POSTSCRIPT

Will a Push for Standards and Accountability Lead to More Motivated Students?

Sheldon and Biddle offer considerable evidence—most of it from experimental rather than correlational studies—that external rewards or systems of control either decrease students’ intrinsic motivation to engage in the controlled activity or lead teachers to alter their behavior in the direction of greater control over the learning process, which in turn limits student motivation. Unfortunately, there are several limitations of the data presented by Sheldon and Biddle that make it impossible to conclude with certainty what effect standards reform will have on student motivation.

Consider two limitations: First, in the research cited by Sheldon and Biddle, the rewards or punishments were grades, prizes, or other relatively minor consequences, and their delivery was contingent on a vague specification of “doing well.” Supporters of standards would argue that their plans are very different from the plans embodied in these studies because their plans involve a clearly articulated set of goals associated with far-reaching consequences (e.g., nonpromotion). Second, the studies cited by Sheldon and Biddle were all short-term, involving an assessment of outcomes only a few days or weeks after implementation of the system of external control. It is possible, argue supporters of standards, that the negative effects of an external system of control are transient—a possibility that would require examining student motivation over the course of several semesters or even years.

There are many articles on the issue of standards and accountability. Two papers that focus on the positive elements of standards reform are “Core Knowledge and Standards: A Conversation With E. D. Hirsch, Jr.,” by John O’Neill, Educational Leadership (March 1999) and “Realizing the Promise of Standards-Based Education,” by Mike Schmoker and Robert J. Marzano, Educational Leadership (March 1999). Several interesting papers have focused on the establishment of standards in particular content domains, most notably mathematics: “Parrot Math,” by Thomas C. O’Brien, Phi Delta Kappan (February 1999); “Issues and Options in the Math Wars,” by Harold L. Schoen et al., Phi Delta Kappan (February 1999); and “A Common Core of Math for All,” by Arthur F. Coxford and Christian R. Hirsch, Educational Leadership (May 1996). The impact of the push for standards and accountability on multicultural education and the marginalization of students from the nonmajority culture can be found in “Multicultural Education and the Standards Movement: A Report From the Field,” by Anita P. Bohn and Christine E. Sleeter, Phi Delta Kappan (October 2000).

Research in the brain sciences has proceeded at a rapid pace since the 1970s, due in large measure to the advent of some amazing new technologies: positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), functional magnetic imaging (fMRI), and high-density event-related potentials (HD-ERP). These technologies provide high-resolution images of the human brain, yielding information about not only structural characteristics but also about how the brain functions “online” as an individual processes perceptual information, solves complex problems, or makes responses as simple as a button press or as complex as a spoken sentence. Some of these techniques require sedation, exposure to radiation, and injections and are thus of limited utility with young children. Other techniques, however, are noninvasive, typically requiring only that the individual whose brain is being “imaged” sit motionless and attend to a set of tasks. The unique properties of the brain sciences make the field one of the most fascinating and challenging in the world of education.
in a special apparatus while performing the cognitive task being studied, which means that many of these techniques can provide a window into the brains of even very young children.

A few of the findings that have captured the attention of educators (not to mention the news media) in recent years follow:

1. In contrast to what was believed only a few years ago, the structure and function of the human brain is not fixed at birth. It now appears that the brain undergoes dramatic changes in connectedness during infancy. The many neurons (nerve cells) in the baby’s brain establish increasing information-exchanging links with each other. The number of connections, or synapses, increases more than 20 times during the first few months of life.

2. The timing of synaptic development varies across different parts of the human brain, which may account in part for the different behavioral capabilities of children at different ages. For example, at 18 to 24 months, a dramatic increase in synaptic density and changes in the metabolic activity of the brain may help to produce the burst in vocabulary learning normally seen at this time.

3. At the same time that synaptic growth is providing the foundation for new skills and capabilities, it is closing off other avenues of learning. For example, there is evidence that early in infancy neurons in the auditory cortex are responsive to a range of speech sounds. As the infant gains exposure to his or her native language, however, neurons become more specialized, responding only to specific, frequently heard sounds, which leaves them “unresponsive” to unfamiliar speech sounds, such as those included in other languages. This seems to occur by 12 months of age.

4. There is evidence that brain regions that are normally responsible for one function can assume other functions depending on the experiences available to the individual. For example, portions of the temporal lobe that are responsive to sound in individuals with normal hearing are sensitive to visual stimuli in congenitally deaf individuals.

5. Chronic traumatic experiences during periods of rapid brain growth can lead to greatly elevated levels of stress hormones, which then flood the brain, altering its structure and function, with serious consequences for subsequent learning and behavior.

Educators have enthusiastically embraced findings emerging from work in the brain sciences. After all, our understanding of the brain informs us about learning; doesn’t it follow that our understanding of the brain will inform us about teaching as well? In the first of the following selections, Mariale M. Hardiman argues that current research on brain function does inform educational practice. In the second selection, Gerald Coles argues that climate and context are the breeding environments for new skills and capabilities, it is closing off other avenues of learning.

