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The First Years of School Pages 6-10

On the Mind of a Child: A Conversation with Sally Shaywitz

A pediatrician, neuroscientist, and member of the National Reading Panel, Dr. Sally Shaywitz talks with *Educational Leadership* readers about the ways the brains of young children develop and what can be done to prevent early learning difficulties.



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Marcia D'Arcangelo

This theme issue is about the first years of school. Would you describe the stages of brain development that children ages 4–6 typically go through?

This period in a child's life is a time of very intense activity in the brain. Between ages 4 and 6, the brain is actually pruning synapses—connections between brain cells.

As the child is exposed to different experiences in life, the brain reinforces some of these connections and prunes back others that are not going to be useful. The brain is becoming more focused and more specialized. It's taking shape.

We often hear that the first three years are the most important, but is that necessarily the case?

The brain is a living, dynamic organ that is plastic throughout life. It is always taking in information and refining and reinforcing connections once they're made. But when a child is young, this refining goes on more easily and as a matter of course. You're starting with so many possibilities. It's like a house. Think of it this way. It is much harder to renovate an already standing house than it is to build it right from the start.

To correct a reading problem in 3rd or 4th grade, you almost have to undo certain pathways that the child has developed. But children between 4 and 6 are at the cusp of learning to read. Their spoken language system is in place. They are ready to build the connection to print. It is an incredibly exciting time. They want the signal "Go." You have wide-open opportunities. You don't have to undo faulty connections.

When we last spoke four years ago, we talked about the advances in technology that allowed us to see what parts of the brain were active during certain reading tasks. What new information do you have about the ways in which readers' brains process information?

There has been an explosion in new knowledge since then, particularly about what happens within the brain systems of people with dyslexia. In order to read, children and adults typically use three brain systems. The first area is in the front of the brain and is called the inferior frontal gyrus, or Broca's area, identified in the mid-19th century by neurologist Paul Broca. The other areas are in the back of the brain: the parieto-temporal region and the occipito-temporal region. These three areas are all on the left side of the brain, the region that is traditionally devoted to language.

Broca's area is responsible for the articulation of spoken language. The parieto-temporal region is involved in analyzing and sounding out the parts of words. And the occipito-temporal region, also called the visual word form area, is where all information relating to words and sound comes together so that the reader recognizes and reads the word instantly. These three regions are crucial in reading.

What happens in the brains of children who have difficulties with reading?

What we find is that there is a disruption in the systems in the back of the brain—the parieto-temporal and the occipito-temporal areas. If we image the brain of someone—adult or child—who is a good reader and we ask them to sound out an unfamiliar word, we see activation in the front of the brain and in the two regions in the back of the brain.

But if we ask children or adults who are struggling readers to sound out a word, we see significant underactivation of these areas in the back of the brain. When we first studied adults who hadn't learned to read, we wondered whether this pattern developed as a result of not having read for many years or whether the pattern was there from childhood. So we studied 70 children ages 7–18 who were struggling readers and compared their brain activation patterns with 74 children in the same age range who were good readers. We saw exactly the same disruption in the back of the brain that we saw in the adults. The disruption is there from childhood.

This is important because often when children are having trouble learning to read, adults tend to think that it is a developmental lag. These data show that children who have this brain disruption do not outgrow it. Thus, it is urgent that children with reading problems get help as soon as possible. The problem is not going to go away.

What else have you discovered about how poor readers process print?

We saw that these readers try to compensate for not activating systems on the back left side of the brain by activating systems in the front of the brain in both the right and the left inferior frontal gyrus.

This is often what a child is doing when he or she is subvocalizing. People will say, "Oh, that child is not a very good reader. Look, he's reading under his breath." Now we have neurobiological evidence that subvocalizing is the way the child is trying to compensate. It seems a very reasonable thing to do.

Because there is a disruption in the back of the brain, the child is using the systems in the front of the brain to try to read. These are the systems responsible for articulation and pronouncing letter sounds. So we think this is what these children are doing.

How else do struggling readers compensate?

Researchers have discovered that the visual word form area in the back of the left side of the brain is very important for skilled reading, for fluency. This area allows a child or an adult to just look at a word and instantly know it without devoting any attention to it.

We know that poor readers use compensatory pathways in the front of both sides of the brain and also in the back of the *right* side of the brain. This allows them to read slowly but not automatically. They read with great effort. The beauty of skilled, fluent reading is that it's automatic. So the goal is to become an automatic reader.

How can teachers help children become automatic readers?

The goal of preschool, kindergarten, and 1st grade is to provide the experiences and the substrate that will lead to automatic reading on a behavioral level, and on a neurobiological level, to begin to build the neural systems that are responsible for fluent reading.

In learning to read, children learn how to make connections over a period of time. First they learn the letters of the alphabet, then the sounds that the letters represent, then, progressively, as they see words in print, they start to build a neural model of that word.

