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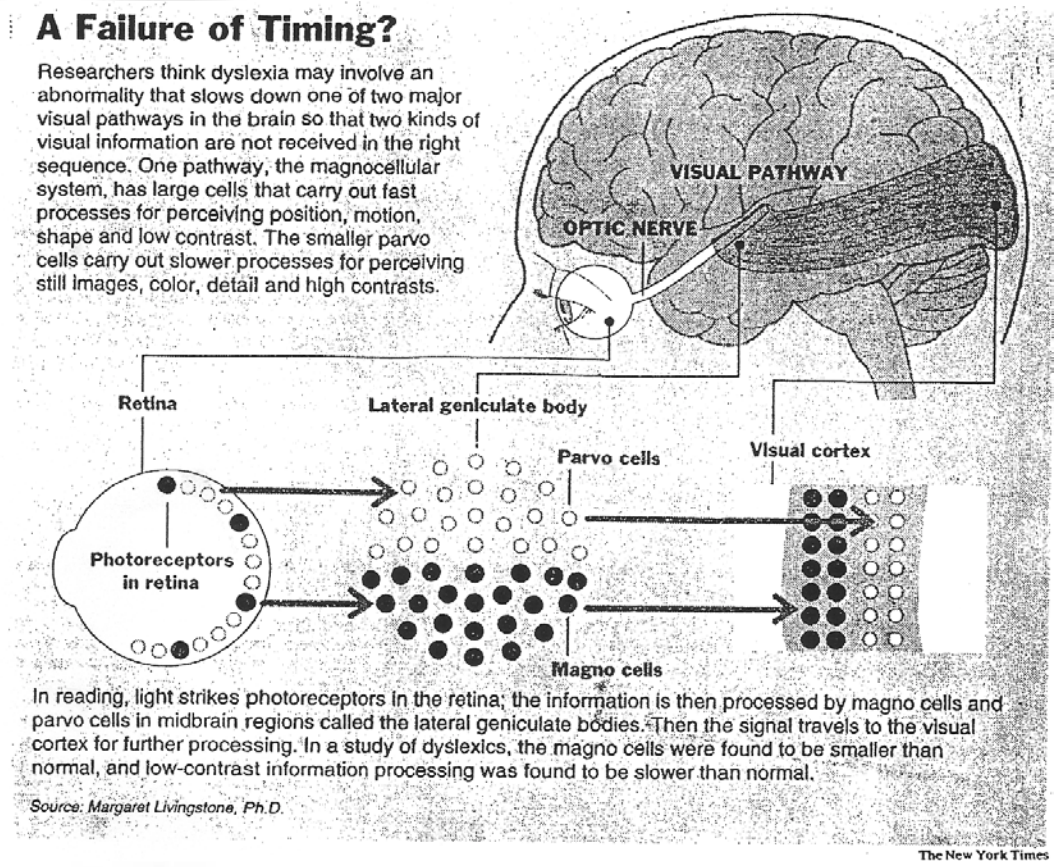
Study Ties Dyslexia to Brain Flaw Affecting Vision and Other Senses



By Sandra Blakeslee

A new finding about dyslexia suggests that the disorder may not be a malfunction in the way people understand language rather a brain abnormality that involves the sense of vision and also hearing and touch.

A team of prominent brain researchers reported yesterday that studies of living dyslexic people as well as autopsies of dyslexic brains suggested that the basis of the condition might be a failure of the visual system circuits to keep proper timing.

"This is the first observation that the visual system may be involved in dyslexia, and it is extremely important," said Dr. Drake Duane, an international authority on dyslexia and learning disorders at Arizona State University. "It reinforces the idea that the nervous systems of those who are dyslexic are atypical."

Implications for Therapy

Dyslexia, a broad term that includes a number of disorders affecting people's ability to read, is believed to affect 4% to 5% of the population, or some 12 million Americans. The new finding gives theoretical support to one method of treating dyslexia, through the use of colored filters in reading. If validated, it is also likely to suggest novel kinds of therapy, Dr. Duane said.

The finding could lead to methods of detecting Dyslexia in infancy, and treatments could begin in very early childhood when the brain's circuitry is most capable of changing. This raises the hope that children with the abnormality might be capable of learning to read by the time they entered school.

The study's results, described in the Proceedings of the National Academy of Sciences, is based on a small number of study subjects and is therefore, preliminary, said Dr. Margaret Livingstone, a Harvard neuroscientist who was principal author of the report. "But we were so excited that we decided to not delay publication," she said in a telephone interview. The research was carried out with two other Harvard researchers, Dr. Glenn Rosen and Dr. Frank Drislane.

"I am very excited about their results," said Dr. Paula Tallal, a professor at the Rutgers Center for Molecular and Behavioral Neurosciences. She said it appeared to support the notion that early language problems, dyslexia and physical clumsiness were manifestations of the same basic brain disorder.

Most experts view dyslexia as purely a language problem said Dr. Albert Galaburda, director of the Dyslexia Neuroanatomical Laboratory at Beth Israel Hospital in Boston and co-author of the report. In reading, dyslexics cannot break words down to their basic sounds, and they have lasting problems with the sound system of language, he said, even if their reading problems improve over time.

The role of vision in dyslexia was ignored, Dr. Galaburde said, in large part because opthalmologists could find no differences between the eyes of good readers and bad readers.

This changed, he said, with the recent finding that the visual system in humans and other primates is composed of two major pathways.

One of these pathways, the magnocellular system, is composed of large cells that carry out fast processes. The pathway is used for seeing motion, stereoscopic vision, depth perception, low contrast in locating objects in space. It probably evolved to help animal see predators move through the night.