In the past 10 years, teachers have been bombarded by education reform initiatives, including standards-based instruction, teaching to students’ learning styles, performance-based instruction, multiple intelligences, and, most recently, brain-based learning. In addition, during the 1990s, the Individuals with Disabilities Education Act (IDEA) mandated that students with disabilities have access to the general education curriculum. This mandate has resulted in more students with special needs being taught in general education classrooms (Lombardi & Butera, 1998).

Meeting the needs of diverse learners can be challenging enough for teachers without the charge of determining how to incorporate reform initiatives into practice. Merely superimposing reforms upon existing practices and requirements is generally ineffective. Education initiatives that link current practice with promising new research in neurological and cognitive sciences, however, offer real possibilities for improving teaching and learning, especially for students with diverse learning needs.

Scientists and researchers are making exciting new discoveries related to how the brain processes and stores information (Sousa, 1998). This research has the potential to unlock the mysteries of learning itself. For example, recent research highlights the differences in brain anatomy of students with learning disabilities and attention deficits that can shed light on their performance in the classroom (Semrud-Clayman et al., 2000). Yet, despite the enormous implications of such research, it is not being effectively disseminated to educators. How can we familiarize teachers with brain-based learning so that they can apply this latest research to meet the needs of all students, including those with disabilities, in the general education classroom? A basic precept of brain-based research states that learning is best achieved when linked with the learner’s previous knowledge, experience, or understanding of a given subject or concept (Perry, 2000). Therefore, we can assume that the use of brain-based research would be most effective when combined with previously established frameworks for teaching and learning (Brandt, 1999).

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One such framework that Roland Park Elementary/Middle School has used since 1994 is the Dimensions of Learning model (Marzano, 1992). Roland Park, a Blue Ribbon School of Excellence in Baltimore, Maryland, has steadily improved the achievement of its 1,350 students during the past six years. Our progress, in part, may be attributed to our use of Dimensions of Learning, which addresses the development of higher-order thinking skills. Robert Marzano describes the five dimensions as "loose metaphors for how the mind works during learning" (1992, p. 2). Linking the five dimensions with the latest brain research suggests a number of best practices for teaching all children—especially students with learning disabilities.

**Dimension One: Positive Attitudes**

Dimension One explains that a student’s attitudes and perceptions serve as filters that enhance or inhibit natural learning. Although educators may have long suspected that attitudes affect learning, brain research clearly supports the link between emotions and cognition. Robert Leammon (2000) explains that neural pathways connect the limbic system, the brain’s emotional center, to the frontal lobes, which play a major role in learning. In addition, hormones alter the chemical makeup of the brain of a person under stress. When the person is threatened, chemicals are released that can impair memory and learning (Jensen, 1998).

**Best Practices**

- **Provide a challenging yet supportive classroom environment by reducing the stress that may come from embarrassment because of academic difficulties or peer rejection.** At Roland Park, we make students feel more comfortable by assigning a "peer buddy" as a homework helper, arranging for tutoring in study skills and test-taking strategies, and providing special meetings outside of class time to encourage a trusting teacher-student relationship.

- **Teach peer acceptance and social behaviors explicitly.** Students with learning disabilities may experience an added fear of rejection from the stigma of special education. Our teachers hold class meetings to encourage social acceptance and interaction, use literature and history to provide instructional materials that demonstrate acceptance of diversity, and model an attitude of acceptance and appreciation for those with different learning styles and needs.

- **To cement long-term memory, connect emotions to learning.** Techniques such as dramatizations, humor, movement, or arts integration can arouse the emotional systems of the brain and stimulate peak performance. For example, teachers may tell a funny instructional story at the beginning of class to foster a relaxed yet supportive atmosphere.

**Dimension Two: Acquiring and Integrating Knowledge**

Dimension Two pertains to the acquisition and integration of knowledge. Marzano (1992) proposes that learning new information must occur within the context of what the learner already knows and must be adequately assimilated so that the information can be used easily in new situations.

Much of brain-based research has focused on how the brain acquires, stores, and uses information (Valiant, 1998). Learning occurs through the growth of neural connections, stimulated by the passage of electrical current along nerve cells and enhanced by chemicals discharged into the synapse between neighboring cells. The more often the "trail is blazed," the more automatic a task or memory becomes (Buchel, Coull, & Friston, 1999). Therefore, the more a student repeats a learning task, the greater the connectivity. Researchers also point out that different parts of the brain store particular parts of a memory (Fishback, 1999). For example, one part of the brain might store the lyrics of one song and another part, the melody. Further, Leammon (2000) explains that the brain must reconstruct a memory each time the person recalls the memory. Learning thus requires both the acquisition of information and the ability to retrieve and reconstruct that information when necessary. Evidence from brain-mapping technology indicates that individual differences in learning styles affect this retrieval process. In a study that investigated the differences between normal and disabled readers in visual-perceptual tasks, Richard S. Krut and Dale M. Willows (2001) found significant processing differences that affected the rate of visual processing for students with reading disabilities. Jean Robertson (2000) suggests that the inability to shift control from the right to the left hemisphere of the brain may cause early reading disorders.

