Why Study Dynamic Visual-Spatial Thinking In Dyslexia? Q&A with Jeffrey Gilger

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Jeffrey Gilger, Ph.D., has been busy. Dr. Gilger is a developmental psychologist at the University of California-Merced (UC Merced) and a former International Dyslexia Association (IDA) board member. He and his team have been conducting brain-imaging studies on the neurobiological processes in adults with dyslexia and in a subgroup who also are gifted in nonverbal-spatial abilities. Within the last year and a half, Gilger and his colleagues have published three studies.

Dyslexia-Talent Debates

Long-standing speculations and questions about a possible dyslexia-talent relationship, particularly in nonverbal-spatial domains, have piqued interest for decades. The questions have remained largely unanswered, at least scientifically, ever since dyslexia was described in early medical literature (e.g., Morgan's 1896 case study on "Percy F"). The possibility of such a paradoxical relationship is intriguing, but remains an open question since only a small body of empirical research has been conducted on this topic thus far. (See Examiner articles "Dyslexia and Visuospatial Processing Strengths: New Research Sheds Light" and "Upside of Dyslexia? Science Scant, but Intriguing." Also see "The Surprising Upside of a Dyslexic Brain," by Annie Murphy Paul.)

The dyslexia community is divided on the question of a dyslexia-talent relationship and its possible etiologies and implications.

Some argue that a single-minded focus on dyslexia's downsides is shortsighted, overly negative, and incomplete. Advocates of the "dyslexia upside" hypothesis point to surveys of successful entrepreneurs, inspirational stories of accomplished individuals, and myriad anecdotal and clinical reports to support the position that dyslexia imparts advantages.

But others argue that the body of scientific evidence to support such a claim does not yet exist and that the anecdotal reports and stories might be just an illusory correlation.1 In a similar vein, others assert that because illiteracy wreaks such terrible havoc on the trajectories of young lives, the primary focus should be to ensure that people with

dyslexia, especially youngsters, get the proven interventions that offer the best chance for becoming proficient readers.

Some counter that technology will render the need for print literacy moot and already offers new opportunities for those with a "dyslexic cast of mind." Others argue that for the foreseeable future, print literacy will remain a gateway (or barrier) to full and productive participation in society. Some assert that stories of high profile and "celebrity dyslexics" offer lifelines of hope and inspiration for families struggling with dyslexia. Others counter that these hopeful narratives become a double-edged sword when high expectations about talents are not fulfilled and that for every celebrity or millionaire success story, there are thousands who struggle with the harsh social consequences of school failure and illiteracy. The media, which loves a feel-good story about overcoming odds, stirs the pot periodically with fabulous stories of celebrities and other accomplished folks who "overcome their dyslexia" to achieve success.

The truth, certainly, is more conditional and nuanced than the synopses above, but they capture the essence of the debate and speculations that have been ebbing and flowing in the dyslexia field and community for decades. This is not an esoteric issue. At its heart lie challenging questions for parents and educators:

What is the right balance between intervention and nurturing strengths?♣
When is it appropriate to shift the emp♣hasis from skill-development to assistive technology?
If a dyslexia-talent relationship exists, can it point to more effective interventions?♣
New UC Merced Research

As in previous articles on studies of various aspects of a possible dyslexia-talent relationship, we urge caution about over interpreting results as well as an open mind about dyslexia's many unanswered questions and its innumerable complexities and possibilities.

Dr. Gilger and colleagues step into this dyslexia-talent debate with the publication of three neuro-imaging studies on dyslexia and nonverbal-spatial abilities.
One study compared "gifted dyslexics" to a group of gifted "normal readers" and showed that although these two groups of adults performed similarly on behavioral tests, they used different neural processes to solve spatial problems. This work may have implications for educators—offering possible insights into how to teach the gifted child with dyslexia and how giftedness "works" in different students.

In another study, Gilger and a team of researchers reported on how adults with dyslexia analyze complex, dynamic spatial material. Results showed that adults with dyslexia seem to process such information differently than those without dyslexia, suggesting that the brains of people with dyslexia are atypical in many areas, not just those areas involved in reading. While the broad differences in brains of individuals with dyslexia already were known, this was the first fMRI study to look at the neurophysiology of dynamic 3-D spatial problem solving.

The third study compared brain activation patterns and behavioral tests in four groups of adults: 1) those with dyslexia who also are gifted in nonverbal areas (so-called "twice exceptional"); 2) those with dyslexia alone; 3) those who are normal readers and gifted; and 4) a control group. This third study found that those with dyslexia who are also gifted resemble those with dyslexia who are not gifted in performance on reading, math, and spatial behavioral tests as well as in brain activation patterns during both word reading and spatial processing. In a recent UCMerced University News article, Gilger said, "This finding suggests that the reading disability and the nonverbal giftedness may not be independent conditions. …There could have been a lifespan interaction between the two skill domains, with reading compensation effects modifying how the adult brain processes text as well as spatial stimuli." Of course, this hypothesis needs further study.

