This book is printed on acid-free paper. ♾

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

For general information on our other products and services please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at http://booksupport.wiley.com. For more information about Wiley products, visit www.wiley.com.

Library of Congress Cataloging-in-Publication Data:
Essentials of planning, selecting, and tailoring interventions for unique learners / edited by Jennifer T. Mascolo, Dawn P. Flanagan, and Vincent C. Alfonso.
pages cm – (Essentials of psychological assessment)
Includes index.
ISBN: 978-1-118-36821-3 (pbk.); ISBN: 978-1-118-41735-5 (ebk); ISBN: 978-1-118-42065-2 (ebk)
1. Linguistic minorities–Education. Children of minorities–Education.Multicultural education./ LC4065Children with social disabilities–Education. 2. Special education. 3. Remedial teaching. 4. Students with disabilities–Education. I. Mascolo, Jennifer T., editor of compilation. II. Alfonso, Vincent C., editor of compilation. III. Flanagan, Dawn P., editor of compilation.
LC3969.E77 2014
371.9–dc23

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

Essentials

of Planning, Selecting, and Tailoring Interventions for Unique Learners

Edited by

Jennifer T. Mascolo
Vincent C. Alfonso
Dawn P. Flanagan

WILEY

Four

TAILORING INTERVENTIONS IN READING BASED ON EMERGING RESEARCH ON THE DEVELOPMENT OF WORD RECOGNITION SKILLS

David Kilpatrick

Imagine taking your poorly running car to a mechanic. Your mechanic says he doesn't understand why the car has this problem, yet suggests different ways that the problem can be minimized or improved upon. However, because the mechanic cannot identify the cause of the problem, there is little hope of fixing it.

When it comes to word-level reading difficulties, those of us who conduct educational evaluations have often been functioning like that mechanic. That is, we tend to design interventions without knowing the nature or source of the reading difficulties. Two emerging sets of research, however, have demonstrated very clearly how we can understand the nature and sources of reading difficulties especially for students who have sufficient learning opportunities and exhibit good effort. First, research has demonstrated that *most* reading difficulties can be prevented or corrected (e.g., Torgesen et al., 2001; Vellutino et al., 1996). Second, the mystery surrounding the cause and nature of word-level reading difficulties has essentially been solved (e.g., Ehri, 1998, 2005; Ziegler & Goswami, 2005).

PREVENTING AND CORRECTING MOST READING DIFFICULTIES

Research over the last two decades has demonstrated that most reading difficulties can be corrected, or better yet, prevented in the first place. It is most unfortunate that the educational community appears to know nothing of these findings. In 1999, the American Federation of Teachers (AFT), the second largest teachers union, published *Teaching Reading IS Rocket Science*. On that document's first page, the AFT readily admitted that there was a large gap between the research findings on literacy and actual classroom practice (American Federation of Teachers, 1999). Ten years later, in 2009, a special issue of the *Journal of Learning Disabilities* was devoted to the question of why the important advances in our understanding of reading acquisition and reading difficulties have not made their way into our K–12 classrooms (Moats, 2009). Nelson and Machek (2007) have demonstrated that even school psychologists are not well acquainted with the major findings of reading research.

There have been many studies addressing the prevention and remediation of reading difficulties. However, two stand out in terms of significance: Vellutino et al. (1996) and Torgesen et al. (2001).

Prevention

In a large-scale study, Vellutino et al. (1996) conducted a 15-week intensive intervention in the spring of first grade for 74 students who represented the lowest 9% of students who were at risk for reading disabilities. By the end of the intervention, 67% scored at or above average on tests of word-level reading (above the 30th percentile), and these results were maintained a year after the intervention was discontinued (end of second grade) as well as three years later (Vellutino, Scanlon, & Lyon, 2000). Only 15% of the original 9% of at-risk students continued to earn scores below the 30th percentile at the end of second grade. Vellutino et al. (1996) projected this finding to the original population from which the 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 earn scores below the 30th percentile and, of those, only half (1.5%) would earn scores below the 16th percentile. That projected figure represents a significant contrast to the annual reports of the *National Assessment of Educational Progress*, which indicate that 30 to 34% of fourth graders perform below a basic reading level. Most schools would not be able to implement the approach of Vellutino et al. (1996) for reasons discussed ahead. However, between Vellutino et al.'s (1996) ideal scenario of having only 1.5 to 3% of students with significant reading difficulties and the reality that 30 to 34% of students experience reading difficulties, there is room for substantial improvement.

Remediation

Torgesen et al. (2001) intervened with 60 fourth graders with very severe reading disabilities. Their mean IQ on the Wechsler Intelligence Scale for Children-Third Edition (WISC-III, Wechsler, 1991) was 96 while their mean standard score for word-level reading on the Woodcock Reading Mastery Test–Revised (WRMT-R, Woodcock, 1987) was 68. Immediately after the intervention, as well as at one- and two-year follow-ups, these students maintained an average 20 standard score point gain on the WRMT-R Word Identification and Word Attack subtests.[1] Forty percent of these students required no ongoing reading help after the intervention ended, and nearly every student had WRMT-R standard scores within the average range after the intervention concluded and at the one- and two-year follow-ups. More surprising was the length of the intervention that produced these substantial, long-term results: eight weeks.

If the results from the two studies just described do not sound like a late-night television commercial for a product that is too good to be true, you may not have been reading carefully. These results are indeed remarkable. In fact, they would be difficult to accept were it not for the facts that they were (1) the result of large U.S. Government grants (NICHD), (2) conducted by world-renowned research teams, and (3) reported in top research journals (*Journal of Educational Psychology* and *Journal of Learning Disabilities*, respectively). More importantly, however, the highly successful techniques used in these studies were drawn from a rich empirical literature on reading acquisition and reading difficulties. For those familiar with this literature, the findings of these studies were very welcome, but not surprising. It is no wonder why the *Journal of Learning Disabilities* devoted a special issue to addressing the gap between findings like these and current classroom practice.

A caveat to these two studies is that they involved 1:1 tutoring for either 30 minutes per day for 15 weeks (Vellutino et al., 1996) or two 50-minute periods a day for 8 weeks (Torgesen et al., 2001). Most schools cannot afford such a remedial ratio. However, it could be argued that the *content*[2] rather than the delivery ratio was the most significant factor in these studies (though the ratio no doubt helped). Some research has suggested that if grouping is done carefully (i.e., students in the group have similar learning needs), small groups of 1:2 or 1:3 may yield nearly the same results as 1:1 remediation (Elbaum, Vaughn, Hughes, & Moody, 2000; Lennon & Slesinski, 1999). In fact, *School Psychology Review* reported on how the Vellutino et al. (1996) study was essentially replicated using 1:2 groups (Lennon & Slesinski, 1999).

1. To appreciate fully the magnitude of this effect, consider that research has shown the popular READ180 program averages approximately a three standard score point gain (Papalewis, 2004; Slavin, Lake, Chambers, Cheung, & Davis, 2009).

2. The content/curriculum of these studies involved intensive phonological awareness training, explicit phonics, and opportunities to apply these skills to reading connected text.

Due to the intensity of the intervention and size of the groups (i.e., 1:1 delivery system), it would not be appropriate to suggest that these two studies represent the new standard for common practice. However, as mentioned, they demonstrate that we have an incredible growth potential in terms of correcting or preventing a large portion of reading difficulties. We can do this by implementing the *content* of the instructional approaches used by these researchers, while doing our best to program small student groupings to maximize the learning opportunities. But none of these substantial changes can occur if educators are unaware that these findings exist, which unfortunately appears to be the case at the present time (Moats, 2009).