As children learn to read, they may start to represent the word *beak* by the first letter. They can convert the printed letter *b* into the /*b*/ sound. Then they convert the final letter, the *k*, into the /*k*/ sound. It's more difficult for children to figure out what to do with the vowels, the inside letters and sounds. But as they learn to read, they clarify their internal representation, or neural model. After they've read the word correctly a number of times, their neural model is an exact replica of the printed word. It reflects the way the word is pronounced, the way it's spelled, and what it means. In the exact neural model, all these features are bonded together. That word is represented in the word form area, and its recognition becomes instant, automatic. That's wonderful because it frees readers to use all their attentional resources to comprehend and think about what they are reading.

How does this process differ in children with reading problems?

Children with reading problems never have the experience and practice of reading the word correctly enough times to build an exact neural model. So their neural models are a little off. They don't form permanent neural models in the word form areas, so the children don't read automatically. They are not skilled readers. Although their accuracy may improve, reading remains effortful; they continue to have to work very hard at reading.

What does it mean to be a skilled reader?

It means that the child can read fluently. When a child sees the word, he or she can read it accurately, rapidly, with good intonation, and with understanding. We have to develop fluency word by word. It's not a stage. Children crawl, then they walk. But for reading words, it's word by word. It is really important to help the child build these exact neural models of each word and word family. Fluency is the goal.

What kind of reading practices do you recommend for building fluency?

The foundation begins when children are very young—talking to them, getting them to

appreciate the sounds of language. In the early preschool phase, it's important to have fun with language and draw a child's attention to rhyme and alliteration, for example, "The pretty pink pig picked petunias."

The National Reading Panel, of which I was a member, found that programs that emphasize repeated oral reading with feedback and guidance build fluency. One of the most important things that teachers and parents can do with young children and adolescents is listen to them read out loud. Children build the neural model by correctly reading the word over and over again. So repeated oral reading with feedback and kind correction helps students connect how the word is spelled, how it's pronounced, and what it means.

Understanding the letter-sound relationship is the foundational skill—drawing a child's attention to the sounds of spoken language. That ability, known as phonemic awareness, and a knowledge of letter names and sounds, are the earliest predictors of later reading ability.

For children with reading problems, a word is almost like a big blur. They have trouble pulling apart the individual sounds in the spoken word. They have to have the individual spoken sounds in order to attach the letters.

What is your opinion of the practice of sustained silent reading?

Clearly, there is a correlation between reading more and being a better reader—better readers read more—but correlations do not imply causation. At this point, we don't have the evidence that there's a cause and effect—that the more you read, the better a reader you *will become*. According to the National Reading Panel, "there is not adequate evidence to sustain the belief that increases in reading practice will be translated into better fluency and higher reading achievement." If you send children who aren't good readers off to read by themselves, they may be daydreaming or reading words incorrectly. You want to encourage children to read, but you want to make sure that children have a specific time set aside when they are reading aloud and are receiving constructive feedback.

Does your research indicate how prevalent reading problems are?

The data show that about 60 to 70 percent of children have an easy time learning to read. That sounds terrific. On the other hand, 30 to 40 percent is a very large number of children. One-third to 40 percent of each class is going to need special help. The National Reading Panel reviewed studies of different approaches to teaching reading. We found that teaching phonemic awareness is extremely helpful, particularly to younger children. But it helps all children. Teaching phonemic awareness and letter-sound relationships helps build the neural systems for reading. Of course, we have to find pleasurable and enjoyable ways to teach.

Phonics is all about building connections between the sounds of spoken language and the letters of printed language. But the crucial thing is that phonics has to be taught systematically. Because English is a very complicated language system, you want to gradually progress from the easiest to the more complex letter-sound relationships. You also want to make sure you cover all of them. By teaching these relationships systematically and explicitly, children will learn them. Certainly, if the relationships are presented haphazardly, 30 to 40 percent of children are not going to learn them by osmosis.

Can functional Magnetic Resonance Imaging (fMRI) technology help identify children with potential reading difficulty?

Yes, but it isn't necessary. We have learned so much about how children learn to read and how to screen for and overcome dyslexia.

Why isn't it necessary to image children to get a diagnosis?

We have many clues to dyslexia, for identifying the child as at risk for reading difficulties. Is there a family history of reading difficulty? This is very important. Listen to children's early language. Are they somewhat delayed in their speaking? Do they have trouble appreciating rhymes? Do they sometimes have difficulty with getting the sounds of words out? Or do they sometimes have phonologic confusions when they speak—for example, confusing words that sound alike, such as *cheer* and *clear*? Do they then have trouble learning the names of letters and the sounds of those letters?

If we look at the history and observe a child, it's possible with a high degree of certainty to identify children early on, even before they begin to read. So my answer is that it is unnecessary to go through the expense of imaging children. Imaging is a wonderful technology, but it still hasn't been refined enough to be as accurate for an individual child as it is for a group.

