One

INTRODUCTION

THE UNFAIR RACE

Picture yourself attending a high school track meet. The athletes are lining up for the 1,600-meter race, which requires four laps around the track. There are six lanes on the track, and you notice that in one lane is a set of high hurdles and in another lane is a set of low hurdles. The other four lanes have no hurdles. When the gun sounds, the runners in the two lanes with the hurdles are soon behind the other runners and continue to get farther behind as the race progresses. The runner in the lane with the high hurdles is the farthest behind. As the race goes on, the gap widens. There is almost no likelihood that either of these runners will catch up with the others. The whole event seems surreal and quite unfair—even painful to watch.

This scenario has close parallels to the development of reading skills among our K–12 students. The top two-thirds of students, as represented by the four lanes without hurdles, take off down the track and have nothing hindering them from running. The bottom third has differing degrees of hindrance based upon how high their hurdles are. Just as one-third of the runners had hurdles, the National Assessment of Educational Progress indicates that each year, about 30% to 34% of fourth graders in the United States read below a basic level.

Efforts to help these weaker readers have been geared toward teaching them how to jump more efficiently over their hurdles. This volume is not about helping children become better and more efficient hurdlers. It is about removing the hurdles from the track before the race even starts. It is also about removing hurdles still ahead of the runners once the race has begun.

DON'T FORGET

This volume is not about helping children become more efficient hurdlers. It is about removing the hurdles from the track.

DON'T FORGET

The goal of this book is to open up the vast and extensive world of empirical research into reading acquisition and reading disabilities in order to capitalize on the most useful findings for assessing reading difficulties and for designing highly effective interventions.

The goal of this book is to open up the vast and extensive world of empirical research into reading acquisition and reading disabilities. Surprisingly, this large and heavily grant-funded scientific endeavor has not had sufficient impact on the fields of general education, literacy education, special education, and school psychology (see more on this later in the chapter). Yet school psychologists, literacy specialists, and special educators play a large role in evaluating children with reading difficulties. They are called upon to make recommendations about how to best address the learning needs of poor readers. This volume will provide educational professionals with the tools and knowledge they need to pinpoint the reasons why a given student is struggling in reading. It will also provide recommendations that result in highly successful interventions.

THE IMPORTANCE OF READING

It is difficult to overestimate the importance of reading for success in school and in life. Reading is essential for all academic subjects. Science and social studies require textbook reading. Many math tests, including state-level assessments, require students to read word problems. Poor reading virtually guarantees poor writing skills. Art, music, health, and physical education classes sometimes require background reading and written projects. As a result, reading affects a student's entire academic experience. How well children succeed in school affects their future endeavors in life (Miller, McCardle, & Hernandez, 2010). While we all know of cases to the contrary, it is normally the students who do well in school who are more likely to go to college and have greater career opportunities.

Poor reading can also affect school behavior (McGee, Prior, Williams, Smart, & Sanson, 2002; Morgan, Farkas, Tufis, & Sperling, 2008; Tomblin, Zhang, Buckwalter, & Catts, 2000; Willcutt et al., 2007). Many children who are poor readers display behavior problems. There appears to be a two-way relationship between poor reading and at least some of the behavior problems we see in schools (Morgan et al., 2008). Significant reading difficulties appear to put students in later elementary school at a higher risk for depression (Maughan, Rowe, Loeber, & Stouthamer-Loeber, 2003). Students who are poor readers in

third grade are 4 times more likely to become high school dropouts compared to skilled readers (Hernandez, 2012). At a 30-year follow-up of over 1,300 adults who had been diagnosed with a reading disability at age 7, McLaughlin and colleagues found that these adults were less likely to have obtained post–high school degrees and were more likely to attain lower levels of income than those who were average or better readers at age 7 (McLaughlin, Speirs, & Shenassa, 2014).

School districts are fully aware of the impact reading has on students. Millions of dollars are spent every year on general educational and special educational reading remediation. Despite this, poor readers generally remain poor readers (Jacobson, 1999; Maughan, Hagell, Rutter, & Yule, 1994; Morgan et al., 2008; Protopapas, Sideridis, Mouzaki, & Simos, 2011; Short, Feagans, McKinney, & Appelbaum, 1986; Sparks, Patton, & Murdoch, 2014). Studies of both general and special educational remedial reading indicate that these efforts have not been effective at normalizing reading performance (Bentum & Aaron, 2003; Jacobson, 1999; Moody, Vaughn, Hughes, & Fischer, 2000; Rashotte, McPhee, & Torgesen, 2001; Swanson & Vaughn, 2010; Torgesen, Rashotte, Alexander, Alexander, & MacPhee, 2003).