MYSTERY SOLVED: UNDERSTANDING WORD-LEVEL READING DIFFICULTIES

Reading progress is largely determined by how efficiently students build a sight vocabulary. A *sight vocabulary* refers to the pool of words students can recognize instantly and effortlessly, without having to guess or sound them out. Poor readers almost invariably have small sight vocabularies. Compared to their peers, there are fewer words they instantly recognize, so they must rely on phonic analysis and/or guessing. By contrast, accomplished readers have large sight vocabularies. Most of the words they encounter are instantly recognized, and only when encountering new words do they have to rely on phonics and/or guessing.

How do students quickly and efficiently build a sight vocabulary? In a sense, the answer to this question represents the proverbial Holy Grail of reading education. Students who can effortlessly identify words can focus all of their attention and working memory on reading *comprehension*. By contrast, students who have to guess at or sound out (i.e., decode) many of the words they read must allocate attentional and working memory resources to decoding, leaving fewer resources available for comprehending what they read.

DON'T FORGET

Sight vocabulary refers to the pool of words that are familiar to the reader. Familiar words are recognized instantly and effortlessly. The more words that are recognized effortlessly, the more the reader can focus on comprehension.

First let's consider what skilled readers can do, ranging from second or third grade to adulthood (Crowder & Wagner, 1992; Rayner & Pollatsek, 1989). They can:

- Identify known words after an exposure of only 1/20 of a second.
- Learn new words after 1–5 exposures.

- Remember the words they have learned without retrieval failures.
- Recognize words instantly, without the aid of context clues.

These skills do *not* characterize weak readers, who typically require many exposures to remember new words, read slowly and with much effort, forget words previously learned, and rely heavily on context cues. What makes the difference is sight vocabulary. So, how do students build a sight vocabulary?

Discovery of the Process Behind Sight-Word Learning

It is encouraging to note that researchers have largely discovered (1) how readers build a sight vocabulary, and (2) why some students have more difficulty building a sight vocabulary than others, including those with reading disabilities. At least in broad outline, the process is no longer a mystery. The problem is that outside the niche area in which these researchers work, few seem to be aware of this discovery (Moats, 2009; Nelson & Machek, 2007). Thus, educators have been making instructional decisions based upon one or two popular theories of word recognition, neither of which is consistent with the empirical findings (which are addressed ahead).

Dispelling Popular Theories That Are Inconsistent With Research

Arguably, the two most popular understandings about sight-word learning are (1) the Psycholinguistic Guessing Game and (2) the visual memory hypothesis.

Psycholinguistic Guessing Game

The *Psycholinguistic Guessing Game* (Goodman, 1976) has been the foundational theory of word perception within Whole Language. This theory claims that skilled readers identify words using three interactive cueing systems, graphophonemic (i.e., basic phonic), contextual, and linguistic. Developed in the 1960s–1970s, this theory has been impervious to the large body of empirical research that has accumulated since then. As it turns out, skilled readers can instantly identify any one of the thousands of words from their sight vocabularies, without recourse to context. While context is central to meaning, it is not necessary for recognizing familiar words. By contrast, weak readers rely heavily on context because of their limited sight vocabularies (e.g., Nation & Snowling, 1998). The Psycholinguistic Guessing Game assumes that words are not necessarily recalled from memory, but rather identified as the student moves through the text using the various cues. This theory essentially downplays or denies the existence of an efficient sight vocabulary.

The Psycholinguistic Guessing Game advocates teaching all children to use the three cueing systems from the beginning of reading instruction. For example, a student sees the sentence, "The boy is waiting for his ____." The student comes to that last word and notes it is a small word beginning with the letter *b*. That information combined with the context allows him to *guess* that the word is *bus*. Also, linguistically, a noun is called for at this point, which helped limit the possibilities. Further analysis of the word may confirm the guess (e.g., noticing the *–us* part of the word *bus*), but this is hardly necessary because the sampling of the phonic aspect (in this case the first letter) along with context and the linguistic parameters allow him to correctly derive meaning from the sentence. So in the Psycholinguistic Guessing Game, decoding is to a large extent the *product* of comprehending what you read, rather than considering comprehension as being largely informed by decoding. Rather than reading words based on instant access of known words from long-term memory (LTM), words are continually guessed at as students move through text using the three cueing systems. It is presumed that skilled readers use these three cueing systems very efficiently, and poor readers are basically poor guessers.[3]

However, as mentioned, skilled readers can instantly identify tens of thousands of words in the absence of any context. There is an abundant amount of research supporting the notion that skilled readers have a vast pool of words stored in LTM (Crowder & Wagner, 1992; Rayner & Pollatsek, 1989). Students destined to be good readers develop a large sight vocabulary whether or not they receive this guessing-type of instruction (Liberman & Liberman, 1990), while poor readers latch onto the contextual guessing because they are inefficient at building a sight vocabulary (Nation & Snowling, 1998). The extensive scientific research into the reading process is inconsistent with the Psycholinguistic Guessing Game, despite the very bold and confident pronouncements from its developers (Ehri, 1998; Liberman & Liberman, 1990). However, as the mechanism for decoding within the Whole Language approach to literacy, it has enjoyed wide popularity for well over two decades, despite its inconsistency with the empirical findings.

Visual Memory

Until recently, almost everyone implicitly assumed that visual memory was the mechanism for sight-word learning. This assumption is based upon strong, intuitive evidence. However, contrary to our intuitions, we do not store words visually. Because this assumption seems so pervasive in education, I will spend some time describing why scientists reject this highly intuitive notion.

Two concepts must be clearly distinguished to understand how we remember words: *input* and *storage*. When we read, we obviously *input* words visually.

3. For a helpful, accessible, and detailed critique, see Dr. Kerry Hempestall's online review at http://www.educationnews.org/articles/the-three-cueing-model-down-for-the-count.html.

CAUTION

Input and *storage* must not be confused. Printed words are input *visually*, but are stored *linguistically* (i.e., *phonologically* and *semantically*).

But that does not mean that our LTM for words involves visual *storage*. In fact, research suggests otherwise. For example, consider the simple working memory task of looking up a number in a telephone directory. That involves visual input and visual-motor output (via the keypad). Despite the visual input (and output), we do not *store* that information visually. Rather, we store it *auditorily/phonologically*.[4] We verbally repeat the number a few times, either aloud or silently. Thus, we are *storing* the number phonologically, even though it was *input* visually. While this illustration involves working memory, the same can be said about LTM—input and storage are not the same process.

To lay to rest the pervasive misunderstanding that visual memory is the mechanism of word storage, the following are several reasons why we now know that sight vocabulary is not based on visual memory:

1. Results of "mixed-case" studies do not support the visual memory hypothesis. Researchers exposed adults to words in mixed case (i.e., every other letter was uppercase: yEsTeRdAy; hAPpY). They assumed these would not match a stored visual memory. Not surprisingly, mixed-case words slowed reaction times. However, when the adults had ample exposure to words printed in this unusual manner, they could read a fresh batch of words they had never seen in mixed case as quickly and accurately as words printed normally (Adams, 1990). This finding demonstrated that readers were not matching those mixed-case words to visual memories because they had never seen those particular words printed that way before.
2. Related to the mixed-case finding is the observation that we read words in many different fonts, uppercase, lowercase, and innumerable variations among people's manuscript and cursive handwriting. We do not have a visual memory for tens of thousands of words multiplied by the countless different ways they are visually presented in print.
3. Over 120 years ago, Cattell (1886) discovered that reaction times to written words (e.g., *chair*) were faster than for drawings (e.g., of a chair),

4. *Auditory* refers to all sound input while *phonological* refers to the auditory information related to the sounds in spoken language. Those with reading disabilities do not have strictly auditory difficulties. Their difficulties are phonological in nature (Share, Jorm, MacLean, & Matthews, 2002).

suggesting that word recognition and visual memory might represent different processes.