**Best Practices**

- **Present new information within the context of prior knowledge and previously learned content.** For example, studies may better understand the bicameral system of U.S. government by comparing it with their own student government.

- **Allow students to repeat learning tasks to cement them in memory.** (Sprenger, 1998). This is especially important for activities that require an automatic response, such as blending phonemes into words (Shaywitz, 1998) or mastering math facts.

- **Use mnemonics, which can significantly increase the memory of content.** (Carney & Levin, 2000), especially for students with special needs (Lombard & Butler, 1998). For example, telling students to "write with their FEAT" can remind them to use the transition words "for example" or "according to" to introduce supportive text in their writing.

- **Use visually stimulating material and manipulatives to activate the right hemisphere of the brain and text presentation to activate the left hemisphere.** (Robertson, 2000). The right brain’s visual-spatial skills can be activated with features such as a balance scale to help visualize algebraic equations or pictures and graphs to enhance the meaning of text.

- **Integrate art, music, and movement into learning activities to activate multiple parts of the brain and enhance learning.** (Rauscher et al., 1997; Vogel, 2000). For example, students can learn how the earth’s tilt and rotation create seasons through body movements—tilting the body toward the center of a circle to simulate spring; turning and tilting away from the center to simulate fall.
Dimension Three: Extending and Refining Knowledge

Extending and refining knowledge requires examining it in a deeper, more analytical way by doing such things as comparing, classifying, inducing, deducing, analyzing errors, constructing support, abstracting, and analyzing perspective (Marzano, 1992). The thinking skills involved in Dimension Three require that the brain use multiple and complex systems of retrieval and integration (Lowery, 1998). Ron Brandt (2000) states that brain research supports thinking-skills programs that have students compare and classify familiar concepts. He explains that neurons that often fire at the same time as certain other neurons become more likely to fire whenever those other neurons fire. We use less brain energy when performing familiar functions than when learning new skills. (p. 75)

Best Practices
- Design tasks that allow students to use prior knowledge to learn new information. For example, students use their prior understanding of photosynthesis to explain the differences between plant and animal cells.
- Offer students an opportunity to compare their performances with model responses and to analyze their error patterns. For example, when asking students to write an essay, provide a model paper that clearly identifies the main idea, supporting details, transition words, and conclusion. Let students use the model to organize their own writing.
- Teach students to identify general patterns that underlie concepts. For example, compare the leadership characteristics of current leaders with those of successful leaders of the past.

Dimension Four: Using Knowledge Meaningfully

Marzano (1992) states that we learn best when we need information to accomplish a goal. Using Dimension Four thinking strategies, students apply information in activities that require them to make decisions, investigate, conduct experiments, and solve real-world problems. Brain research confirms that this type of experiential learning activates the area of the brain responsible for higher-order thinking (Sousa, 1998). Moreover, enriched instruction has been shown to produce significant chemical changes in the brains of students with learning disabilities—changes that indicate less exertion of effort in learning (Richards et al., 2000). A similar study (Bower, 1999) indicated that reinforcement of active learning tasks improves brain efficiency.

Learmnson (2000) warns, however, that merely providing students with hands-on activities does not guarantee learning. Teachers must pair physical activities with problem-solving tasks to connect the “acting modules” of the brain—the motor cortex—with the “thinking modules”—the frontal lobes. Such experiences increase memory and learning, thereby modifying brain structures (Kandel & Squire, 2000).

Dimension Five: Habits of Mind

Dimension Five describes the mental habits that enable students to facilitate their own learning. These habits include monitoring one's own thinking (metacognitive thinking), goal setting, maintaining one's own standards of evaluation, self-regulating, and applying one's unique learning style to future learning situations. Understanding and facilitating one's own learning style is especially important for students with learning disabilities. According to Martin Languis (1998), brain-mapping tests reveal individual differences in brain organization and structure that relate to specific differences in learning style. Studies showed that students who were more skilled in spatial-visualization tasks such as visualizing three-dimensional objects demonstrated different brain-processing patterns compared with less-skilled students. Students, however, significantly improved their scores in spatial-visualization assessments after taking courses that taught them specific learning strategies such as the use of imagery, graphic organizers, and puzzles.

Best Practices
- Provide ways for students to engage in metacognitive reflection. Students benefit from the use of think logs, reflective journals, and group discussions within a cooperative learning setting.
- Include reflective discussions of lessons to foster the habit of reflection on learning. Ask students to record one important concept that they learned from the lesson and several important facts.

