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Chapter 8

Developmental Changes in Reading Comprehension: Implications for Assessment and Instruction

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Concerted efforts have been made in recent years to understand the development of reading comprehension skills, but translating knowledge gained from this research into improved instructional practices can be difficult. Reading comprehension is complex; it involves numerous cognitive processes and is influenced by many task-related factors. Models that illustrate how different knowledge sources and cognitive processes might interact to transform linguistic units into meaning in the mind can be helpful for researchers who wish to delineate the potential types of knowledge and skills involved in reading (see, e.g., Perfetti, 1999). However, their complexity can be overwhelming for practitioners. The goal for classroom teachers, special educators, paraprofessionals, administrators, parents, and others is to teach children to read with understanding. To accomplish this, practitioners need to assess children's current literacy skills, identify those who are at risk for reading difficulties, and determine which types of instruction will be most effective for which types of students.

Simplifying Comprehension

In the "simple view of reading" (Gough & Tunmer, 1986; Hoover & Gough, 1990), reading comprehension is modeled as the product of word reading and language comprehension. Word reading involves decoding or translating the letters on a page or screen into pronounceable words. Language comprehension involves making sense of the decoded words. Language comprehension is sometimes measured by asking individuals to listen to a text and answer questions about it. Other times, it is measured with assessments of separate language domains, such as oral vocabulary or syntax (grammar). However, the basic idea is that understanding language is similar whether it is communicated by ear or by eye.

What Research Has to Say About Reading Instruction (4th ed.) edited by S. Jay Samuels and Alan E. Farstrup.

The multiplicative relationship between word reading and language comprehension underscores two important theoretical points of the simple view. First, both components are necessary, but neither is sufficient for successful reading comprehension. Second, although the two factors are usually highly correlated, they are also dissociable: It is possible to have high ability in one component but low ability in the other.

Imagine yourself reading in an unfamiliar language. If it uses the Latin alphabetic script and you have good decoding skills, you can likely "sound out" the words fairly well. However, if you have no idea what those words mean, your language comprehension is zero—and your reading comprehension will also be zero (because the product of zero and any number is zero). Likewise, it is possible to have strong oral language skills but little decoding ability. For example, imagine trying to read Braille without being taught; similarly, one could learn to speak and understand conversational Chinese without learning to recognize its print characters. In both cases, although oral language knowledge might be very good, reading comprehension will still be zero because decoding is zero.

Numerous studies have shown that measurements of word reading and language comprehension do an excellent job of accounting for individual differences in reading comprehension in populations ranging from primary school through adulthood (Adlof, Catts, & Little, 2006; Braze, Tabor, Shankweiler, & Mencl, 2007; Catts, Hogan, & Adlof, 2005; Chen & Vellutino, 1997; Dreyer & Katz, 1992; Gough, Hoover, & Peterson, 1996; Hoover & Gough, 1990; Kendeou, van den Broek, White, & Lynch, 2009; Landi, 2010; Malatesha Joshi & Aaron, 2000). Studies have also found that modeling an additive relationship between word reading and language comprehension provides nearly as good (or sometimes a better) a fit to the data as does the multiplicative relationship (Chen & Vellutino, 1997; Dreyer & Katz, 1992; Hoover & Gough, 1990; Malatesha Joshi & Aaron, 2000). This finding is likely explained by the fact that the two factors involved in the simple view are correlated, and true zeroes in either are extremely rare.

Longitudinal studies also have shown that measurements of early word reading and language comprehension can be used to predict later performance in reading comprehension (Adlof et al., 2006; Muter, Hulme, Snowling, & Stevenson, 2004; Storch & Whitehurst, 2002). Furthermore, measurement of skills considered precursors of word reading and language comprehension can be used to predict a child's risk for reading comprehension difficulties later on (Adlof, Catts, & Lee, 2010; Catts, Fey, Tomblin, & Zhang, 2002; Scarborough, 1990; Wood, Hill, Meyer, & Flowers, 2005). Thus, the simple view of reading provides a useful model

for professionals interested in the assessment and instruction of both typically developing children and children with reading difficulties.

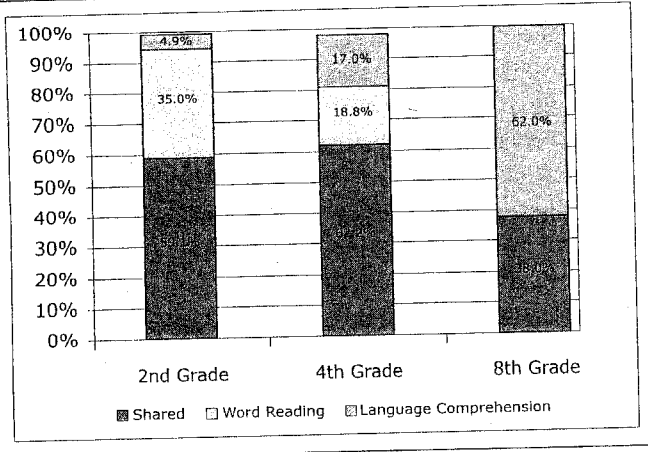
Changes in Reading Comprehension Over Time

To assess reading comprehension skills in a meaningful way, it is important to understand how the task of reading comprehension changes over time. In the early grades, word reading is the primary factor associated with reading comprehension. As students move into the upper elementary grades and beyond, language comprehension becomes the most important factor. This shift was highlighted in a set of longitudinal studies in which 604 children from the U.S. state of Iowa were followed from kindergarten through eighth grade, with assessments of word reading, language comprehension, and reading comprehension occurring at second, fourth, and eighth grades (Adlof et al., 2006; Catts et al., 2005).