4. Since the 1970s researchers have known that the visual memory skills of students with reading disabilities (i.e., no concurrent math disabilities) are comparable to typical readers (Swanson, 1978; Vellutino et al., 1996; Vellutino, Steger, DeSetto, & Phillips, 1975). This would not make sense if visual memory is central to skilled word reading.
5. Many studies have shown high correlations between word-level reading skills and phonological awareness yet very low correlations (typically not significant) with visual memory tasks. (Adams, 1990; Vellutino et al., 1996). These findings seem inconsistent with the notion that visual memory is the basis of sight-word learning.
6. Don't those who are deaf read by visual memory? Actually, research does not support this intuitive assumption (Hanson, 1991; Leybaert, 2000). Many individuals who are deaf never read higher than the third- or fourth-grade reading level (Leybaert, 2000). Over 95% of those who are deaf wear hearing-aids, which means they have at least some residual sound input. As a result, the correlation between phonological awareness and reading is similar in deaf and hearing populations (Hanson, 1991).

Rapid Reference 4.1 Some Reasons We Know Words Are Not Stored via Visual Memory

- MiXeD cAsE sTuDiEs.
- High correlation between sight-word learning and phonological awareness.
- Exclusively students with reading disabilities (i.e., no math problems) have average visual memory but weak orthographic memory.
- With the help of hearing-aids, individuals who are deaf can develop the phonological structure of the spoken language and can learn to read while those who do not develop phonological awareness struggle in reading—there is no efficient visual alternative for readers who are deaf.
- Naming speed for written words is faster than for objects, suggesting printed word memory and visual memory involve different processes.
- We sometimes fail to retrieve the names of familiar objects and people (temporary visual-association memory failure), but never fail to retrieve the written words we have learned.

While visual memory is not the primary mechanism for sight-word storage, that does not mean it is unrelated to reading acquisition. Common sense and empirical research (Crowder & Wagner, 1992; Vellutino et al., 1996) suggest visual memory affects the process of learning letter names and sounds. However, visual memory is not the basis of sight-word reading for the reasons outlined earlier.

CAUTION

While visual memory is not the mechanism for sight-word storage, it is very important for letter-sound learning.

Neither visual memory nor the Psycholinguistic Guessing Game can provide an adequate explanation of word-level reading acquisition or reading difficulties. Neither correctly explains how readers establish a sight vocabulary.

HOW WE STORE WORDS

Though largely unknown outside a limited circle of researchers, scientists have developed a fairly well established understanding of how we store words in LTM for fast, accurate retrieval. In the research literature, this understanding is referred to by various terms, including *bonding* (Ehri, 2005), the *representation hypothesis* (Perfetti, 1991), *direct mapping* (Rack, Hulme, Snowling, & Wightman, 1994), *unitization* (Treiman, Sotak, & Bowman, 2001), the *lexical tuning hypothesis* (Castles, Davis, Cavalot, & Forster, 2007), the *self-teaching hypothesis* (Share, 1999), or simply *mapping*[5] (e.g., Landi, Perfetti, Bolger, Dunlap, & Foorman, 2006). In what follows, we will be using the terms *orthographic memory, orthographic mapping*, or simply *mapping* to refer to the process researchers have discovered that explains how individuals store words for fast, accurate retrieval.

Orthographic mapping is the mental process we use to store permanently words for immediate, effortless retrieval. It is the process that transforms an unfamiliar printed word into an instantly recognizable sight-word. Thus, orthographic mapping is the mechanism we use to develop a sight vocabulary.

DON'T FORGET

Orthographic mapping is the mental process we use to store words for instant, effortless retrieval. It is our mechanism for developing our sight vocabulary.

But precisely what does *orthographic* mean? The word *orthography* is based on two Greek words, *orthos* ("straight," "correct") and *graphos*

5. This simple term, *mapping*, is also used as a synonym for *phonic decoding words* (e.g., Landi et al., 2006; Stahl & Murray, 1994), which adds imprecision to the term's usage.

DON'T FORGET

Orthography refers to the precise/correct spelling of words. The sequence of letters in words becomes bonded to the spoken pronunciation and meaning. Thus, orthographic memory, not visual memory, is the basis for sight-word learning.

("writing"). Orthography refers to the correct spellings of specific words. A sight vocabulary refers to a memory for specific words whose spellings have been committed to recognition memory.[6]

The process of orthographic mapping occurs quite naturally for students who have the prerequisite skills of letter-sound knowledge, phonemic awareness, and oral vocabulary (Ehri, 1998, 2005; Laing & Hulme, 1999) see, Rapid Reference 4.2. For students who lack one or more of these component skills, mapping is very inefficient and a sight vocabulary grows very slowly. Understanding this process of sight-word storage is essential for addressing the reading acquisition of all learners. It will assist educators in determining what to teach and how to teach it.

Orthographic Mapping Process

Our oral lexicons involve a lightning-fast lookup system allowing us to comprehend instantly the words we hear. As it turns out, sight-word learning piggybacks on this existing system of instantaneous oral recall. When reading, we do not use a separate visual lookup system that parallels our oral one. This unified system is

Rapid Reference 4.2 Key Elements of Sight-Word Learning

- Sound-symbol skills
- Phonemic awareness
- Oral vocabulary

6. Orthographic memory (i.e., the memory for specific spellings of specific words) appears to operate on two broad levels. Orthographic *recognition* memory allows a reader to distinguish instantly that *pear* is a fruit while *pair* refers to two things. The reader does not have to produce those spellings, only *recognize* them. Orthographic *recall* memory seems to be a more rigorously encoded form of orthographic memory. It allows us to correctly spell words. There are, no doubt, more readers who can instantly recognize words like *tongue, bouquet, colonel, rendezvous,* or *licorice* than can consistently spell them.

Table 4.1 Examples of Types of Letter Sequences

Random Letter Sequences (Not Meaningful or Familiar)		Meaningful Letter Sequences: Familiar		Meaningful Letter Sequences: Unfamiliar	
NZQ	SRTE	CIA	USMC	IEEE	UMWA
SBMR	QWS	NCAA	YMCA	SBE	TAOM

why word recognition is so quick for competent readers. The *input* is visual, but the *storage* is linguistic (i.e., phonological and semantic). To understand this process, it may be helpful to use terms that focus on the mechanics behind orthographic mapping, namely *meaningful letter sequences* and *familiar letter sequences*. Consider the acronyms in Table 4.1.

The letter strings in the first set are meaningless—they were made up for this table. Thus, they are not likely to be familiar to the reader. The second two sets of letter sequences are all meaningful. They are all acronyms for organizations in the United States. Acronyms are *meaningful* because each letter represents the first letter in the words in the organization's name (e.g., CIA = Central Intelligence Agency). But both sets of meaningful acronyms are not likely to be *familiar* to the reader. The first set is more common and familiar, but the second set includes organizations less well known to the average reader (e.g., SBE = Society of Broadcast Engineers). But all of these acronyms are equally *meaningful*, even if they are not equally *familiar*.

It is the precise order of the letters that make acronyms meaningful. The National Basketball Association is referred to as the *NBA*. Neither NAB nor BNA are likely to activate "National Basketball Association" in the minds of those familiar with the acronym NBA. The precise order is needed to do that. After a few exposures, the acronym becomes familiar. So when someone sees *NBA*, he or she does not say "*Hmm, N – B – A.* Oh, *NBA!*" Rather, he or she instantly knows it upon seeing it and no longer has to focus on the parts of that letter sequence. Once familiar, the letter sequence is recognized *as a unit*. Any change in that sequence throws off the reader as the examples NAB and BNA illustrate. So, the precise order of letters in meaningful letter sequences becomes familiar, that is, the sequence becomes *unitized* for instant recognition. By contrast, meaningless letter strings are very difficult to remember. There is little or nothing we can use to anchor them in memory.