It would be easy to conclude from this that there is a substantial portion of students, perhaps due to neurodevelopmentally based reading disabilities, who are simply unable to develop normal reading skills, regardless of the nature of the remediation. However, there is ample empirical evidence to challenge such an assumption. For example, in a large study funded by the National Institute of Child Health and Development (NICHD), researchers were able to reduce the number of children who require ongoing general or special educational remediation from the national average of about 30% down to 3% (Vellutino et al., 1996). In another NICHD-funded study, researchers showed that a large percentage of third through fifth graders with severe reading disabilities could reach an average reading level, and stay there (Torgesen et al., 2001). In fact, it has been shown in multiple empirical studies that a large proportion of students at risk for reading difficulties, as well as students with severe reading disabilities, can develop and maintain normalized reading skills when provided with the right kind of intervention (Alexander, Andersen, Heilman, Voeller, & Torgesen, 1991; Lennon & Slesinski, 1999; Rashotte et al., 2001; Shapiro & Solity, 2008; Simos et al., 2002; Torgesen, 2004a; Torgesen et al., 2001, 2003; Torgesen, Wagner, Rashotte, Herron, & Lindamood, 2010; Truch, 1994, 2003, 2004; Vellutino et al., 1996).

If this is the case, why are we not capitalizing on these findings?

THE GAP BETWEEN READING RESEARCH AND CLASSROOM PRACTICE

There are several reasons why our K–12 schools are not making use of the kinds of encouraging findings described above. In what follows, some of the most important ones are presented.

An Illustration of the Gap Between Research and Practice

Since the release of the Report of the National Reading Panel in 2000, phonological awareness has gained popularity in the literacy-teaching repertoire of early elementary school teachers. *Phonological awareness* refers to an awareness of the sound structure (syllables, phonemes) of spoken language. There has been an explosion of materials, programs, and opportunities available regarding phonological awareness. One might even consider phonological awareness to be an educational fad. Consider the following quote by Nancy Lewkowicz in the *Journal of Educational Psychology*:

> The ability to perceive a spoken word as a sequence of individual sounds, which has been referred to recently as phonemic awareness, phonological awareness, and auditory analysis skill, is attracting increasing attention among reading researchers. The high correlation between this ability and success in reading is by now well established. (p. 686)

This quote appears to support the emerging interest in phonological awareness in recent years. In reality, this quote does no such thing—the quote is from 1980! It seems there was a lag time of about 20 years from when the scientific findings regarding phonological awareness became "well established" and when it became popular in schools. Actually, phonological awareness training *was* popular in the 1970s and early 1980s, but ironically it began to decline not long after Lewkowicz's comment just quoted. It fell out of use, apparently as a result of changes in reading philosophies in the 1980s and 1990s, even though researchers continued to study the role of phonological awareness in reading. This example serves to illustrate just how large the gap between research and practice can be. It was well established by 1980 that phonemic awareness was an essential element for successful reading, but there were nearly two decades in which it was not being incorporated into literacy instruction.

THE UNFORTUNATE REALITY ABOUT READING RESEARCH: NOBODY KNOWS ABOUT IT!

In 1999, the American Federation of Teachers (AFT), the second-largest teachers' union in the United States, published *Teaching Reading IS Rocket Science*

(American Federation of Teachers, 1999). This book stated that a "chasm exists" between the scientific research into literacy and classroom practice.

Fast-forward 10 years to July 2009 at the international conference for the Society for the Scientific Study of Reading. R. M. Joshi, a professor of literacy from Texas A&M, was presenting to about 40 researchers in a breakout session I attended. Joshi displayed results from a survey of college literacy instructors who teach and train public school teachers to teach children to read. His data showed that, as a group, these literacy instructors were unfamiliar with the scientifically oriented research on reading. For example, 80% confused phonemic awareness with phonics. The reaction in the room was astonishing and uncharacteristic of a room full of scientists. There were audible gasps and moans, as if Joshi had announced that a beloved member of the society had passed away. The reactions suggest that the researchers in the room were confronting the reality that their life's work was not making its way out of the scientific journals and into our K–12 classrooms.

Other studies have shown that K–3 general education teachers (Cunningham, Perry, Stanovich, & Stanovich, 2004), reading teachers/literacy specialists (Moats, 1994, 2009), special education teachers (Boardman, Argüelles, Vaughn, Tejero Hughes, & Klingner, 2005), teachers-in-training (Ness & Southall, 2010), Head Start teachers (Hindman & Wasik, 2008; O'Leary, Cockburn, Powell, & Diamond, 2010), and English as a second language (ESL)/English language learner (ELL) teachers (Goldfus, 2012) are generally unfamiliar with the scientific findings regarding reading acquisition and reading difficulties. Sally Shaywitz, a neuroscientist and reading researcher who heads the Yale Center for Dyslexia and Creativity, expressed frustration over "the relative lack of dissemination and practical application of these remarkable advances" (2003, p. 4).

