



## Discovering How Reading Intervention Changes the Brains of Children With Dyslexia

by Christine Waresak

Dyslexia affects millions of people of all backgrounds and intellectual levels. It is the most common language-based learning disability. People with dyslexia have difficulties reading, especially decoding the symbols of language—that is, translating letters into sounds and words and easily recognizing words. However, the experience of dyslexia, its causes, and the ways that educational methods can help people with dyslexia learn to read vary for each individual with this disability. Jason D. Yeatman, Ph.D., assistant professor of speech and hearing sciences and CHDD research affiliate, is working with children with dyslexia to better understand the underlying mechanisms of the disorder in the children's brains. In a National Science Foundation–funded study, Yeatman is looking at how the reading circuitry in the brains of children with dyslexia develops in response to specialized, intensive reading instruction. By using magnetic resonance imaging (MRI) and original data analysis software, Yeatman and his team are seeking to understand the structural and functional brain changes that underlie learning to read. This knowledge is a first step toward developing personalized programs that target an individual's unique difficulty with reading.



*Yeatman is working to better understand the neurobiological mechanisms of dyslexia and how the brains of children with dyslexia develop in response to reading intervention.*

### Teaching the building blocks of reading

In Yeatman's study, 30 children with dyslexia took part in an intensive reading intervention program created especially for children with this disorder. "Children with dyslexia don't just need more practice reading, they need instruction in the building blocks that kids without dyslexia tend to learn much more easily," Yeatman said. One issue that children with dyslexia often have is trouble understanding single sounds within words and how they relate to letters and combine to create a word. For example, the way the sounds "kah" and "aht" together create the word "cat." This skill, called phonological awareness, is easily picked up by children without dyslexia, but children with the disorder need more explicit instruction in learning this skill.

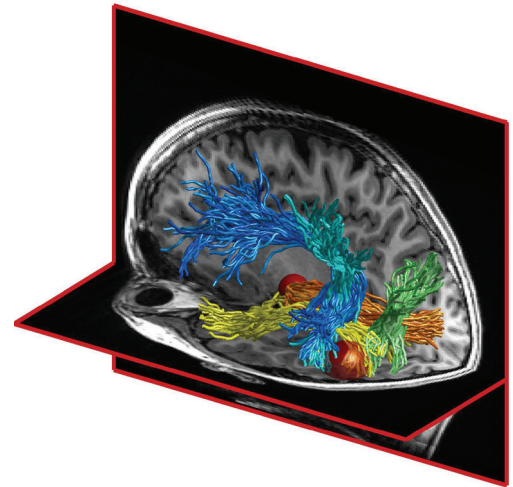
Yeatman's team, which includes two post-docs, a graduate student, and three research assistants, is partnering with Lindamood-Bell Learning Processes, a company with expertise in teaching children and adults to read. "They're delivering the intervention," Yeatman explained. "We're doing the science to understand how the intervention is changing children's brains."

### Measuring changes in the brain

Understanding if and how reading intervention changes children's brains tackles an important question in the field of dyslexia. "You have children that are struggling with reading and they go through these intensive intervention programs and their reading abilities improve. But one of the big questions is if this intervention is changing the underlying deficit in the brain or if the children are just learning a compensatory strategy," Yeatman

said. “That’s one of the types of things we can answer using these detailed measures of the brain—what are the mechanisms of improving reading skills.”

For eight weeks during the summer, the 30 children in the study spent four hours a day, five days a week in the intervention program. At intervals throughout the program, the children received behavioral assessments and had MRIs done of their brains, which Yeatman’s team is continuing to analyze. “A lot of the research is about brain connections, about identifying major connections in an individual’s brain and then quantifying properties, such as how tightly packed these connections are in the brain,” Yeatman explained. “A vast majority of our time is spent writing software. We acquire this data and then develop algorithms to process it, to extract the properties from this brain data that we are interested in.” The research is yielding promising results. “One thing I can say definitively is that the intensive reading intervention program changes the underlying structure of the brain. That’s something that we’re clearly seeing,” Yeatman said.



*Brain connections allow for signals to be communicated between different components of the brain’s reading circuitry. Yeatman’s research seeks to determine how these connections differ in children with dyslexia and how the process of learning to read changes the underlying structure of these pathways.*

## Sharing the research and tools with the community

All the software Yeatman’s team writes is open source and published on the [lab website](#) as they’re writing it. “That’s a big part of lab philosophy,” Yeatman said. “That we should release all the algorithms and software we’re developing so that people can reproduce what we’re doing. Scientific reproducibility is incredibly important.” Yeatman noted that hundreds of university labs and companies are using the software his team is creating.

## Next step: Personalized programs

“One of the next projects that we’re starting is trying to identify different types of underlying impairments that cause poor reading skills, and then test new intervention approaches that are specifically tailored to those impairments,” Yeatman said. In this separate study, funded by Microsoft, Yeatman’s team is researching an aspect of vision that might be impaired in people with people with dyslexia. It’s a condition called “crowding,” where the letters of words become collapsed and jumbled together. If this contributes to reading difficulties for some people with dyslexia, Yeatman explained, changing the spacing or fonts of text could help those people read better.

“I think that’s going to be a growing area of research in the lab—how we can identify something unique about an individual that is causing their difficulty and then change something to personalize the reading process,” Yeatman said.

## Volunteers needed for future research projects

Yeatman’s lab is looking for volunteers for upcoming research studies on reading and dyslexia. In addition to needing children and adults with dyslexia, the program is also recruiting children, adolescents, and adults with a diverse range of reading skills who are interested in participating in research. To learn more, visit the [UW Reading & Dyslexia Research Program website](#).

CHDD is an interdisciplinary center dedicated to the prevention and amelioration of developmental disabilities through research, training, clinical service, and community outreach. CHDD includes the University Center of Excellence in Developmental Disabilities and the Eunice Kennedy Shriver Intellectual and Developmental Disabilities Research Center.

### CHDD Outlook

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