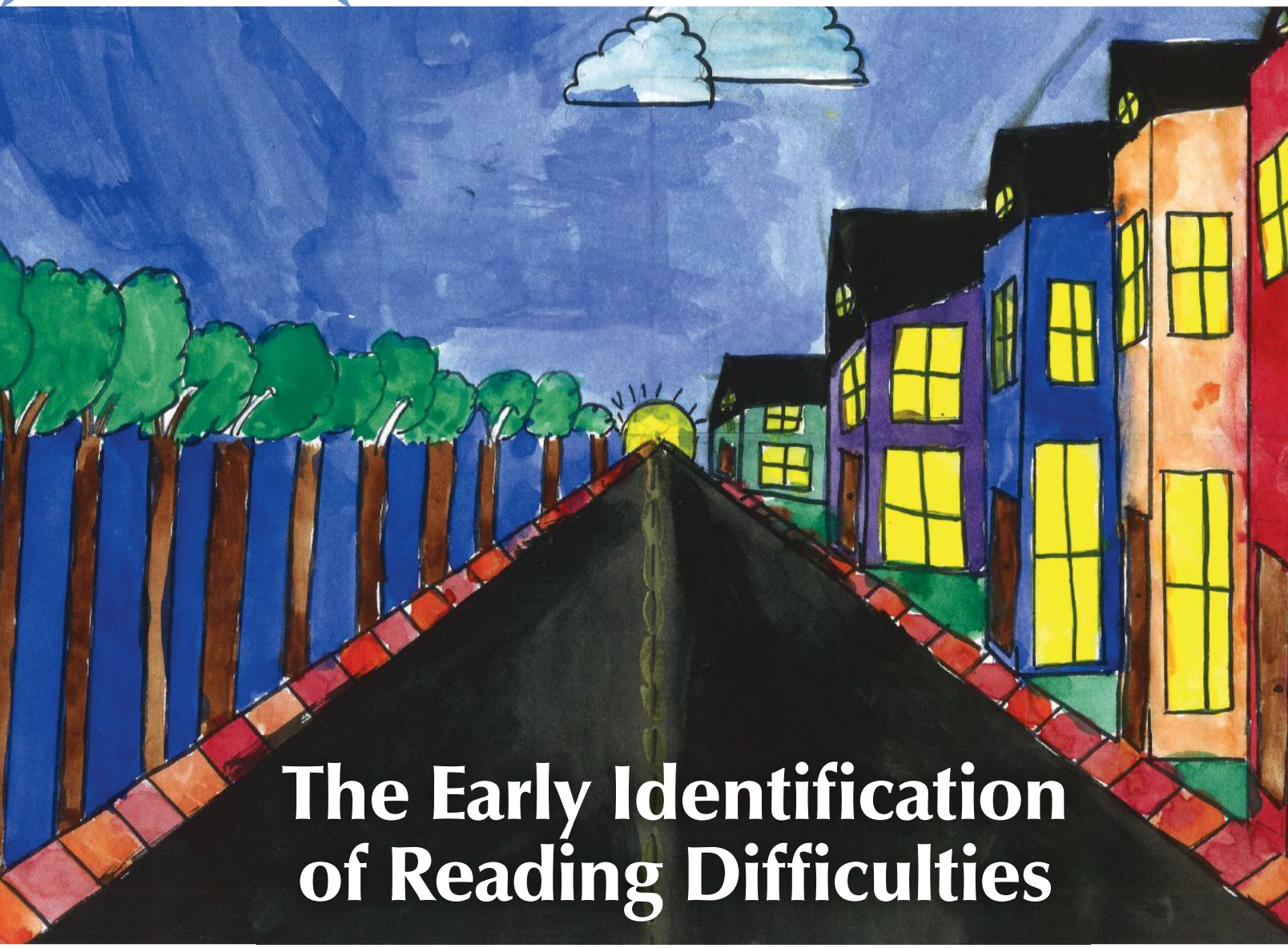
SUMMER EDITION 2018
Timothy Shanahan, Theme Editor

# PERSPECTIVES

## ON LANGUAGE AND LITERACY

A Quarterly Publication of the International Dyslexia Association

Volume 44, No. 3



# The Early Identification of Reading Difficulties



International DYSLEXIA Association®

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# PERSPECTIVES

## ON LANGUAGE AND LITERACY

*A Quarterly Publication of the International Dyslexia Association* *Volume 44, No. 3*

### MISSION

The International Dyslexia Association (IDA) is committed to creating a future for all individuals who struggle with dyslexia and other related reading differences so that they may have richer, more robust lives and access to the tools and resources they need.

The International Dyslexia Association (IDA) is a 501(c)(3) non-profit, scientific and educational organization dedicated exclusively to the study and treatment of the specific language disability known as dyslexia. We have been serving individuals with dyslexia, their families, and professionals in the field for over 65 years. IDA was first established to continue the pioneering work of Samuel T. Orton, M.D., in the study and treatment of dyslexia.

IDA members include people with dyslexia and their families, educators, diagnosticians, physicians, and other professionals in the field. IDA's home office, 42 branches in the United States and Canada, and 30 Global Partners provide educator training, publications, information, and support to help struggling readers around the world. IDA's Annual Conference attracts thousands of outstanding researchers, clinicians, parents, teachers, psychologists, educational therapists, and people with dyslexia.

# The Early Identification of Reading Difficulties



ON THE COVER: "Untitled" by Sully Clattenburg.

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# The Pathway to Making Early Intervention a Reality

If I had just one wish in the field of special education, I would wish that we would institute a systematic way to find children at risk for reading and/or mathematics difficulties and start with targeted instruction in kindergarten. I am sure that many parents, teachers, educators, speech pathologists, psychologists, and people with reading and mathematics difficulties would join me in this wish.

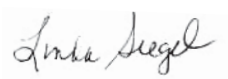
The articles in this issue bring us closer to that goal by highlighting the potential for identifying children before they begin reading instruction, the challenges and trade-offs when we try, and the rare successes. But we are still very far away. It would take a concerted effort of professionals and parents, lobbying and working with politicians, to make this dream happen. Anyone reading this issue of *Perspectives on Language and Literacy* knows all the reasons why we need to work toward this dream. I shall briefly list some of them here:

"Untitled" by Sully Clattenburg

- It is much easier to prevent the problems from becoming serious than to wait until they are fully developed.
- It is much cheaper to provide early intervention than to wait when intervention requires more intense remediation and therefore becomes much more costly.
- Early identification and intervention will reduce, and, in many cases, prevent serious social and emotional consequences of not paying attention to these problems.
- The brain of a young child is more plastic and amenable to change than that of an adolescent or adult.

The articles in this issue show us the beginning steps in the way forward. It is up to us all to continue the journey.

This issue also includes a tribute to a true pioneer in our field. The IDA and the dyslexia community lost a friend and champion with the recent passing of Diana Hanbury King. She inspired us with her commitment, wit, and compassion. Her colleagues, her students, and their families are all better for having known her.



Linda S. Siegel, Ph.D.
Editor-in-Chief

# THEME EDITOR'S INTRODUCTION
# The Early Identification of Reading Difficulties

by Timothy Shanahan

When I was a young teacher, I taught children with reading problems. Teachers would refer some of their students for evaluation, I would give them a test and decide who I could work with. One youngster that I added to my rolls was a first-grader.

I soon found myself chastised by the district school board for this particular decision.

"Why would you give special reading teaching to a 6-year-old?" I was asked.

In 2018, my decision seems more like "business as usual" than the board's questions might. These days I would have little to explain for providing extra reading tuition to a first-grader. But why was that so unusual 50 years ago?

The ideology around reading in those days held that students who struggled with beginning reading would eventually outgrow the problem. Low maturity was seen not as something that prevented learning—it simply delayed it. Intervening too early would not help, since the student would still be immature (what 6-year-old isn't?), and my extra instruction might do harm and was certainly a waste of resources.

The idea of preventing—as opposed to remediating—reading difficulties has been around since the 1930s. However, researchers made little headway with the problem for about 30 years.

The earliest study of the issue that I'm aware of is Chester Bennett's (1938) *An Inquiry into the Genesis of Poor Reading*. Bennett's idea of early identification was to look at second- and third-graders to try to figure out their differentiating characteristics. Given that goal, the study was an abject failure. The author looked at a wide range of characteristics… birth order, speech defects, persistence, physicality, attitude toward school, incidents of crying, fear, headaches, and so on. With the exception of the ordinal birth position and, perhaps, speech defects, the whole list of features was as likely to be the results of reading problems as their cause. The author's conclusion: researchers should go back to an earlier time in the child's life. Indeed.

Unfortunately, it was a good long time before researchers took him up on the challenge. Oh, there were small investigations here and there showing that speech problems implicated in reading disability could be detected earlier (Hildreth, 1946), or that using more effective instructional procedures in grade 1 could "prevent" reading problems (Dunklin, 1940; Yoakam, 1943). But there was no concerted effort to develop schemes for predicting who was likely to have difficulty in learning to read—or to develop interventions aimed at disrupting these predictions (rendering the sure failures successful).

That would change with the landmark contributions of Jansky and deHirsch. Katrina deHirsch was the director of the Pediatric Language Disorder Clinic at Columbia-Presbyterian Medical Center from 1941 to 1972 and her colleague Jeannette Jansky was a learning disabilities specialist. Their book, *Preventing Reading Failure: Prediction, Diagnosis, Intervention* (1972) provided a longitudinal analysis of more than 400 kindergarten children, in an effort to try to identify—prior to the onset of formal teaching—who would likely fail at reading. (An earlier, less ambitious version of the book had been published in 1966.) Their data led them to conclude that the best approach to early identification was a quick screener to pinpoint which children would struggle, and then a more extensive battery of diagnostic tests (covering a wide range of physical, cognitive, and perceptual variables) to explore the patterns of competencies that would guide instruction.

That effort was far from the last word on the subject and today, I think it is fair to say, much of their scheme has been superseded. However, at least partly due to that work, there is now a clear mandate to figure out which children are likely to struggle—and to do so prior to the onset of that struggle. Unless reading problems can be prevented, or addressed successfully very early, there are likely to be damaging secondary problems (the students' reactions and responses to their failures) that can only complicate eventual remediation.

These days we have many more variables available to us—variables that go well beyond anything Jansky and deHirsch could have hoped for, including genetic screenings and various kinds of brain scans. Nevertheless, we are still confronted by many of the same problems that their work uncovered more than 50 years ago: the multivariate nature of reading difficulty, the complication of poor or inadequate teaching, false-negatives in prediction, and so on.

This issue of *Perspectives on Language and Literacy* provides a decidedly contemporary perspective on the early identification of reading difficulties. Mads Poulsen, a psycholinguist based in Copenhagen, Denmark, provides a thoughtful analysis of the need for accuracy in any early prediction model. Any scheme sensitive enough to reveal all students who will eventually struggle inevitably will result in "false-positives"—the misclassification of students with no need of extra learning support. And, schemes that minimize such misidentification will necessarily miss some of those in need. Professor Poulsen explains why that is and what is required to optimize early identification efforts so that they will have practical value.

In the 1930s "early identification" meant revealing those who had failed to learn to read after only a year or so of instruction. These days by early we tend to mean kindergarten. But what if it were possible to figure out who was going to suffer from reading disability years earlier than this? Recent advances in brain science suggest that this possibility may be more than a science fiction dream. Ola Ozernov-Palchik and John Gabrieli are neuroscientists who use brain imaging to identify the neural structures and functions that underlie reading development. Their work is pertinent to the issue of prediction of dyslexia

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because they explore neuroanatomy at a variety of ages, including infancy. Most studies of the neurological correlates of reading are conducted with already-struggling readers. From such studies it is impossible to discern which differences predate the failure to learn. Since learning to read changes the brain, there is a real need for pre-instruction neural exploration.

Then we explore a couple of practical pedagogical issues in the early identification of reading difficulty. David Kilpatrick, a clinical psychologist and author of the influential *Essentials of Assessing, Preventing, and Overcoming Reading Difficulties,* explores the role of causation in prediction and assessment schemes. His conclusion: once a reading problem emerges it doesn't matter much what its etiology—since ultimately etiology cannot determine what assessments to use or which instructional interventions will work.

His discussion of the causes of reading problems made me think about the biggest gap in the prediction literature: No matter how incisively we measure those child factors that suggest future failure…such efforts cannot tell us anything about the instructional environment the student will have to learn within and respond to. Linda Siegel is the former Dorothy C. Lam Chair in Special Education and is editor-in-chief of *Perspectives*. In this issue, she elaborates on this conundrum, providing a case study of early identification and intervention and how it actually can work within the practicalities of a real school.

