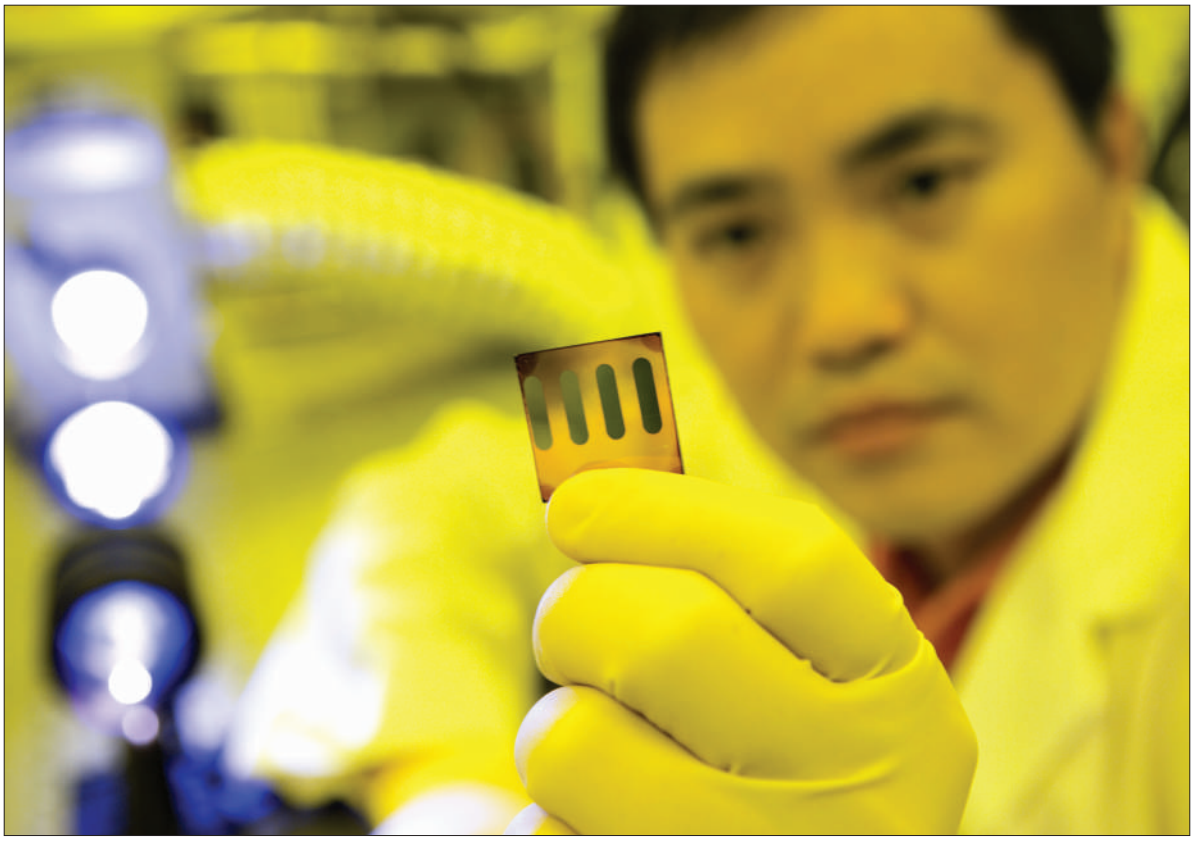

Singapore Journal of

Scientific Research

ISSN: 2010-006x

science alert

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Neuroimaging Helps to Predict Which Dyslexics Will Learn to Read

Researchers at the Stanford University School of Medicine have used sophisticated brain imaging to predict with 90 percent accuracy which teenagers with dyslexia would improve their reading skills over time.

Their work, the first to identify specific brain mechanisms involved in a person's ability to overcome reading difficulties, could lead to new interventions to help dyslexics better learn to read.