Joshi's study appeared later that year in a special issue of the *Journal of Learning Disabilities* that was devoted to addressing the gap between reading research and classroom practice (Joshi, Binks, Hougen, et al., 2009). Another study in that special issue found that undergraduate and graduate textbooks on literacy that were designed to prepare teachers drew very little from the empirical findings on reading (Joshi, Binks, Graham, et al., 2009).

It would be easy to conclude that college professors and textbook authors are to blame for this gap between research and practice. However, such finger-pointing would be overly simplistic, unfair, and quite unproductive. The problem is that the fields of early childhood education, literacy, and special education all have their own journals and textbooks. Most of the scientific research on reading is outside the journals in those fields. In an article about dyslexia for reading specialists, Erika Gray laments: "Unfortunately, many of the

articles and studies on this disorder are published in journals teachers rarely read" (2008, p. 116).

An example that is closer to home for school psychologists may bring the issue into focus. In a report in *School Psychology Review*, Nelson and Machek (2007) surveyed 497 school psychologists' knowledge and graduate training regarding the research related to reading acquisition and reading difficulties. Their results indicated that knowledge about the scientific findings on reading is quite limited within our field. This raises the question as to why there is such limited knowledge of reading research among those who need it the most.

WHY IS THERE A GAP BETWEEN RESEARCH AND CLASSROOM PRACTICE?

There are several reasons that reading research is not well known to educational professionals. One is the fact that scientific journals are inaccessible unless one lives near a university library. Once educators get their degrees, they lose access to the journals. Second, even if the journals were accessible, where would one begin? There have been thousands of research reports on reading acquisition and reading difficulties in the last 40 years, spread across over 100 journals (see Rapid Reference 1.1). It would be the proverbial needle in a haystack problem trying to find the most relevant information. While preparing this chapter, a search on the term "dyslexia" in the PsycINFO database, which is comprised primarily of scientific research journals like those in Rapid Reference 1.1, yielded 6,875 articles. The term "phonics" returned 1,309 results and "phonological aware-ness" and "phonemic awareness" combined to yield 3,659. The terms "visual word recognition" and "visual word identification" had 1,471 hits and "reading comprehension" returned 12,731 articles! The needle in a haystack analogy is no exaggeration.

Every year, there are hundreds of newly published, scientifically oriented research reports on reading. Even the researchers themselves struggle to remain current in their niche areas within the broader field of reading research. Books are more accessible than journals, and there are dozens of books written by reading researchers that cover many facets of the scientific study of reading. Most of these books, however, are technical books written for others in the field and presume much prior understanding on the part of the reader. Also, they are not typically available in catalogs or on websites aimed at teachers, administrators, and school psychologists. Books that accurately review reading research written for educational professionals are surprisingly scarce. A list of such books is provided in the "Further Reading" section at the end of this volume.

≡ *Rapid Reference 1.1 Journals That Report Empirical Research on Reading*

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Reading/literacy journals that publish only empirical studies on reading acquisition and/or reading difficulties

Annals of Dyslexia

Dyslexia

Journal of Research in Reading

Reading and Writing: An Interdisciplinary Journal

Scientific Studies of Reading

Written Language and Literacy

Reading/literacy journals that routinely publish empirical studies on reading acquisition and/or reading difficulties

Journal of Literacy Research

Literacy Research and Instruction

Reading Psychology

Reading Research Quarterly

Non-literacy-related journals that regularly include empirical studies on reading

American Educational Research Journal

Applied Psycholinguistics

Assessment for Effective Intervention

Australian Journal of Learning Difficulties

Brain and Language

British Journal of Educational Psychology

Cognition

Cognitive Psychology

Cortex

Journal of Child Psychology and Psychiatry

Journal of Educational Psychology

Journal of Experimental Child Psychology

Journal of Experimental Psychology: Human Perception and Performance

Journal of Experimental Psychology: Learning, Memory, and Cognition

Journal of Learning Disabilities

Journal of Memory and Language

Journal of Research on Educational Effectiveness

Language, Speech, and Hearing Services in Schools

Learning and Instruction

Learning Disabilities: A Contemporary Journal

Learning Disabilities: A Multidisciplinary Journal

Learning Disabilities Quarterly
Learning Disabilities: Research and Practice
Memory and Cognition

Psychonomic Bulletin and Review
Quarterly Journal of Experimental Psychology

A sampling of journals that occasionally include empirical research on reading acquisition and/or reading disabilities

Applied Neuropsychology
Australian Journal of Language and Literacy
Australian Journal of Psychology
Behavior and Brain Function
Behavior Research Methods, Instruments and Computers
Biological Psychiatry
Biological Psychology
Brain
Brain Research
British Educational Research Journal
British Journal of Developmental Psychology
British Journal of Psychology
Canadian Journal of Experimental Psychology
Child Development
Cognitive Brain Research
Cognitive Neuropsychology
Cognitive Science
Contemporary Educational Psychology
Developmental Neuropsychology
Developmental Psychology
Developmental Science
Early Childhood Research Quarterly