Adlof et al. (2006) used latent regression models to assess both the unique and the shared contributions of word reading and language comprehension to reading comprehension concurrently within each grade and predictively from second to fourth grades and from fourth to eighth grades. Three important findings are displayed in Figures 8.1 (concurrent models) and 8.2 (predictive models). First, nearly all the individual differences in reading comprehension could be explained by the word reading and language comprehension factors in each grade (98–100% in the concurrent models, and 90–97% in the predictive models). Second, a large amount of the explained variance in reading comprehension was shared between word reading and language comprehension, underscoring the fact that, for most individuals, the two are highly related. Third, there was a striking difference in the importance of each component between second and eighth grades. In the concurrent models, word reading by itself accounted for 94% of the variance in reading comprehension in second grade, whereas it accounted for only 38% of the variance in eighth grade, and all of that was shared with language comprehension. Because language comprehension and reading comprehension shared all of their reliable variance in eighth grade, they formed a unitary construct. Thus, language comprehension accounted for 100% of the variance in reading comprehension in eighth grade compared with 64% in second grade.

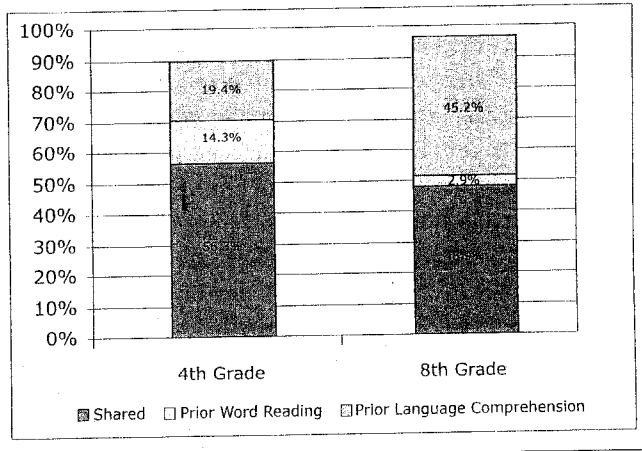
When comparing these results to those of other studies, it is important to note that the contribution of each component—word reading and language comprehension—to reading comprehension is influenced

Figure 8.1. Variance in Reading Comprehension Explained by Concurrent Word Reading and Language Comprehension Skills



Note. Reported in "Should the Simple View of Reading Include a Fluency Component?" by S.M. Adlof, H.W. Catts, and T.D. Little, 2006, *Reading and Writing: An Interdisciplinary Journal, 19*(9), pp. 944–946.

Figure 8.2. Variance in Fourth- and Eighth-Grade Reading Comprehension Explained by Second- and Fourth-Grade Component Skills



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by the type of test used. Some tests, especially those that employ very short passages, are more highly correlated with word reading skills, while others show a stronger reliance on language comprehension (Cutting & Scarborough, 2006; Francis, Fletcher, Catts, & Tomblin, 2005; Keenan, Betjemann, & Olson, 2008; Nation & Snowling, 1997). However, the general pattern of association remains the same: Regardless of the tests employed, the correlation between word reading and reading comprehension decreases with progression through the grades, whereas that between language comprehension and reading comprehension increases (Francis et al., 2005; Gough et al., 1996; Keenan et al., 2008).

Why does this shift occur? For starters, word reading always sets a ceiling for comprehension, as demonstrated in our example of reading Braille. In the early grades, children are just beginning to learn how to decode print, and their spoken language knowledge far exceeds their decoding abilities; thus, in early grades, word reading skills best explain individual differences in reading comprehension. However, by the later grades, word reading accounts for less variance because most people know how to read most words.

Another possible reason for the shift is that the nature of the materials to be comprehended changes across grades. Consider the reading materials presented to second-grade students versus eighth-grade students. Second graders typically encounter far more narrative than expository text, which tends to follow a predictable structure that most children are familiar with. Even when expository texts are presented to children of this age, they generally use simple sentence structures and a restricted, familiar, and sometimes repetitive vocabulary. They are often about familiar topics for which children have a good amount of background knowledge. Overall, the language in texts for second graders is not that different from the language that might be used to talk to second graders about the same topics.

Take as an example this excerpt from *Penguins* by Bobbie Kalman (1995), an expository text recommended for skilled second-grade readers:

> Penguins may not look like other birds, but they are birds. Like all birds, penguins are covered with feathers. They are **warm-blooded,** which means their body stays the same temperature no matter how warm or cold their surroundings are. All birds, including penguins, hatch from eggs.
>
> Penguins have different shapes and colors. Some penguins have only black and white feathers. Others, such as the emperor penguin on the left, have brightly colored patches of feathers. Special head markings help penguins recognize other members of their species. (pp. 5–6; emphasis in original)

The average sentence length in this brief passage is 10.4 words. Although the word *penguin* might be difficult initially for children to decode, it is repeated seven times. The average frequency of the content words (i.e., words that carry meaning, as opposed to function words that convey grammatical relationships) in texts appropriate for school-age children is high: 448 per million words, according to the *Educator's Word Frequency Guide* database (Zeno, Ivens, Millard, & Dubburi, 1995).

Comprehension questions for this type of text might ask, What kind of animal is a penguin? What does it mean to be warm-blooded? How are baby penguins born? How do penguins recognize other members of the species? Most children who have read the text should be able to answer these questions correctly (and some—especially those who have seen any of the films about penguins that have been released in recent years—could probably answer at least a few without reading). Comprehension assessments used with children in the early grades tend to stress word reading; if the children are able to read the words in the text, they can generally answer the comprehension questions.

In contrast, by the eighth grade, children encounter more expository texts than narrative, and they usually have less background knowledge about the topics. In second grade, children are learning to read; by eighth grade, they are expected to be reading to learn (Chall, 1983). Students at this age are building background knowledge about academic subjects through assigned readings. Word reading should be occurring automatically, but comprehension requires more cognitive effort.