Putting the Research to Use

Although most researchers agree that our understanding of the human brain is in its infancy, the explosion of research in the field of neurology and cognitive sciences in the past 10 years can and should play an important role in education reform, especially for students who demonstrate differences in their thinking and learning patterns. If teachers combine brain research with a thinking skills framework such as Dimensions of Learning as we have at Roland Park Elementary/Middle School, the research will translate more effectively into practice. Our use of this model has resulted in exciting learning experiences for students as well as increased scores on our state performance assessment every year since 1994.
Moreover, the potential of brain research to provide new approaches to teaching students with information-processing difficulties makes its use all the more vital in classrooms today. Students with learning differences, including those with learning disabilities who are in general education classrooms, deserve to have available to them a program of research-based instruction to nurture and enhance both thinking and learning.

References

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Danger in the Classroom: “Brain Glitch” Research and Learning to Read

Did you know that recent studies of the brain and reading support the reading instruction mandated in George W. Bush’s No Child Left Behind (NCLB) legislation? And did you know that this research also supports the legislation he has proposed to dismantle Head Start’s comprehensive approach to preschool education? And were you aware that, thanks to this brain research, we now know how children learn to read and which areas of the brain must first be stockpiled to promote skilled reading? Did you realize that we now have strong brain-based evidence that the best reading instruction is heavily prescriptive, skills-emphasis, building-blocks teaching that starts with small pieces of written language and proceeds to larger ones—and teachers are fortunate because these features are contained in reading programs like Open Court?

You didn’t know all that? Good, because none of it is true, although you would never know that if you just listened to the President, the educators and assorted researchers who support his educational agenda, and the media who repeat their assertions.

Over 25 years ago, when I began appraising theories about faulty brain wiring in beginning readers, my criticism of the research then being conducted was limited to ersatz explanations of so-called brain dysfunctions in children called “learning disabled,” “reading disabled,” or “dyslexic.”1 Contrary to the assertions made then, the research had never shown that the overwhelming number of these children did not have normal brains. Certainly a portion of poor readers had problems that were the result of exposure to such toxins as lead and cadmium, to food additives, and to other environmental influences. But, I argued, there was no evidence that they accounted for more than a small portion of the large numbers of children given these labels and shunted into special education programs.

At some point, thanks to increased, widespread criticism of these “brain-based” explanations, I had thought a change had started toward more informed, measured interpretations. However, my naïve thinking has long been gone. Not only are explanations about “brain glitches,” to use the term employed by reading researcher Sally Shaywitz, now being applied more forcefully to “dyslexics,” but they have also been reworked to explain how all children learn to read, what single method of instruction must be used to teach them, and why the single method mandated in Bush’s Reading First, part of the NCLB legislation, is a wise, scientifically based choice. Thus never have these “brain glitch” explanations been more pervasively intrusive for all beginning readers and their teachers in classrooms across the nation.

In the forefront of the Bush educators who promote claims about brain studies is Reid Lyon, dubbed Bush’s “Reading Czar” by the Wall Street Journal. Lyon is the chief of a branch of the National Institutes of Child Health and Human Development (NICHD) that has funded much of the reading research used to justify Reading First and comparable instructional mandates at the state level. At least $12 million of these funds have been used for studies on brain activity and reading. When the President introduced legislation to “improve” Head Start by weighting it heavily with building-blocks instruction, he talked about the scientific findings that had informed him and expressed special appreciation to Lyon and like-minded researchers who, the President emphasized, knew what they were talking about because they “studied the brain.” “Reading Czar” Has Talk with Educators is the headline of a newspaper article describing one of Lyon’s many presentations in which he uses “pictures of the brain to illustrate how it functions while a person is reading—or having trouble reading” to promote Reading First instruction in schools around the country.2

A new best seller, Overcoming Dyslexia, by Sally Shaywitz, who has received considerable NICHD funding for her research, claims to present “the advances in brain science” that inform what “at last we know,” which are “the specific steps a child or adult must take to build and then reinforce the neural pathways deep within the brain for skilled reading.”3 Shaywitz served on the panel whose findings, she proudly explains to readers, “are now part of the groundbreaking No Child Left Behind Legislation,” and, not surprisingly, she is a reviewer of Reading First grants.4

In an interview published last summer, Shaywitz announced, “The good news is that we really understand the steps of how you become a reader and how you become a skilled reader.”5 No wonder the Time magazine cover story on dyslexia, which featured the Shaywitz interview, lured readers with the headline “Up to One in Five Kids Might Simply Not Be Wired to Read” and then went on to report that “new researchers know what’s wrong—and what to do about it.”6 Similarly, a Florida newspaper headline exclaimed, “Brain Studies May Lead to Reading Revolution.”7

Given these widely disseminated claims, colleges of education have been bashed for perpetuating the nation’s reading crisis by not teaching about brain functioning and the need for building-blocks instruction. “Teachers are rarely if ever taught about how reading gets accommodated in the brain,” proclaimed the right-wing Center for Education Reform. “And of course without that knowledge, we’ll never be a nation of readers, and the nearly 40% of children who are mainly disadvantaged will never reverse that label.”8