Educational and Child Psychology
Educational Psychology Review
European Journal of Cognitive Psychology
Exceptional Children
Exceptionality
International Journal of Disability, Development and Education
International Journal of Language and Communication Disorders
Journal of Behavioral Education
Journal of Child Neurology
Journal of Cognitive Neuroscience
Journal of Communication Disorders
Journal of Deaf Studies and Deaf Education
Journal of Educational and Developmental Psychology
Journal of Educational Research
Journal of Psychoeducational Assessment
Journal of Research in Childhood Education
Journal of School Psychology
Journal of Special Education
Journal of Speech, Language, and Hearing Research
Journal of Vision

Language and Cognitive Processes

Learning and Individual Differences

NeuroImage

Neurology

Neuron

NeuroReport

Neuropsychologia

Neuropsychology

Proceedings of the National Academy of Sciences

Psychological Bulletin

Psychological Review

Psychological Science

Psychology in the Schools

Remedial and Special Education

Review of Educational Research

Scandinavian Journal of Educational Research

Scandinavian Journal of Psychology

School Psychology Quarterly

School Psychology Review

Trends in Cognitive Science

Vision Research

The Most Important Scientific Discovery You Have Never Heard Of

Another problem with translating research into practice is that one of the most significant discoveries about reading is absent from nearly every presentation of reading research to those outside the research community. This is the discovery and empirical validation of *orthographic mapping,* which is the process students use to turn unfamiliar written words into instantly accessible "sight words" (Ehri, 1998a, 2005a, 2014; Kilpatrick, 2014a; see Chapter 4). How does an unfamiliar word become a familiar sight word? Why do poor readers have limited sight vocabularies? Orthographic mapping

> **CAUTION**
>
> The term *sight word* has at least three different definitions in education: (1) an alternative term for the classic *whole-word,* Dick-and-Jane-style reading approach; (2) an irregular word that cannot be adequately sounded out, such as *sign, one, from, said*; and (3) a word that is instantly recognized. This third definition of sight word refers to a known or familiar word as opposed to an unfamiliar word that has to be sounded out or guessed. In this book, *only the third definition* of sight word is used.

answers these questions. When reading research is presented, whether in books or other documents such as the National Reading Panel (NICHD, 2000), the

focus is on phonemic awareness, phonics, fluency, and reading comprehension. Absent from such presentations is information on (a) *how* a student develops a large and instantly accessible pool of sight words, and (b) *why* some students have such limited sight vocabularies (see the Caution regarding the term *sight word*).

DON'T FORGET

In this book, a *sight word* refers to a word that is instantly recognized regardless of whether it is phonically regular or irregular. Thus, a sight word is a known or familiar written word as opposed to a word that is unfamiliar and needs to be sounded out or guessed. A *sight vocabulary* refers to the pool of words that an individual can instantly and effortlessly recognize.

In a sense, orthographic mapping represents the "holy grail" of reading education. This skill determines whether students easily remember the words they see. Students who are poor at remembering the words they read must rely heavily on phonic decoding and/or guessing words from context. Students with reading problems are very inefficient at orthographic mapping, whereas typically developing readers acquire this skill quite naturally. Chapter 4 of this book covers orthographic mapping in detail.

Questioning a Scientific Approach to Reading

An additional factor that has hindered the adoption of reading research findings is the apparent distrust of the scientific study of reading by some prominent authors in the literacy field (Goodman, 1989, 2005; Smith, 1999). They are advocates of the three-cueing systems model of reading. The three-cueing systems model represents the foundation of the approach to reading that has gone by various names such as the *literacy-based approach, whole language,* and *balanced instruction* (Goodman, 2005). This philosophy of literacy has had an enormous impact on reading instruction since the 1980s. Some high-profile proponents of this approach argue against most of the methods used in the current enterprise of reading research (Goodman, 1989, 2005; Smith, 1999). Various scientists (e.g., Ehri, 1998b; Stanovich, 1993) have catalogued the vociferous efforts by some advocates of whole language to steer teachers away from the scientific findings on reading. The point here is not to malign proponents of the whole language approach to literacy. They have clearly dedicated their careers to helping children develop a love of literacy. Rather, the point is to recognize one of the significant reasons why there exists such a gap between reading research and classroom literacy instruction.

The Contentious Environment of the "Reading Wars"

In 1955, Rudolph Flesch published *Why Johnny Can't Read* and made a presentation at a large reading conference claiming that phonics was superior to the classic whole word type of instruction. He concluded his presentation by saying that teachers who did not use phonics were communists! In 1955, McCarthyism was in full swing.