Compared with texts for younger children, the sentence structures in texts in the later grades are more complex, and they contain more advanced, topic-specific, and abstract vocabulary. The language used in these texts is usually more complex than the language used in conversations—or even in classroom instruction. Here is an excerpt from *The Field Guide to Geology*, a trade book by David Lambert and The Diagram Group (2007) written at an early high school reading level:

> Earth is a rocky spinning ball—one of nine planets and many lesser bodies (moons, asteroids, and comets) orbiting a star (the Sun). All of these together constitute our solar system.
>
> Earth is tiny compared to the four largest planets. But our solar system's largest and most influential body is the Sun, a glowing ball of gases

a million times the volume of Earth and far bigger than all the other objects orbiting the Sun. The Sun's immense gravitational force prevents the entities around it from flying outward into space. And its electromagnetic radiations produce the heat and light that help make life possible on Earth—the third nearest planet to the Sun. Most planets closer in or farther out appear too hot or cold for life.

Earth's behavior and that of its Moon determine time on Earth. Like all planets, Earth spins on a central axis with imaginary ends at the poles. Each rotation of about 24 hours produces day and night. (p. 14)

The sentences in this passage average 16.6 words, longer than those in the second-grade text, and they are more complex. The vocabulary is also more difficult. Although there are few rare words in this passage, the average frequency of the content words, at 295 per million, is lower than in the second-grade passage.

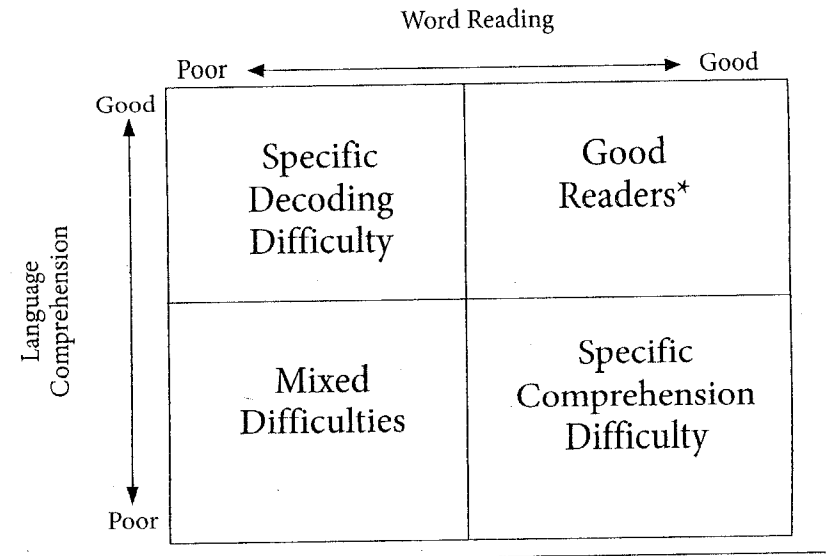
To understand this passage, you need to have at least some familiarity with words and concepts such as *planet*, *solar system*, *gravitational*, and *orbiting*. You need to understand that *bodies* in this paragraph does not refer to human or animal forms. You need to understand the use of parentheses. Several simple fact-based questions could be asked about this text, such as What is the biggest body in the solar system? or What keeps planets from flying into space? But more advanced comprehension questions for this text might ask, Why does Earth orbit the Sun? How is gravity related to the existence life on earth? It is unlikely that a student without considerable background knowledge could answer these questions without sufficient skills in language comprehension.

Reading Dimensions and Reading Subgroups

As we have explained, skilled readers usually show strengths in word reading and language comprehension, while less skilled readers generally show weaknesses in both areas. However, the correlation is not perfect, and studies employing factor analysis and latent modeling procedures have demonstrated that the constructs of word reading and language comprehension are separable (Aaron, Joshi, & Williams, 1999; Adlof et al., 2006; Kendeou, Savage, & van den Broek, 2009; Landi, 2010).

Because readers can vary along dimensions of word reading and language comprehension, four basic profiles of readers are predicted, as displayed in Figure 8.3. (It is important to remember that these subgroups are not distinct, but rather indicate profiles of relative strength and weakness.) Individuals in the top right quadrant have relatively good skills

Figure 8.3. Basic Profiles of Readers



*Some children who are predicted to be good readers using this model still experience difficulties. In Catts and colleagues' studies, poor readers who fall in this quadrant are said to have "non-specified" reading difficulties (Catts et al., 2003; Catts et al., 2005).

in both word reading and language comprehension and are expected to be good readers, whereas individuals in the other three quadrants are expected to have reading difficulties. Those with low skills in both word reading and language comprehension fall in the lower left quadrant. This "mixed-difficulties" group displays the most common profile of reading difficulty, and individuals fitting it could be described as "garden-variety poor readers" (Gough et al., 1996; Stanovich, 1988). The top-left quadrant includes children with specific decoding deficits in spite of relatively good language skills. These children might also be described as having dyslexia (Catts & Kamhi, in press). In the lower right quadrant are children with specific comprehension deficits, whose language comprehension is low relative to their word reading abilities.

With the Iowa longitudinal data set described earlier, Catts and colleagues (Catts et al., 2005; Catts, Hogan, & Fey, 2003) used this model to examine developmental changes in the proportion of poor readers in each subgroup in second, fourth, and eighth grades. A "poor reader" was defined as any child who scored at least one standard deviation below the mean (i.e., below the 16th percentile) on the composite measure of

reading comprehension. The same cutoff was used as the delineation between "good" and "poor" word reading and language comprehension skills. Table 8.1 lists the percentage of poor readers who fit the criteria for each of the subgroups at each grade. Across all grades, the poor readers who fell in the mixed-difficulties quadrant formed the largest subgroup; approximately one-third of poor readers in each grade showed difficulties with both word reading and language comprehension. However, there was an interesting shift in the proportion of poor readers in each of the specific-deficit subgroups. In the decoding-deficit subgroup, the proportion of poor readers decreased from 32% in second grade to 22% in fourth grade to 13% in eighth grade. In contrast, the proportion of poor readers in the comprehension-deficit subgroup increased from 16% in second grade to approximately 30% in fourth and eighth grades.