In this article I will argue that, despite all the unbridled assertions about the wonder of it all, this new “brain glitch” research is theoretically, empirically, and conceptually deficient, as was the deficit-driven work that preceded it by

decades and which I reviewed in 1987. More than ever, claims about the research constitute an ideological barrier to a sounder understanding of the connections between brain activity and learning to read. More than ever, this work is a danger in the classroom both because it applies unproven labels to an ever-larger number of children and because it promotes a single kind of instruction that, based on the actual empirical evidence mustered for it, contains no promise for leaving no beginning reader behind. To all of this, add the false and cruel expectations that these claims generate in parents.

To help illustrate my critique, I will use as an example a recent, highly publicized study on reading and brain activity whose co-authors include Reid Lyon, Sally Shaywitz, and several other researchers whose work argues for building-blocks teaching and has been used as evidence for Reading First instruction. (For convenience I call it the Shaywitz/Lyon study).10

Is the Brain “Reading”? Functional magnetic resonance imagery (fMRI) is a valuable diagnostic and investigative technology that can measure blood flow in the brain and thereby provide information about certain kinds of brain activity when someone is performing a task. However, like every technology used in research, its value and the information it produces are never better than the initial theory and concepts that steer its application. Perhaps the biggest misrepresentation in the “brain glitch” research is that the color scans produced by fMRI provide information about “reading.” In fact, they provide no such thing, because the “reading” tasks under study are largely a person’s performance on simple sound and sound/symbol (phonics) tasks with words and parts of words, rather than performance in reading as conventionally defined, that is, reading and comprehending sentences and paragraphs . . .

The puny definition of reading used in this research appears not to concern the investigators, though, because they design their studies on the assumption that these simple tasks involving words and parts of words embrace the core requirements for beginning readers: that is, mastery of phonological awareness (distinguishing and manipulating sounds in words) and sound/symbol relationships. As the Shaywitz/Lyon study explains, there is now “a strong consensus” (that is, a broad unanimity of professional opinion) that phonological awareness is the first building block within the sequence and that reading disability reflects a deficit in this “lower level component” of “the language system.”11 Only after mastering this component can beginning readers effectively continue to master other reading skills.

That’s the claim. The reality is that the so-called strong consensus does not exist.1,2 I and others have published thorough research reviews that critique and dismiss—the “lower level component” model and the supposed empirical evidence showing the superior effect of early, direct, and intensive instruction in word sounds on later reading. As I have also argued, this narrow, do-as-you’re-told instruction not only pushes aside numerous issues that bear on beginning literacy—such as children’s backgrounds, interests, problem-solving approaches, and definitions of “reading”—it also masquerades as a bootstrap policy solution for poor children that takes off the table all other policies required to address the many needs that influence learning success or failure. However, for the advocates of this “strong consensus,” especially those linked to the political power pushing these claims, conflicting views are never allowed to ruffle their harmony.

Hence, an experiment, such as those reported in the Shaywitz/Lyon study, can be designed in which subjects do “lower level component” tasks, such as deciding if non-words rhyme (“Do last and bete rhyme?”) or making judgments requiring both phonological and semantic knowledge (“Are corn and rice in the same category?”), and the researchers can claim that the data generated tell us a great deal about “reading,” the reading process, and the best kinds of instruction. The conclusions in this work display no awareness of the self-fulfilling prophecy at play when the research focuses solely on “lower level components” decontextualized from a full appraisal of reading, uses no other model of reading and instruction, and then concludes that these components are the initial and key ones in learning to read.

A Real “Brain Glitch”? Looking more deeply into the research design of the “brain glitch” studies, we find a problem that dyslexia researchers have long encountered but not overcome when organizing an experiment so that data on brain activity can be meaningfully interpreted: the experiment must start by grouping dyslexics separately from other kinds of poor readers. This distinction is required because even in studies using the fMRI, the data are about brain activity associated with the word-level tasks, not about micro brain damage. Therefore, fMRI differences in brain activity among a group of unsorted poor readers would not provide information about the cause and meaning of the various differences in activity.

To solve the problem, these studies and previous ones employing simpler technologies try first to separate from a group of poor readers those whose problems are assumed to have non-neurological causes, such as emotional, familial, social class, and similar “exclusionary” influences, as they have been called. If these poor readers are excluded, researchers have reasoned, the probability is high that the reading problems of those who remain are caused by a “brain glitch.” While this might make sense in theory, in practice it has not worked, because researchers have not created evaluation methods and criteria for separating the two groups of poor readers.