Finally, Hugh Catts and Yaacov Petscher, experts in the field of learning disabilities (the former a specialist in Speech, Language and Hearing and the latter a psychologist focused on reading), point us toward the future of early identification. They hypothesize that since reading development is undermined by multiple causal deficits, successful early identification schemes will need to be multifactorial in design and they argue for including computer assisted technology, gamification, and longitudinal models in the development of 21st century early identification efforts. This approach may seem to contradict David Kilpatrick's claims about the current usefulness of causal explanations in the diagnosis and correction of reading difficulties; but remember, Kilpatrick is explaining the current state of the art in the field, while Catts and Petscher are imagining a future when we will surely know more. If they are correct, then it seems likely that early identification in 2030 will be as different from our 2018 concept as our current efforts are from those of the Jansky and deHirsch era.

Buckle your seat belts; it could be a bumpy—but fascinating and rewarding—ride.

Meanwhile, if I were a kindergarten teacher I'd screen my students early in the year to see what they knew about reading…particularly examining their knowledge of letter names and sounds, their phonological awareness, and awareness of print features (the kinds of skills that Kilpatrick describes). My focus would be on knowledge of literacy rather than on underlying causes or correlates. Although Ozernov-Palchik and Gabrieli and Catts and Petscher's insights are exciting and hopeful, they are not yet user-ready. I'd implement daily lessons aimed at teaching these early literacy skills, monitoring student progress over the first semester. The screening information, although helpful, is not likely to be sufficiently predictive on its own (Poulsen), both because of the imperfections of testing and the variability evident in classroom environments (Siegel). Predictions based on children's learning success during those early months improve prediction and are sufficiently accurate to allow for the implementation of intensive early interventions aimed at getting such children on track for success. I hope someday that the future research advances heralded in this issue will render my approach hopelessly outdated, but for now it is likely the best we can do.

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***Timothy Shanahan, Ph.D.**, is Distinguished Professor Emeritus at the University of Illinois at Chicago, where he was Founding Director of the UIC Center for Literacy. Previously, he was director of reading for the Chicago Public Schools. He is author/editor of more than 200 publications on literacy education. His research emphasizes the connections between reading and writing, literacy in the disciplines, and improvement of reading achievement. Tim is past president of the International Literacy Association. He served as a member of the Advisory Board of the National Institute for Literacy under Presidents George W. Bush and Barack Obama, and he helped lead the National Reading Panel. He chaired two other federal research review panels and helped write the Common Core State Standards. He was inducted to the Reading Hall of Fame in 2007, and is a former first-grade teacher.*

IN MEMORIAM

# The Legendary Diana Hanbury King

(September 2, 1927 – June 15, 2018)

Diana Hanbury King (1927-2018), pioneer and legend in the field of dyslexia, passed away at her home on June 15 after a short illness.

Under the aegis of mentor Helene Durbrow, Diana began her nearly 70-year career in the field of dyslexia at Sidwell Friends School in Washington, D.C., where Anna Gillingham visited regularly to supervise teachers. Prior to that, she had spent time in Southern Rhodesia (now Zimbabwe) on her uncle's farm, Kildonan; both her uncle and his daughters had what she later realized was dyslexia. Her first teaching job—at Ruzawi—came about by pure chance while she lived there, and thus began a lifelong passion.

In 1955 Diana established Dunnabeck, a summer camp in Pennsylvania, designed to meet the needs of dyslexic students. She served as the camp's director for 35 summers. In 1969, with the help of Kurt Goldman, she established The Kildonan School, first in Bucks County, Pennsylvania, then in Amenia, New York. Both programs continue to flourish. Schools, camps, and training programs around the world, including Fraser Academy (Canada) and Camp Spring Creek (North Carolina), have been established with her vision and guidance. Durango Mountain Camp was also inspired by Camp Dunnabeck, and The Diana Hanbury King Academy for training teachers opened recently in Australia.

Diana mentored dozens of leaders in the field of learning difficulties—authors, school administrators, dyslexia rights advocates, and international presenters who acknowledge her as a driving force behind their work. She authored some 15 important teaching books and continued to write up until a few weeks before her death.

A gifted presenter, Diana trained thousands of teachers in both public and independent schools. Never one to suffer fools gladly, she expected only the best of teachers—because, as she often said, our students "do not have any time to waste." It was rare to win an argument with Diana. You needed to come prepared, and sometimes with research done, usually to find that she was correct in her initial position. Even so, she

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gave of herself selflessly to her students and her trainees, never unwilling to share her time and advice, her suggestions, and her passion for teaching.

A founding fellow of the Academy of Orton-Gillingham Practitioners & Educators and a member of the International Dyslexia Association (formerly known as the Orton Dyslexia Society) since 1951, Diana received the New York Branch Annual Award (1985), the Samuel T. Orton Award (1990), and the Margaret Byrd Rawson Lifetime Achievement Award (2013) for her work on the national level. In 2016, she received the National Teachers Hall of Fame Lifetime Achievement Award, only the second time in 25 years that they have bestowed this honor.

When asked, Diana was always quite clear that her first passion and best skill was tutoring students with dyslexia. At her passing, a former student wrote, "Mrs. King was the best teacher I ever had. She was always hard but gentle with me because she knew the potential of her students." She was a gifted instructor who understood deeply the notion of diagnostic-prescriptive teaching and used her almost limitless knowledge to inform her instruction in each session with her students, who ranged in age from five to adult. She taught at schools and camps, in public and private school settings, and even for a time at a prison.

Diana was born in England and was a naturalized American citizen. She held a B.A. Honors degree from the University of London, an M.A. from George Washington University, and an honorary doctorate from New England College. She knew to some degree five languages, including French, German, Italian, Spanish, and Russian. She was a passionate gardener, a vodka drinker, a world traveler, and a lover of words and their origins. She read extensively across a wide variety of disciplines. She was an avid horseback rider and downhill skied well into her 60s. By the age of 80, she had two tattoos, including a full color dragon, which adorned her shoulder.

Diana was devoted to her extensive family as well. She is survived by her son, Christopher King; grandchildren Ian Michaels, Sol Michaels, and Eliana Ballen; sisters Jillian Poole, Anna Larkin, and Josephine Coatsworth; ex-husband and lifelong friend James Cecil King; nephews Tony Poole (Elizabeth) and Colin Poole (Kristine); two grandnieces, Natalie and Alison; and first cousin, Ashley Hanbury, in South Africa. She was predeceased by her parents, Una and Anthony Hanbury; her daughter, Sheila King; and her son-in-law, Murray Michaels.

A lifelong teacher and learner and a force to be reckoned with, Diana leaves behind an enormous legacy in the programs she built, the teachers she inspired, and the students she taught. Those who work in the field of dyslexia have benefited from her wealth of knowledge and her passion for teaching. Her legacy lives on through them.

In lieu of flowers, Diana's family asks that donations be made to The Kildonan School Pool Fund (kildonan.org), the International Dyslexia Association (DyslexiaIDA.org), or the Academy of Orton-Gillingham Practitioners & Educators (ortonacademy.org).

# The Challenge of Early Identification of Later Reading Difficulties

by Mads Poulsen

Preventing reading difficulties before they arise is by far preferable to attempting to remediate difficulties after a child has lagged visibly behind. There are two components in preventing reading difficulties: One is to provide strong instruction for everyone. The other is to identify which children should be given additional attention. All children need to learn the same principles and practices of decoding, but some children may require more support and attention, either because it takes them longer to learn the principles with the same amount of effort or because they have difficulty applying the necessary amount of effort by themselves. This article is about the benefits, but more so of the challenges with formalized screening procedures for early identification of children who later develop reading difficulties. The main challenge with early identification is that it tends to be somewhat inaccurate. This is to be expected. Predicting the future is hard. Screening can still be useful, and maybe more so if this limitation is understood and can be taken into account. This article describes the limitations and different approaches to dealing with them.

Early identification of difficulties is beneficial because it allows early support (intervention) and, one hopes, prevention or softening of reading difficulties. "Early" could be defined in many ways. It should be sufficiently early for intervention to be able to prevent a feeling of failure that could extinguish the child's motivation to keep trying, and before limited reading abilities become a clear impediment to participation in general classroom activities. In this article, early identification will mean *before* actual direct instruction in reading words, but possibly *while* learning foundational skills such as letter knowledge and phoneme awareness.

## Predicting Something that Has Not Happened is Difficult

The challenge of early identification before instruction is that it involves predicting something—reading development and difficulty—that has not happened yet. Once instruction is underway, children's present reading ability becomes a strong predictor of their future reading ability and difficulty: If children struggle to read after a certain amount of instruction, then the risk is high that they will continue to struggle. But before instruction in reading words, reading ability is often not a very good indicator of later reading ability. Children who can read without instruction are probably in the clear. But it does not tell much about a child that he or she cannot read before being taught how!

There are other and better early indicators of later reading performance. For example, there is a statistical tendency for children with poor letter knowledge and phoneme awareness to have difficulties years later with reading. However, it is a tendency, not a certainty. Some children with poor letter knowledge catch up just fine after some time. The consequence is that an early screening will flag some children as being at risk, who will turn out to be fine. These cases are sometimes referred to as *false positives* because they are falsely flagged as being positive for possible reading difficulty. On the other hand, some children who actually do develop reading difficulties will be overlooked. These are sometimes referred to as *false negatives*. In other words, early identification of later reading difficulties is not going to be 100% precise. Most of us accept solutions that do not work perfectly all of the time. Knowing how well a solution can be expected to work allows us to take reasonable precautions.

*Most of us accept solutions that do not work perfectly all of the time. Knowing how well a solution can be expected to work allows us to take reasonable precautions.*

## How to Evaluate Identification Accuracy

One way of evaluating how well an early screening procedure works is to use the procedure with a group of children before or in the beginning of reading instruction, and then revisit the children after a few years to see who developed reading difficulties. It is then possible to compare who the screening procedure predicted to have difficulties with who actually developed difficulties. This comparison can be made in many ways. The simplest statistic is unfortunately not very good: It is tempting to simply calculate the percentage of children who were correctly classified by the screening as having reading difficulties or not. For example, an early screening might classify 92% of the children correctly. This may sound impressive, but if 8% of the children ended up with reading difficulties, the test could accomplish a 92% classification accuracy simply by predicting that nobody would develop reading difficulties! No legitimate screening procedure would do this, but it shows that this simple statistic can be very misleading. Instead, there exists a number of different and complementary statistics, each highlighting different aspects of identification accuracy.

Since the goal of screening is to identify children who need special instructional attention, it is useful to know how well a screening tool does this. The *sensitivity* is the percentage of children who are correctly flagged for being at risk (*true positives*) out of all the students who will experience difficulties. Since the aim is to identify children in need of attention, this percentage should preferably be as high as possible.

But the screening should also avoid raising unnecessary concern associated with flagging children as being at risk when

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in reality they are going to catch up just fine. The *false positive rate* (also known as *1-specificity*) is the percentage of children who will not develop difficulties, but who are incorrectly identified as being at risk. The aim is to keep the false positive rate low. It is important to keep in mind that at the point in time of early screening, there is no way of differentiating between true and false positives. Besides raising unnecessary concern, false positives may tie up resources that could have been used more productively elsewhere. For example, the more children a teacher has to direct special attention to, the less intense that attention is probably going to be.

### Trade-off Between Finding Those in Need and Raising Unnecessary Concern

For a given screening tool, the sensitivity and the false positive rate are determined by the cut-off test result that determines whether a child is flagged as at risk or not. The cut-off could, for example, be a certain number of letters on a letter knowledge test. People, not nature, decide cut-offs. The decision is made difficult by the fact that there is a trade-off between the sensitivity and the false positive rate. If the cut-off is set such that many children will be flagged as at risk (e.g., they should know at least 24 letters by school entry, otherwise they are flagged), then many of the students who will eventually have reading difficulties will be flagged appropriately: The sensitivity will be high, which is the goal. However, the flip side is that many students who will turn out not to have reading difficulties will be inappropriately flagged, too. The false positive rate will unfortunately also be high. For example, in one study where we followed a group of Danish students from kindergarten to grade 2, we found that an early screening procedure that set the cut-off to produce a sensitivity of 80% resulted in a false positive rate of 29% (Poulsen, Nielsen, Juul, & Elbro, 2017). In other words, if the ambition was to early identify 80% of those who would require special attention in grade 2, that would entail also flagging for special attention about a third of the children who would do well if they received no special attention.