This analogy using acronyms helps illustrate the concepts of *meaningful* and *familiar* when it comes to letter sequences. In a similar sense, written words in alphabetic languages are meaningful sequences of letters *because the letter sequences are designed to represent the oral sequences of phonemes in spoken words. Phonemes* are the smallest units of spoken language. For example, the word *red* has three phonemes (/r//ĕ//d/)[7] while the word *shoe* has two (/sh//ū/). Written words are not random letter sequences to be memorized. Rather, each phoneme in a spoken word is represented by a letter or digraph (e.g., *ch, sh, ee, oa*).[8] So there is a meaningful connection between the spoken sequence of phonemes and the written sequence of letters.[9] This is the whole idea behind alphabetic writing systems.

Two of the major components necessary for this orthographic memory process to work are (1) sound-symbol skills (e.g., knowing *t* says/t/and *m* says/m/) and (2) phonemic awareness. *Phonemic awareness* is the most advanced form of phonological awareness. *Phonological awareness* is the ability to notice the sound structure within spoken words. It may involve rhyming or alliteration, but also the ability to segment, blend, or manipulate syllables, onsets and rimes,[10] and phonemes (Scarborough & Brady, 2002). Phonemic awareness is thus a subcategory of phonological awareness. However, *phonemic* awareness is the level of awareness necessary to interact with an alphabetic writing system, because written *letters* represent oral *phonemes.*

Students with poor phonemic awareness do not notice the phoneme structure within spoken words. Thus, they have a difficult time recognizing that the specific letter sequences within written words are *meaningful.* They do not naturally notice the precise relationship between the sounds in spoken words and the letters used to represent those sounds due to the fact that they cannot attune themselves to the sounds/phonemes in spoken words. The exception to this is the first sound in a word, which even the most disabled readers seem to get.

Consider an imaginary study with two groups of adults who have to memorize a set of 15 sequences of random letters. In one group are American sports fans while in the other group are Australians who know nothing about American sports. The 15 "random" letter strings are comprised of sequences like NFL, NBA, LPGA,

7. Letters printed between slash marks (e.g., /t/) represent sounds, not letters.

8. Exceptions to this are *extremely* rare. The only common words violating this pattern are *one* and *once*, neither of which has a letter to represent the/w/sound at the beginning. Virtually all other irregular words represent every sound in the word; they just do so irregularly.

9. The problem of irregular words will be addressed ahead.

10. An *onset* is the consonantal portion of a syllable before the vowel (e.g., *c-ap, bl-ink, scr-eech*). *Rime* is not a misspelling of *rhyme*, but an obscure alternative spelling that reading researchers use to refer to the part of the syllable that includes the vowel and anything after the vowel sound in that syllable (e.g., *m-ake, f-eet, g-o*). Rimes can be oral or written (Scarborough & Brady, 2002).

Rapid Reference 4.3 Key Phon-Terms

Phonics: "An approach to, or type of, reading instruction that [promotes] . . . the correspondences between phonemes and graphemes [i.e., letters and digraphs]."

Phonological awareness: Involves "attending to, thinking about, and intentionally manipulating the phonological aspects of spoken language."

Phonemes: "The smallest units into which speech can be divided."

Phonemic awareness: "The particular kind of phonological awareness that involves attending to, thinking about, and intentionally manipulating the individual *phonemes* [my emphasis] within spoken words and syllables."

Source: Scarborough & Brady (2002, pp. 326, 312, 303, and 313).

MLB, WNBA, PGA, NHL, NCAA, and so on. Because these strings are not really random and represent American sports leagues, we can be sure the American sports fans would remember more sequences. Also, when asked to reproduce the sequences, who might get the letter order mixed up? We could imagine seeing some of the Australians remembering NFL as NLF, but could not imagine a single American sports fan transposing any letters.

By analogy, the American sports fans are like students who begin their literacy careers with sufficient phonological awareness and sound-symbol skills. The Australians in our make-believe study are like students who lack adequate phonological awareness and/or sound-symbol skills. For this latter group, letter strings have to be memorized *as if* they were random, even though they are not. The former group, by contrast, can recognize that the sequences are meaningful, which greatly facilitates the process of making them familiar.

Students who struggle with phonemic awareness and/or sound-symbol skills struggle in reading. Why is this so? Because *the letter strings they see are not particularly meaningful to them, which makes them very difficult to remember.* Unless these foundational skills are developed, a student will not have an efficient way to make letter sequences familiar. Students with good phonemic awareness and phonics skills naturally associate the sounds in spoken words with the letter sequences used to represent those spoken words. As a result, they remember the words they read. Phonemic awareness allows students to effectively key letter strings into the lightning-fast oral lexicon they use for spoken language.

Identification Versus Recognition

Given proper clues, we can identify people and things we have never seen before. If I tell you there is a group of 30 people in the next room and I want you to give a

DON'T FORGET

Word *identification* could involve phonic decoding, visual feature memorization, contextual guessing, or instant recognition of stored words. In each case, the word is *identified*. Word *recognition*, however, is a subcategory of word identification that refers to instant, effortless recall of known words (i.e., words in the reader's pool of sight-words).

message to a tall man with red hair and glasses, you could identify him without having seen him before. Yet if I tell you to deliver a message to your best friend, no clues are needed. Recognition presumes previous experience and memory, while identification does not. The focus of phonic decoding is on identification of unknown words. If you have sufficient sound-symbol skills and *blending* skills (i.e., when you hear the sounds /r//ĕ//d/ separately, it activates the oral word *red*), you can identify words you have never seen before. You can also identify words based on guessing from context. Or, you can combine phonics and contextual guessing. But these are *identification* approaches that presume the word is unfamiliar. If the word were familiar, there would be no need for guessing or phonic decoding.

With orthographic mapping, we are not talking about identifying unfamiliar words. Rather we are talking about storing words so they immediately activate the pronunciation of the oral word. With word recognition, the precise letter order becomes consolidated in memory in a unitized fashion, just like NFL will not be confused with NLF or FNL.

Orthographic Mapping Versus Phonic Decoding

Orthographic mapping must not be confused with phonic decoding. Phonic decoding is a strategy to identify unfamiliar words. By contrast, orthographic mapping is the process that produces a unitized memory for specific letter sequences. It involves bonding the specific letter sequence to the word's pronunciation and meaning. So, rather than a visual memory lookup process, instant recognition involves rapid access to familiar letter sequences that are visually input into the linguistic system. This means that sound-symbol skills are necessary for word identification (via phonic decoding) and permanent word storage (via orthographic mapping). The same sound-symbol skills are used for two different and complementary aspects of word-level reading (see Figure 4.1).

CAUTION

Orthographic mapping must not be confused with phonic decoding. Each involves sound-symbol skills. However, phonic decoding is a strategy to identify *unfamiliar* words while orthographic mapping is the process that makes words *familiar* for instant recognition.

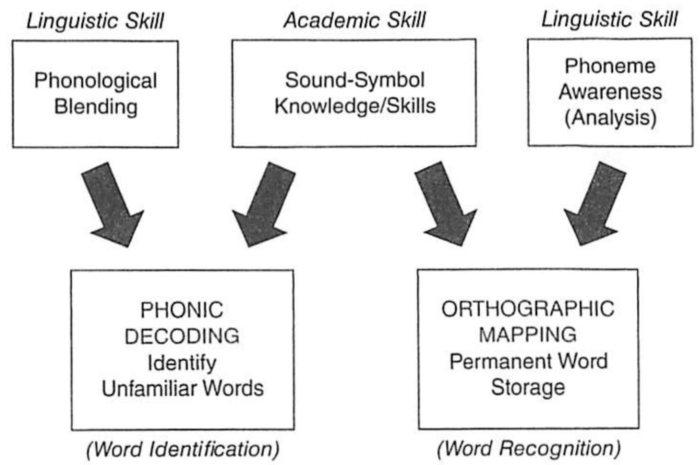

Figure 4.1. Relationships Among Some of the Components of Word-Level Reading

To read efficiently in an alphabetic script, particularly English, orthographic memory is absolutely essential (Ziegler & Goswami, 2005). The word *make* is spelled *m-a-k-e*, not *m-a-k*. Homophonic words (e.g., *right/write, see/sea, stair/stare*) are words that are pronounced the same, but are spelled differently. This means they share the same *phonology*, but differ in their *orthography*. We must therefore develop a memory for the precise spellings of words, which instantly activates the pronunciations and meanings of those words. But to anchor that orthographic sequence into our memory system, we participate in a connection-forming process that aligns or *maps* the sequence of oral phonemes in a spoken word onto the actual orthographic sequence used to spell that word. So, with orthographic memory, *visual* characteristics of the word (uppercase or lowercase, handwriting, differing fonts, etc.) are not the least bit important, as long as the letters are legible. Once that letter sequence enters the system via visual input, the previous connections between orthography and phonology allow our phonological/pronunciation system and our semantic system to take over for instant recognition.