Even worse, for decades, researchers have frequently stated that they have used a thorough process of distinguishing between the two groups, but the assertion has rarely been accompanied by evidence. In the Shaywitz/Lyon study, for example, dyslexics were supposedly identified after the researchers had determined that the subjects’ reading problems were not caused by emotional problems or “social, cultural, or economic disadvantage.” Yet the researchers, so dedicated to obtaining and reporting a surfeit of brain data, offered not a whit of information on this process of elimination. Presumably, readers of the published study were expected to accept without question the assertion that genuine dyslexics had been identified and that these children could then
be compared to "nonimpaired" readers (an odd term, since it refers to normal or average readers but is used in the study to underline a priori the assumption that the dyslexics' brains were impaired).

The need to provide evidence of thorough appraisals of the roots of subjects' reading problems is usually obvious to anyone who has actually taught poor readers and, therefore, knows that there can be numerous contextual causes of poor reading in middle-class children that will not be readily apparent. In my extensive work with children, young adults, and adults with severe reading problems, I have found that causes can be uncovered only after spending considerable time both evaluating and teaching a student, with the latter especially necessary. Poor teaching--such as using a one-size-fits-all reading program, insufficient individualized instruction, too much phonics, too little phonics--is just one of the many influences that can produce reading problems in a variety of ways, but those problems will not be apparent without thorough analysis of a person's instructional history and current active reading.

Many unusual family circumstances and stresses can impair a child's early reading progress. A parent losing a job, a family moving to another city in the middle of the first grade, overworked parents, grandparents dying around the time a child began school are all examples of problems I have identified. These experiences hinder reading development by distracting and stressing a child, but they are not overt "emotional" problems. Even when a poor reader comes from a family that appears "normal," only an extensive exploration of the family dynamics can determine whether this appearance might cloak problems that have affected a child's beginning reading.

By not providing criteria and evidence that the "dyslexics" are different from other poor readers, the brain research studies use another self-serving, self-fulfilling prophecy: because the fMRI shows differences in brain activity between "dyslexic" and "nonimpaired" readers, the differences in brain activity must be visual demonstrations of impairment and nonimpairment. How do we know the fMRI data reveal impairment? Because one of the groups was initially identified as impaired. How do we know the group was impaired? Because the group was first identified as impaired and the fMRI data corroborated the impairment. No other explanations can explain the dyslexics' different brain activity. Impaired, for sure! No question about it. For more on the logic of this reasoning, let's look at Czechlexia.

What Causes Czechlexia?
The Shaywitz/Lyon study concluded that the "brain activation patterns" provided neurobiological evidence of an "underlying disruption in the neural systems for reading in children with dyslexia and indicate that it is evident at a young age." More specifically, the impaired readers demonstrated "a functional disruption" in the rear area of the brain where visual and sound identification and associations are made during reading. NICHD, which funded the study, summarized the results this way in its press release: "Children who are poor readers appear to have a disruption in the part of their brain involved in reading phonetically."

In the eyes of some, that conclusion does "appear" to be true. But the data could easily suggest other interpretations. Why would anyone assume that the brain activity for two groups who differ in reading abilities would be the same when the groups are engaged in reading-related tasks? Shouldn't the researchers conclude that, unless demonstrated otherwise, a difference in the brain activation between the groups would be caused by the respective reading abilities and not necessarily by a brain impairment? In other words, should not one expect, until demonstrated otherwise, that the brain activity, reading ability, and task performance were simply correlated and that the brain activity did not "cause" the other two? Consider the following experiment. If two groups of normal people were asked to read a Czech text, and if only one group could read Czech, who would expect the brain activation of the two groups to be the same? And who, except those with other agendas, would think that differences in brain activity revealed dysfunctions, not differences, and that the "condition" should be named Czechlexia?

Moreover, as I discussed in The Learning Mystique, rather than a brain disruption, many other influences--such as a group's problem-solving approaches, personal meanings, emotions, motivation, and self-confidence--have been shown to affect cognitive outcomes and patterns of brain functioning and could reasonably explain such data. Only deficit-driven interpretations could continue to fail to take any of this into account.

Fixing the "Brain Glitch"
Beyond finding "brain glitches," researchers have reported other good news: building-block skills instruction can remedy the glitch. "An effective reading program" can produce "brain repair," Shaywitz reports. "The brain can be rewired." Elise Temple and her colleagues, who used a skills training program described by the publisher as fitting "with the No Child Left Behind Act," concur. Beginning with the assumption that dyslexia is caused by "a deficit in the neural mechanisms underlying phonological processing," they found that their instructional program ameliorated the "disrupted function in brain regions associated with phonological processing and produce[d] additional compensatory activation in other brain regions." Similarly, an intervention study funded by NICHD reported that a reading program emphasizing skills reversed a brain deficit underlying dyslexia.