History repeated itself around 1990 at an International Reading Association conference. M. J. Adams read a report from a research review that indicated that phonics and phonemic awareness were essential for skilled reading. A whole-language advocate was the next speaker, and he was visibly upset by Adams's presentation. He said to the crowd: "Someone get a silver bullet and shoot this woman, she's a vampire!" Dr. Philip McInnis was in the audience and recounted the story (personal communication, July, 1998). Reading researcher Linnea Ehri (1998b) and a reporter for the *Atlantic Monthly* (Levine, 1994) also chronicled the incident. McInnis indicated that he was puzzled that an educated person would say something so bizarre; everyone knows a silver bullet is for a werewolf and a stake through the heart is required for a vampire (McInnis, personal communication, July, 1998).

Humorous anecdotes aside, such outlandish comments illustrate the heated debates about reading over the last few decades. Yet, we have a way of resolving such debates: the scientific method. Matters of importance should be "settled by research rather than by proclamation" (Ehri, 1998b, p. 100). However, scientific findings are not always met with enthusiasm in the atmosphere of the Reading Wars, which has fostered defensiveness rather than an openness to new findings.

Summarizing the Causes of the Gap Between Research and Practice

We have identified several reasons why reading research is not making its way into K–12 contexts: inadequate training of teachers and school psychologists, inaccessibility of the research journals, the sheer volume of the research, limited available books summarizing the research for teachers, the efforts by some to dissuade educators from paying attention to the research, and the limited openness resulting from the Reading Wars. There are likely other reasons, but these seem sufficient to account for much of the problem.

THE POWERFUL RESEARCH RESULTS WE HAVE BEEN MISSING

The most encouraging findings from the research are not about small improvements in struggling readers. They are about a revolution in how we understand

literacy development and reading difficulties. The following are descriptions of studies with highly successful outcomes in at-risk readers and students with reading disabilities.

Prevention in At-Risk Students

The National Reading Panel (NICHD, 2000) reviewed numerous studies regarding kindergarten instruction that substantially reduced the number of struggling readers. The basic gist is that if you provide kindergarteners with (a) direct and explicit phonological awareness training, (b) ample letter-sound instruction, and (c) if you teach the connections between those two, you will substantially reduce the number of students struggling in reading at the end of first, second, and even later grades. To illustrate, Shapiro and Solity (2008) did explicit and systematic phonological awareness training and letter-sound instruction with low socioeconomic status (SES) students and compared their findings to a school matched for SES and beginning skills that was doing "business as usual" kindergarten instruction. They found that by the end of first grade, the number of struggling readers in the school that represented the experimental condition was 75% lower than in the comparison school.

Early Intervention

Vellutino et al. (1996) intervened in the spring of first grade with 74 students who were at risk for reading difficulties. They represented the lowest 9% of students who did poorly on letter names, letter sounds, and basic phonological awareness in a kindergarten screening the year before. The intervention consisted of intensive phonemic awareness training, systematic instruction in phonics, and the opportunity to read connected text. By the end of the 15-week intervention, 67% of these most severely at-risk students scored at or above average on tests of word-level reading (above the 30th percentile), and these results were maintained 3 years later (Vellutino, Scanlon, & Lyon, 2000). For those not up to an average level, an additional 8 weeks of tutoring was provided in the fall of second grade, resulting in only 15% of the original at-risk students continuing to score below the 30th percentile at the end of second grade. Vellutino et al. (1996) projected their results across the original population of students screened in kindergarten from which these at-risk students were drawn. Assuming their intervention would work with less involved cases (and research suggests it would, e.g., Fletcher

et al., 1994; Stanovich & Siegel, 1994), they indicated that with such an intervention available, only 3% of the total population they drew from would score below the 30th percentile and of those, only half (1.5%) would score below the 16th percentile.

Intervention With Older Students

Torgesen et al. (2001) intervened with 60 third through fifth graders with average IQ scores and very severe reading disabilities. Their mean standard score for word-level reading on the Woodcock Reading Mastery Test–Revised (WRMT-R) was in the bottom 2% nationally. Following intensive instruction in phonemic awareness and phonics and the opportunity to read connected text, these students made average gains of 14 standard score points on the WRMT-R Word Identification subtest and 20 to 27 points on the Word Attack subtest. These results were maintained at 1- and 2-year follow-ups. Most startling was that nearly 40% of these students with severe reading disabilities required no ongoing special educational reading help after the intervention.

Some of the most common approaches used with poor readers (e.g., repeated readings, READ 180, Reading Recovery; see Chapter 11) tend to display improvements that range from 3 to 5 standard score points. With such small gains, these children rarely catch up. However, there is ample research to show that weak readers can progress far beyond that, with a fairly large percentage developing normalized reading skills, even for students who previously scored in the bottom 2% to 3% of the population. There is no suggestion here that reading problems can be eliminated entirely. However, based on the studies with the most successful outcomes, it seems that a large majority of reading difficulties/disabilities can be prevented or corrected, and for those not normalized, reading performance can be much higher than traditionally thought.