CAUTION

Orthographic memory must not be confused with *visual memory*. *Visual memory* involves memory for objects, people, numbers, letters of the alphabet, and so on. *Orthographic memory* is memory for the specific letter combinations that form written words. The *visual* characteristics of words, such as uppercase, lowercase, varying fonts, and handwriting, are not important for orthographic memory.

The Formative Research on Orthographic Mapping

What is here called *orthographic mapping* represents the theory developed by Linnea Ehri in the late 1970s.[11] Ehri has called this process *sight-word learning, bonding, amalgamation*, and *graphophonemic awareness* (Ehri, 1998, 2005). Ehri provided tentative empirical support for her theory in the late 1970s and 1980s (e.g., Ehri & Wilce, 1985). However, the theory seemed to gain broader acceptance among reading researchers following confirmation via a series of studies by British researchers (Laing & Hulme, 1999; Rack et al., 1994). Since then, further support has come in English and in other languages (e.g., Cardoso-Martins, Mamede Resende, & Assunção Rodrigues, 2002; Dixon, Stuart, & Masterson, 2002; Share, 1999).

Ehri and Wilce (1985) taught preschoolers and kindergarteners two different types of words. They compared modified phonetic forms of words (e.g., TRDL for *turtle* and NE for *knee*) with visually distinctive forms of words with no phonetic correspondence (e.g., Y^{M}P for *turtle* and Fo for *knee*). They found that non-readers with minimal letter-sound knowledge remembered the visually distinctive forms more easily, while those with good letter-sound knowledge found the phonetic spellings easier to remember. This suggested that as soon as they gain letter-sound knowledge, beginning readers use that knowledge in a process of creating a bond or map between the sequence of phonemes in the oral word and the sequence of letters used to represent that oral word. Such connections make those letter sequences familiar.

Rack et al. (1994) improved Ehri's methodology by controlling for the look of the words. They taught five-year-old non-readers and beginning readers two types of modified words, varying the degree of phonetic correspondence in the spellings. For example, the word *farmer* was represented as *vmr* or *zmr*, the former being closer phonologically to *fmr*. The sounds /f/ and /v/ differ only in voicing (i.e., whether vocal cords vibrate), while /f/ and /z/ differ in voicing and place of articulation. Their results were similar to Ehri and colleagues. Readers with letter-sound knowledge made use of the letter sequences to *remember* words. This was word memory, not phonic decoding, because they prescreened these children and they could not yet sound out words. Others have replicated this finding (Cardoso-Martins et al., 2002; Dixon et al., 2002), including Laing and Hulme (1999), who demonstrated the importance of phonemic awareness in producing this effect. They found that the more skilled the students were in phonemic awareness, the more efficiently they mapped the words to memory.

11. For a historical perspective on the origin and development of the theory, see Ehri (1998).

How Orthographic Mapping Works

Consider an example to understand this mapping process. Two students in late first grade see the word *sent* for the first time. The first student has good phonemic awareness and sound-symbol skills while the second does not. The first student notices that the spelling of *sent* aligns with the sequence of phonemes in the spoken word (i.e., /s//ĕ//n//t/). For this student, it will be easy to remember that sequence, and distinguish it from similar-looking sequences (e.g., *set, send*). However, the second student will not be aware of the phonemes in the spoken word *sent*. He will not notice why the spelling *s-e-n-t* is any more meaningful than *s-n-e-t* or *s-e-t-n*. If there is nothing meaningful about the letter order, then only an inefficient, raw memorization strategy is possible, and sight vocabulary growth will be dramatically hindered.

Irregular Words

English has many words in which the phonemes and letters are not tightly aligned. Consider the word *island*. When a student first sees it, he may say "iz-land." He eventually learns the *s* is silent (not common in English). He is able to recognize the logical connection between the oral phonemes and the letters in the *rest* of the word, with a mental note about the irregularity. A more subtle example is *put*. It does not use the short *u* sound as in the word *but*. The student with adequate orthographic mapping skills can notice how the oral sequence maps onto *that particular written sequence*, as each sound aligns with a particular letter, even if the vowel connection is not typical (see Figure 4.2). After a few exposures, the sequence becomes a fully automatic sight-word. In a sense, the student says to himself, "Oh, *that's* how the word *put* is represented in print." If he can attune himself to the sounds in the spoken word, he is prepared to see how those sounds map onto the written form of the word. Then when he sees the orthographic sequence (i.e., the particular spelling of that word), he can notice how the sounds align with that particular sequence. This mapping process makes the sequence meaningful, even if not phonically regular. Once meaningful, the sequence can more easily become familiar.

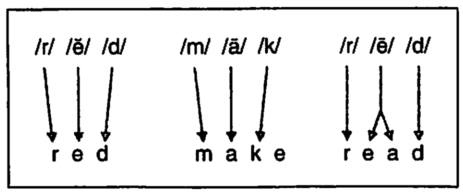

Figure 4.2. Examples of How Phonemes Map onto Letters

Consider the word *take*. Like *island*, but unlike *put*, there is not a one-to-one correspondence between letters and sounds. The student notices connections to the meaningful parts of the sequence, but adjusts for the irregular part. The silent-*e* pattern may be "phonically regular," but with orthographic mapping it presents a problem because it is an extra letter not connected with a phoneme. But if the student is aware of the "silent-*e* rule," he can more quickly appreciate the meaningfulness of this sequence. Once familiar, *take* becomes unitized and not confused with *tame*, *tape*, or *tack*.

The Graphophonemic Connection-Making Process

Let's further examine how the orthographic mapping process creates unitized orthographic sequences. When letter-sound knowledge becomes automatic, the sight of a letter activates the associated sound instantly.[12] As skills develop, a sequence of two or more letters can activate the sounds associated with that two-letter sequence. For example, when we see *ip* within a word, we do not have to determine its pronunciation by sounding out each letter separately. Rather we treat that letter sequence and its pronunciation together, simply as /ĭp/. There are many common word parts, such as rime units (e.g., *–et*, *–ig*, *–ake*, *–ot*,), beginning and ending blends (e.g., *tr–*, *bl–*, *str–*, *–nd*, *–rt*,), suffixes (e.g., *–ing*, *–ed*, *–tion*), and prefixes (e.g., *re–*, *con–*, *un–*, *dis–*). When we see these letter sequences in the context of words, their respective pronunciations are activated. We no longer need to break them apart letter-by-letter (Kilpatrick & Cole, 2013).

But how do words or word parts become familiar? Here is where phoneme awareness is very important. While oral word parts such as /ĭp/ are not words, they are part of our existing oral language system and familiar to us if we have adequate phonological awareness. That's because /ĭp/ appears in many oral words such as *dip*, *hip*, *lip*, *rip*, *sip*, *trip*, *zip*, and so on. If a student does not have phonological awareness, the letter sequence *ip* will not anchor to anything in particular in his memory. For him, *ip* represents two letters to memorize. If we have phonemic awareness we can use a connection-forming process between the letter combination and its pronunciation. The oral pronunciation of the sub-word sequence /ĭp/ is already stored in the linguistic system and we map the specific sequence of letters (*i-p*) to that pronunciation. We cannot do that without adequate sound-symbol skills and phonemic awareness. We can extend this multi-letter bonding process to larger letter sequences and words, based on reading experience.