*For a given screening procedure there is a tough choice between finding as many as possible of the children who need the attention and ending up with a manageable group size where not too many of the children might better spend their time elsewhere.*

If we instead chose a less ambitious cut-off corresponding to a 60% sensitivity, then the false positive rate would improve; it would go down to 14%. But that would be at the cost of overlooking more students who likely would have benefited from some special teaching. These results are not very different from other studies of attempted identification prior to formal reading instruction (Sittner Bridges & Catts, 2011; Catts, Petscher, Schatschneider, Sittner Bridge, & Mendoza, 2009; Gellert & Elbro, 2017; Johnson, Jenkins, Petscher, & Catts, 2009).

Thus, for a given screening procedure there is a tough choice between, on the one hand, finding as many as possible of the children who need the attention, and, on the other hand, ending up with a manageable group size where not too many of the children might better spend their time elsewhere.

It is natural to have high ambitions for the sensitivity. After all, the goal is to find those who need attention. But finding the students in need is only the first step. They also need to be given the attention. And if too many are flagged as being at risk, then it may be difficult to give the necessary amount of attention to each child, unless one's education budget is infinite.

From a day-to-day practical standpoint, it might be useful to keep an eye on another statistic. The *total positive rate*, that is the overall percentage of children who are flagged as being at risk, disregarding whether they end up with difficulties or not. This is the number of children who the school has to provide with special instructional attention. On a fixed budget, the total positive rate may thus dictate what kind of special attention is feasible. For example, it may not be possible to offer many hours of one-on-one instruction for, say, one third of the students in every classroom.

The total positive rate is heavily influenced by the false positive rate because most children do not end up having reading difficulties. It can be calculated from the prevalence, sensitivity, and false positive rates. In the study noted above (Poulsen et al., 2017), the prevalence of reading difficulty was 15%. If we aimed at 80% sensitivity, we could expect a false positive rate of 29%. Thus, out of 100 students, about 25 would be false positives ((100-15) x 0.29), and 12 (15 x 0.80) would be true positives in actual need of attention, for a total of 37 students flagged for attention. If the aim was a more modest 60% sensitivity, then the total positive rate would be a more manageable 21 students flagged for attention ((100-15) x 0.14) + (15 x 0.60).

### Improving Screening Accuracy

Some screening procedures are better at predicting future reading difficulties than others. They have more favorable trade-offs between sensitivity and false positive rates, meaning that it will be possible to set more ambitious goals for finding those in need, while keeping the false and total positive rates at manageable levels.

There is important research that has shown how early screening accuracy can be improved. Accurate screening procedures typically use tests of multiple foundational skills. Lately, tests that measure how well children learn principles of reading from brief instruction during a testing session have shown very promising results (Gellert & Elbro, 2017). But still, early screening cannot yet be assumed to be so precise that the practical problem of the trade-off disappears.

### Addressing the Trade-Off: Two Scenarios

Again, the challenge of early, relatively inaccurate screening leaves a tough choice between two goals: identifying as many children in need as possible (high sensitivity) versus not raising unnecessary concern and having enough resources to actually help the children who are identified as being in need (low false positive and total positive rates). By acknowledging this trade-off, it may be possible to anticipate and meliorate the problems associated with different approaches to the trade-off.

One approach to the trade-off is to prioritize the identification of as many of those who will develop reading difficulties as possible. In other words, failing to identify a child with learning needs may be thought to be a worse outcome than the problem of falsely identifying a child who really did not need extra assistance. This strategy involves setting cut-offs with the aim of achieving high sensitivity, despite the associated high false and total positive rates. Say a third of an average classroom could be flagged for attention, as in the above example that aimed at finding 80% of the students who would develop reading difficulties. On a fixed budget, this probably constrains the intensity of the intervention. To accommodate this situation, the intervention could consist of dividing the classroom into two or three groups who work on different tasks that are suitable for different reading levels (see Connor et al., 2013 for a similar approach with first- to third-grade students). Communication with students and parents should be mindful of the fact that many of the students who are flagged for attention will not develop reading difficulties.

*One approach to the trade-off is to prioritize the identification of as many of those who will develop reading difficulties as possible. Another approach is to prioritize providing relatively intensive interventions for the few students who are most likely to develop reading difficulties.*

Another approach is to prioritize providing relatively intensive interventions for the few students who are most likely to develop reading difficulties. This strategy involves setting the screening cut-off value at a level where the total positive rate is low enough to allow the desired intensity of intervention within the available resources. Such an intervention can be organized in many ways, from simply letting a proficient classroom teacher focus more time on these few students and maybe including the parents in the efforts, to providing pull-out individual or small group instruction with specialized teachers. In the above example, when a cut-off was set to produce a true positive rate of 60%, the total positive rate was 21% or about five students in a classroom of 25. Possibly not low enough for intensive individual instruction, but small group instruction might be manageable in such a case. Of course, the downside to this approach is that many of the children who will develop difficulties will not be flagged. These may be children who did not do too badly on the letter knowledge and phoneme awareness tasks, but who for some reason later struggle with learning the more complex task of reading actual words of increasing difficulty. In any case, this approach can be expected to overlook a substantial number of the children who will eventually develop difficulties. To offset this, it would be necessary to keep a close eye on how *all* the children progress.

After instruction begins, the students' performance on actual reading tests becomes a better predictors of later reading difficulty (Catts et al., 2009; Compton et al., 2010; Poulsen et al. 2017), allowing more precise identification. In the Danish example (Poulsen et al., 2017), much better identification accuracy was achieved with relatively simple word-list reading measures in the January of grade 1: for example, 80% sensitivity with an 8% false positive rate. In another study, Compton and colleagues (2010) demonstrated even better identification accuracy of reading difficulties in the end of grade 2 with measures that were administered in the fall of grade 1: about 90% sensitivity with a 10% false positive rate. However, it should be noted that this impressive result came at the cost of a rather intensive testing procedure involving weekly progress monitoring with word-list reading measures for five weeks. At some point, the benefit of small improvements in screening accuracy should be weighed against the cost of disrupting ordinary instruction and collecting and managing the data—especially considering that the identification accuracy with simple tools increases automatically as instruction progresses, and it becomes easier to notice which students are not responding to ordinary instruction or specialized intervention.

Screening does not have to be a one-off affair. Early, inaccurate screening can, and probably should, be supplemented with follow-up screening or monitoring at suitable intervals. The intervals could be long enough to allow some of the slow learners to progress meaningfully, but short enough to allow teachers to catch students who are not responding or find new challenges for students who are responding.

*Screening does not have to be a one-off affair. Early, inaccurate screening can, and probably should, be supplemented with follow-up screening or monitoring at suitable intervals.*

The two above approaches to *early* identification can be seen as early starts that either prioritize giving some instruction to the many who need it (and many who probably do not), or prioritizing giving more intensive instruction to a few who can be expected to need it the most. Which approach to take will depend on many factors in a school system. But knowing the limitations of early screening allows finding a solution that fits the students and resources of particular schools.

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# Neuroimaging, Early Identification, and Personalized Intervention for Developmental Dyslexia

by Ola Ozernov-Palchik and John D.E. Gabrieli

Neuroimaging has revealed much about the brain basis of the development of reading ability and disability, but it remains unknown as to how neuroscience knowledge can be translated into educational practices and policies that promote reading ability. This concern is especially salient for the approximately 5–10% of children with developmental dyslexia (Siegel, 2006), a poorly understood difficulty in learning to read that has broad and long-term consequences for the academic and socio-emotional growth of those children (Lyon, Shaywitz, & Shaywitz, 2003). Here we relate the remarkable scientific progress in the cognitive neuroscience of reading and dyslexia to fundamental educational challenges in helping children with dyslexia become effective readers through 1) early identification of risk for dyslexia and 2) personalized intervention.

## The Need for Early Identification

Currently, dyslexia is diagnosed after reading failure is substantial and chronic, usually in the second grade or later. This waiting-for-failure approach is problematic. First, years of failure to read can lead to reduced self-esteem, depression, and other unfortunate outcomes (Riddick, 2009). Second, targeted interventions are most effective when administered early—in kindergarten and first grade (Torgesen, 2000). Early identification of high risk for reading difficulty, coupled with effective intervention, could improve reading and other outcomes for many children.

Early identification of children at high risk for reading difficulty can be made even before school instruction for reading begins by measuring the preliteracy skills that are the building blocks of learning to read. These skills can be assessed in children before they learn to read. Longitudinal studies starting in kindergarten suggest that the best predictors of future reading ability are scores on tests of phonological awareness (ability to identify and manipulate units of spoken language), rapid automatized naming (fast and accurate naming of colors, objects, and letters), letter knowledge (naming the letters of the alphabet), and vocabulary (knowledge of words and word meanings) (Kirby, Desrochers, Roth, & Lai, 2008; Ozernov-Palchik, Norton, et al., 2016; Scarborough, 1998; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). Although these measures are fairly accurate in identifying children who are likely to progress to reading difficulty (good sensitivity), they tend to result in over-identification (that is, flagging children who do not eventually have reading problems) (poor specificity). [See the Poulsen article in this issue for more on these problems.]

*Identifying the important characteristics of learners at the outset, before intervention begins, as to who will or who will not respond to a given intervention can inform selection of personalized interventions that could be effective for many more children.*

## The Need for Personalized Intervention

Even after being diagnosed with dyslexia and receiving intervention, many children fail to make expected gains in reading. There is great variability among children with dyslexia in their response to intervention. Several studies show that 20–30% of children with dyslexia do not respond adequately to interventions that are generally effective (Brown & Felton, 1990; Torgesen, 2000), and nonresponse can be even higher (Romeo et al., 2017). Several factors have been identified as contributing to this lack of positive response including: level of intelligence, severity of deficit, socioeconomic status, language impairment, and others (Al Otaiba & Fuchs, 2002; Lam & McMaster, 2014; Stuebing et al., 2015). However, there are conflicting data about the effects of these factors and about the circumstances in which accounting for these factors in an assessment battery might be useful (Stuebing et al., 2015). Currently, there is a wait-for-failure approach to intervention in which the efficacy of an intervention for an individual student is discovered *after* an intervention has been delivered. Identifying the important characteristics of learners at the outset, *before* intervention begins, as to who will or who will not respond to a given intervention can inform selection of personalized interventions that could be effective for many more children.

## Measuring Structure and Function of the Human Brain

Modern neuroimaging methods have revealed the brain structures and functions that underlie reading development. These non-invasive methods are safe and can be used from infancy through adulthood. Brain structure (neuroanatomy) can

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### Abbreviations

DTI: Diffusion tensor imaging
EEG: Electroencephalography
ERP: Evoked response potential
fMRI: Functional MRI
MRI: Magnetic resonance imaging

be assessed with structural magnetic resonance imaging (MRI) that allows the measurement of the anatomical size or thickness of structures within an accuracy of a few millimeters. This method is often used to characterize the gray matter of the brain, which is composed primarily of neuronal cell bodies. Another method termed diffusion tensor imaging (DTI) is also measured in an MRI scanner and can characterize the properties of white matter in the brain. White matter is composed of myelinated axons: projections of neuronal cell bodies that transmit information to distant brain regions and are covered with a fatty substance to increase insulation and enhance transmission. Large bundles of these myelinated axons are called tracts or fasciculi, and they connect distant brain regions into networks.

Brain function (neurophysiology) is measured in ways that maximize either spatial accuracy (where in the brain a function occurs) or temporal accuracy (when the function occurs on the order of a few milliseconds to a few seconds). The most common measure of where a brain function occurs is functional MRI (fMRI). The most common measure of when a brain function occurs is electroencephalography (EEG), which measures electrical activity detected by electrodes placed on the skull. When this electrical activity is related or time-locked to a specific task, such as reading a word, it is termed as an evoked response potential (ERP).

## The Reading Brain

Neuroimaging has identified a core reading network located primarily in the left hemisphere, which is dominant for language in most individuals from birth (Dehaene-Lambertz, 2017). Learning to read can be conceptualized as making spoken language visible through print, therefore the network includes the two brain regions that are at the core of the language system: Broca's area in left inferior frontal cortex and Wernicke's area in left temporo-parietal cortex (Figure 1). These two areas are involved in phonology (processing speech sounds) and phonological awareness (Pugh et al., 2001). The third major component develops in children or illiterate adults as they learn to read print—*the visual word form area* (Dehaene & Cohen, 2011) located in left occipito-temporal cortex. This is the first region in the brain that recognizes print as a special kind of visual percept (injury to this region in an adult makes them selectively unable to read (Cohen et al., 2003)).