Vellutino, Scanlon, Zhang, and Schatschneider (2008) pointed out that the entire enterprise of Response to Intervention (RTI) was the result of trying to capture the incredible results from the Vellutino et al. (1996) and Torgesen et al. (2001) studies previously

> ## DON'T FORGET
> ....
> RTI was prompted by the tremendous results from the studies previously described. Yet, when RTI was translated into a process and a framework, the instructional techniques that produced these great results were left behind. Chapters 10 and 11 describe these techniques in detail.

described. However, in developing the framework and process of RTI, the highly effective intervention methods that provided such outstanding results were left behind. Teachers and school psychologists now struggle to figure out those elusive researched-based approaches needed for effective RTI. Chapters 10 and 11 present those approaches.

ACKNOWLEDGING AND RESPONDING TO THE GAP BETWEEN RESEARCH AND PRACTICE

Millions of our tax dollars are spent each year on reading-related research. On one level, these research grants have been a huge success because researchers now have a very good understanding of the nature of reading acquisition and of reading disabilities. However, on another level, the whole enterprise has been a failure because children are not benefitting from these important findings.

Although this situation may be difficult to believe, it is nonetheless a fact that desperately needs to be addressed. Reading research has had minimal impact on professional fields that could benefit from its findings, such as education, literacy, special education, and school psychology. This is despite the fact that the reading research field is comprised of scientists from many different fields (see Rapid Reference 1.2, list C), including each of those just mentioned. These researchers are not part of some academic "fringe." They come from Harvard, Yale, Oxford, Cambridge, and dozens of top universities around the world. To illustrate, three different colleges at Harvard University—the Medical School, the School of Arts and Sciences (Department of Psychology), and the School of Education—have all made tremendous contributions to the scientific research on reading. The same can be said of other institutions. Reading researchers are awarded countless millions of dollars in research grants each year. One would expect a field comprised of scientists from many disciplines, top universities, and many countries would be more widely known and have a greater influence on educational practices. However, studies show that this research has been having limited impact on our K–12 students. Based upon U.S. government statistics, the finding that nearly one-third of fourth graders read below a basic level has been stable for decades. While it is true there will always be a "bottom third" of a distribution, the reality is that the status of being "bottom third" does not presume a functional level. For example, the bottom third of NBA players are still excellent basketball players.

≡ *Rapid Reference 1.2 Where Does Our Scientific Knowledge of Reading Come From?*

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Note: All lists are alphabetical.

A. Languages

The following is a sample of languages for which there are hundreds of scientific research studies related to reading acquisition and reading difficulties.

Arabic[1]	Greek
Chinese[2]	Hebrew[1]
Dutch	Italian
English[3]	Japanese[4]
Finnish	Korean[4]
French	Norwegian
German	Portuguese
Russian	Spanish
Serbo-Croatian[5]	Turkish

Notes:

1. Arabic and Hebrew writing are often studied because they are halfway between an alphabetic and a syllabic form of writing (in syllabic scripts, characters represent syllables, not individual sounds). Those writing systems only represent the consonants of spoken words and typically not the vowels. Wrds r wrttn lk ths.

2. Chinese written language is *logographic* not *alphabetic*. That means, roughly speaking, that Chinese characters represent whole words, whereas the characters in an alphabetic script (i.e., letters) represent sounds within words.

3. By a wide margin, English is the most commonly studied written language.

4. Japanese and Korean are of interest to researchers because they each use two different writing systems. Japanese uses *syllabic* and *logographic* scripts, and Korean uses *alphabetic* and *logographic* scripts.

5. Serbo-Croatian is of interest because it is a language that uses two different alphabets that do not completely overlap. Some of the letters that are the same in both alphabets represent the same sound in the spoken language. Other letters between the two alphabets look the same but represent different oral

sounds. Finally, some letters are unique to each alphabetic script. This situation provides scientists with interesting controls on the relationships between letters and sounds.

B. Countries

The following list is a sampling of countries that routinely contribute to the scientific research into reading acquisition and reading difficulties.

Australia	Italy
Belgium	Japan
Brazil	Korea
Canada	The Netherlands
China	Norway
Finland	Spain
France	Sweden
Germany	United Kingdom
Greece	United States
Israel	

C. Disciplines

The following are academic disciplines represented among reading researchers.

Deaf education	Psychology—cognitive
Education	Psychology—developmental/child
Linguistics	Psychology—educational
Literacy/reading education	Psychology—experimental
Medicine—neurology	Psychology—neuropsychology
Medicine—pediatrics	Psychology—psycholinguistics
Medicine—ophthalmology	Psychology—school
Optometry	Special education
Psychology—behavioral	Speech/language pathology

Note:

Worldwide, more scientific research on reading comes out of departments of psychology than any other discipline.