The shift in size of the different poor-reader subgroups across grades was not caused by children from one subgroup moving into a different subgroup. Rather, most children who were identified as having decoding deficits in second grade continued to show the same profile in fourth and eighth grades: Their word reading performance remained low relative to their measured language comprehension. Likewise, children with specific comprehension deficits in eighth grade tended to show low comprehension skills relative to word reading skills in second and fourth grades. What changed was whether the child was considered to be a poor reader, based on his or her score on the reading comprehension composite. Children with specific decoding deficits were more likely to score low in reading comprehension in earlier grades, whereas children with specific comprehension deficits were more likely to score low in reading comprehension in later grades. Thus, the shift in the profiles of children identified as poor readers corresponded to the shift in skills most related to reading comprehension as children progress through the grades.

Table 8.1. Percentage of Poor Readers in Each Simple View Subgroup by Grade

	Specific decoding difficulties	Mixed difficulties	Specific comprehension difficulties	Nonspecified difficulties
Grade 2	32.3%	36.3%	16.3%	15.0%
Grade 4	22.3%	32.9%	31.0%	13.8%
Grade 8	13.3%	33.0%	30.1%	23.6%

Note. Reported in "Developmental Changes in Reading and Reading Disabilities" (pp. 29–31) by H.W. Catts, T.P. Hogan, and S.M. Adlof, 2005, *The Connections Between Language and Reading Disabilities* edited by H.W. Catts & A.G. Kamhi, Mahwah, NJ: Erlbaum. Rows all do not sum to 100% due to rounding.

A fourth subgroup of poor readers scored above the cutoffs for word reading and language comprehension, but still scored below the cutoff on the reading comprehension measure. In Catts and colleagues' studies (Catts et al., 2003; Catts et al., 2005), these children were said to have "nonspecified" reading difficulties. As in the comprehension-deficit subgroup, the number of children meeting the criteria for this subgroup also increased over time, from 15% in second grade to 24% in eighth grade. Note that most were just slightly above the cutoffs for inclusion in the other subgroups, and nearly all showed below average language comprehension. Thus, it appeared that relatively mild oral language weaknesses were associated with more severe reading comprehension difficulties.

Late-Emerging Poor Readers

Recently, there has been increasing interest in children who appear to be good readers in the early grades but show reading difficulties around fourth grade and beyond (e.g., Badian, 1999; Catts & Hogan, 2002; Compton, Fuchs, Fuchs, Elleman, & Gilbert, 2008; Leach, Scarborough, & Rescorla, 2003; Lipka, Lesaux, & Siegel, 2006). The simple view model helps explain why children with specific comprehension deficits appear to have late-emerging reading difficulties. Because early assessments of reading comprehension are explained primarily by word reading skills, these children initially appear to be good readers. When comprehension demands on reading assessments increase after second or third grade, children's reading comprehension difficulties may emerge as a surprise to parents and teachers.

There is evidence that some specific decoding deficits can be late to emerge (Leach et al., 2003; Lipka et al., 2006). The mechanisms behind such deficits are not clear, but it is possible that very subtle early word-reading difficulties could become more severe in later grades, when phonologically and morphologically complex words become more prevalent. However, the evidence also suggests that children with specific comprehension deficits are most at risk for late identification. For example, Leach et al. (2003) identified 18 children with specific decoding deficits, 12 with specific reading comprehension deficits, and 26 with mixed deficits in grades 1 through 5. Just over a third of the children with specific decoding deficits (39%) and mixed deficits (38%) were late identified, whereas 83% of the children with specific reading comprehension deficits were late

identified. Similarly, Catts, Adlof, and Ellis Weismer (2006) found that eighth graders with specific reading comprehension deficits had an average reading comprehension standard score of 95 in second grade. (Note that children with specific reading comprehension deficits, also known as "poor comprehenders," have good word reading skills but poor reading comprehension, which is slightly different from the subgroup previously described with language comprehension deficits. In the Iowa longitudinal data, there is a very significant overlap between children identified using each method in later grades but slightly less overlap in early grades, when, as noted previously, reading comprehension measures are more reliant on word reading skills.) Likewise, Nation, Clarke, Marshall, and Durand (2004) have referred to the language deficits of children with specific reading comprehension difficulties as "hidden deficits," because parents and teachers rarely report any concerns about reading or language achievement before a formal assessment has been conducted.

The characterization of "late-emerging" poor readers is based solely on reading measures. However, as we will explain, measures of oral language skills can be used to identify children who are at risk for reading difficulties prior to the onset of reading instruction. Following a simple-view model, one might expect that predictors of word reading difficulties might differ from those of comprehension difficulties. Likewise, prediction of risk for "early-emerging" reading difficulties (which generally involve word reading problems) might involve different measures than prediction of risk for later reading problems (which typically involve comprehension). Before turning to this discussion, however, we first consider whether factors should be added to the simple-view model.

What's Missing? Considering Additions to the Simple View

Although word reading and language comprehension generally account for substantial amounts of variance in reading comprehension, studies employing regression analyses often report a large amount of variance not explained by these factors. Estimation of variance is always limited by the precision of the measures employed, so many of the effect-size differences across studies are likely related to differences in measurement. Other differences may be related to sampling.

Still, the simple view of reading comprehension is *simple*, and many have considered whether other predictors should be added to the model. In Perfetti's (1977) conception, for example, reading comprehension was modeled as the sum of word reading, language comprehension, and *X*, with *X* being open to an "everything else" interpretation. Here we consider four potential additions: fluency, vocabulary, background knowledge, and nonverbal cognitive abilities.