The Examiner spoke recently with Dr. Gilger to learn more about his studies and their findings.

Q&A With Dr. Gilger

Q: A rich body of neuroimaging work already has shed considerable light on possible causes of dyslexia and effective interventions. Why is it also important to study dynamic visual-spatial processing in people with dyslexia?

A: We study this subject for several reasons. First, nearly all neuroimaging studies of people with dyslexia have focused on language-related processing. Comparatively little is known about neural mechanisms for complex spatial processing in people with dyslexia. We believe it is important to acquire a more complete understanding of how the brains of people with dyslexia differ from the brains of normal readers. This study must include more than the skills related to the analysis of text. Second, although there have been a few imaging studies that have looked at the orthographic (visual) aspects of text, magno-parvocellular visual processing, and the like, these studies did not address dynamic visual-spatial thinking that requires the individual to reason nonverbally by mentally manipulating visual stimuli. Whether or not people with dyslexia are neurologically different from those without dyslexia when it comes to spatial thinking has been long debated. This is the first study to actually look at this possibility via imaging during dynamic 3-D spatial reasoning. Your readers might also want to review a recently published article by Josh Diehl and colleagues that shows that people with dyslexia process certain types of static or "impossible" geometric figures in neurologically unique ways compared to normally reading peers. (See prepublication discussion in January 2014 Examiner and reference below.)

Q: You have commented elsewhere that the issue of inherent spatial-intellectual gifts in people with dyslexia is controversial—that it is related to, but different from, the general issue of twice exceptionality. Can you help us understand this difference?

A: These are two closely related yet subtly different perspectives. Sometimes the two overlap. The first perspective is that the intellectual gifts found in people with dyslexia are inherently part of, or a consequence of, the neurology that led to the reading disorder

According to this view, spatial or nonverbal talents and reading deficits share the same etiology; thus, people with dyslexia are predisposed to certain talents, and those without dyslexia are not.

The second perspective—often found among professionals in special education or disability services—uses the term "twice exceptional" or "2e" for someone who has dyslexia (or other learning disorder) and intellectual gifts. While those who speak about the talent-dyslexia link may also use this term, 2e does not concern itself with the cause of the talent-dyslexia co-occurrence. Rather, the focus is on the description and "treatment" for this "condition" in schools, public policy, and mental health. Twice exceptionality is a broad term that encompasses many conditions and disorders alongside intellectual gifts, including savantism.2

Q: Tell us about your study comparing subjects with dyslexia with and without nonverbal gifts and gifted subjects without dyslexia. What did this study show?

A: The 2e study we conducted was the first of its kind. Our hope was to use the lens of neuroscience to focus on the important but neglected area of gifted people with dyslexia. We wanted to know how the neurology of "gifted dyslexics" compared to the neurology of people who are gifted and not LD and to the neurology of people who have dyslexia without being gifted. Do the 2e brains, for example, function like gifted brains, like dyslexic brains, or like some combination of both?

In brief, the study showed that the functional neurology of gifted people with dyslexia (2e) was pretty much the same as that of individuals with dyslexia who were not gifted, whether they were processing text or spatial stimuli. Moreover, while the 2e subjects and gifted subjects were matched on nonverbal IQ (our measure of giftedness), their functional neurology was very different as was their performance on behavioral spatial tests. The 2e subjects were depressed in neural activation and did not activate the same areas relative to the gifted subjects, nor did they perform as well as the gifted subjects on behavioral measures of spatial skills, other than the defining measure of nonverbal IQ. In fact, the 2e subjects looked much like the non-gifted dyslexics in both behavior and neurology.

Q: What might this mean?

A: There are probably multiple ways to interpret these findings. However, considering some prior work, we formed a hypothesis we are exploring currently: First, that being born with dyslexic neurology predisposes a person to usurp—as a compensatory mechanism—brain regions not commonly used for reading. This may be especially true of our adult subjects who had many years of remediation and education that required practicing reading skills. Second, some of the areas usurped for reading may have been otherwise used for the development of nonverbal abilities. With stimulation and practice in the early years, some of these subjects may have further developed their spatial skills, and the competition between reading and spatial thinking for neurological resources may have turned out differently. In such a case, the functional neurology and behavior of the

2e group would not have looked like the pure dyslexic group, and may have looked more like the gifted group with greater activation of key areas needed for spatial processing. The idea that learning to read may require a neural trade-off between language and non-language processing areas also is supported by other work. (See, for example, the Diehl et al. article mentioned above and work by Dehaene in 2010 and McClintock-Chang in 2011, among others.)

Q: Do you have caveats or cautions for parents, educators, and people with dyslexia as they seek to understand these findings and think about them in their work or lives?