The reading network involves multiple brain regions that interact to support reading, and those components communicate with one another through three left-hemisphere pathways (Figure 1). The left arcuate fasciculus connects temporo-parietal cortex with frontal regions and supports phonological processing (Wandell & Yeatman, 2013). Learning to read, both in children and adults, has been associated with stronger connectivity in the left arcuate fasciculus (Thiebaut de Schotten, Cohen, Amemiya, Braga, & Dehaene, 2014). The inferior longitudinal fasciculus connects the temporal and occipital lobes, including the visual word form area. This tract is thought to be important in connecting print to meaning (Wandell & Yeatman, 2013). The superior longitudinal fasciculus connects parietal and frontal lobes and is important for mapping phonemic representations to motor representations. The strengths of connectivity in left arcuate fasciculus and left inferior longitudinal fasciculus increase over age in typical readers (Yeatman, Dougherty, Ben-Shachar & Wandell, 2012), and properties of these tracts are associated with phonological awareness and reading outcomes in typically reading children (Myers et al., 2014).

## Brain Differences in Dyslexia

Children and adults with dyslexia have shown brain differences in both function and structure relative to typically developing readers. Both the left temporo-parietal and left occipito-temporal (visual word form area) parts of the reading network exhibit reduced responses to print in people with dyslexia (Hoeft, Meyler et al., 2007; Temple et al., 2001). Response to print in left frontal cortex is often atypical in dyslexia, and sometimes greater in people with dyslexia (Shaywitz et al., 1998). The increased activation in left frontal cortex may

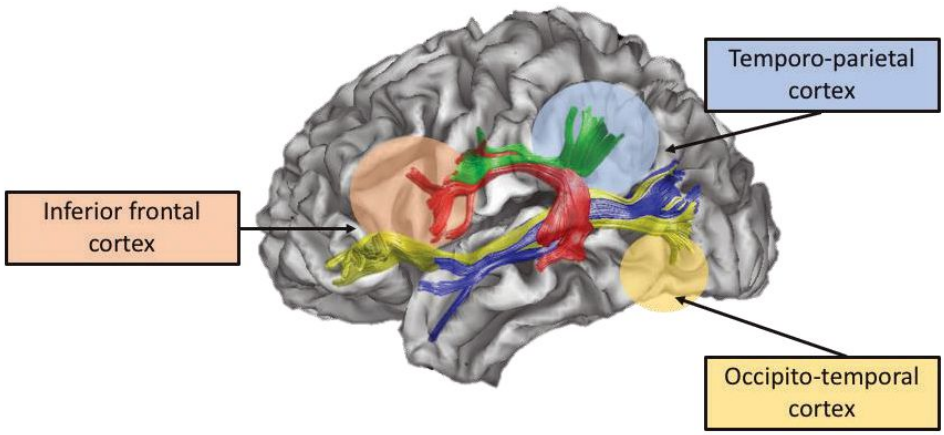


Figure 1. Brain regions and white matter tracts (arcuate fasciculus-*red,* inferior frontal occipital fasciculus-*yellow*, inferior longitudinal fasciculus-*blue,* and superior longitudinal fasciculus-*green)* important for reading that are commonly found to be associated with atypical function or structure in developmental dyslexia.

reflect the greater effort that individuals with dyslexia must exert to read words (Hoeft et al., 2006). In regard to brain structure, people with dyslexia often exhibit reduced gray-matter volume or thickness in the same regions of the reading network that exhibit altered functional responses (Hoeft et al., 2006; Kronbichler et al., 2008) and reduced structural connectivity in the three white-matter tracts that integrate the components of the reading network (Hoeft et al., 2011; Langer et al., 2015; Myers et al., 2014; Vandermosten et al., 2012).

*Prereading children around ages 5 or 6 at familial risk for dyslexia have shown structural and functional differences in some of the same brain regions that have shown differences in older children and adults with developmental dyslexia.*

### Neuroimaging Relevant for Early Identification

Neuroimaging has revealed brain differences in prereading children at risk for reading difficulty well before formal reading instruction begins in kindergarten, and these differences are similar to those observed in older children and adults who have received years of reading instruction (Ozernov-Palchik & Gaab, 2016). The findings of specific brain differences in children before learning to read strengthen the rationale for early identification of risk for later development of dyslexia.

Risk has been defined in two ways, familial and behavioral. Dyslexia is a familial disorder affecting approximately 50% of children with a first degree relative with dyslexia (i.e., parent or sibling) (Finucci & Childs, 1983; Grigorenko, 2004). Most studies of risk for developmental dyslexia in prereaders have compared children with versus without a familial history of dyslexia so as to study a group in which a substantial number of prereading children are likely to progress to reading difficulty. Family history of dyslexia is usually defined by a first-degree relative having had a clinical diagnosis of dyslexia. A second approach has been to associate prereading behavioral risk factors (such as a weakness in phonological awareness) with brain differences. This approach has the benefit of being applicable to all children regardless of family history, but with the limitation that children must be able to perform the tests that measure the relevant behaviors. It is not yet practical to measure phonological awareness in infants or very young children.

Both kinds of risk studies have found evidence that brain differences are present prior to formal reading instruction and are present even at infancy. ERP studies have shown that newborns from families with a history of dyslexia exhibit altered functional brain responses to language sounds within hours or days of birth (Guttorm, Leppänen, Tolvanen, & Lyytinen, 2003). Although only about half of those infants will have reading difficulties, the importance of these brain differences is revealed by the finding that ERP differences at infancy are related to language and reading difficulties years later (Guttorm et al., 2005; Lohvansuu, Hämäläinen, Ervast, Lyytinen, & Leppänen, 2018; Molfese, 2000). Infants with a family history of dyslexia also exhibit altered white-matter properties of the left arcuate fasciculus (Langer et al., 2017). This same tract has shown alteration in prereading children at familial (Kraft et al., 2016; Vandermosten et al., 2015; Wang et al., 2016) and behavioral (Saygin et al., 2013) risk for dyslexia. There appears to be a continuity between atypical development of the left arcuate pathway from infancy through the preschool years and into late childhood and adulthood, when a diagnosis of dyslexia can be made. This continuity has been confirmed through longitudinal and cross-sectional investigations (Wang et al., 2016).

Prereading children around ages 5 or 6 at familial risk for dyslexia have shown structural and functional differences in some of the same brain regions that have shown differences in older children and adults with developmental dyslexia. Prereaders at familial risk for dyslexia have exhibited reduced gray-matter volume in occipito-temporal and temporo-parietal regions (Raschle, Chang, & Gaab, 2011). Functional (fMRI) studies in prereaders at familial risk for dyslexia have reported altered functions during auditory tasks demanding phonological awareness (Raschle, Zuk, & Gaab 2012), during rapid auditory processing that has been linked to phonological processing (Raschle, Stering, Meissner, & Gaab, 2013; Raschle, Zuk, & Gaab, 2012), and also in response to common words in occipito-temporal regions important for reading (Specht et al., 2009). Although such studies of infants and prereading children are intuitively interpreted as reflecting genetic factors, it is important to note that both genetic and environmental factors (such as home language and literacy experiences) influence brain structure and function (see Ozernov-Palchik, Yu, Wang, & Gaab, 2016 for an overview; Powers, Wang, Beach, Sideridis, & Gaab, 2016).

*A few neuroimaging studies have suggested that brain measures might substantially contribute to better prediction of which intervention will work for which child with dyslexia.*

What are the implications of these findings of brain differences in infants or prereading young children before reading instruction begins? It is, at present, unlikely that brain imaging would become a routine part of screening, but these findings underscore the point that neurobiological differences that lead to dyslexia appear to be present early in development and before reading instruction. The evidence from longitudinal studies is especially compelling in this regard (Guttorm, Leppänen, Hämäläinen, Eklund, & Lyytinen, 2010; Leppänen et al., 2010; Wang et al., 2016). These neuroimaging findings encourage early identification of individuals at risk for developmental dyslexia, which would lead to early interventions that are more effective than interventions administered later (Catts, Nielsen, Bridges, Liu, & Bontempo, 2015; Vellutino, Scanlon, Zhang, & Schatschneider, 2008).

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## Neuroimaging for Personalized Intervention

A few neuroimaging studies have suggested that brain measures might substantially contribute to better prediction of which intervention will work for which child with dyslexia. In one study, children ages 8–12 were identified by their teachers at the beginning of the school year as being at risk for reading difficulty (Hoeft, Meyler et al., 2007). The children received multiple education and clinical assessments of reading and language ability, and also both functional and structural MRI measures. At the end of that school year, progress in reading was measured. The combination of behavioral and brain measures at the beginning of the year predicted each child's progress significantly better than the behavioral measures alone. In another study, children with and without dyslexia were followed longitudinally over 2.5 years. Initially, at baseline, children received extensive testing for reading and language abilities, and underwent functional and structural MRI imaging (Hoeft et al., 2011). About half the children with dyslexia made substantial gains in reading over the next 2.5 years, but the others did not make such gains. The tests of reading and language abilities did not predict which child with dyslexia would or would not make substantial progress in reading, but the brain measures did yield such predictions (Figure 2). Another longitudinal study of kindergarten children with and without dyslexia reported that ERP measures not only improved predictions of reading ability above and beyond behavioral measures over the next several grades, but that only the ERP measures (and not the behavioral measures) predicted reading ability in fifth grade (Maurer et al., 2009). A limitation of these studies is that they did not control the interventions provided by schools or parents.

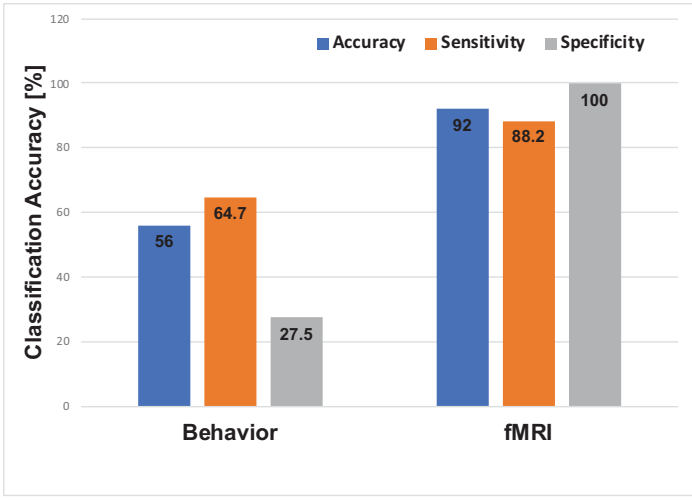


Figure 2. Findings from the Hoeft et al., 2011 study demonstrating multivariate pattern classification accuracy using behavioral versus whole-brain fMRI measures (Accuracy: Overall accuracy of classification of reading gains in children with dyslexia. Sensitivity: Percentage of children who were correctly predicted to have made gains out of all children who were labeled as making gains. Specificity: Percentage of children correctly predicted to have not made gains out of all children who were labeled as not making gains).

Prediction of improvement in reading reflects the interaction between an individual student's patterns of abilities and the reading instruction provided to each student. If brain measures add substantially to (Hoeft, Ueno et al., 2007) or meaningfully outperform (Hoeft et al., 2011; Maurer et al., 2009) conventional educational and clinical measures in predicting reading development, that means that there are some characteristics of students we do not yet understand that predict who will or will not respond to specific kinds of education or intervention. The brain findings show that these characteristics are objectively measurable, which encourages efforts to develop behavioral test measures that can better guide an individual student to the particular program that will best help that student succeed despite having developmental dyslexia.

## Ushering in Personalized Interventions

Neuroimaging has revealed brain differences that are highly relevant to helping people with developmental dyslexia. These brain differences are observable from infancy and before reading instruction in school and provide convergent evidence that early screening ought to identify children who are at high risk for developmental dyslexia at young, prereading ages when interventions are most effective. Further, the findings that brain measures add to or even outperform conventional behavioral tests in predicting the reading progress of a child with developmental dyslexia may open up new frontiers in personalized interventions in which such a child may be guided directly towards an optimal intervention.

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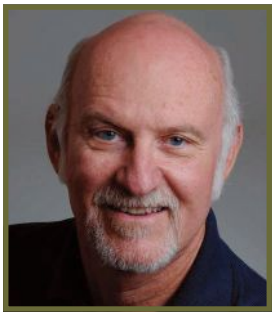

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# Genetics, the Environment, and Poor Instruction as Contributors to Word-Level Reading Difficulties: Does it Matter for Early Identification and Instruction?

by David A. Kilpatrick

If you get in your car and discover it won't start, there could be several possible reasons for this problem. Perhaps the battery is dead, or the starter no longer works, or there's an electrical problem. Maybe you are out of gas. Each of these causes would require a different response on your part if you wanted to get somewhere.

