access GUIDE CANADA

Reading Revolution

Understanding Dyslexia with Science

Robyn Suriano

Mariel Segovia changes from her stylish denim jacket and black jeans into drab, green hospital scrubs and climbs onto a table for a brain scan.

The neuroimaging machine is pulled into place, swallowing most of the 10-year-old's head like a giant helmet. The $1.8-million device is so sensitive that the metal buttons on Mariel's jeans would disrupt the machine. Any body movement - even blinking - is also bad for the machine. So Mariel is lying still with her hands clasped on her chest, eyes focused on a computer-like screen hanging above her.

This is not a medical test, and Mariel is not a patient. The healthy fifth-grader with a sister, brother and a trampoline at her Texas home is helping research that could revolutionize the way reading is taught in North America.

Scientists at the University of Texas Health Science Center are tracking Mariel's brain activity while she reads words from a screen suspended overhead. Researchers hope to learn how the brain function of this good reader - one who plows through books about Egypt for fun - differs from that of a child who struggles through picture books.

Already, researchers nationwide have found significant differences in the brain's workings between good readers and poor ones.

In the Houston study, struggling readers get brain scans, then go through an intense reading program at school. Their brain activity is measured again at the end of the tutoring to see whether new patterns have been awakened.

The goal is to discover what teaching methods best stimulate the parts of the brain that support reading. It is early in this marriage of education and neuroscience, but researchers say there is evidence that children's brains can be rewired - provided teachers know how to tap into the circuitry most effectively.

"We now know that people with reading problems are using the wrong hardware in their brains, and if we can get them to switch to the right hardware, we might be able to improve their reading," says Andrew Papanicolaou, a professor and director of neurosurgery at the University of Texas.

This field of research is young, emerging in the mid-1990s when advances in technology allowed scientists to track brain activity with greater precision.

When reading, brain function starts with sight. As the eyes focus on letters, an area on the back of the brain - called the primary visual cortex - becomes highly activated. Instantly, impulses travel along the network of cells, or neurons, firing up areas needed to decipher letters and give them meaning.

A key region is called Broca's area, named after the French anthropologist who first described it in the 1860s, where words are sliced into smaller units of sound. Also critical for speech, Broca's area is nestled inside the front of the brain.

But it's back in the rear, left side of the brain that sounds are put together with meanings in a region called the angular gyrus.

Poor readers tend to have more activity in Broca's area and within the brain's right hemisphere, a sign that they are recruiting areas typically not used for reading to help with the task.

In contrast, good readers show most activity in the rear, left of the brain. This implies that a good reader's brain quickly assigns sound to the word, freeing the brain for higher thinking.

"We've found a direct correlation between the amount of activity in the left, back of the brain and reading ability," says Dr. Sally Shaywitz, a pediatrician at Yale University and leading researcher on the brain-reading connection. "In other words, the more activity you have in the left, back of the brain, the better reader you are."

These differences have been found in studies worldwide in just the past few years, regardless of the reader's age or native language. On the adult end, similar patterns between good and poor readers were seen in people from ages 18 to 52 at Wake Forest University in North Carolina.

And researchers at the University of Texas found the telltale signature when they tested kindergarten kids who had not begun to read, says Panagiotis Simos, an associate professor of neurosurgery. The kids were shown single letters and asked to say their sounds.

Children who easily matched sounds with the letters showed more activity on the left side of the brain, indicating the faulty patterns are woven into the brain even before a child begins to read. Once embedded, the pattern persists into adulthood.

Researchers say the laboratory findings have important implications for the classroom.

"This shows us is that this is real, this is in the brain; it's not the child's motivation or their attitude," says Shaywitz, co-director of the Yale Center for the Study of Learning and Attention. "The schools may say to a parent, 'Don't worry, boys develop late,' or, 'She'll grow out of it,' but they won't.

"The same neural disturbance we see in children, we still see in adults. It stays with you," Shaywitz says.

So the question becomes, what can be done to reorganize the brain?

Beyond Houston and Yale, research to answer that question is being done at Georgetown University in the nation's capital and at the University of Seattle in Washington. Their methods of exploring the brain vary, and each location employs different teaching approaches to reach the struggling children.

But altogether, these efforts are bringing scientific scrutiny to reading instruction for the first time, says

G. Reid Lyon, who oversees reading research at the National Institute of Child Health and Human Development.

"For the past 30 years, reading instruction has not been based on science at all," Lyon says. "It's based on philosophies and assumptions. There's still this big, black hole, this gap between science and the classroom, and it doesn't make sense."

The National Institute of Child Health and Human Development has earmarked $20-million for reading research this year, and $12-million of that is paying for studies that incorporate brain scans with reading instruction. The University of Texas has received some of this funding for its work, which includes the study involving Mariel.

As a good reader, Mariel belongs to a "control" group whose brain patterns already indicate that her brain is working optimally for reading. Her counterparts who struggle are first- through third-graders at four Houston elementary schools.

They include Alexander Vaughan and Larissa Goulet, both seven-year-olds in the first grade at Ashford Elementary in a middle-class suburb on the west side.

Both children had early brain scans that indicate a lack of activity on the left sides of their brains, in contrast to Mariel's patterns of heavy left-sided activity in the region of the angular gyrus.