Nearly 20 years ago, Leonide Goldstein and I published a study on differences in brain hemisphere activation in adult beginning readers as they were learning to read. We found that these adults, when they were poor readers or nonreaders, did, indeed, demonstrate brain activation that was different from that found among good readers. However, as their reading improved, through the use of a holistic, comprehensive teaching approach over many months, their brain activation changed toward that commonly found in good readers. We interpreted these data as evidence that new knowledge and competencies were linked to concomitant changes in brain structure and functioning, as one would expect for all kinds of learning. There was nothing in the data to suggest that these beginning readers started learning to read with anything
other than normal brains that were configured as they were at the beginning of the study because the students had not learned to read; no data suggested that the educational intervention we provided somehow repaired or circumvented dysfunctional brain areas.

To restate a central point for appraising these glitch-fixing interventions: although researchers insist that the training programs they use repair or ameliorate brain hardware or glitches, there is no evidence in any of their studies that this rewiring was different from that which is concomitant with the learning that continues throughout our learning lives. Nor does this so-called repair demonstrate that phonological processing is the initial key component in learning to read. The subjects apparently lacked this ability and then learned this ability, and their brain processing changed accordingly. Using modern technology to identify and track brain changes related to changes in reading ability is an extraordinary achievement. Using the achievement for ideological ends is not.

**Emotionless “Cognition”**

Like the assumed “consensus” on building-blocks instruction, “brain glitch” research assumes that cognition—that is, the process that creates images, of the brain, on the assumption that a particular part of the sites of emotion, cognition, and memory. But from ram, registries, psychologists have written extensively on cognitive connectivity such as those related processes, that actually describes the brain processes associated with reading. Ignored in this assumption is the ever-growing evidence suggesting that thinking is an inseparable interaction of both cognition and emotion (feelings, desires, enthusiasms, antipathies, etc.).

Neurologist Antonio Damasio, for example, rejects the traditional distinction between cognition, thought to be neocortical, and emotions, thought to be subcortical. There are no “higher” and “lower” brain centers, he argues. The neocortex (the “high-level” part of the brain) does not handle reason while the subcortex (the “low-level” part of the brain) handles emotions. Rather, the neural substrates for cognitive responses are associated with neural substrates for emotions: both so-called high and low levels are integrated in thinking processes. Similarly pertinent is the work of neural scientist Joseph LeDoux, who has identified brain pathways connecting sites of emotion, cognition, and memory. These interconnections mean that emotions and cognition are integrated and interactive and that an emotional response can, in terms of pathway activity, precede a cognitive perception and response. Focusing only on cognition when studying the brain and reading ignores the areas of networks whose emotional activation is part of “cognition.”

Unfortunately, none of this new perspective on the “continuous and interwoven cognitive-emotional fugue,” to use pediatric researcher Michael Lewis’s metaphor, has entered the “brain glitch” research. As a result, the question of whether diminished activity in a portion of the brain of someone doing a reading task might be a consequence of an emotional response, in that emotional memories can exert a powerful influence on “thought processes,” remains unaddressed. By purging emotions and focusing only on cognition, the “brain glitch” research also purges the alternative: a holistic instructional approach based on the assumption that classrooms are filled with whole children for whom learning is always grounded in the fugue of cognition and affect.

**How the Brain Works: Modules?**

The interrelationships and interactions missing from the narrow cognitive model of “brain glitches” research lead us to a final concern. A chief premise of this research holds that the brain has specific modules for specialized operations that work in sequence with other modules in learning written language and that foremost of these is at least one module that can process basic sound and symbol skills. This kind of modular model has a certain palpable, visual appeal (not unlike “building-blocks instruction”), but the actual existence of such modules is a theory, not a fact, that has increasingly been questioned. Most likely, the modular model is not one that explains how the brain actually works.

For instance, Merlin Donald, a psychologist who has written extensively on human consciousness, rejects the explanation that modules perform “specialized operations,” such as deciphering portions of language. While language areas of the brain, such as those related to aspects of reading, are important in processing particular functions, all are intertwined in extensive networks (a polyphony) of brain areas that are simultaneously and interactively communicating and constructing and reconstructing particular areas within the whole. Yes, the brain has fundamental mechanisms for beginning to learn written language, but it does not begin with a “fixed pattern of connectivity.” Instead, the “connectivity pattern is set by experience” with “countless interconnection points, or synapses, which connect neurons to one another in various patterns.” In other words, learning and experience create and shape the brain’s circuits and how they are used in learning to read; the circuits are not predetermined.

Linguist Philip Lieberman has also criticized modular explanations, calling them “neologenomenal theories,” that is, theories that “map complex behaviors to localized regions of the brain, on the assumption that a particular part of the brain regulates an aspect of behavior.” In these theories, he remarks, the functional organization of the brain is run by “a set of petty bureaucrats each of which controls a behavior.” Like Donald, Lieberman proposes that converging behavioral and neurobiological data indicate that human language is composed of a hierarchical system but of neural networks, including the traditional cortical “language” areas (Broca’s and Wernicke’s areas), formed through circuits that link populations of neurons in neuroanatomical structures that are distributed throughout the brain. Lieberman stresses, “Although specific operations may be performed in particular parts of the brain, these operations must be integrated into a network that regulates an observable aspect of behavior. And so, a particular aspect of behavior usually involves activity in neuroanatomical structures distributed throughout the brain” (emphasis in original).