≡ Rapid Reference 1.3 A Sampling of Common Types of Methods Used to Study Reading

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General Research Designs

Experimental	Quasi-experimental
Cross-sectional	Longitudinal
Correlational	ABAB and lag designs
Case study	Multiple case study

Statistical Analyses Commonly Used

Correlational analysis	Latent growth curve modeling
Factor analysis	Multiple regression
Structural equation modeling	Principal components analysis
ANOVA/ANCOVA/MANOVA	ROC curve
Path analysis	

Types of Research Participants

- Children who are typical readers
- Pre-readers
- Students at risk (pre-K to grade 1)
- Students at every elementary grade level
- Middle school readers
- High school readers
- ELL students
- Adult skilled readers
- Adult ELL readers
- Adult literacy participants
- Adults with head injury or stroke

- Dyslexics
- Hyperlexics
- Individuals with mixed reading difficulties
- Individuals with speech or language impairment
- Individuals who are deaf or hard of hearing
- Individuals with intellectual disabilities
- Individuals with emotional disturbance
- Individuals with autism or other syndromes (e.g., Williams syndrome)

Specific Experimental Methodologies

Methods Used Primarily in Reading Comprehension Research

Sentence Reading The participant reads sentences with certain semantic and syntactic structures.

Paragraph Reading This is similar to sentence reading, but with more opportunity for reading extended text, and can include a greater number of comprehension-related elements.

Open-Ended Responses The participant reads a single sentence or a lengthy passage and the experimenter asks open-ended questions requiring a verbal response from the participant.

Multiple Choice The participant reads a sentence or paragraph then reads and answers multiple-choice questions.

Cloze Questions A sentence or brief paragraph is read in which there is a blank space indicating a missing word. The participant must supply a reasonable word to indicate comprehension of the sentence or paragraph.

Literal and Inferential Questions Different types of questions are asked to determine various levels of understanding of a passage.

Garden Path Passages A sentence or passage is read that leads the individual to expect something in the final sentence, and there is a twist in that final sentence that tends to catch weaker readers unaware, but does not catch stronger readers.

Methods Used in Both Reading Comprehension Research and Word-Level Reading Research

Eye Movements This technique measures the precise timing and tracking of eye fixations during reading. An advantage is that with many eye-movement studies, individuals read connected text, which directly parallels normal reading behavior. A special issue of *School Psychology Review* (2013, vol. 42[2]) provides an introduction to eye-movement research in reading.

Reaction Time This tests how quickly a student responds to a stimulus, typically reading a word or pressing a button indicating yes/no response. This is commonly used with lexical decision and masked priming tasks (see below).

Homograph/Homophone Reading Homographs are words with different meanings that are spelled the same (e.g., *dove/dove; bass/bass*) and homophones are words pronounced the same but with different spellings (*I'll/aisle; their/there*). Such words are sometimes used in comprehension research to add ambiguity to sentences. Also, such words are used to test their effects on word-level learning and retrieval.

Morphological Tasks The participant interacts with morphological elements in words, such as the root, prefixes, suffixes, indicators of verb tense, and so forth.

Semantically Ambiguous Words Semantically ambiguous words (e.g., *ring, match*) can be used to assess sentence comprehension.

ERP Event-related potentials (ERP) are electrophysiological responses in the brain that follow a particular stimulus. These are used to help determine the timing and location of responses in various areas of the brain during reading.

Brain Scanning (fMRI, MEG/MSI, PET) Unlike traditional static MRI or CT scans, there are techniques that can look at the brain in action as individuals perform basic cognitive tasks, such as listening, speaking, or reading. These include functional magnetic resonance imaging (fMRI); magnetoencephalography (MEG), which is combined with an MRI to produce magnetic source imaging (MSI); and positron emission tomography (PET). These have been used to evaluate different aspects of the reading process among skilled readers, beginning readers, average readers, and struggling readers.

Neurological Studies These involve examining individuals, typically adults, who had been competent readers but who lost some or most of their reading skill as a result of a stroke or head injury.

Genetic Studies These can range from family studies of the incidences of various types of reading and reading-related problems to a direct examination of the human genome. Multiple large-scale twin studies in multiple countries have contributed to understanding the genetic bases of reading difficulties.

Methods Used Primarily in Word-Level Reading Research

Context-Free Word Identification The participant is asked to read words from a list, either timed or untimed. Or, words are flashed on a computer screen one at a time.

Nonsense Word Reading Pronounceable nonsense words (e.g., *prute, spreng*) are read either from a list or one word at a time on a computer screen. This is designed to determine an individual's phonic decoding ability.

Passage Reading Fluency Students read normal, connected text, and the evaluator makes note of reading speed, reading accuracy, and prosody (i.e., intonation, emphasis).

Lexical Decision A participant responds as quickly and accurately as possible to yes/no response keys indicating whether a string of letters is a word, or whether a word belongs in a semantic or phonological category (e.g., Is *pair* a fruit? Is *splanch* a word? Does *been* rhyme with *seen*?).