By analogy, if you were trying to identify a child's potential for reading problems, it makes sense that you might seek to find out if the child faced challenges due to neurological, genetic, biological (e.g., lead paint exposure), or sensory deficits, or whether there were environmental (e.g., limited early language opportunity), or motivational troubles. Knowing these things would presumably help us to determine who would be likely to develop dyslexia. Despite its intuitive appeal, there are some important difficulties with this reasoning.

*Reading skills fall along a fine-grained continuum, and there is no consensus on where to draw the line in terms of how depressed reading skills must be to be considered dyslexia.*

## Defining Our Terms

The focus of this article is on word-level reading difficulties, a phenomenon researchers call *dyslexia* (Fletcher, Lyons, Fuchs, & Barnes, 2018; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Researchers do not make a distinction between dyslexia and "other" types of word-level reading difficulties. Rather, they operationally define dyslexia as word-level reading difficulty despite adequate student effort and learning opportunity (and not attributable to blindness, deafness, or a severe intellectual impairment). Reading skills fall along a fine-grained continuum, and there is no consensus on where to draw the line in terms of how depressed reading skills must be to be considered dyslexia. The lack of a uniform cut-off point creates variability in determining who qualifies as dyslexic. For the sake of clarity, in what follows, the term *word-level reading difficulty* (or simply *word-reading difficulty*) will be favored and used synonymously with *dyslexia*.

## Genetics, Environment, and Hearing Impairments

There is ample research showing that genetics is implicated in the reading difficulties of a large portion of students (Byrne, Olson, & Samuelsson, in press). Poor word reading can result from environmental factors as well; children with sub-optimal early exposure to language are at risk (Metsala, 2011).

A third factor that can affect word reading development is hearing impairments. Individuals who are deaf have difficulty learning to read. Average reading skill for graduating high school students who are deaf is about the third-grade level (Lederberg, Schick, & Spencer, 2013). Difficulty reading due to deafness is not considered dyslexia, however it is a factor that can disrupt reading development. There is also evidence that a childhood history of chronic ear infections (otitis media) may be a risk factor for reading difficulties (Winskel, 2006; but see Roberts, Burchinal, & Zeisel, 2002).

## Models for Understanding Causes of Word Reading Difficulties

To connect reading difficulties with the causes mentioned above, we could develop two different models. Figure 1 displays one such model. In this model, genetics, environment, and hearing deficits are risk factors that may contribute to word reading acquisition.

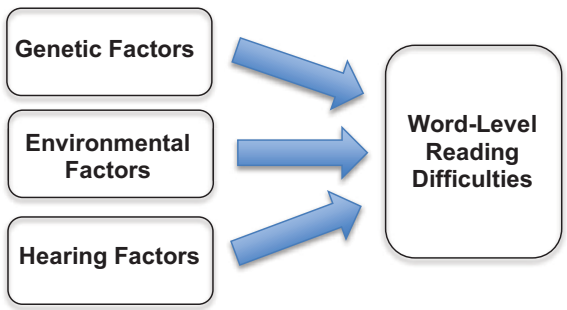


Figure 1. The Causes of Word-Level Reading Difficulties: An Intuitive Model

This model, though it appears reasonable, is problematic. What is it about genetics that contributes to word reading problems? How does the environment disrupt word reading? What is it about difficulties with hearing that interferes with reading

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## Abbreviations

CTOPP-2: Comprehensive Test of Phonological Processing – Second Edition

TOWRE-2: Test of Word Reading Efficiency – Second Edition

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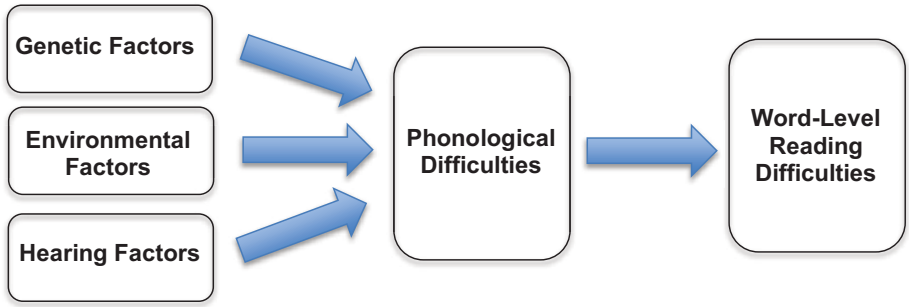


Figure 2. The Causes of Word-Level Reading Difficulties: An Empirical Model

development? The problem is that answers to these questions do not, at this time, lead to different assessment or instructional choices.

Figure 2 presents a contrasting model that is well supported by research. It answers the questions raised in the previous paragraph regarding the specific reason why the underlying factors influence learning to read. They all are, ultimately, potentially contributing factors to phonological skill deficits. Individuals who struggle in word-level reading, regardless of cause, are likely to have poor phonological skills—the immediate factor that disrupts reading development.

The second model is preferred because it guides us to make useful early identification choices that can lead to productive interventions. Genetics, the environment, and hearing deficits all influence phonological development, but the reasons they do so do not appear to be relevant for early identification.

## The Phonological-Core Deficit

Researchers have identified the *phonological-core deficit* as the source of difficulty among children who struggle in reading (Morris et al., 1998; Stanovich & Siegel, 1994; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Usually researchers have stated that the phonological-core deficit was "typically" or "primarily" the reason that children struggle in word-level reading, but some researchers have gone even further, referring to it as the "universal cause" of dyslexia (Ahmed, Wagner, & Kantor, 2012). However it is referred to, its centrality seems to be beyond argument given that students with poor word-level reading invariably display one or more of the phonological-core deficit symptoms; and, so far there has been no convincing alternative to the phonological-core deficit explanation. [For some recent considerations of alternatives see Catts and Petscher in this issue.]

The characteristics of the phonological-core deficit are:

1) Poor phonemic analysis/awareness
2) Poor phonemic synthesis/blending
3) Poor rapid automatized naming
4) Poor phonological working memory
5) Poor nonword reading/letter-sound skills

Students who struggle in word-level reading usually display low performance in one or more of these, and some do poorly in all of them. Children with average or better reading development rarely display low performance on any of these skills.

## Alternative Theories: Visual Processes in Reading

Many alternative explanations for dyslexia have been considered, but none have gained much traction. Usually these explanations have focused on *epiphenomenal* characteristics, which are correlated features that may commonly accompany dyslexia, but which are unlikely to be its cause. The most common alternative explanations of dyslexia have focused on vision, visual processing, and visual memory.

*The correlation between word recognition and visual memory is weak while the correlation between word recognition and phonological tasks is consistently moderate to strong.*

Visual explanations of poor word reading have not proven useful in advancing our understanding of dyslexia. Visual memory does not appear to be involved in word-level reading, despite strong intuitions to the contrary (Kilpatrick, 2015): The correlation between word recognition and visual memory is weak while the correlation between word recognition and phonological tasks is consistently moderate to strong; reaction time to printed words is faster than to pictures of the objects those words represent, suggesting that visual memory and word reading represent different mental processes; and, neuroimaging studies show different activation patterns for visual memory tasks and orthographic memory (i.e., memory for printed words; Dehaene & Cohen, 2011).

Another visual explanation is that individuals with dyslexia display poor visual tracking. Poor visual tracking and poor reading correlate, but this is likely due to poor reading disrupting tracking, not the reverse. Poor readers struggle to read words in isolation, when tracking words is not an issue. Also,

because poor readers cannot fluently identify words, they often skip ahead to use context to help figure out a word or go back earlier in a sentence once they realize they have misread some words (Ahmed et al., 2012). The erratic eye movements displayed by some individuals with dyslexia appear to be a byproduct of poor reading skills, not their cause.

For these and other reasons, visual theories of dyslexia have not had much explanatory power. The American Academy of Pediatrics, in cooperation with various ophthalmological and optometric associations, issued a position statement aimed at steering educators and parents away from vision-based claims about reading disabilities and their corresponding visual therapies (American Academy of Pediatrics, 2009).

## Why Phonology?

So why is phonology so central to word-level reading when written words are input visually? The short answer lies in the nature of alphabetic-based writing systems. Alphabetic writing systems involve the use of characters that represent phonemes within the spoken speech stream. Individual written characters usually do not represent words; they represent spoken phonemes. Difficulty in accessing oral phonemes creates significant challenges for reading written words in a writing system that is based on the idea of representing phonemes.

## Instructional Casualties

It is worthwhile to note that one of the major causes of reading difficulties is poor instruction. Although not relevant to issues of early identification—that is identification of dyslexia prior to the onset of formal teaching—it is a complicating factor for any early identification scheme. No matter how effectively we are able to identify who will likely have trouble learning to read, those student-focused testing regimens do not reveal what instructional barriers children may face in the classroom. Estimates of the prevalence of reading difficulties suggest that very few children (3–8%) should struggle with reading (Foorman & Al Otaiba, 2009; Vellutino et al., 1996). These estimates stand in stark contrast to the 2015 National Assessment of Educational Progress (NAEP) results, which show that 31% of U.S. fourth-graders read below a basic level. This discrepancy is due primarily to instructional deficits, rather than child factors. This is why some authorities argue that early identification can be too early [see Poulsen, this issue].

## Distinguishing Among Causes of Word Reading Problems

When considering the various possibilities described above, it seems that there are, broadly speaking, two sources of poor word-level reading: the phonological-core deficit and inadequate instruction. These two are not necessarily independent of one another. Phonological skills fall along a continuum and those with milder phonological skills presumably do more poorly when presented with inadequate instruction than those with better phonological skills. The National Reading Panel's review of research (National Institute of Child Health and Human Development, 2000) strongly suggests that children with milder phonological skill deficits respond well to quality instruction. The panel found that when children who were at risk for reading difficulties were provided with explicit and systematic instruction in phonics and phonemic awareness in kindergarten and first grade, the percentage of struggling readers was dramatically reduced.

*It seems that there are, broadly speaking, two sources of poor word-level reading: the phonological-core deficit and inadequate instruction. These two are not necessarily independent of one another.*

## Early Identification and Intervention

This brings us back to the issue of early identification. If a student is struggling in reading, does determining if genetics or the environment "caused" the reading problem improve our ability to identify who will be a struggling reader or how to respond best to preventing that failure?

The simple answer is "no." In the words of Foorman and Torgesen (2001), "The components of effective reading instruction are the same whether the focus is prevention or intervention: phonemic awareness and phonemic decoding skills, fluency in word recognition and text processing, construction of meaning, vocabulary, spelling, and writing" (p. 203). The first part of that quote could be reworked to say, "The components of effective reading instruction and intervention are the same whether the student is struggling due to early environmental factors or a genetic predisposition to poor word-level reading . . ." To be a skilled reader, there are certain components that need to be in place. Regardless of the reason they are not, they must be addressed in order for a student to be successful in reading.

We have no genetic tests in schools, nor do we have ways to precisely determine the adequacy of the students' early language opportunities. If there is a history of reading difficulties or inadequate early language opportunities, will that affect our assessment choices—and, consequently, how we would teach reading? No, they wouldn't, nor should they. The more immediate and relevant "cause" of the reading problem is the phonological-core deficit itself. The phonological-core deficit is something that can be evaluated and addressed via intervention. Whether due to genetic or environmental causes, the issue is that the child has poor phonological skills and those skills can be improved, which will consequently improve reading (Foorman & Al Otaiba, 2009; Kilpatrick, 2015; NICHD, 2000).

Any early assessment of word reading skills would involve, first and foremost, word reading tests! Secondarily, the skills that underlie word reading should be evaluated to more properly pinpoint which aspects of the word reading skill set require additional attention. Two useful and co-normed batteries are the *Comprehensive Test of Phonological Processing – Second Edition* (CTOPP-2) and the *Test of Word Reading Efficiency – Second Edition* (TOWRE-2). In a comprehensive evaluation for word reading skills, these are a great supplement to the reading tests found on academic assessment batteries. The CTOPP-2

*Continued on page 28*

assesses the first four of the five phonological-core deficit skills listed earlier while the TOWRE-2 assesses the fifth. The TOWRE-2 provides a timed nonword reading test to assess proficiency in those skills and supplements traditional untimed nonword reading subtests from academic achievement batteries. In addition, the TOWRE-2 has a subtest for real word reading. The administration of these or other tests is designed to address the immediate deficit areas affecting reading (phonological-core characteristics), without reference to whether the source of those deficits was genetic or environmental. Even if the source of the problem was inadequate instruction, such tests can guide instructional decisions because they target a student's weak areas along with his or her strengths.