Now, Alexander and Larissa are working through an eight-week program called Phono-Graphix, one of many on the market that focus on phonics. After finishing it, they will go through another eight-week program called Read Naturally. New brain scans are to be taken after the completion of each program.

On this day in early November, the kids are sitting side by side in front of Melinda McGrath, a special-education teacher and Phono-Graphix instructor. Larissa has taken her shoes off underneath the table, twirling a sneaker on one toe. Alexander is leaning sharply to his side, pushing an ear into his shoulder as he works through an exercise.

The word "truck" is broken into pieces on cards in front of him. For now, the kids are learning to pull words apart like taffy, stretching them to find each sound buried inside. Alexander moves a finger from one card to the next.

"TUH-RRR-UH-KUH," he says, then sweeps his finger across the cards quickly as he slides the sounds together. "Truck!"

McGrath pushes the kids steadily through the exercises, using small cards with letters or pictures to help things along. Sometimes, she writes with a marker on an erasable board. A smaller portion of the time is spent reading sentences.

Kids such as these youngsters tend to get lost in the system, lumped into special-education classes where instruction varies from school to school, said Carolyn Denton, a UT assistant professor involved in the study.

"It's not the teacher's fault; it's the system that fails these kids," Denton says. "But we're getting a lot more information now about what these kids need and how to identify them early. This field is really undergoing enormous growth."

If the kids' brain patterns can be realigned more closely to those of good readers, early studies have shown children do make gains.

It doesn't mean there is a magic transformation of the child, but the kids generally become more accurate readers. They still read slowly, but with the proper neural circuitry in place, researchers hope they will show ongoing improvement.

"Just because the brain changes doesn't mean they're cured," says Virginia Berninger, a developmental neuropsychologist at the University of Washington, where studies on dyslexia are being done. "What we're seeing is that dyslexia is certainly treatable, but it may not necessarily be curable. These kids need very explicit instruction and much more of it."

By finding what works with these children in very small, intense reading programs, researchers think they will find tips for every classroom.

"Anyone who is in the business of teaching kids how to read needs better information about what it takes a child to learn to read," said Guinevere Eden, director of the Center for the Study of Learning at Georgetown University Medical Center. "And researchers need to do a better job of making that information available to them."

(Robyn Suriano is a medical reporter with the Orlando Sentinel in Orlando, Florida, U.S.A. This article originally appeared in the newspaper's December 15, 2002, edition and is used with permission. A paper detailing the research study, "Dyslexia-Specific Brain Activation Profile Becomes Normal Following Successful Remedial Training," appeared in the April 2002 issue of Neurology.)

LIGHTING UP THE BRAIN

Dyslexia isn't the only disability to have new light shed on it, thanks to the latest advances in brain scans.

Scientists are making discoveries about a host of other disorders with functional magnetic resonance imaging (fMRI). This relatively new application of MRI technology allows researchers to visually track activity in the brain. It maps changes in the chemical composition or blood flow of parts of the brain over a few seconds or minutes. In effect, it "lights up" the areas of brain activity, creating a sort of real-time, colour video of the goings-on inside the mind.

Dr. Daniel Levitin of McGill University, has been using fMRI to study people with Williams syndrome. These individuals, in addition to having intellectual disabilities, are often highly musical - even gifted. Levitin has found that while most people process music in a fairly small, specific region of the brain, people with Williams syndrome are using a surprising range of areas in their brains that are not normally linked to music. "Imagine opening up the hood of the car and finding all the parts are doing things they weren't supposed to be able to do," Levitin told The Globe and Mail. (His paper, "Neural Correlates of Auditory Perception in Williams Syndrome: An fMRI Study" was published in the scientific journal NeuroImage in January.)

In the case of stroke, on the other hand, fMRI can demonstrate how usage of the brain has changed since an injury. For instance, researchers at Harvard University used fMRI to study motor activity in people who had recovered considerably well from a stroke. They found successful "reshuffling and reorganization" in the brains of stroke survivors - tasks were being reassigned from the damaged motor cortex to other nearby, well-connected areas. The team also learned that additional areas of the brain were being recruited to compensate for stroke damage, meaning much more of the brain was involved in moving various parts of the body.

"Just to get out of bed in the morning, a stroke patient has to turn on all the areas of the brain a golfer would use to sink an 18-foot putt," researcher Dr. Steven C. Cramer told a University of Washington reporter.

Functional magnetic resonance imaging is also being used to learn more about mental health disorders such as schizophrenia and obsessive-compulsive disorder, and neurological disabilities such as multiple sclerosis and epilepsy.

Studies such as these can help us learn about brain differences with various disabilities. And, as in the case of the dyslexia study, fMRI can actually lead to our training our brains to help us function more effectively.

Talk about a brain gain.

-- LISA BENDALL

Originally published in the Feature department of Abilities, Issue 54, pp. 17-19, Spring, 2003

General contact information

Description

- Advances in brain scanning technology are making it easier for researchers to study the way our brains work. And that includes the brains of children with reading disabilities. What’s more, these children can be helped to become better readers, simply by training their brain patterns. It’s the cutting edge of dyslexia research.