12. Technically, it can activate more than one sound, if the letter has more than one sound associated with it. The context of that letter allows us to determine the correct sound and the others get discarded (Crowder & Wagner, 1992; Rayner & Pollatsek, 1989).

Contrary to a popular "e-mail forward" that has circulated for several years, we attend to virtually every letter of every word we read[13] (Crowder & Wagner, 1992; Rayner & Pollatsek, 1989). This has been demonstrated using various experimental paradigms. If we did not attend to every letter of the words we read, we could not instantly recognize any one of the thousands of words we know that differ from another word by a single letter (e.g., *strand/stand*, *black/block*, *send/sent*). When we see a word, our perceptual span can take in all of the letters simultaneously (Rayner & Pollatsek, 1989). Because we are able to attend to every letter in the word, the orthographic sequence representing that word will immediately be recognized as familiar or unfamiliar, depending on past learning.

Consider your web browser. As you type a web address, the browser tries to "guess" what you are intending to type based on addresses already stored in the browser's memory. With each letter you type, the guesses get more limited and refined, because more information is available for its "guess." Each new letter you type *constrains* the possibilities of what word you are intending. Our brains seem to work in a similar way, but with much greater efficiency because our eyes see *all* of the letters in the word simultaneously. Thus, our word perception is not limited to a letter-by-letter refinement process like the web browser. Nor is it like phonic decoding, which deals with one letter or digraph at a time. Rather the entire string is perceived simultaneously, and this immediately *constrains* the possibilities down to the specific word with that specific letter sequence. Our simultaneous perception of all the letters in printed words allows recognition to be instantaneous. To push the analogy further, the letter order of a printed word represents the "address" in our brains to the specific pronunciation and meaning of the oral word, like the precise web address takes you to a specific site.

So, *familiar* letter sequences are *unitized* letter sequences. When we see *spend*, we don't say, "*Hmm, s – p – e – n – d.* Oh, *spend*!" Rather, we instantly recognize that letter sequence as familiar. *Spend* is familiar to us, while *stend* or *slend* are not. And, we do not confuse the letter order in *spend* with words like *spent* or *send* because those are different sequences of letters that have been unitized in their own right. Thus, we no longer have to focus consciously on the parts of the letter string, because the precise sequence has been unitized, just like we don't focus on the parts of IRS, FBI, or NFL. The individual letters are still perceived (that's how we

13. Those adhering to the Psycholinguistic Guessing Game have widely promoted the mistaken notion that we don't attend to every letter of every word we read. While this may be true for weak readers or good readers who are skimming, it is not true for typical readers. The popular e-mail mentioned here purports to prove this (by jumbling the order of letters). But that e-mail demonstrates a phenomenon called *contextual facilitation* and does not represent our normal word recognition processes, contrary to its claims.

tell similar looking words apart), but are not separately processed, like in phonic decoding. This unitization phenomenon is why our intuitions mislead us to think we are reading words based upon some sort of visual memory bank. We know we are not phonically decoding words that quickly, so we mistakenly think that the only other alternative is visual memory.

Letter Transpositions and "Dyslexia"

The previous information makes clear why children with reading difficulties sometimes transpose letters (e.g., spelling *said* as *siad* or reading *form* as *from*) during reading and spelling—a symptom more common among dyslexics than typical readers and spellers. These transpositions are not due to poor visual-spatial processing. It happens because specific letter sequences are not well established in the LTM of dyslexics. Their poor phonemic awareness and poor orthographic mapping skills make it difficult to anchor the precise letter order into LTM. Incidentally, *dyslexia* is defined by many researchers and *Webster's Collegiate Dictionary* as simply referring to individuals with reading difficulties.[14] Because the phonological-core deficit is so common with word-level reading difficulties, transpositions become associated with dyslexia. This has become part of the popular lore that dyslexia is based on visual-spatial deficits.

Traditional Instructional Practices and Sight-Word Learning

The traditional whole-word, phonics, and Whole Language approaches were formalized in the 1800s (Adams, 1990). We have learned a lot since then and need to make use of recent findings rather than rely, as we do, on prescientific approaches to teaching reading (AFT, 1999; Moats, 2009). None of the classic approaches adequately addresses orthographic mapping. This is understandable because they all predate its discovery. The Whole Language approach mistakenly assumes that contextual guessing is an important part of mature word recognition while the whole-word method assumes visual memory is the mechanism for skilled reading. As a result, these approaches have not incorporated the kinds of instructional activities that would promote sight-word development in all students. In a sense, most kids learn to read *in spite of* these methods. Liberman and Liberman (1990) estimate that 75% of children will develop the skills needed for reading, "no matter how unhelpful the instruction is" (p. 54). We do not have that room for error with struggling readers. In fact, some instructional activities (e.g., contextual guessing or drawing attention to visual features of words) actually direct attention away from the connection between the orthographic and phonological properties of words—the very properties central to the mapping process. While most kids figure this all out naturally, struggling readers do not.

14. Dictionary.com and the *American Heritage Dictionary* (upon which dictionary.com is based), include a definition of dyslexia hinting at popular misunderstandings about visual processing. However, dictionaries *reflect* usage, so the eventual inclusion of this popular misunderstanding is inevitable.

CAUTION

Phonics and phonological awareness must not be confused. Phonological awareness pertains to *oral* language while phonics pertains to *written* language. Just remember: You can do phonological awareness with your eyes closed.

Phonics instruction promotes sound-symbol skills as a word identification strategy. Such skills must be coupled with phonemic awareness to allow students to make orthographic sequences meaningful and familiar. Thus, while phonics takes us part-way there, it needs to be supplemented, particularly for students with weak phonological awareness skills.

The author has presented this information about orthographic mapping to hundreds of teachers, administrators, and school psychologists and realizes that it is not always understood the first time through. If you find this to be the case, a careful re-reading of this chapter may help. Also, another presentation of mapping is provided on the supplemental CD.

RECOMMENDATIONS BASED ON CURRENT KNOWLEDGE

The research findings about sight-word learning and the studies on effective prevention and intervention have led to specific ways we can dramatically improve our ability to prevent and/or correct most reading difficulties and reading disabilities.

Prevention

To prevent reading difficulties, we must make certain that all students arrive at the beginning of reading instruction with the skills needed for mapping. This means letter names and then letter sounds in kindergarten (e.g., Treiman, et al., 2001), along with phonological awareness at the syllable and onset-rime levels. Basic phoneme-level awareness needs to be developing adequately throughout first grade in order for the mapping process to take hold. Without this, students are likely to develop compensating habits inconsistent with efficient sight-word development. For students who develop these skills early, success in reading is nearly assured (Liberman & Liberman, 1990; McInnis, 1999). All kindergarten teachers work on letter names and sounds. But comprehensive phonological awareness training of all students in kindergarten must become standard practice to prevent reading difficulties. This would be an integral part of using scientifically validated approaches to reading instruction that is called for by the National Reading Panel (NRP, 2000) and by Tier 1 of the Response to Intervention (RTI) approach.

Intervention 1: Before They Fail

All students should be screened in the fall of kindergarten for letter-name and letter-sound knowledge and phonological awareness.[15] For those with low skills, additional intervention in these skills is essential. The clock is ticking and reading instruction will soon commence. To be sure that these at-risk students will be successful, they will need to get up-to-speed on these basic sound-symbol and phonological awareness skills. Additional intervention (Tier 2 of RTI) is needed for these students before reading instruction begins (Vellutino et al., 2000).