Is the term dyslexia synonymous with reading difficulty?

Dyslexia is a term that's been used for more than 100 years. We define it as difficulty in learning to read for children and adults who have the intelligence and motivation to be able to read and who have been exposed to good reading instruction. Reading is something you need to be taught.

We did a study to classify reading problems and found that 88 percent of the children with reading problems had phonologic difficulties. That's a pretty high percentage: almost nine out of ten.

What is happening in the brains of people with dyslexia?

I conceptualize it like this. If you think of a language module as being a series of component parts, or a hierarchy, the lowest level is the module that has to do with phonology, or the sounds of language. At higher levels are components that have to do with vocabulary, syntax, reasoning, and discourse.

In dyslexia, you have a weakness, a deficit, in getting to the sounds of language. But these other components are intact and may even be functioning at a very high level. So you have an unexpected difficulty in reading. That's always been the hallmark of dyslexia. It's unexpected; people seem to have all the cognitive equipment they need to read, yet reading is difficult.

Do you have any new information about gender differences in learning to read?

All boys and girls can learn to read. Girls, however, are often underidentified. They can struggle as much as boys with learning to read but may be less likely to be noticed by their teacher.

Is there any justification for delaying school for children with late birthdays?

No. The evidence is quite the contrary. Children ought to be given the help they need or they are going to fall farther behind. There is growing evidence that children learn to read in school. So you don't want to deprive children of that experience. You want to give them an experience that will help build their reading system and be sensitive to their needs as a young child. And that can be done. We must intervene early to help ensure that a child will become a fluent reader. What nature hasn't built, schools can help to build. The whole idea is to build the systems and the right connections, so you won't have to repair faulty connections. Do it early and do it right!

The "No Child Left Behind" legislation says that every child should be able to read by the end of 3rd grade. Do you think that is realistic?

Every single child? Probably not, but I think we can come pretty close to it. We have learned so much about teaching reading on a theoretical and practical level. Studies show that if a skilled teacher uses an evidence-based reading program with the right intensity for sufficient duration, all but a very few children will learn how to read.

Your work now focuses on the physiology of brain function related to reading, but you started out as a pediatrician. How did you come to focus your work on reading?

I learned as a pediatrician that the issue cutting across age, background, and gender that concerned most parents was how their child was doing in school. There were parents who cried during a visit when they said, "I'm worried about his asthma, but, Doctor, the real problem is he's not reading," or "The teacher sent home a note; what should I do?" That's when I began to focus on learning, and, particularly, reading. When we physicians go through medical training, it is exciting to learn about complicated cardiac problems, or anemia, or renal problems. Those are very high-intensity, acute problems. Fortunately, most children do not have these problems.

But all children go to school. I thought that if I was going to be a pediatrician and care about the overall development of children and guide them to happy futures as adults, it was imperative that I learn something about learning and about reading.

It sounds as if you have spent a lot of time in classrooms?

When my children were very young, I didn't work. I took off eight years from the time my youngest two children were born until they were in 1st grade. I volunteered at our local school in a consultant capacity. I was wise enough to know what I didn't know.

And what I didn't know was what happens in a classroom. I spent hours talking to teachers and getting to know them and developing an enormous appreciation for what it is to teach. It's so complicated and so demanding. You have all these eager faces looking at you. And you have to provide the answers.

Sometimes, you have to be firm and sometimes gentle. It's a nonstop day, with all kinds of frustrations and joys. My children's elementary school made me an honorary teacher because I spent so much time there. I went to parent-teacher meetings, sports events, everything. I spent time with the principals, the teachers, the aides, and the children. It gave me a wonderful perspective about teaching.

If you were to give one last point of guidance to educators about the early years in children's schooling, what would you say?

Today, most children in the United States are identified as having a reading problem in 3rd grade or later. That's unconscionable. We can identify problems much earlier and we can even prevent reading problems. Of course, we can help older children, too, but by then, we really put a burden on them to catch up with their peers and make rapid progress.

To teachers of children in the important first few years of school, I would say that you can teach almost any child in your class to read, but to do so, you have to become knowledgeable about how children learn to read and what the evidence says about specific methods and programs. Look to the evidence.

Sally Shaywitz, M.D., is Codirector of the Yale Center for the Study of Learning and Attention at the Yale University School of Medicine, 333 Cedar St., New Haven, CT 06510; sally.shaywitz@yale.edu. Her just-released book is *Overcoming Dyslexia* (Knopf, 2003). **Marcia D'Arcangelo** is a program manager and video producer at ASCD; mdarcang@ascd.org. Her recent programs on this topic include *The Brain and Early Childhood* and *The Brain and Reading*.

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1703 N. Beauregard Street, Alexandria, VA 22311 USA • 1-800-933-2723 • 1-703-578-9600

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