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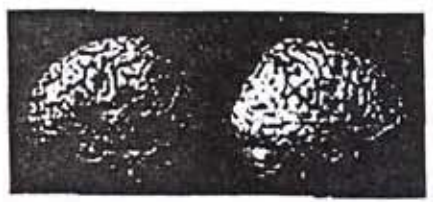
NEUROSCIENCE:
Dyslexia: Same Brains, Different Languages

Laura Helmuth

Pity the poor speakers of English. New research suggests that they may be especially prone to manifest dyslexia, the language disorder that makes reading and writing a struggle, simply because their language is so tricky.

The distinctive pattern of spelling and memory problems that characterizes dyslexia has a strong genetic basis, suggesting that some neurological oddity underlies the disorder. But there appears to be a cultural component to the disease as well, because dyslexia is more prevalent in some countries than others; for instance, about twice as many people fit the definition of dyslexic in the United States as in Italy. Researchers have suspected that certain languages expose the disorder while others allow dyslexics to compensate. Now a brain imaging study backs this theory up.

A multinational team of researchers used positron emission tomography (PET) scans to observe brain activity in British, French, and Italian adults while they read. Regardless of language, the team reports on page 2165, people with symptoms of dyslexia showed less neural activity in a part of the brain that's vital for reading.



Spelled out. As shown in this model, red areas are equally active in dyslexic and normal readers; green areas are sluggish in dyslexics.

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Companion article to E. Paulesu orig, same Journal #.

➤ "Neurologically, the disease looks very much the same" in people who speak different languages, says

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neurologist Eraldo Paulesu of the University of Milan Bicocca in Italy. "Therefore, the difference in prevalence of clinical manifestations [among different countries] must be attributed to something else." The researchers blame language.

English consists of just 40 sounds, but these phonemes can be spelled, by one count, in 1120 different ways. French spelling is almost as maddening. Italian speakers, in contrast, must map 25 different speech sounds to just 33 combinations of letters. Not surprisingly, Italian schoolchildren read faster and more accurately than do those in Britain. And it's no surprise that people have a harder time overcoming reading disorders if their language, like English or French, has a very complex, arbitrary system for spelling. "English comes with a built-in deficit," says education researcher Ken Spencer of the University of Hull in the United Kingdom.

Diagnosing a learning disability is notoriously subjective. Lack of access to good education and other social factors probably account for most reading disorders, says psychologist Richard Olson of the University of Colorado, Boulder. To avoid some of these issues, the researchers tested university students--people who have served plenty of time in classrooms and don't lack intelligence or willpower. The English and French dyslexic students have compensated for their disorder and are "very successful people," says study co-author Ute Frith of University College London, even though they need more time when taking exams and make frequent spelling mistakes.

Finding dyslexic Italian subjects was trickier, because practically no university students have been diagnosed with the disorder, Frith says. The team tested 1200 students and identified 18 with a pattern of verbal memory problems (such as difficulty remembering telephone number-like strings of digits) and slowed reading typical of the diagnosed dyslexics in France and the U.K. The "dyslexic" Italian students weren't told how they scored, but some (aware that they were participating in a dyslexia study) volunteered that they'd had trouble learning to read as children, Paulesu says.

Even though the Italian subjects were unaware of and unhindered by having dyslexia-like reading skills, under the PET scan they looked just like British and French students who struggled with reading. Compared to normal readers, dyslexics from all three countries showed less activation in parts of the temporal lobe while reading. The underutilized areas are familiar to neurologists: Patients with strokes in this area often lose the ability to read and spell, even though they still speak fluently.

The researchers aren't sure why the dyslexics seem to access this brain area less than normal readers do. Other PET studies and scattered neuropathological reports have led to speculation that, in general, dyslexics have fewer neural connections among cells in this region. Although most researchers think that's plausible, little consensus exists on more detailed explanations of how or why dyslexics' brains are different from those of normal readers, Olson says. His research suggests that genetic factors account for about half of someone's risk of developing dyslexia, although no single gene is likely to be to blame.

This research doesn't supply ready solutions for how to help dyslexic students overcome their reading disability. Paulesu says, short of moving to Italy, Turkey, or Spain, where spelling is simple and straightforward. So sympathize when English- or French-speaking students complain about having to memorize arbitrarily spelled words; they're right to feel wronged.

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Summary and Comment

Dyslexia: A Disease Without a Country

It has long been noted that the prevalence of dyslexia varies with the ratio of sounds to written letters in the native language. Thus, in Italy, where the language contains 25 sounds to 33 letter combinations, the prevalence of dyslexia is low, but in English-speaking and French-speaking countries, where there are at least 40 sounds to 1120 letter combinations, the prevalence of dyslexia is relatively high. To determine whether dyslexic individuals have similar brain activity regardless of their native languages, researchers administered IQ and specific reading tasks to 54 Italian, French, and British dyslexics (age range, 21 to 27) and to 76 matched controls as they underwent labeled-water PET scans.

Previously diagnosed dyslexics with college-level educations were selected from the U.K. and France; because of difficulty in locating college-educated dyslexics in Italy (likely due to the overall low prevalence), Italian dyslexics were chosen after more complicated screenings. Dyslexics from all 3 countries scored worse than controls on all reading tasks. Although Italian-speaking dyslexics did score lower than Italian controls, they were less impaired on reading tasks than English- or French-speaking dyslexics. Dyslexics from all 3 countries had similar PET scans with reduced activity in the left middle, inferior, and superior temporal gyri and the middle occipital gyrus, compared with findings for controls.

Comment: This impressive study establishes that the neurologic mechanisms of dyslexia are similar regardless of native language. The brain regions involved correspond to areas of the brain concerned with language processing and are consistent with postmortem findings of ectopic areas in the cortex and dyslamination of cortical layers of dyslexic individuals.

— *B Geller*

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Paulesu E et al. Dyslexia: Cultural diversity and biological unity. Science 2001 Mar 16; 291:2165-2167. [Original article] [Medline

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