A: First, there often is a drive to consider people with dyslexia as one homogeneous group. They are not! Individuals with dyslexia have their own unique profile of strengths and weaknesses. Not all have a severe spelling deficit; not all are good at visual spatial processing or art. It is important to look at the individual and not make assumptions about what the person can and cannot do based on summaries of research. Second, our sample was small, although it involved 4 groups of carefully selected and matched subjects, with relatively rare samples of individuals with dyslexia, gifts, and dyslexia and giftedness alone. As it is the first such study, interpretations and extensions need to be made cautiously. Our hope is that this work will stimulate questions and further research in the area that includes empirical neuroscience.

Q: How might your three studies factor into the debates about a dyslexia-talent relationship?

A: One message we convey in each of these reports is that empirical research is greatly needed to adequately address the proposed linkage of nonverbal talents and dyslexia, as well as to address the neurological foundations of 2e. In that way, our research presses the point and, perhaps, gives some direction on one way these questions might be addressed. That said, we have mentioned a developing theory we have as to why our fMRI data on the four groups came out as it did. The pattern of results we observed does not rule out a common etiology, although it does not support one either.

Q: Where is your research heading next?

We are planning other studies, one of which will replicate this design with young children, and another that will take a closer look at why 2e adults with dyslexia look so similar to people with dyslexia alone. I should also mention that we have completed preliminary analyses looking at brain structures (size and thickness of specific brain regions) and how these structures might differ across our four groups. There are, in fact, some surprising differences that we hope to report on soon.

Q: A final question: You probably saw the recent article in Scientific American, "The Advantages of Dyslexia." What are your thoughts?

The summary in Scientific American presents some interesting information that essentially suggests that the dyslexic brain is different, and that this difference goes

beyond reading deficits and may include the development of strengths in more visual-spatial or holistic analysis. Results of our research and the research of others also have pointed to this possibility, although the strength of the dyslexia-spatial/holistic talent link remains unclear and open to debate. Nonetheless, it is clear that the dyslexic brain is broadly atypical and may have a potential we do not fully understand.

The dyslexic reading deficit and correlated cognitive abilities are a consequence of unique prenatal neurodevelopment in combination with experience, particularly early on. In fact, studies by Dehaene et al (2010) and McBride-Chang et al. (2011), among others, suggest that an early emphasis on learning to read alphabetic text may modify neurology in ways that may influence processing of visual-spatial information later on. Our research parallels these studies, suggesting an interaction between early experience with text and a neurology that also may have been primed towards talents in nonverbal areas. Clearly, additional studies that go beyond reading, with adults and children, are needed to fully address the interesting questions posed by the unique dyslexic brain.

Q: Any closing thoughts?

A: As we have noted here and in other articles, it is important to take a developmental perspective when considering learning disorders, their etiology, and their effects. Our recent research highlights this concept for me even more. I can see clearly how early neural development can have diffuse effects and that the same behaviors in any two people can have quite different neurological mechanisms. Results of our research, and the research of others, demonstrate that regions of the brain interact across the lifespan and early (even prenatal) developmental events typically affect multiple brain areas—for better or worse. Thus, what may have started off as a specific disability (or ability) rarely stands alone. Rather, it tends to draw in other neurological areas and functions along its developmental course. This in turn can affect other abilities, change expression of the disability over age, or perhaps modify neurology such that "gifts" are gained or lost.

Last Word

We thank Dr. Gilger for sharing the results of the three UC Merced studies—referenced below—and for his thoughtful review of their findings. As in previous articles on studies of various aspects of a possible dyslexia-talent relationship, we urge caution about over interpreting results as well as an open mind about dyslexia's many unanswered questions and its innumerable complexities and possibilities. And, as always, IDA asserts that all children in every classroom across the nation need effective reading instruction. IDA has outlined the distinguishing characteristics of such instruction in Knowledge and Practice Standards for Teachers of Reading and recently has termed such instruction "Structured Literacy."

1Illusory correlation: The phenomenon of perceiving relationships among variables when no relationships exist. See Chapman (1967), who coined the term.

2Savant syndrome is a condition in which a person with a mental disability exhibits exceptional talents or brilliance in specific areas, such as rapid calculation or artistic or musical ability.

For those who wish to delve into other aspects of neuro-imaging recent research on dyslexia, the following Examiner articles may be of interest.

- "Dyslexia and Visuospatial Processing Strengths: New Research Sheds Light"
- "Visual System Differences in Dyslexia Do Not Cause Reading Problems"
- "Brain Activity Associated with Dyslexia Predates Difficulty Learning to Read"

Also check out the IDA Fact Sheet authored by Dr. Gilger, "Gifted and Dyslexic: Identifying and Instructing the Twice Exceptional Student."

The Three UC Merced Studies

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