The second pathway, the parvocellular system, is composed of smaller cells that carry out smaller processes. It specializes in color, detail forms, high contrasts and stationary images. It

probably evolved to help primates to see brightly colored fruits to see while swinging through the trees.

Question of Timing

The question arose, Dr. Galaburda said; Could defects in the magno or the parvo systems be involved in dyslexia? Experimental psychologists in the United States and Australia had developed tests suggesting that there was some sluggishness in the visual systems of dyslexics, Dr. Livingstone said. When two visual stimuli were presented in rapid succession, she said, dyslexics reported seeing only one image. Normal people saw both. When the same stimuli were presented more slowly, she said, dyslexics saw both.

In the new study, five dyslexics and seven normal people were studied, Dr. Livingstone said. They were shown a 36-rectangle checkerboard on which the squares were reversed at different speeds under conditions of high and low contrast. Contrast is the ratio of brightness between two objects.

At high contrast, when both the magno and parvo system should be responsive, the dyslexics showed a normal response to rapidly changing checkerboards, Dr. Livingstone said.

But at low contrast, when only a fast magno system should be responsive, she said, the dyslexics showed a greater diminished response, suggesting that their magno system was sluggish.

Dr. Galaburda then performed autopsies on five dyslexic brains and five normal brains. Looking at a major visual relay station, he found that the parvocellular system were similar in all brains. But the magnocellular layers were more disorganized and the cell bodies appeared smaller in the dyslexic brains, he said. Overall, the magnocellular

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New ways to detect and treat dyslexia may lie ahead.

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system was 27% smaller in this crucial area of the visual system.

Smaller cell bodies are likely to conduct impulses more slowly, Dr. Galaburda said.

Auditory Similarities

Dr. Tallal said her research supported the idea that fast components of the auditory system were similarly impaired and that the problem was manifest in young children with language-learning problems. Ninety-eight percent of language impaired children also have trouble learning to read, she said, suggesting are linked.

In one experiment, Dr. Tallal, presented children with combinations of the same high and low tone and asked the children to repeat what they heard. Normal children can discriminate tones presented 8 thousands of a second apart, she said, but language- impaired children need at least 300 such milliseconds between tones to recognize a difference.

Language-impaired children have great difficulty hearing the difference between sounds like “ba” and “da,” said Dr. Tallal. The “b” and “d” sounds occur in the first 4 milliseconds followed by a 40 millisecond transition to the “ah”

sounds, she said. Language-impaired children cannot process sounds in that 40 millisecond time window, she said, and thus cannot hear the difference between "ba" and "da."

But when the sounds are synthesized on a computer so that the "b" and "d" sounds are artificially lengthened, she said, the children can discriminate "ba" and "da." Children who practice hearing lengthened sounds on computers sometimes make permanent improvements in their speech, she added.

Dr. Tallal also found that children with language and hearing impairments have a defect in their sense of touch and sometimes seem clumsy. When their hands are hidden under a table and one finger is touched, she said, they can identify that finger. But if two fingers are touched in rapid succession, the children only sense a single touch, she said.

Such children must make sense of the world without perceiving vast amounts of fast- moving visual, auditory and tactile information, said Dr. Tallal. They rely instead on context, facial expressions, repetition and other strategies to know what is going on, she said, and are often not identified as having a learning problem until they enter primary school and try to learn to read.

Colored Light Filters Help

For a person to be able to read, the information from the fast magno system must preceed the slower parvo system in exactly the right timing, said Dr. Breitmeyer. If the magno system is operating sluggishly, words might seem to blur, fuse or jump off the page.

Based on Dr. Breitmeyer's research, Dr. Mary Williams of the University of New Orleans has been experimenting with colored light filters to see if the two pathways of dyslexic children can be altered to become better timed.

Dr. Williams has found that reading through blue filters helps 80% of the children read better, and 8% are helped by red filters. The filters which are pieces of transparent colored plastic like those sometimes used in overhead projectors, cost pennies apiece, she said.

Dr. Breitmeyer said he was trying to replicate the research and was optimistic, although exactly how the filters help the problem remains a mystery. The nerves cells of the fast magno pathway are inhibited by diffuse red light, he said, so the a blue filter may remove enough of the red in what a dyslexic person sees to thus allow the magno cells to work normally.

In what may be the most hotly disputed facet of the new research, a California psychologist, Helen Irlen, has been offering colored lenses and spectacles to dyslexic adults and children since 1983. Criticized as a charlatan whose remedy is without scientific basis, Dr. Irlen three states have tried to ban her lenses from their schools, largely at the urging of optometrists.

But Dr. Irlen, whose Irlen Institute is in Long Beach, said she had never claimed to understand the theoretical basis of using colored lenses to treat dyslexia. She said that she based her work on research with dyslexic adults who said

that words literally swayed or rippled across the page, and sometimes vanished from view. The discovery that colored lenses help hold the words in place on the page was accidental, she said.

Related Avenue of Research

Small or sluggish magno systems may be a normal variation of the human brain, Dr. Galaburda said, and probably should not be viewed as a disorder. While such people may have trouble learning how to read, he said, they can be extraordinarily gifted in other realms of life, including theoretical physics or brain surgery.

In a related avenue of research, scientists have found that animals can form antibodies that destroy a protein found only in the magnocellular system. This suggests that dyslexia could be an autoimmune disease acquired before or soon after birth, Dr. Galaburda said.

Thus, abnormally processed sights and sounds might begin to shape the infant's brain and cause it to be wired up differently from the start, he said, suggesting that interventions to help such children should begin as early as possible.