*For those with the phonological-core deficit, there is no substitute for quality instruction in the alphabetic code. But that instruction must acknowledge the underlying issues responsible for the struggles, and directly address them.*

Similarly, instructional efforts aimed at prevention are not affected by whether the reading difficulties resulted from genetic tendencies, environmental influences, chronic otitis media, or inadequate environmental supports. Researchers have identified the skills required to be a good reader, and those are the skills that need to be directly addressed in the context of a systematic and explicit code-based reading approach. For those with the phonological-core deficit, there is no substitute for quality instruction in the alphabetic code. But that instruction must acknowledge the underlying issues responsible for the struggles, and directly address them. This would typically involve addressing deficits in letter-sound skills, phonemic analysis/awareness and phonemic synthesis/blending.

### Continuing Research

Researchers continue to investigate the causes of word reading difficulties. Findings related to the genetics of reading, as well as the environmental contributors, will continue to enhance our knowledge of reading disorders. However, this knowledge has not yet led to any obvious improvements in early identification or intervention. This is because the various sources of difficulty described in this article all function as sources for the phonological-core deficit, and it is the phonological-core deficit that is the immediate cause of word-level reading difficulties. The goal of both early identification and efforts at prevention is to address the more immediate causes in the context of a code-based instructional approach that allows for letter-sound learning, phonemic awareness development, and practice reading instructionally relevant text to support the student's developing skills.

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# A Case Study of Successful Early Screening and Intervention

by Linda S. Siegel

As a psychologist who has spent many years doing research on and assessing people for dyslexia and other learning disabilities, I have been concerned about the large number of people who escape detection and who fail to get the remediation necessary to become successful readers. Early detection of children at risk and early intervention to prevent the devastating effects of school failure, including homelessness (e.g., Barwick & Siegel, 1996), anti-social behavior (Sprague & Walker, 2000, Wasserman et al., 2003), and suicide (e.g., McBride & Siegel, 1997), would go a long way to solving this problem.

The aim of this body of research was to identify children at risk for reading difficulties early in their school career. Once identified, an additional aim was to develop a classroom-based program that would address the difficulties that these children experienced. We believed that it was important to provide a classroom-based program rather than a pullout intervention as it is more practical, less expensive, and easier to implement.

*The project involved the introduction of phonological awareness training and direct instruction in letter/sound knowledge to teachers, which was a new initiative for the district that had primarily stressed guessing words from context and provide little instruction in systematic phonics.*

This article describes the implementation of an early screening and intervention project, the results, and lessons learned. In 1996, a fortuitous set of circumstances provided an opportunity to examine the possible success of an early screening and intervention program. Some forward-thinking educators in the North Vancouver school district, nestled in the Coast Mountains in British Columbia, Canada, on the shores of the Pacific Ocean, allowed our team from the University of British Columbia to study the implementation of this program in their schools. Similar to many other districts in Canada and the U.S., this district had a large number of English Language Learners (ELL) who typically experience challenges in learning literacy skills. This research, an early implementation of a type of Response to Intervention (RTI), was a new experience for the researchers and school personnel. The project was a cooperative one between the university and the school district. Two dynamic and knowledgeable school psychologists introduced the concepts of phonological awareness and systematic phonics into the district. The project involved the introduction of phonological awareness training and direct instruction in letter/sound knowledge to teachers, which was a new initiative for the district that had primarily stressed guessing words from context and provide little instruction in systematic phonics. The early screening and intervention program was designed to be sensitive to the needs of these ELL students as well as to those who spoke English as a first language.

As is often the case, the school district was uncomfortable with the use of a control group, as they thought it was not ethical to deny this instruction to children. However, they did want the entire district included in the study so that it became a type of population study, not a limited sample. Every student whose parent signed the consent form participated in the study. Only two parents declined at initial intake. These parents eventually consented at the request of their children. While they participated in the annual assessment, the children enjoyed the break from class and the undivided attention of the research assistant.

The children in this school district represent mixed socioeconomic levels, with 20% of the children coming to school with a first language other than English. At the time of this study, there were 30 languages spoken by the children in this district; the most common ones were Cantonese, the language of Hong Kong and south China, and Farsi, the language of Iran and spoken in a number of other countries by some minorities.

Children were assessed in kindergarten and every year through the seventh grade for our study and as part of the progress-monitoring program. Most of the ELL children attended Heritage language programs in which they were taught reading and writing skills in their first language. These classes are sponsored by the Canadian government and occurred after school or on Saturdays.

All instruction, including intensive instruction in small groups, was implemented by the general education classroom teacher within the core classroom (Tier 1 in the terminology of RTI).

Initially, one of the 30 schools in the district decided not to use the program. All but one school in a high socioeconomic level area of the district participated. However, the "hold-out" school later decided to implement the screening and intervention because the children's performance fell relative to the other schools in the district.

The version of RTI used for this intervention was designed

*Continued on page 30*

**Abbreviations**

ELL: English Language Learners

RTI: Response to Intervention

to develop reading skills for all children, but especially those struggling with reading and for children learning English as a second language (ELL), and was based on several principles:

1. Intervention should begin as soon as the child was experiencing some difficulties.
2. Early screening is critical, and children should be screened for potential problems as soon as possible.
3. Good classroom instruction in reading is essential and should begin as early as possible.
4. Teachers need to be trained in developing phonological awareness and phonics skills in their students. In this case, the teachers were partners in the design of the intervention. The book, *Firm Foundations*, (no date) was the basis of the Tier 1 intervention and was written by teachers in the North Vancouver School District.
5. Monitoring progress is key to understanding student development and detecting the difficulties that students may experience.
6. Emphasis should be on intervention, rather than labeling and classifying students.

The intervention emphasized Tier 1 skills. Tier 1 instruction in kindergarten and grade 1 focused on phonological awareness and phonics. Tier 1 instruction continued in grade 2 and the later grades and stressed reading comprehension, vocabulary, morphology, and word analysis strategies. The school district also used two locally developed resources: Reading 44 and Writing 44, North Vancouver School District. Most children had successfully mastered decoding and reading comprehension skills so relatively few children needed more detailed and comprehensive interventions.

## Risk Identification

The first step in implementing RTI with these students was to identify the children at risk. We used a screening tool consisting of a letter naming task, some phonological awareness tasks, a simple spelling task, and a syntactic awareness task, which was a test of grammatical skills in which the children heard a sentence and had to fill in the missing word. An example of this syntactic awareness task is as follows: The children heard the sentence; "Dad _____ Bobby a letter yesterday" and we said "Bing" instead of the missing word. This task measures the children's ability to understand the basic structure of English sentences and is important in reading text. These tasks are described in detail in Lesaux, Lipka, and Siegel, (2006) and Lesaux and Siegel (2003).

In many cases it was possible for the teachers to administer these tasks, after a relatively brief training. The advantage of having teachers administer the tasks was that they could see the children's language and phonological awareness skills (or lack of them). We used local norms that we generated and informed teachers as to whether a child was above average, average, or below average on each task. A below average ranking on a particular task was considered in the "at-risk" range. The teachers used this information to pay special attention and monitor the progress of the all the children, but especially the "at-risk" students.

*We believed that if we could implement a good reading program in the early grades, then it would reduce the need for specialized intervention in later grades.*

## Tier 1 Intervention

For our Tier 1 intervention, we designed a program to be used with the entire class. For most school districts specialized intervention is expensive and often difficult to implement. We believed that if we could implement a good reading program in the early grades, then it would reduce the need for specialized intervention in later grades.

The intervention that we chose is called Firm Foundations (North Vancouver School District, no date). It is a program developed by the school psychologists and teachers of the North Vancouver School District. It was designed to develop vocabulary, phonological awareness, and some phonics skills. It consists of games and activities addressed to the following skills: vocabulary, that is, picture labeling, rhyme detection, syllable detection, and segmentation; phoneme detection and segmentation, for example, recognizing the first or the final sound in a word; and knowing the sounds of letters.

The Firm Foundations program consists of Circle Time, Center Time, and Performance Assessments. In Circle Time, the entire class is together and the children sit on the floor and engage in a particular activity. For example, they may tap on their arms to indicate the number of syllables (or sounds) in a particular word. In Center Time, they can visit centers in which they work on certain skills, such as literacy. Often, the teacher takes a small group of children who are having difficulty with a particular literacy concept, such a recognizing the initial phoneme in a word, and works intensively with them. Performance Assessments are informal tests of a particular concept. These tests were not given to arrive at grades or a diagnosis but were developed for the classroom teacher to get an idea of the strengths and challenges for an individual child. Small group instruction, and in some rare cases individual instruction, was provided for students who needed it. Targeted, systematic, explicit instruction including teacher modeling, scaffolding of instruction, and ample opportunities for students to practice was characteristic of the instruction.

## Results

Our study demonstrated how effective Tier 1 instruction reduced the incidence of later reading problems and cut the need for later remedial instruction. We found that 25% of the children who had English as a first language and 50% of the ELLs were showing significant difficulties in kindergarten and

we considered these students to be at risk (Lesaux & Siegel, 2003). There was no stigma attached to this identification since it was merely for the benefit of the teacher and was not for a special education designation. The proportion of students experiencing reading difficulties declined steadily throughout the grades (Lipka & Siegel, 2010; Lipka, Vukovic, & Siegel, 2005, Low & Siegel, 2005). In seventh grade we found that virtually all the children had developed proficient reading skills and only 1.5% of the children who had English as a first language and 1.5% of the ELL were dyslexic. In addition, Low and Siegel (2008) also found that the reading comprehension skills of the children in the district were at a high level on standardized tests.

In general, we found no differences between the normally achieving readers in the group that had English as a first language and the group that were English language learners However the situation with dyslexics was different (Etmanskie, Partanen, & Siegel, 2016). In some cases, notably reading, spelling, phonological awareness, and morphological and syntactic skills, the ELL dyslexics had *higher* scores than the dyslexics who were first-language English users. There are several possible reasons for this finding. English spelling requires the awareness of how English represents sounds in print and visual memory for irregular words, such as *said*, *does*, *want*, which cannot be spelled correctly by using the sounds of the letters alone. Exposure to a language increases one's sensitivity to the sounds of language. Therefore, children who are exposed to more than one language may have an advantage in that they have a wider repertoire of sound awareness. Most of the ELL children in this study were exposed to instruction in reading and writing in their first language. Many of the children in this study learned to read and write in Chinese in their Heritage Language classes. Chinese has phonological components but also requires a great deal of visual memory. The other most common language spoken by the ELL children was Farsi, which is written in Arabic script. Arabic script also requires a great deal of visual memory and visual discrimination. It should be noted that the dyslexics still had significant reading and spelling problems compared to typically achieving readers, but their language experiences and bilingualism appear to have attenuated their reading difficulties.

*One of the most important lessons is that it is possible to identify children at risk for reading disabilities in kindergarten and to provide them with an effective classroom-based intervention.*

In other studies, we have also found the same superiority of bilingual to monolingual dyslexics in Portuguese (Da Fontoura & Siegel, 1995), Arabic (Abu Rabia & Siegel, 2002), and Italian (D'Angiulli, Siegel, &Serra, 2001). It is important to remember that these students learned reading and writing in their first language, in addition to English.

## The Positive Role of Education in Reducing the Influence of the Home Environment

The intervention appeared to be successful for children from a wide variety of backgrounds (D'Angiulli, Siegel, Hertzman, 2004; D'Angiulli, Siegel, & Maggi, 2004). We examined the relationship between socioeconomic status and reading skills in both the ELL group and the children who had English as a first Language. As is common, when the children first entered school, there was a strong correlation between their socioeconomic status (home background) and their reading skills. This relationship decreased considerably as students progressed up the grades, indicating that proper instruction could significantly reduce the influence of home background on reading skills. Therefore, the beneficial effects of early intervention are especially important for children whose home backgrounds do not include an emphasis on literacy and/or children who are being educated in a second or additional language.

## What We Learned from this Case Study

One of the most important lessons is that it is possible to identify children at risk for reading disabilities in kindergarten and to provide them with an effective classroom-based intervention (Partanen & Siegel, 2014; Siegel 2009, 2011). A consistent, aligned, and standardized curriculum, based on scientific research and implemented well, can result in significant improvements in achievement without the need to pull children out of their daily classroom instruction.

Phonological awareness training, in addition to phonics, is helpful. An emphasis on oral vocabulary is critical for many children, including those who are English language learners or from lower socioeconomic backgrounds. Early intervention, in terms of appropriate Tier 1 instruction that is classroom based, is essential.

Classroom teachers have a critical role to play in developing phonological awareness skills. Firm Foundations, the program used in this district, was written by teachers for teachers and is easy to use. The teachers placed an emphasis on developing vocabulary and modeling appropriate grammatical structures, which helped develop the language skills of all the children and especially the ELL group.