Intervention 2: Students With Reading Difficulties

For students who display reading difficulties in grades 1–12, assessment of sound-symbol skills (using a nonsense word task from a commercially available test), phonological awareness, rapid automatized naming (RAN), and working memory (WM) will invariably suggest a problem in one or more of these lower-level linguistic skills. The *Comprehensive Test of Phonological Processing, Second Edition* (CTOPP-2, Wagner, Torgesen, & Rashotte, 2013) assesses these latter three skills. In most cases, phonological awareness will be an issue. The supplemental materials on the CD include a sensitive phonological awareness test.

The statute of limitations never runs out on phonemic awareness (e.g., Bruck, 1992). If 3rd, 8th, or 12th graders struggle in reading and have poor phonemic

15. Not all phonological awareness tasks/tests are equally sensitive to phonological awareness difficulties. It is unfortunate that until recently there has been no research comparing among the various phonological awareness tasks to answer the practical question of which task is most well suited for practitioners to use to determine if a student has a phonological awareness problem. All phonological awareness tasks *correlate* with reading, but those correlations vary widely (.3 to .8). The question of which is/are the most sensitive to reading difficulties has only recently been examined (Kilpatrick, 2012a, 2012b). Due to this lack of comparative research, one of the *least* sensitive tasks has become the one most commonly incorporated into the comprehensive screening batteries (e.g., DIBELS, AIMSweb, easyCBM), namely phonological *segmentation*. Phonological *manipulation* tasks such as deleting a sound from a word (found on the CTOPP-2 and PAT-2 and on the supplementary CD) appear to be more sensitive to reading difficulties (see Kilpatrick, 2012a, 2012b, and Chapter 7 on the supplementary CD) and should be preferred when seeking to determine the presence of phonological awareness difficulties.

awareness, they will not likely display much reading improvement until the phonemic awareness difficulty is corrected (e.g., Swanson, Hodson, & Schommer-Aikins, 2005). The same could be said regarding phonics skills (Rack, Snowling, & Olsen, 1992). In addition, students will need to be retrained to approach words to counteract the years of compensating strategies (Kilpatrick, 2013). The supplementary CD provides several approaches for doing this.

The recommendations included on the CD match the types of interventions that were used by Vellutino et al. (1996) and Torgesen et al. (2001). You may remember that these studies had very substantial results. These researchers made no mention of Ehri's theory of sight-word learning in their articles. Rather, they were drawing upon earlier, smaller-scale studies that had demonstrated success with at-risk and struggling readers that validated the approaches they used. However, Ehri's theory can now explain *why* those studies were so successful. The techniques used by Vellutino et al. and Torgesen et al. directly promoted orthographic mapping. They specifically addressed the reasons these students were struggling and fixed those problem areas. These studies relied heavily on sound-symbol learning and phonological/phonemic awareness training. As a result, they produced successful orthographic mappers who were then able to efficiently build a sight vocabulary. Follow-up showed that these results continued long after the intervention was over. For the most part, they solved the reading problem of most of these students who were (1) most seriously at-risk (Vellutino et al.), or (2) most seriously reading disabled (Torgesen et al.). Thus, while these important studies made no reference to our current understanding of sight-word learning, their interventions match the kind of recommendations that are suggested based on the more recent findings regarding permanent word storage.

SUMMARY

Research has demonstrated that we can prevent or correct most reading difficulties, though currently, educators do not appear to be familiar with this research. Scientists have developed an understanding of how we store sight-words for instant, effortless retrieval, which allows readers to focus on comprehension. This process is not based on visual memory. Rather, it involves forming connections between the precise sequence of phonemes in the spoken words and the letters used to represent those phonemes in printed words. Sequences become familiar and unitized for instant recognition. It is now incumbent upon school personnel to make use of this research to enhance the educational success of students who struggle in reading or who are at risk for reading difficulties or disabilities.

REFERENCES

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT Press.

American Federation ofTeachers (1999). *TeachingreadingISrocketscience.* Washington, DC: AFT.

Bruck, M. (1992). Persistence of dyslexics' phonological awareness deficits. *Developmental Psychology, 28,* 874–886.

Cardoso-Martins, C., Mamede Resende, S., & Assunção Rodrigues, L. (2002). Letter name knowledge and the ability to learn to read by processing letter-phoneme relations in words: Evidence from Brazilian Portuguese-speaking children. *Reading and Writing: An Interdisciplinary Journal, 15*(3–4), 409–432.

Castles, A., Davis, C., Cavalot, P., & Forster, K. (2007). Tracking the acquisition of orthographic skills in developing readers: Masked priming effects. *Journal of Experimental Child Psychology, 97,* 165–182.

Cattell, J. M. (1886). The time taken up by cerebral operations. *Mind, 44,* 524–538.

Crowder, R. G., & Wagner, R. K. (1992). *The psychology of reading: An introduction.* New York: Oxford University Press.

Dixon, M., Stuart, M., & Masterson, J. (2002). The relationship between phonological awareness and the development of orthographic representations. *Reading and Writing: An Interdisciplinary Journal, 15*(3–4), 295–316.

Ehri, L. C. (1998). Research on learning to read and spell: A personal-historical perspective. *Scientific Studies of Reading, 2*(2), 97–114.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading, 9*(2), 167–188.

Ehri, L. C., & Wilce, L. S. (1985). Movement into reading: Is the first stage of printed word learning visual or phonetic? *Reading Research Quarterly, 20,* 163–179.

Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology, 92*(4), 605–619.

Fletcher, J. M., Shaywitz, S. E., Shankweiler, D. P., Katz, L., Liberman, I. Y., Steubing, K. K., . . . Shaywitz, B. A. (1994). Cognitive profiles of reading disability: Comparisons of discrepancy and low achievement definitions. *Journal of Educational Psychology, 86,* 6–23.

Goodman, K. S. (1976). Reading: A psycholinguistic guessing game. In H. Singer & R. B. Ruddell (Eds.), *Theoretical models and processes of reading* (2nd ed.), pp. 497–508. Newark, DE: International Reading Association.

Hanson, V. L. (1991). Phonological processing without sound. In S. A. Brady & D. P. Shankweiler (Eds.), *Phonological processes in literacy: A tribute to Isabelle Y. Liberman* (pp. 153–161). Hillsdale, NJ: Erlbaum.

Kilpatrick, D. A. (2012a). Not all phonological awareness tests are created equal: Considering the practical validity of phonological manipulation vs. segmentation. *Communiqué, 40*(6), 31–33.

Kilpatrick, D. A. (2012b). Phonological segmentation assessment is not enough: A comparison of three phonological awareness tests with first and second graders. *Canadian Journal of School Psychology, 27*(2), 150–165.

Kilpatrick, D. A. (2013, in press). *Equipped for reading success: A comprehensive, step-by-step program for developing phonemic awareness and fluent word recognition.* Syracuse, NY: Casey & Kirsch. (Portions included on the supplemental CD).

Kilpatrick, D. A., & Cole, L. A. (2013). Exploring the development of sight-word learning in second and fifth graders using rimes, pseudorimes, and real-word rimes. *Reading and Writing: An Interdisciplinary Journal.* (submitted).

Laing, E., & Hulme, C. (1999). Phonological and semantic processes influence beginning readers' ability to learn to read words. *Journal of Experimental Child Psychology, 73,* 183–207.

Landi, N., Perfetti, C. A., Bolger, D. J., Dunlap, S., & Foorman, B. R. (2006). The role of discourse context in developing word form representations: A paradoxical relation between reading and learning. *Journal of Experimental Child Psychology, 94,* 114–133.

Lennon, J. E., & Slesinski, C. (1999). Early intervention in reading: Results of a screening and intervention program for kindergarten students. *School Psychology Review, 28*(3), 353–364.

Leybaert, J. (2000). Phonology acquired through the eyes and spelling in deaf children. *Journal of Experimental Child Psychology, 75,* 291–318.

Liberman, I. Y., & Liberman, A. M. (1990). Whole language vs. code emphasis: Understanding assumptions and their implications for reading instruction. *Annals of Dyslexia, 40,* 51–76.