Masked Priming A target word is flashed on the screen for a fraction of a second and is preceded and/or followed by another stimulus, which is called a *mask.* The mask could be a set of characters following the word (e.g., #####) to cancel out any after image on the retina to ensure a very precise exposure time. The mask could also be another word or set of letters that will either facilitate or hinder the speed or accuracy of the participant's recognition of the target word (e.g., *pear* flashed quickly before *pair* vs. *zqrm* flashed before *pair*).

Homophone and Pseudohomophone Reading Words are used that sound the same (homophone) but are spelled differently (e.g., *right/write, close/clothes*) to evaluate orthographic knowledge during reaction time or masked priming tasks. Pseudohomophone tasks involve nonsense words that are spelled to sound like real words (e.g., *brain/brane, wait/wate*) and are commonly found in lexical decision tasks (e.g., Is *brane* a body part?).

Orthographic Choice Task The participant is asked to determine which alternative spelling is correct (e.g., Which of the following is a fruit: *pair, pare, or pear*?).

Wordlikeness Task The participant is asked to indicate which of the following nonsense words displays a spelling pattern most like real words (*plmk* vs. *bock, rrin* vs. *rinn*).

Use of Different Fonts, Mixed Case, or Degraded Appearance Words are printed in very different fonts (e.g., avenue, `avenue`), mixed case (hApPiLy), or with degraded visual appearance (e.g., only parts of the letters show through a screen or mask).

SUMMARY

There is a vast amount of empirical research on literacy acquisition and reading disabilities that has been largely untapped by those working in schools. This is due, in part, to the sheer volume of this research and its inaccessibility. Many educational professionals in general and special education can benefit tremendously from this information, not to mention developers of reading series and intervention materials. This book is designed to communicate the most important findings from that vast research. The focus will be on applying the most relevant research findings to assessing, preventing, and correcting reading problems.

🖋 TEST YOURSELF 🖋

1. **According to the National Assessment of Educational Progress, approximately what percentage of fourth graders read below a basic level?**
   (a) 3%–5%
   (b) 8%–10%
   (c) 13%–15%
   (d) 30%–34%

2. **Since _____, it has been well established that phonological awareness is critical for reading.**
    (a) 2000
    (b) 1995
    (c) 1990
    (d) 1980 or earlier

3. **Professors of literacy routinely make use of the empirical reading research when training future teachers.**
    (a) True
    (b) False

4. **School psychologists generally have a good working knowledge regarding empirical reading research.**
    (a) True
    (b) False

5. **Which one of the following is *not* a likely reason why there is a gap between reading research and classroom instruction?**
    (a) Teachers' unwillingness to change the way they teach
    (b) Lack of easy access to the research
    (c) The overwhelming amount of research available to sift through
    (d) Attempts by some high-profile literacy experts to discourage teachers from incorporating practices based on scientifically oriented research findings

6. **What appears to be "the most important scientific discovery that educators have not heard about"?**
    (a) The research findings about phonics
    (b) The research findings about reading comprehension
    (c) The research findings about how readers build a sight vocabulary
    (d) The research findings about English language learners

7. **What is *orthographic mapping*?**
    (a) Making sure all letter-sound relationships are systematically introduced in a developmentally appropriate fashion in a kindergarten curriculum
    (b) A strategy for enhancing spelling instruction in younger students
    (c) A strategy for enhancing spelling instruction in older students
    (d) In reading, the mental process used to store words for later, instant retrieval

8. **Prevention research indicates that we can reduce the number of struggling readers by:**
    (a) 10%–12%
    (b) 15%–18%
    (c) 20%–25%
    (d) 50%–80%

9. What does the best intervention research suggest about the most severely reading-disabled students (i.e., the bottom first to third percentiles)?

(a) While milder cases of reading difficulties can be corrected, the amount of growth potential among the most severely reading disabled is quite limited.

(b) With the right kind of intervention, we can expect that these individuals make 4 to 6 standard score point gains on nationally normed reading tests.

(c) These students can make an average of about a standard deviation of improvement based on nationally normed reading tests.

(d) The outcomes are so variable that no estimate can be made.

10. What was the major problem with the origin of RTI highlighted in this chapter?

(a) The original developers of RTI could not decide on whether RTI should represent a three- or four-tier service delivery model.

(b) There was no real scientific foundation for the development of RTI; it was just a clever idea.

(c) RTI was inspired based on very strong research outcomes, but during the development of the RTI service delivery model, the instructional and intervention approaches that produced such successful results did not get widely disseminated.

(d) The developers could not agree on whether to capitalize the *t* in the middle (i.e., RTI vs. RtI).

Answers: 1. d; 2. d; 3. False; 4. False; 5. a; 6. c; 7. d; 8. d; 9. c; 10. c