Fluency

According to verbal-efficiency theory, when word reading is fluent, or automatic, cognitive resources that would otherwise be allocated to decoding can instead be devoted to comprehension (LaBerge & Samuels, 1974; Perfetti, 1985). Based on this theory, as well as recent emphasis on fluency in the field (e.g., National Institute of Child Health and Human Development [NICHD], 2000), some have considered whether speed of word reading might influence comprehension above and beyond accuracy, and if so, whether measures of reading speed should be added to the simple view (e.g., Aaron et al., 1999; Adlof et al., 2006; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009).

Overall, there is little evidence to support such an addition. Although studies employing regression analyses found that fluency (accuracy + speed) accounted for small amounts of unique variance in reading comprehension after controlling for word reading and language comprehension (e.g., Aaron et al., 1999; Tilstra et al., 2009), a study drawing on the Iowa longitudinal database—employing a larger sample, latent factors composed of norm-referenced assessments, and three time points (second, fourth, and eighth grades)—found that speed did not ever account for unique variance (Adlof et al., 2006). Rather, the speed construct was always very highly correlated with accuracy and moderately to highly correlated with language comprehension. Follow-up analyses were conducted among individual participants in the Iowa study to determine whether speed might be independently related to reading comprehension difficulties for any children in any grade. In the full sample of more than 500 children, no child could be found whose reading comprehension problems could be attributed to speed alone. That is, children who were accurate but slow readers *always* had good reading comprehension if their language comprehension was also good. Those who had poor reading comprehension also showed language comprehension problems. These findings suggest that fluency develops as an outcome of good word reading and language skills. Fluency is important, but speed itself does not appear to be an independent source of comprehension difficulty.

In the Iowa second-grade data, the best fit was achieved by modeling accuracy and fluency as a unitary construct. This indicates that the same

information was provided by the measures of accuracy as by the measures of fluency. Children who were able to read more difficult words in the accuracy assessments (the word attack and word identification subtests of the Woodcock Reading Mastery Test—Revised [Woodcock, 1998] and the accuracy score from the GORT-3 [Wiederholt & Bryant, 1994]) were also able to read more total words, and more difficult words, in the fluency assessments (the sight words and decoding subtests of the Test of Word Reading Efficiency [Torgesen, Wagner, & Rashotte, 1999] and the fluency score from the GORT-3).

Some definitions of fluency also include reading with appropriate prosody or intonation (e.g., Miller & Schwanenflugel, 2008; NICHD, 2000; Rasinski, Rikli, & Johnston, 2009). When defined this way, fluency is best characterized as an outcome of efficient word reading and comprehension, rather than as a predictor of comprehension. In other words, oral reading with appropriate prosody can be construed as a marker that sentence-level comprehension is occurring, but prosody is most likely not a causal factor for comprehension. Fluency defined as accuracy + speed + prosody *should* be affected when comprehension is difficult.

These findings have implications for how we approach fluency in practice. Measures of reading speed can be especially useful for measuring children's progress with word reading skills. They can be faster to administer than accuracy measures, and they may also identify children with more subtle word reading difficulties or those who may be in a period of "illusory recovery," with deficits that appear to have been remediated but will resurface later (e.g., Compton et al., 2008; Scarborough & Dobrich, 1990). These children, as well as those who have benefited from intensive interventions (e.g., Torgesen et al., 2001), may be able to decode grade-level words accurately but not at the level of automaticity. They might benefit from additional practice in word reading, but they do not have a specific "fluency" deficit.

Passage-level fluency measures may also be useful to assess progress in overall reading skills, including both word reading and comprehension (e.g., Good & Kaminski, 2002a), but users of these tests must realize that slow reading can be caused by a variety of factors. Likewise, we do not want to encourage children to become speed-readers, but rather to read for comprehension (e.g., Samuels, 2007). We should also be cautious about assuming that a child comprehends a text fully just because her oral reading sounds fluent; the level of comprehension needed for appropriate prosody is likely lower than the level needed to build a situation model. Interventions to improve fluency in reading connected text, such as wide reading and repeated readings, are sometimes effective for improving reading comprehension (e.g., Edmonds et al., 2009; Meyer & Felton, 1999; O'Connor, White, & Swanson, 2007; Schwanenflugel et al., 2009; cf. Wexler, Vaughn, Roberts, & Denton, 2010), likely because they improve both word reading and language comprehension skills. One benefit of the wide reading approach is that it exposes students to a variety of complex texts, which include more vocabulary and more content. Finally, these approaches are likely to be most effective when used in combination with other activities aimed at improving language and reading comprehension skills.

Vocabulary

Typically, vocabulary is conceptualized as a part of language comprehension; obviously, knowledge of word meanings is crucial for understanding text. This does not mean that vocabulary knowledge is not important for word reading. Although one can decode words without knowing their meanings, there is substantial evidence that vocabulary knowledge does influence word reading for both skilled and unskilled readers (see Nation, 2008, for a review). At the most basic level, it is easier to recognize a word if one already knows that it exists in the world. Evidence suggests that even shallow knowledge of word meanings is associated with better word reading, especially for words with irregular or inconsistent letter–sound mappings (Nation & Cocksey, 2009; Ouellette, 2006; Perfetti, 2007; Perfetti & Hart, 2001).

Vocabulary size may also indirectly influence the development of word reading abilities through phonological awareness in young children. In the lexical restructuring model, Metsala, Walley, and colleagues (Metsala & Walley, 1998; Walley, Metsala, & Garlock, 2003) hypothesize that children begin with coarse-grained phonological representations of words, but as their vocabularies grow, their word representations become increasingly fine-grained due to the need to distinguish similar sounding words in the mental lexicon. In line with this hypothesis, Metsala (1999) reported positive associations between individual differences in vocabulary size and phonological awareness; Lonigan (2007) more recently reviewed converging evidence from longitudinal studies. Metsala (1999) also found that children performed better at phonological awareness tasks for real-word items as opposed to nonwords, for familiar words as opposed to unfamiliar, and for words with many similar-sounding

neighbors in the child's mental lexicon. Recent results reported by Hogan (2010) and De Cara and Goswami (2003) provide supporting evidence but suggest that a child's vocabulary must be of sufficient size before lexical restructuring can occur.