For children who enter school speaking a language that is not the language of instruction, maintenance of and instruction in their first (Heritage) language is essential. Finally, excellent Tier 1 instruction is of critical importance.

A small number of people working cooperatively with teachers and administrators can make significant changes in the system. Commitment from the school and district leaders is essential. Developing partnerships with teachers maintains commitment and helps to insure fidelity of the intervention. Involvement of teachers in planning and executing the program is essential. The results of this study show that early screening and intervention are possible and are successful in improving the literacy skills of all students.

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# Early Identification of Dyslexia
## Current Advancements and Future Directions

by Hugh W. Catts and Yaacov Petscher

Early identification is an essential component of an effective intervention program for developmental dyslexia. Research demonstrates that children who are at risk for dyslexia have better outcomes when identified early and provided with appropriate intervention (Wanzek & Vaughn, 2007). Despite the importance of early identification, there are significant challenges to carrying it out. Whereas current procedures are successful in identifying many children who are at risk, these procedures are often associated with high false-positive rates. This over-identification can be costly and lead to many children receiving unnecessary intervention. There are also other challenges concerning the implementation of early identification programs; that is, who will do the assessment, when will it be done, how to get children engaged, and how much time can be devoted to assessment. In this article, we will briefly discuss recent advancements in theory, measurement, and technology that can help address some of the challenges faced in the early identification of dyslexia.

### Multifactorial Assessment

Dyslexia is a complex developmental disorder involving genetic, neurological, and environmental factors. Early models focused primarily on single deficits as causal factors of dyslexia. Primary among them has been the phonological core deficit model (Stanovich, 1988). This model argues that deficits in phonological (speech sounds) processing, specifically phonological awareness, leads to a cascade of difficulties in learning to decode and recognize printed words. Numerous studies have examined the link between dyslexia and deficits in phonological processing and there is considerable support for a causal connection (Elliott & Grigorenko, 2014). Other single deficit accounts have focused on visual problems in individuals with dyslexia. Research indicates that some individuals with dyslexia do have visual deficits, but it remains unclear how much of a causal role these deficits play in dyslexia (Saksida et al., 2016).

Whereas single deficit models have received much attention, there is now clear evidence that they are not sufficient to account for dyslexia. For example, the relationship between phonological processing deficits and dyslexia is far from complete. Some children with dyslexia have no history of phonological deficits and many children with phonological deficits do not develop dyslexia (Catts, McIlraith, Bridges, & Nielsen, 2017; Pennington et al., 2012). Such evidence has led to the proposal of multiple causal deficit models of dyslexia (see Catts, 2017). These models argue that multiple genetic, neurological, and environmental factors interact to increase the risk of dyslexia. For example, oral language impairments, slowed speed of processing, and/or limited early literacy experiences can combine with phonological deficits to increase the probability of dyslexia. Haft, Myers, and Hoeft (2016) have also introduced the Compensatory Risk and Protection model that not only posits multiple risk factors but highlights the importance of protective factors. They argue that protective factors such as early intervention, growth mindset, and task-focused behavior can provide resilience and reduce the probability of dyslexia in at-risk children.

*Some children with dyslexia have no history of phonological deficits and many children with phonological deficits do not develop dyslexia. Such evidence has led to the proposal of multiple causal deficit models of dyslexia.*

The above work indicates that if procedures for early identification are to be accurate, they will need to be multifactorial and consider more than one or two factors during assessment. Other fields commonly use multiple factors to identify risk. For example, in medicine, practitioners have used multiple indicators to determine risk of cardiovascular disease. In fact, recently, a cardiovascular disease risk calculator has been introduced to assist in this identification. This online calculator uses data for nine variables to determine the probability of cardiovascular problems in the next 10 years. It can be completed by a practitioner during an office visit or is available to the public online. See *http://www.cvriskcalculator.com/*. An accompanying application also includes readily assessable reference information related to therapy, health monitoring, and lifestyle.

A comparable procedure could be adapted to assist in the early identification of dyslexia. In fact, a prototype of such a calculator was introduced by Catts, Fey, Zhang, and Tomblin (2001). This calculator used five kindergarten variables (phonological awareness, rapid naming, letter identification, sentence repetition, and mother's education) to estimate the probability of reading difficulties in second grade. While the accuracy of the calculator was limited, current science and technology could be leveraged to create a more accurate and useful

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### Abbreviations

CAT: Computer adaptive testing

EARS: Earlier Assessment for Reading Success

probability calculator for dyslexia. As in medicine, it could be used by both practitioners and public to identify dyslexia and provide information concerning further assessment and treatment.

Building on this idea, Petscher, Truckenmiller, and Zhou (2016) developed an automated, online risk calculator (i.e., the Earlier Assessment for Reading Success; EARS) that uses one or more curriculum-based measurements in K–3 to predict reading comprehension and language risk. Similar to the approach of Catts et al. (2001), the EARS estimates various probabilities of reading and language success based on available curriculum-based measures in K–3. For example, suppose Teacher A has a kindergarten student's fall and winter letter naming fluency scores, but Teacher B only has a winter letter naming fluency score for one of her students. Both teachers could use the EARS to enter their respective student's score(s) and both will receive a report that provides the student's probability of reading success at the end of kindergarten and grades 1–3. In other words, EARS is programmed to handle single and multivariate informed predictions concerning the likelihood of success.

One of the challenges to the use of multiple indicators is the time required to complete an assessment. Assessment time can increase significantly with each additional measure for an indicator. One approach that has proven to reduce the amount of time required for assessment is computer adaptive testing (CAT). Adaptive testing optimizes the assessment experience by creating individual forms of items for individual students. Traditional paper-and-pencil assessments typically involve one form of fixed items and are delivered to a set of individuals, such as students in a classroom. A problem with a set of fixed items is that item content can be too easy or too hard depending on the ability of the student. For students with reading problems, even the "easiest" items on a grade-level assessment can be challenging because they may not have knowledge commensurate with a typically achieving student. As a consequence, the resulting assessment score is an imprecise estimate of the student's actual knowledge; rather than the assessment showing what the student knows, it instead represents what they *do not* know, and the teacher is left with little actionable information about how to target instruction and intervention based on the student's supposed capabilities.

CATs attempt to circumvent this problem by creating custom-built forms for each individual student at the individual student's unique ability level. By leveraging a set of algorithms and estimating item and person features using item response theory psychometric models, a CAT can precisely calibrate a student's ability. More succinctly, CAT can be analogized to the childhood game of "hot and cold," where the CAT is seeking to find items that are close to the ability of the student (Mitchell, Truckenmiller, & Petscher, 2015). There are many commercially available CATs that can be used for screening and progress monitoring purposes (Shapiro & Gebhardt, 2012). CATs may be beneficial for dyslexia screening not only for their increased precision in skill estimation and time savings, but also for their ability to measure a breadth of content (e.g., word reading, language, and phonological memory) in a timeframe that has typically allowed for only one construct to be assessed (Petscher, Foorman, & Truckenmiller, 2017).

*Computer adaptive testing may be beneficial for dyslexia screening not only for its increased precision in skill estimation and time savings, but also for its ability to measure a breadth of content in a timeframe that has typically allowed for only one construct to be assessed.*

### Computer Assisted Technology

Another issue related to screening is how test items are delivered and scored. In most "pencil and paper" assessments, a teacher or aide provides instructions, delivers items, and scores responses. Such implementation takes time and relies on the fidelity and reliability of the examiner. With the development of technology, computer assisted devices can now provide instructions, present items, and score responses. Until recently, real time computer-based scoring has been limited to items in which the child selected the item/answer using touch screen technology. This has meant that these assessments could only be used to measure "receptive" abilities. However, advancements in speech recognition now allow for some computer-based scoring of children's spoken (expressive) responses. For example, Northwest Education Association recently introduced a new version of its Measures of Academic Progress reading fluency measure in which speech recognition software encodes children's reading of computer-presented passages and calculates words read correctly per minute. The software is specifically tailored to children 4–8 years of age and is sensitive to beginning readers' behaviors such as word and line skips, substitutions, and long pauses. This is an important advancement and similar software could be developed to record and score measures used in screening tests for dyslexia.

### Gamification

In addition to considerations for how to more efficiently administer and score assessments, an emerging component of the assessment process is how to engage and enhance the user experience. One method for increasing the motivation and enjoyment of assessments is gamification, which is the use of gaming elements in non-game contexts (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). Children are increasingly exposed to social media, interactive advertising and micro-transactions, and video games in general. As a result, researchers and practitioners have become interested in how gamification may be used in the assessment process as a means for improving motivation, effort, and overall satisfaction with an assessment experience (Hanus & Fox, 2015). Gaming has

seemingly intuitive appeal. Rather than a student being situated within a typical didactic examiner-child environment with items statically delivered, the student could instead be immersed in a live, electronic platform with art, music, and audio that could bring an assessment to life. Gamification may be inclusive of basic environments that use animation to deliver item content in a unique, created world, or as advanced as including competitive games with rewards, trophies, and avatar customizations for the student. The research on gamification is mixed. In a study by Domínguez et al. (2013), participants who participated in an e-learning platform reported higher motivation and overall performance in the assessment but did worse on subsequent classroom assignments. Conversely, in a study of gaming and course feedback (Charles, Charles, McNeill, Bustard, & Black, 2011), the authors found that students who were given skill progress through gamification were more likely to enjoy the feedback and had higher rates of success compared to a control group.

Where gamification considerations have promise for holding student interest, researchers are quick to note that how a reward system is embedded should be carefully considered. Deci, Koestner, and Ryan (2001) have suggested that motivation may actually decrease in gamified environments when those who are already interested in learning shift their motivations from intrinsic (i.e., motivated to learn for themselves) to extrinsic (i.e., motivated for the reward) factors. Because many electronic games are based on reward systems, gamified assessment with rewards should be sensitive to the motivational profile of a student.

*Where traditional screeners use short-window longitudinal data within one academic school year to create cut-points for the assessments, following students over multiple years and building out longitudinal risk models may be advantageous in capturing the students who are late-emerging in their reading difficulties.*

## Longitudinal Risk Models

A final consideration for future directions in early identification lies at the very heart of screening assessment itself, "What are we screening for?" A single screener is inherently composed of two assessments—the screener and the outcome. Outcomes can range from criterion-referenced tests, such as state achievement tests, to norm-referenced tests that include national norms for word reading and/or comprehension. Independent of the outcome type, virtually all screeners share a commonality in that they screen for risk at the end of the current grade level. This objective is a natural outcome for practitioners and educational researchers since the progression of student development easily can be tethered to end-of-year academic success. A limitation of calibrating screener cut-points to end-of-year performance is that a sizable percentage (40%) of students with word reading deficits may not be identified for the first time until after grade 2 (e.g., Catts, Compton, Tomblin, & Bridges, 2012). Where traditional screeners use short-window longitudinal data within one academic school year to create cut-points for the assessments, following students over multiple years and building out longitudinal risk models may be advantageous in capturing the students who are late-emerging in their reading difficulties. Additional progress monitoring assessments can further assist us in understanding the time course of these difficulties.

In this short article, we have highlighted recent developments or considerations that have the potential to improve the efficiency and accuracy of early identification of dyslexia. For these to have their maximum benefit, newly developed assessment tools will need to be matched with interventions that can address the full range of problems associated with dyslexia. Significant advancements are being made in the development of intervention programs for dyslexia (e.g., Lovett et al., 2017) and we are optimistic that these programs can be coupled with effective screening and progress monitoring tools.

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# Maharashtra Dyslexia Association Offers Support in Three Western States in India

by Masarrat Khan

The Maharashtra Dyslexia Association (MDA) is a not-for-profit organization in India that is committed to building an integrated support system for individuals with dyslexia. Our aim is to equip every individual with dyslexia with the necessary skills and opportunities required to lead a successful and fulfilling life.

A member of the Global Partner program of the International Dyslexia Association (IDA) in India, MDA actively works towards spreading awareness, imparting training, and investing in research along with providing appropriate support services to ensure individuals with dyslexia achieve their full potential.

A low level of awareness coupled with a dearth of standardized procedures and appropriate tools results in a large number of individuals with dyslexia being misdiagnosed as lazy, careless, distracted or even intellectually challenged and hence failing to receive timely help. MDA works with local education authorities and schools to provide early and appropriate intervention together with the required support services for such individuals, along with advocacy, research, and capacity building.