The view of a “connectivity pattern” that emerges and is activated as children learn to read contrasts with the model of step-by-step progression from module to module. If the former is an accurate model of brain organization and functioning, it suggests that the connectivity pattern should be the focus of research because only by looking at the overall pattern can researchers begin to
determine the functioning and interrelationships of any part and the causal, consequential, or interactive function of that part within the entire pattern.

From the perspective of a connectivity pattern model, not only do the brain areas involved in grasping the sound/symbol correspondence not have to be primed first before other areas of the pattern can become effectively operable, the creation and functioning of these areas depends on connections within the entire pattern. And because the pattern is not innately fixed, if instruction were to stimulate certain areas more than others, a particular connectivity pattern would emerge. That specific pattern, however, might not necessarily be the sole one required for reading success and might not be superior to other connectivity patterns. Moreover, a more complex connectivity pattern could be created through richer written language learning. None of this is addressed in the "brain glitch" research.

Conclusion

To make research on the brain and reading work, it must be informed by the complexity of reading acquisition, and it must begin to address such questions as: Will alternative teaching approaches configure brain activity in alternative ways? Will children’s differing assumptions about what it means to “read” correspond to differing brain activity and organization? How do different aspects of reading, such as comprehension, syntax, and word analysis, interact in certain reading tasks and what kinds of brain activity do the interactions produce? How does the knowledge children bring to literacy learning affect brain activity?

These and similar questions can begin to contribute to a better understanding of the relationship between brain function and reading acquisition, which in turn can help promote ecological approaches that are grounded in an understanding of the unified interrelationships of brain, active child, and learning environment. They can also begin to help identify genuine brain-related reading impairments. Developing this kind of understanding of integrated interrelationships will require that we eschew views that are either “brain based” or conceive of the brain as an extraneous “black box.”

Notes

2. Mary Gall Hare, “Reading Czar Has Talk with Educators,” Baltimore Sun, 17 September 2002.
4. Ibid., p. 175.
6. Ibid.

15. Shaywitz, p. 86.
Do Recent Discoveries about the Brain and Its Development Have Implications for Classroom Practice?

Any plausible theory of learning must include the assumption that learning involves the brain. Why, then, is there any controversy about the implications of brain research for educational practice? Doesn’t any finding about the brain tell us something useful about how to teach? Unfortunately, it is not always possible to move directly from knowledge about the brain to recommendations for educational practice. This is because learning always involves more than the activity of the brain. Learning results from the interaction of the child (and, of course, his or her brain) with the environment.

Consider, for example, the finding that the “spurt” in children’s vocabulary seen at 18 to 24 months of age is associated with a rather dramatic increase in the synaptic density and activity of the brain. This finding is important because it suggests that something may “click” in children’s brains at this time that increases their preparedness to learn words. But this finding does not by itself tell us very much about what parents and educators should do during this time to assist children. On the one hand, it may be that children are so prepared at this time that they can pick up words effortlessly from just about any sort of interaction and in any environment. On the other hand, what adults do when children are ready to “spurt” may matter a great deal.

Highly recommended for readers interested in learning more about research on brain sciences is a text by Mark H. Johnson, Developmental Cognitive Neuroscience, 2d ed. (Blackwell, 2005). It is an up-to-date, comprehensive, and highly readable (although still fairly technical) summary of much of the current wave of research on the brain-behavior relation. For readers who wish to delve into more technical discussions of research and of the methods used in brain research, there is a wonderful collection of papers in the edited volume by G. Reid Lyon and Judith M. Rumsey, Neuroimaging: A Window to the Neurological Foundations of Learning and Behavior in Children (Paul H. Brookes, 1996). Highly recommended is a series of articles on educational applications of brain research in the November 1998 and November 2000 issues of Educational Leadership. Particularly noteworthy in these series are “The Brain-Compatible Curriculum,” by Anne Westwater and Pat Wolfe, Educational Leadership (November 2000) and “Unconscious Emotions, Conscious Feelings,” by Robert Sylwester, Educational Leadership (November 2000). An interesting, more recent article that delves into the possible educational implications of our knowledge of the human brain is “The Way We Learn,” by Renate Nummela Caine and Geoffrey Caine, Educational Leadership (September 2006). A book-length treatment of teaching strategies derived from research on neural development and functioning is provided by Eric Jensen in Teaching with the Brain in Mind (Association for Supervision and Curriculum Development, 1998). And finally, a recent article on the classroom implications of recent research on neural differences between boys and girls entitled, “With Boys and Girls in Mind,” by Michael Gurian and Kathy Stevens, Educational Leadership (November 2004), is sure to generate its own controversy.