At least three additional studies—Braze et al. (2007), Ouellette and Beers (2010), and Verhoeven and van Leeuwe (2008)—have shown that vocabulary knowledge accounts for unique variance in reading comprehension over and above that explained by word recognition and listening comprehension measures. Our point, however, is not necessarily to propose that vocabulary needs to be added to the simple-view model, but rather to highlight the pivotal role of vocabulary knowledge as the link between word reading and comprehension (e.g., Perfetti, 2010). Because of its fundamental importance to reading overall, assessment of vocabulary knowledge is informative both for explaining current reading skills and for predicting future reading achievement. Furthermore, as vocabulary interventions have been shown to increase reading comprehension skills (e.g., Elleman, Lindo, Morphy, & Compton, 2009), vocabulary instruction should be considered an essential component of any reading curriculum.

Background Knowledge

It is commonly reported that to comprehend a text, a reader must know most of the words it contains (e.g., Nagy & Scott, 2000). The role of background knowledge in reading comprehension is similar: The more one knows about a topic, the easier it is to comprehend a text about it (Adams, Bell, & Perfetti, 1995; Spilich, Vesonder, Chiesi, & Voss, 1979). (Logically, there should also be a relationship between background knowledge and vocabulary: The more one knows about a topic, the more likely one is to be familiar with vocabulary specific to that topic.) An individual with significant background knowledge about a topic needs only to update her preexisting situation model with the new information provided in the text; an individual with no previous background knowledge must construct a new model (e.g., Kintsch, 1988). Individual differences in reading experience are significantly correlated with adult knowledge across a variety of domains (Stanovich & Cunningham, 1993). Thus, the relationship between knowledge and reading comprehension is logically reciprocal. The more one knows, the more one can comprehend—and the more one learns.

Background knowledge affects language comprehension just as it affects reading comprehension. Thus, for general reading comprehension, no additional background knowledge component is needed. Standardized reading and listening comprehension assessments often attempt to limit the influence of background knowledge on performance by using multiple texts on a variety of topics or texts for which the knowledge required for understanding is assumed to be very general. Unfortunately, there is frequently a large gap in even very general world knowledge between children from economically advantaged versus disadvantaged backgrounds (Burkam & Lee, 2002; Chall, Jacobs, & Baldwin, 1990). Thus, low background knowledge can be a source of generally poor reading comprehension performance for some children. Without appropriate instructional support, this gap is expected to grow over time. High-quality, content-rich instruction has the potential to level the playing field and reduce the knowledge gap (Hirsch, 2001, 2003; Neuman, 2006).

As children move into the upper grades, comprehension of texts in different academic disciplines requires attention to different aspects of the text. Experts in different disciplines read differently. For example, Shanahan and Shanahan (2008) discovered that historians pay considerable attention to the author's perspective when reading a historical text. They are not merely looking for a timeline of events and characters; rather, they are looking for the connections between the events and explanations of why things happened. These explanations can differ depending on perspective; "truth" in history is in the eye of the beholder. In contrast, because knowledge in chemistry is generated through experimentation and objective data, chemists might place less emphasis on the source of information but more on understanding the process behind the experiment that produced the finding. Therefore, chemists tend to pay more attention to figures, graphs, and formulas, relating those with the information presented in the prose. They try to visualize the process of the experiment and predict the conditions in which it can or cannot be replicated. Thus, knowing what information should be attended to is another source of background knowledge needed for advanced comprehension.

Nonverbal Cognitive Abilities

Some evidence suggests that cognitive skills that go beyond language processing may be involved in reading comprehension. For example, Cutting, Materek, Cole, Levine, and Mahone (2009) found that 9- to 14-year-old children with specific reading comprehension deficits (i.e., good word reading but poor reading comprehension) showed significantly worse performance on tasks involving nonverbal executive

function that require planning, organization, and self-monitoring (such as mazes) than good readers of the same age. Similarly, using data from the Iowa database, Catts and Compton (in preparation) found that late-emerging poor readers are as likely to have had deficits in nonverbal IQ as in oral language skills. In a related analysis, Adlof et al. (2010) found that kindergarten measures of nonverbal IQ were better predictors of eighth-grade reading difficulties than of second-grade reading difficulties. These findings are interesting in light of the fact that nonverbal cognitive skills are not predictive of response to early reading instruction (see, e.g., Stuebing, Barth, Molfese, Weiss, & Fletcher, 2009). Furthermore, they suggest that the higher level cognitive skills needed for reading comprehension in later grades may not be restricted to language.

Implications for Assessment and Instruction: What Matters and When?

Developmental changes in the relative influence of word reading and language comprehension on reading comprehension have important implications for how reading assessment and instruction should be carried out. First, it is important to understand that poor reading performance is affected by different underlying skills in early versus later grades. Therefore, different types of assessments are needed to explain or predict reading outcomes in early versus later grades. Second, it is important to foster the development of language skills that will facilitate comprehension throughout schooling, especially for children with oral language weaknesses that place them at risk for reading comprehension problems.

Rather than recommend that specific tests or interventions be used, our goal in this section is to provide basic guidelines with reference to the developmental timeline. (We cite some commonly used assessments merely as examples.)

Assessment

There are many different reasons for assessing reading skills, and often they vary according to the developmental period. In the preschool and kindergarten years, the goal of assessment is typically to determine a child's risk for having reading difficulties later on. In the elementary grades, after reading instruction has begun, assessments can be used to evaluate current reading skills, to measure progress in the reading curriculum, and to identify risk for future problems. At each point along the developmental continuum, it is important to be mindful of the relative roles of word reading and language comprehension in reading comprehension when planning assessments.