## Advocacy

Now in its 21st year, MDA has maintained a strong focus on advocacy in order to ensure inclusive policies and systemic accommodations that facilitate equal opportunity for individuals with dyslexia. The year 2016 has been significant, with the passing of the Rights of Persons with Disabilities Act 2016 by Parliament. The implementation of the act came into force on April 19, 2017. This act recognizes dyslexia under the category of neuro-developmental disorders and has clear guidelines for providing appropriate educational provisions within the mainstream education system. MDA was one of the numerous organizations that actively campaigned for the bill and was also a key contributor to its drafting.

## Services

Services at MDA are geared towards enabling students to realize their full potential and blossom into productive adults.

- ***Assessment:*** A comprehensive psycho-educational assessment is conducted using standardized tools to understand the student's strengths as well as areas of concern. The detailed report, with recommendations, is designed to assist in the creation of an individualized education plan and further facilitates access to tailor-made accommodations offered by the Indian Certificate of Secondary Education (ICSE), the International General Certificate of Secondary Education (IGCSE), the International Baccalaureate (IB) Boards, and foreign universities, and for international college and university entry level tests like the School Admission Test (SAT), Law School Admission Test (LSAT), Graduate Management Admission Test (GMAT), and the International English Language Testing System (IELTS).
- ***Intervention:*** One-on-one remediation, two to four times a week, with special educators trained in scientifically developed programs with the focus on developing language, academic and cognitive skills. Salient features of the services are:
  1. Multisensory Structured Language curriculum and methodology recognized by the IDA;
  2. PASS Reading Enhancement Program (PREP), a short-term program that targets fluency and comprehension skills that are important for textbook learning;
  3. Study Skills Program aimed at older school and college students that helps improve their study and test-taking skills; and
  4. The Feuerstein Instrumental Enrichment program (FIE), an intervention program designed to modify the cognitive structure of not only those students experiencing learning difficulty, but also those facing psycho-social issues.

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Masarrat Khan, chief executive officer of the Maharashtra Dyslexia Association, offers instruction in reading and spelling rules.

Sandra Dillon, center, director of the Multisensory Language Training Institute of New Mexico, supervises trainee dyslexia therapists.

- ***Training Programs:*** MDA trains and provides opportunities for psychologists and special educators to gain necessary skills and experience required to work with children and adults with dyslexia. The following programs are therefore offered at MDA:
  1. **Dyslexia Therapist Training Programme:** MDA's flagship program, the Dyslexia Therapist Training Programme, is the only one of its kind in India to be recognized by the Academic Language Therapy Association (ALTA) and the IDA. This is a two-year part-time certificate course in Dyslexia Therapy organized in collaboration with the Multisensory Language Training Institute of New Mexico (MLTI-NM). Trainees have to complete 700 hours of hands-on teaching to qualify for certification. Course completion certificates are awarded by MLTI-NM and MDA jointly.
  2. **Apprenticeship Programme:** MDA offers paid apprenticeships for recent postgraduates in Clinical Psychology and for graduates/postgraduates in Special Education. It gives them an opportunity to get exposure and cutting-edge training in the emerging field of Specific Learning Disability under the guidance of experts.

Manek Chitalwala training teachers.

Students having fun at an Adventure Camp.

Masarrat Khan addresses parents in an informational session. The program aims to equip parents with an understanding of the challenges of dyslexia and provide strategies for supporting their children.

## Workshops & In-Service Training

In order to equip parents and schools with information about dyslexia, MDA conducts awareness and practical workshops that provide them with an understanding of the challenges of dyslexia and equip them with real-world strategies to support their children and students to cope with everyday challenges. Additionally, MDA works with numerous schools on an ongoing basis to provide advice and guidance on curriculum development as well as to train educators in order to be able to provide institutional support for students with dyslexia.

In order to ensure that resources are constantly available for parents, teachers and students with dyslexia, various workshops such as the ones listed below are conducted all year round.

- Awareness workshops on dyslexia;
- Teaching Reading and Comprehension in the mainstream classroom;
- Teaching Reading and Comprehension to children with Specific Learning Disability;
- Teaching Maths the Multisensory Way;
- Using assistive technology for students with reading and writing challenges;
- Tailor-made workshops for teachers and parents;
- An International Conference on Language and Reading once every two years.

## Other Services

- Information related to Specific Learning Disability;
- A reading library open to the public;
- Counseling for students and parents;
- Aptitude testing and career counseling;
- Summer program designed to build confidence and social skills.

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### Strategic Partnerships

- MDA has been in a year-long association with Pratham, another non-profit organization working with government schools all over India, the Bombay Municipal Corporation and the Maharashtra Social Welfare Department, to review and standardize assessments in schools for Special Education needs. MDA was also one of the contributors to the "Manual for Parents on Disabilities" published recently by Pratham.
- MDA has recently initiated a project with the Learning Disability Clinic of a public hospital in Mumbai to train their Special Educators in the use of the multisensory structured language methodology to develop reading and spelling skills in students affected by dyslexia.
- MDA is collaborating with schools in Mumbai and Pune to develop pre-primary and primary curriculum to teach English to first-generation English Language Learners, utilizing the multisensory structured approach with a focus on listening and phonological awareness leading to phonics. Additionally, classroom teachers are trained in delivering systematic and explicit instruction.

With a presence in three Western Indian states, MDA ensures that necessary support is available in every aspect of life – be it at home, at school or at a policy level – so as to stay true to our vision of ensuring that all individuals with dyslexia thrive and achieve their full potential.

Please visit *www.mdamumbai.com* to learn more about MDA and its work.

Speakers/Presenters at READ 2016, an international conference on dyslexia and learning disabilities.

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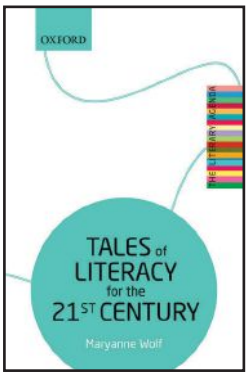
# Book Review by Margie Gillis




## Tales of Literacy for the 21st Century

*Maryanne Wolf*

Oxford University Press: 2016

224 pages, paperback

Many of you, like me, wondered when Maryanne Wolf would enlighten us again with her knowledge, wisdom and brilliant explanations about reading. Having read *Proust and the Squid* quite a few years ago, albeit in bite-sized pieces, I couldn't wait to read *Tales of Literacy for the 21st Century*. I was not disappointed. Like *Proust and the Squid*, it took me several weeks to read and absorb the information, ideas, and suggested hypotheses for the future of literacy, but it was well worth the time and effort.

*Tales* is one book in the series, *The Literacy Agenda*, published by Oxford University Press. Compiled by Philip Davis, the series "believes there is a great deal that needs to be said about the state of literacy education inside schools and universities." In Wolf's introduction, the following excerpt sets the stage for the book: "What we know about our past and what we are learning about our present reading brain can help us address three issues that will be leitmotifs in this book: What it means to be literate or non-literate in human development; how the future of the expert reading brain is intimately connected to what and how we read and write; and what the effects of a digital 'screen culture' may be for the development of children and adults in literate and non-literate environments." Wolf's well-established literacy agenda is to ensure that hers and others' work will lead to a decline in the numbers of children worldwide—estimated at 200 million—who are illiterate. This book attempts to advance this agenda.

Wolf uses a series of six tales divided into three parts to address her themes. The first part uses three tales to summarize findings from linguistics, child development, and cognitive neuroscience to explain how literacy develops. In "A Linguist's Tale," Wolf describes the relationship between language and literacy and the importance of early language skills. In the next chapter, "A Child's Tale," she explains the differences between the development of young literate and non-literate children. The final chapter in this section, "A Neuroscientist's Tale of Words," expands on Wolf's earlier work and describes the reading brain. This chapter not only provides a deeper understanding of how the brain reads words versus literary text (including poetry, philosophy, and narrative fiction), but it also prepares the reader to better understand the second section of the book.

"The Deep Reading Brain," which Wolf refers to as the heart of reading, explores what it means to read "deeply." Presently, most states are focused on the Common Core State Standards and teachers hear and use the terms "deep reading" and "close reading" daily. As one who interacts regularly with teachers, I have frequently asked what those terms mean to them. In many cases, the responses that I hear demonstrate a superficial understanding of what comprehension means and even more importantly, how to support their students' reading comprehension skills. Though this chapter is quite dense, it is worth the trip through an explanation of the various deep reading processes (cognitive, perceptual, and affective) that are implicated in understanding complex text. Wolf explains why these processes are important: "Literacy adds to the background knowledge of the literate person, which, in turn, changes the way that person thinks, reads, reasons, and dreams, whether about becoming a hero or about a postal clerk in Prague who writes novels and stories that change the way the world views itself." This chapter gave me an even greater appreciation for the depth of understanding teachers must have about reading to ensure that their students can comprehend, reason, and think deeply about what they read.

The third and final section describes Wolf's and her colleagues' attempt to address the issues of global literacy in non-literate children by sharing her insights from research on the literate- and the digital-reading brain. Three questions frame Chapter 6, "A Second Revolution in the Brain": First, how do our early *digital habits* impact us as readers; second, what impact do these digital habits have on the *nature of attention—how we attend* and *how and what we read*; and third, what are the effects of this *information overload*? The chapter's discussion of attention in relation to digital reading is especially informative and, I believe, extremely important for parents and educators alike.

The final chapter, "A Tale of Hope for Non-Literate Children," describes the project that Wolf has spearheaded in partnership with her colleagues at Tufts, including Stephanie Gottwald, her long-time reading partner, researchers at Massachusetts Institute of Technology, and Robin Morris at Georgia State University and its goal—"to use insights from research on the literate- and digital-reading brain to address the issue of global literacy in non-literate children." Begun in 2011, the project has been studying digitally based learning-to-read experiences in remote areas of the world, including Appalachia, as non-literate children are learning prereading skills from digital tablets that have apps designed to support oral and written language development. The advances that have been made on several literacy fronts, the multidisciplinary nature of the research, and the attempt to tackle a monumental problem are both fascinating

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and inspirational. Knowing Wolf's passion and tenacity when it comes to solving problems, many more research questions will be asked and answered along the way.

As Wolf quotes Pope Francis, *"Without a solution to the problems of the poor, we cannot resolve the problems of the world."* I deeply respect Wolf for her noble efforts to contribute to the world's literacy solution as told through her *Tales of Literacy for the 21st Century*.

**Margie Gillis, Ed.D.**, *is the president of Literacy How and a research affiliate at Haskins Laboratories and Fairfield University. While her professional roots are in special education, her work for the past 20 years has focused on providing embedded professional development to general education teachers in evidence-based literacy instructional practices. She is a member of IDA's Perspectives Parent/Practitioner Publications Committee and IDA's Professional Development Committee.*

*The opinions of this reviewer are not necessarily the opinions of the International Dyslexia Association.*

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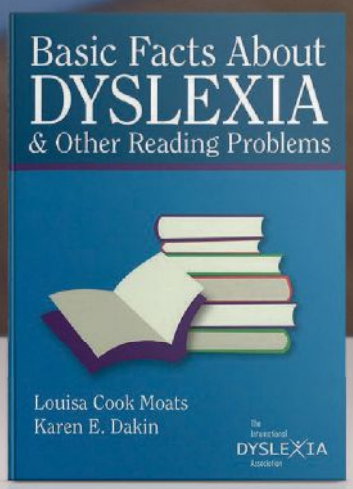


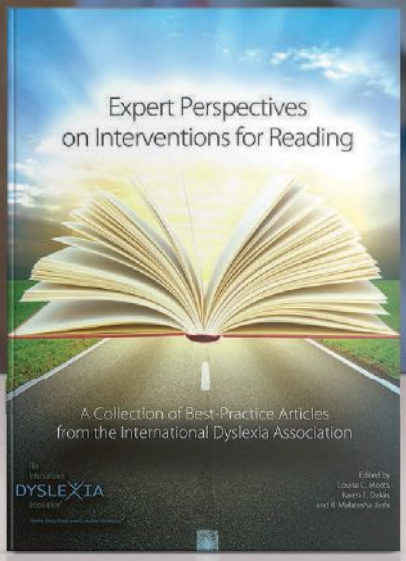


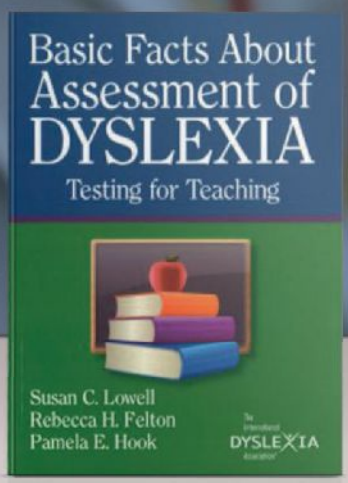


**#UntilEveryoneCanRead**

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