"This gives us hope that we can identify which children might get better over time," said Fumiko Hoeft, MD, PhD, an Imaging Expert and Instructor at Stanford's Center for Interdisciplinary Brain Sciences Research. "More study is needed before the technique is clinically useful, but this is a huge step forward."

Hoeft is first author of a paper, which will be published online Dec. 20 in the Proceedings of the National Academy of Sciences. The senior author is John Gabrieli, PhD, a Former Stanford Professor now at the Massachusetts Institute of Technology.

Dyslexia, a brain-based learning disability that impairs a person's ability to read, affects 5 to 17 percent of U.S. children. Affected children's ability to improve their reading skills varies greatly, with about one-fifth able to benefit from interventions and develop adequate reading skills by adulthood. But up to this point, what happens in this brain to allow for this improvement remained unknown.

Past imaging studies have shown greater activation of specific brain regions in children and adults with dyslexia during reading-related tasks; one area in particular, the inferior frontal gyrus (which is part of the frontal lobe), is used more in dyslexics than in typical readers. As the researchers noted in their paper, some experts have hypothesized that greater involvement of this part of the brain during reading is related to long-term gains in reading for dyslexic children.

For this study, Hoeft and colleagues aimed to determine whether neuroimaging could predict reading improvement and how brain-based measures compared with conventional educational measures.

The researchers gathered 25 children with dyslexia and 20 children with typical reading skills -- all around age 14 -- and assessed their reading with standardized tests. They then used two types of imaging, functional magnetic resonance imaging and diffusion tensor imaging (a specialized form of MRI), as the children performed reading tasks. Two-and-a-half years later, they reassessed reading performance and asked which brain image or standardized reading measures taken at baseline predicted how much the child's reading skills would improve over time.

What the researchers found was that no behavioral measure, including widely used standardized reading and language tests, reliably predicted reading gains. But children with dyslexia who at baseline showed greater activation in the right inferior frontal gyrus during a specific task and whose white matter connected to this right frontal region was better organized showed greater reading improvement over the next two-and-a-half years. The researchers also found that looking at patterns of activation across the whole brain allowed them to very accurately predict future reading gains in the children with dyslexia.

"The reason this is exciting is that until now, there have been no known measures that predicted who will learn to compensate," said Hoeft.

As the researchers noted in their paper, "fMRI is typically viewed as a research tool that has little practical implication for an individual with dyslexia." Yet these findings suggest

that, after additional study, brain imaging could be used as a prognostic tool to predict reading improvement in dyslexic children.

The other exciting implication, Hoeft said, involves therapy. The research shows that gains in reading for dyslexic children involve different neural mechanisms and pathways than those for typically developing children. By understanding this, researchers could develop interventions that focus on the appropriate regions of the brain and that are, in turn, more effective at improving a child's reading skills.

Hoeft said this work might also encourage the use of imaging to enhance the understanding (and potentially the treatment) of other disorders. "In general terms, these findings suggest that brain imaging may play a valuable role in neuroprognosis, the use of brain measures to predict future reductions or exacerbations of symptoms in clinical disorders," she explained.

The authors noted several caveats with their findings. The children were followed for two-and-a-half years; longer-term outcomes are unknown. The study also involved children in their teens; more study is needed to determine whether brain-based measures can predict reading progress in younger children. Hoeft is now working on a study of pre-readers, being funded by the National Institute of Child Health and Human Development.

Hoeft and Gabrieli collaborated on the study with researchers from Vanderbilt University, University of York in England and University of Jyväskylä in Finland. Stanford co-authors include Gary Glover, PhD, Professor of Radiology, and Allan Reiss, MD, the Howard C. Robbins Professor of Psychiatry and Behavioral Sciences and Professor of Radiology and Director of the Center for Interdisciplinary Brain Sciences Research.

The study was supported by grants from the National Institute of Child Health and Human Development, Stanford University Lucile Packard Children's Hospital Child Health Research Program, the William and Flora Hewlett Foundation and the Richard King Mellon Foundation.

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