Preschool and Kindergarten. Typically, studies aimed at the early identification of risk for reading difficulties (e.g., in preschool or kindergarten) focus on reading outcomes in the primary grades (e.g., Elbro, Borstrøm, & Petersen, 1998; Gallagher, Frith, & Snowling, 2000; Lonigan, Burgess, & Anthony, 2000). Thus, they tend to emphasize measures that are predictive of skills in word reading, such as phonological awareness, alphabet knowledge, and rapid automatic naming (RAN). See the report of the National Early Literacy Panel (National Center for Family Literacy, 2008) for a review.

These measures, as well as demographic risk factors such as a family history of reading difficulties (Elbro et al., 1998; Scarborough, 1989), are very useful for predicting early reading outcomes. Generally, accuracy of prediction is greatest when a combination of these measures is used. It is important to keep in mind that measures related to word reading may be somewhat less useful for identifying children with mild oral language weaknesses that might lead to reading comprehension problems later on. Therefore, the addition of broader, nonphonological language assessments, such as those that consider vocabulary, grammar, and discourse skills, may also be useful.

In a recent study using the Iowa longitudinal database, Adlof and colleagues (2010) confirmed that the kindergarten measures needed to best predict a child's likelihood of having reading problems in second grade were different from those needed to predict problems in eighth grade. The kindergarten battery included assessments of cognition, alphabet knowledge, and a variety of oral language skills, as well as mother's education level. In both second and eighth grades, children were classified as poor readers if they scored more than one standard deviation below the mean on a composite measure of reading comprehension (i.e., the same criteria used in the subgrouping study described previously). All children who scored above this cutoff were considered good readers. Notably, just under half of the children who were classified as "poor" readers in second grade were considered "good" readers in eighth grade, and vice versa.

The analyses examined all possible combinations of variables to find the best models in terms of prediction accuracy, parsimony, and statistical goodness of fit. Across multiple models, several variables were found to be highly predictive of outcome status in both second and eighth grades. These included measures of sentence imitation, phoneme

deletion, RAN, and mother's level of education. However, kindergarten alphabet knowledge was highly predictive of reading outcome status in second grade, but not in eighth grade. Likewise, measures of grammatical knowledge and nonverbal intelligence were predictive of eighth-grade outcome status, but not second-grade.

Eighth-grade outcomes were predicted with nearly as high accuracy as second-grade (90% concordance rate in second grade vs. 86% in eighth grade). The slight difference in accuracy of prediction resulted in a higher false-positive rate for eighth grade. In other words, to make sure that all eighth graders with reading problems were correctly identified as "at risk," the model overidentified students who were not at risk. Further, more research is needed to develop more sensitive and specific early predictors of later reading outcomes.

Numerous screening batteries are available for assessing children's risk for reading difficulties in the primary grades (e.g., Bridges & Catts, 2010; Catts, Fey, Zhang, & Tomblin, 2001; Good & Kaminski, 2002b; Invernizzi, Swank, & Juel, 2007; Wood et al., 2005). Until preschool and kindergarten batteries that can predict later reading outcomes are available, practitioners may wish to supplement with screens of vocabulary, grammar, and narrative or discourse skills, such as those used by speech-language pathologists (e.g., Dunn & Dunn, 2007; Justice et al., 2006; Rice & Wexler, 2001; Semel, Wiig, & Secord, 2004; Williams, 2007; Zimmerman, Steiner, & Pond, 2002). However, it is important to note that the language difficulties of children likely to have specific reading comprehension deficits in later grades may not be severe enough to be flagged by these measures (Catts et al., 2006; Nation et al., 2004; Nation, Cocksey, Taylor, & Bishop, 2010). Most important, the emergent literacy skills of students who are already receiving speech-language services should be monitored closely, as they are most at risk for later comprehension problems.

Early School Years. Assessments during the primary grades, when formal reading instruction has begun, can be used to monitor progress in reading, as well as to identify risk for later difficulties. At this stage, it is important to ensure that children are acquiring good word reading skills. A thorough assessment will include measurements of children's decoding skills (e.g., their ability to "sound out" nonsense words) and their ability to recognize both regularly and irregularly spelled real words (e.g., Torgesen et al., 1999; Woodcock, 1998). Children who have difficulty with word reading may need more intensive instruction to develop phonological awareness and knowledge of letter–sound correspondence, and they may need extra practice to ensure that word recognition becomes automatic, especially for irregularly spelled words.

As noted previously, reading comprehension measures in the early grades are reliant on assessment of word reading abilities, and these alone may not be sufficient to identify children who will have comprehension difficulties later on. Thus, supplemental assessments of language comprehension skills can be useful for obtaining a clearer picture. Several of the commercially available reading assessment batteries for school-age children include listening comprehension and vocabulary assessments for this purpose (e.g., MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2006; Stanford Achievement Test Series, 2003; Williams, Cassidy, & Samuels, 2001). Note that children with word reading difficulties may need to complete oral, rather than written, vocabulary assessments. Children who show mild difficulties with language comprehension may benefit from supplemental comprehension-focused instruction. Those with more severe difficulties may need to be referred to a speech-language pathologist for in-depth testing and possible language intervention.

Middle Grades and Beyond. By around fifth grade, children should have a solid foundation in both word reading and language comprehension. At this point, it is probably not as important to assess for "risk" of future reading problems as it is to identify children with current problems.

