues now understand that problems associated with the encoding of sound also can occur in lower perceptual structures.

Source: Northwestern University