McInnis, P. J. (1999). *A guide to readiness and reading: Phonemic awareness and blending* (3rd ed.). Penn Yan, NY: ARL.

Moats, L. (2009). Still wanted: Teachers with knowledge of language. Introduction to special issue. *Journal of Learning Disabilities, 42*(5), 387–391.

Nation, K., & Snowling, M. J. (1998). Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. *Child Development, 69*(4), 996–1011.

National Institute of Child Health and Human Development. (2000). Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction (NIH Publication No. 00-4769). Washington, DC: U.S. Government Printing Office.

Nelson, J. M., & Machek, G. R. (2007). A survey of training, practice, and competence in reading assessment and intervention. *School Psychology Review, 36*(2), 311–327.

Papalewis, R. (2004). Struggling middle school readers: Successful, accelerating intervention. *Reading Improvement, 41*(1), 24–37.

Perfetti, C. A. (1991). Representations and awareness in the acquisition of reading competence. In L. Rieben & C. A. Perfetti (Eds.), *Learning to read: Basic research and its implications* (pp. 33–44). Hillsdale, NJ: Erlbaum.

Rack, J., Hulme, C., Snowling, M., & Wightman, J. (1994). The role of phonology in young children's learning of sight words: The direct mapping hypothesis. *Journal of Experimental Child Psychology, 57,* 42–71.

Rack, J. P., Snowling, M. J., & Olsen, R. K. (1992). The nonword reading deficit in developmental dyslexia: A review. *Reading Research Quarterly, 27,* 28–53.

Rayner, K., & Pollatsek, A. (1989). *The psychology of reading.* Hillsdale, NJ: Erlbaum.

Scarborough, H. S., & Brady, S. A. (2002). Toward a common terminology for talking about speech and reading: A glossary of the "phon" words and some related terms. *Journal of Literacy Research, 34*(3), 299–336.

Share, D. L. (1999). Phonological recoding and orthographic learning: A direct test of the Self-Teaching Hypothesis. *Journal of Experimental Child Psychology, 72,* 95–129.

Share, D., Jorm, A. F., MacLean, R., & Matthews, R. (2002). Temporal processing and reading disability. *Reading and Writing: An Interdisciplinary Journal, 15*(1–2), 151–178.

Slavin, R. E., Lake, C., Chambers, B., Cheung, A., & Davis, S. (2009). Effective reading programs for the elementary grades: A best-evidence synthesis. *Review of Educational Research, 79*(4), 1391–1466.

Stahl, S. A., & Murray, B. A. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology, 86*(2), 221–234.

Stanovich, K. E., & Siegel, L. S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology, 86*(1), 24–53.

Swanson, L. (1978). Verbal encoding effects on the visual short-term memory of learning disabled and normal readers. *Journal of Educational Psychology, 70*(4), 539–544.

Swanson, T. H., Hodson, B. W., & Schommer-Aikins, M. (2005). An examination of phonological awareness treatment outcomes for seventh-grade poor readers from a bilingual community. *Language, Speech, and Hearing Services in Schools, 36*(3), 336–345.

Torgesen, J. K., Alexander, A. W., Wagner, R. K., Rashotte, C. A., Voeller, K. K. S., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long-term outcomes from two instructional approaches. *Journal of Learning Disabilities, 34*(1), *33*, 58–78.

Treiman, R., Sotak, L., & Bowman, M. (2001). The roles of letter names and letter sounds in connecting print to speech. *Memory & Cognition, 29*(6), 860–873.

Vellutino, F. R., Scanlon, D. M., & Lyon, G. R. (2000). Differentiating between difficult-to-remediate and readily remediated poor readers: More evidence against the IQ–achievement discrepancy definition of reading disability. *Journal of Learning Disabilities, 33*, 223–238.

Vellutino, F. R., Scanlon, D. M., Sipay, E. R., Small, S. G., Pratt, A., Chen, R., & Denkla, M. B. (1996). Cognitive profiles of difficult-to-remediate and readily remediated poor readers: Early intervention as a vehicle for distinguishing between cognitive and experiential deficits as basic causes of specific reading disability. *Journal of Educational Psychology, 88*, 601–638.

Vellutino, F., Steger, J., DeSetto, L., & Phillips, F. (1975). Immediate and delayed recognition of visual stimuli in poor and normal readers. *Journal of Experimental Child Psychology, 19*, 223–232.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (2013). *The Comprehensive Test of Phonological Processing (CTOPP)–Second edition*. Austin, TX: Pro-ED.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children* (3rd ed.). San Antonio, TX: Psychological Corporation.

Woodcock, RN. (1987). *Woodcock Reading Mastery Tests-revised examiner's manual.* Circle Pines, MN: American Guidance Service.

Ziegler, J. C., & Goswami, U. (2005). Reading acquisition, developmental dyslexia, and skilled reading across languages: A psycholinguistic grain size theory. *Psychological Bulletin, 131*(1), 3–29.

TEST YOURSELF

1. According to the NAEP, about what percentage of fourth graders in the United States read below a basic level?

a. 30–34%

b. 22–25%

c. 16–18%

d. 10–11%

2. Reading researchers used to assume that visual memory was the mechanism for sight-word storage. Which of the following types of research demonstrates why they no longer accept that?

a. Studies show that linguistic skills strongly predict sight vocabulary.

b. Research shows LD readers have fairly normal visual memory.

c. Mixed-case experiments (using words like: tAbLe, eLePhAnT, etc.) where adults learned to quickly read words even though the visual image was disrupted.

d. All of the above are correct.

3. All of the following statements about competent readers are true except:

a. They can identify a word in 1/20 of a second.

b. They can read 150–250 words per minute.

c. They can identify tens of thousands of words immediately by sight, without a context.

d. They require 10–20 exposures to new words in order to permanently store those words.

4. Orthographic mapping (also called *bonding, direct mapping, self-teaching hypothesis*, etc.) is:

a. The mental process we use to store words for immediate retrieval.

b. A learning strategy using children's literature to motivate interest in reading.

c. A method of evaluating which words children have learned.

d. A method of determining which types of words children learn most quickly.

5. Orthographic mapping involves:

a. Applying phonemic awareness to the phonic aspects of words.

b. Hearing the sounds in spoken words and noticing how they relate to their printed forms.

c. Connecting printed forms of words to a child's existing oral/mental dictionary.

d. All of the above

6. What is phonological awareness?

a. It is an awareness that oral words are made up of smaller sound parts.

b. It is a teaching strategy that emphasizes the differences between regular and irregular words.

c. It is when children read aloud, they notice when they have misread a word.

d. It is the ability to answer comprehension questions when a passage is read to the student.

7. The American Federation of Teachers and a 2009 special issue of the *Journal of Learning Disabilities* pointed out that:

a. Reading difficulties are genetic and can be helped only to a limited degree.

b. The only effective way to remediate reading is with 1:1 instruction.

c. There is a gap between scientific research on reading and classroom practice.

d. Reading scores have consistently improved over the last 30 years.

8. Large-scale U.S. government–funded studies (e.g., Torgesen et al., 2001; Vellutino et al., 1996) have suggested that

a. Reading progress in reading disabilities is limited because of the genetic/neurological origin of this condition.

b. With the right kind of prevention and remediation opportunities, *all* children can become skilled readers.

c. With the right kind of prevention and remediation opportunities, *most* reading disabilities can be prevented or corrected.

d. Success with overcoming reading difficulties is directly keyed to a student's IQ.

(continued)

(continued)

9. **To prevent reading disabilities, we must be sure that students begin their reading careers with:**
   a. Sufficient phonological awareness to begin mapping words to permanent memory.
   b. Sufficient sound-symbol skills to begin mapping words to permanent memory.
   c. Sufficient graphophonemic awareness to allow students to notice the relationship between the sounds in spoken words and the letters used to spell them.
   d. All of the above will prevent reading disabilities.

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