For most children, performance in the classroom is an adequate indicator of reading progress. Some children may show difficulty with reading in a particular content area, and they may demonstrate better comprehension once they have been provided with background information to familiarize them with the topic. Other children may show difficulty with comprehension across several subject areas. For them, a standardized assessment of reading comprehension will confirm whether general reading skills are progressing normally. For children who earn low scores, follow-up assessments of word reading (decoding and sight words) and language comprehension (vocabulary, grammar, discourse) are needed to determine the source of difficulty. It is also useful to assess children's knowledge and use of general reading strategies, such as self-monitoring of comprehension. Although lack of reading strategies is not likely a primary cause of reading difficulties, evidence suggests that children with reading difficulties are less aware of inconsistencies in text and do not make attempts to repair comprehension breakdowns (e.g., Oakhill, Hartt, & Samols, 2005; van der Schoot, Vasbinder, Horsley, Reijntjes, & van Lieshout, 2009).

Once areas of weakness are identified, plans for addressing them may include supplemental instruction or referral to a reading or speech-language specialist for further assessment or intervention.

Informed Instruction

If the goal of reading instruction is to teach children to read with understanding, then instruction must include a focus on the code-based skills needed for word recognition, as well as the broad language skills needed for comprehension. Embedding instruction of these skills in a content-rich curriculum will facilitate the development of world knowledge, which in turn supports comprehension.

Over the past 30 years, a great deal of research on beginning word reading and dyslexia has provided us with valuable guidelines for word reading instruction. We know that high-quality instruction in word reading explicitly and systematically teaches phonological awareness, the alphabetic principle, and letter–sound correspondence, and it employs plenty of practice to facilitate automatic word recognition (e.g., NICHD, 2000; Snow, Burns, & Griffin, 1998). Furthermore, we know that most children with word reading difficulties do not need qualitatively different instruction to make gains in reading, but they do need longer, more explicit, and more intensive instruction to increase their skills (Torgesen et al., 2001; Vellutino et al., 1996).

Partly because of the push for evidence-based practice in teaching reading—and of the growth in studies of word reading—there can be a tendency in the primary grades to focus nearly exclusively on decoding and code-based skills, especially in special education classrooms and in high-poverty schools where the knowledge gap is widest (e.g., Duke, 2000; Klingner, Urbach, Golos, Brownell, & Menon, 2010; Neuman, 2006). Even when comprehension instruction is included, it is often very shallow (Klingner et al., 2010). While it is true that code-based skills have the largest influence on reading performance in the early grades, the evidence we have reviewed highlights the importance of focusing also on language comprehension, even in the early years. The influence of language skills on reading comprehension is observable throughout all grades, and language skills are the strongest predictor of comprehension in the later grades. Most children who turn out to be poor readers in later grades show difficulties with language comprehension in early grades. Language skills develop along a slower trajectory than code-based skills, and early gaps in language skills and world knowledge can be difficult to close. By explicitly focusing on language comprehension skills early (in addition to code-based instruction), we should be able to reduce the number of children who experience comprehension difficulties later on.

Facilitating the growth of these skills involves building children's vocabulary knowledge, ensuring that they understand complex syntactic structures, teaching them to draw inferences, and supporting their understanding of abstract language. None of this requires actual reading, so it can begin as early as preschool. The same is true for building children's world knowledge and knowledge in the academic disciplines, and even for comprehension strategies such as self-monitoring. Teaching these during oral activities—during teacher read-alouds, for example—can be useful in the early grades, when children can understand much more complex topics and language than appear in their grade-level reading materials. Recent studies investigating the efficacy of comprehension-oriented instruction for preschoolers have found that it does improve oral language skills, with gains maintained for several months after training ended (Bianco et al., 2010; Bowyer-Crane et al., 2008). These studies also show that gains in comprehension following oral language instruction do not generalize to code-based skills, nor do gains in code-based skills following instruction in them generalize to language comprehension. Thus, both types of instruction are necessary for optimal development.

The benefit of the assessment approach we have proposed is that it guides practitioners to provide individualized instruction according to each student's profile of strengths and weaknesses in word reading and language comprehension. Children enter school with varying levels of skills in each area, and a one-size-fits-all approach is not likely to optimize reading achievement for every student. Work by Connor and colleagues (Connor, Morrison, Fishman, Schatschneider, & Underwood, 2007; Connor et al., 2009) has shown that precise individualization of first-grade reading instruction based on each child's word reading and vocabulary knowledge leads to stronger growth in both word reading and reading comprehension skills. In these studies, a computer algorithm was used to prescribe the appropriate amounts of code-focused and meaning-focused instruction that each child should receive, as well as the amont of time that each type of instruction should be teacher managed or child managed. Future research to incorporate information from additional language skills and from older children may provide more guidance in ways to increase reading comprehension levels for all students across the school grades.

Conclusion

The relative importance of skills influencing reading comprehension changes over time, with word reading abilities having a greater influence on early reading comprehension and language skills having a greater influence on later reading comprehension. Facilitating the development of advanced comprehension requires attention to both word reading and language comprehension skills from an early age.

Risk for difficulty with word reading and comprehension can be identified at least as early as kindergarten, using assessments of precursor skills. As children begin formal reading instruction, progress in word reading can be measured using assessments designed for this purpose, while progress in comprehension can be measured using assessments of listening comprehension and oral language. In the middle grades, word reading abilities should be well established, but oral language assessments may be useful for evaluating the source of problems among individuals with reading difficulties.

By attending to children's individual profiles of relative strength and weakness in word reading and broader language skills, teachers can provide individualized instruction for optimal reading achievement across the school grades.

Questions for Reflection

1. Interview an elementary school teacher or principal and ask how reading skills and reading progress are assessed in different grades. Are both word reading and comprehension skills assessed? How does assessment inform instruction?
2. Observe a language arts period in an elementary school classroom. What kinds of texts are being used? How are word reading and comprehension skills addressed? What positive aspects of instruction did you observe? Were there any things you would do differently?
3. A parent comes to you for help in determining why his daughter is having trouble in reading. Sarah is in fifth grade, and she recently scored below average on a large-scale reading assessment. Her former teachers always described her as a good reader. Sarah's father is concerned that she is just not motivated or that she may not be paying attention in class. How will you respond to his concerns?

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