The Road Not Taken: An Integrative Theoretical Model of Reading Disability

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This article describes a theoretical model of reading disability that integrates a wide range of research findings in cognitive psychology, reading, and education across the age and grade span. The model shows how reading disability relates to normal reading acquisition, and includes four possible patterns of reading disability: nonalphabetic readers, compensatory readers, nonautomatic readers, and readers delayed in the acquisition of word-recognition skills. We compare our model to the models of other investigators and argue that our model is especially useful to practitioners. Finally, we discuss some of the educational implications of the model.

Children with reading disability (RD), have been described in part as individuals who have unusual difficulty learning to read, despite adequate or even above-average intelligence. Reading disability has long been assumed to involve a biologically based disorder (e.g., Hammill, Leigh, McNutt, & Larsen, 1981) and to be qualitatively distinct from ordinary poor reading. However, in our view, both of these claims—that children with RD have a biological abnormality, and that reading disability constitutes a discrete syndrome of poor reading—lack convincing empirical support. In this article, we present a theoretical model of reading disability that conceptualizes children with RD as essentially normal youngsters who have left the road to proficient reading at one of several predictable points, traveling down roads that lead to reading disability. Like the protagonist in Frost's 1949 poem, "The Road Not Taken," these children wander off the path of normal reading acquisition. For them, too, taking the less-traveled road "makes all the difference," but, unfortunately, not in the positive way the poet intended.

After reviewing evidence regarding the biological bases of learning disabilities, Coles (1987) argued persuasively against the notion that children with learning disabilities (most of whom are classified based on problems in reading) have a biological deficit. Although Coles's work has been criticized as providing a better account of generalized difficulties in learning than of reading disability, most critics would also agree that only a minority of children classified as having RD have problems stemming from a true biological deficit (e.g., Stanovich, 1989; Torgesen, 1991, 1993)—probably a biologically based deficit in phonological processing. Furthermore, there is as yet little evidence that individuals with RD differ from other kinds of poor readers, either in cognitive processes related to reading (especially decoding) or in the kind of instructional program they require (Torgesen, 1991).

Other investigators (e.g., Rapala & Brady, 1990) have suggested that, rather than being biologically abnormal, individuals with reading disability may be at the low end of a continuum of normal phonological-processing ability. Thus, an individual difference in phonological-processing ability might make certain children vulnerable to difficulties in learning to read, especially via conventional methods of instruction. Clearly, even in cases of RD with a biological base, environmental factors, such as the nature of instruction, will play a critical role in long-term outcomes (Alexander, Andersen, Heilman, Voeller, & Torgesen, 1991). Although both biological and environmental factors may interact in some cases of RD, it is likely that more can be done to remedy a child's environment than his or her biology. Thus, in emphasizing the importance of instructional, social, and environmental factors in reading disability, we also emphasize the power that teachers and others have to improve the outlook for children with RD.

Before proceeding, we should say a few words about the population addressed by our model. We are interested in the way that the concept of RD tends to be applied in educational settings. Thus, our population of interest involves the kinds of readers typically identified as having reading disability by the schools: children who have IQ-achievement discrepancies in reading, and who also meet exclusionary criteria. However, we recognize that this population frequently does not meet the more-stringent criteria advocated

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by some researchers and may not be as severely impaired as individuals seen in clinic or hospital settings. A biological deficit may be much more common in stringently defined or severely impaired populations than in typical school-identified populations of youngsters with RD.

The body of research associated with reading disability is unusually complex and confusing. Researchers interested in RD generally have focused on one particular ability (e.g., a specific language skill), in one particular age group (e.g., kindergartners or first graders). This narrow focus has made it difficult to see the "big picture"—to know which of the many problems of individuals with RD are primary and which are secondary. In addition, the literature on reading disability is filled with apparently contradictory findings. At least two things are needed to remedy the confusion: (a) attention to the methodological soundness of the various research findings, and (b) a theoretical model that ties together and explains the most reliable research findings across the age and grade span. Such a model would have to show how RD relates to normal reading acquisition. This is what our model, which is based on current research findings in cognitive psychology, reading, and education, attempts to do.

In the next section, we describe our model at length and show how it relates to a wide variety of research findings. We then compare our model to the views of other investigators in the field of reading disability. We conclude with a description of some of the educational implications of our model.

An Integrative Model of Reading Disability

Our theoretical model (see Figure 1) suggests that at least four possible patterns of performance are found in individuals with RD, depending on the point at which the individual deviates from the path of normal reading acquisition. Thus, that the literature on reading disability is confusing may be due, in part, to the fact that multiple phenomena are given a single label. Before discussing the four different patterns, we will discuss how our model conceptualizes normal reading acquisition. (See Table 1 for characteristics of each phase of normal reading acquisition.) This, of course, is "the road not taken" by students with reading disability.

At this point, we should also acknowledge some crucial influences on the development of our model. We have been influenced by the work of many researchers, but among the most important are Ehri (1991, 1992), LaBerge and Samuels (1974), the Haskins Laboratories group (Liberman, 1989; Mann & Liberman, 1984; Shankweiler & Crain, 1986), Stanovich (1986, 1992), Chall (1983; Chall, Jacobs, & Baldwin, 1990), and Coles (1987).

The Road to Proficient Reading

In our model, there is just one road to highly proficient reading, and this

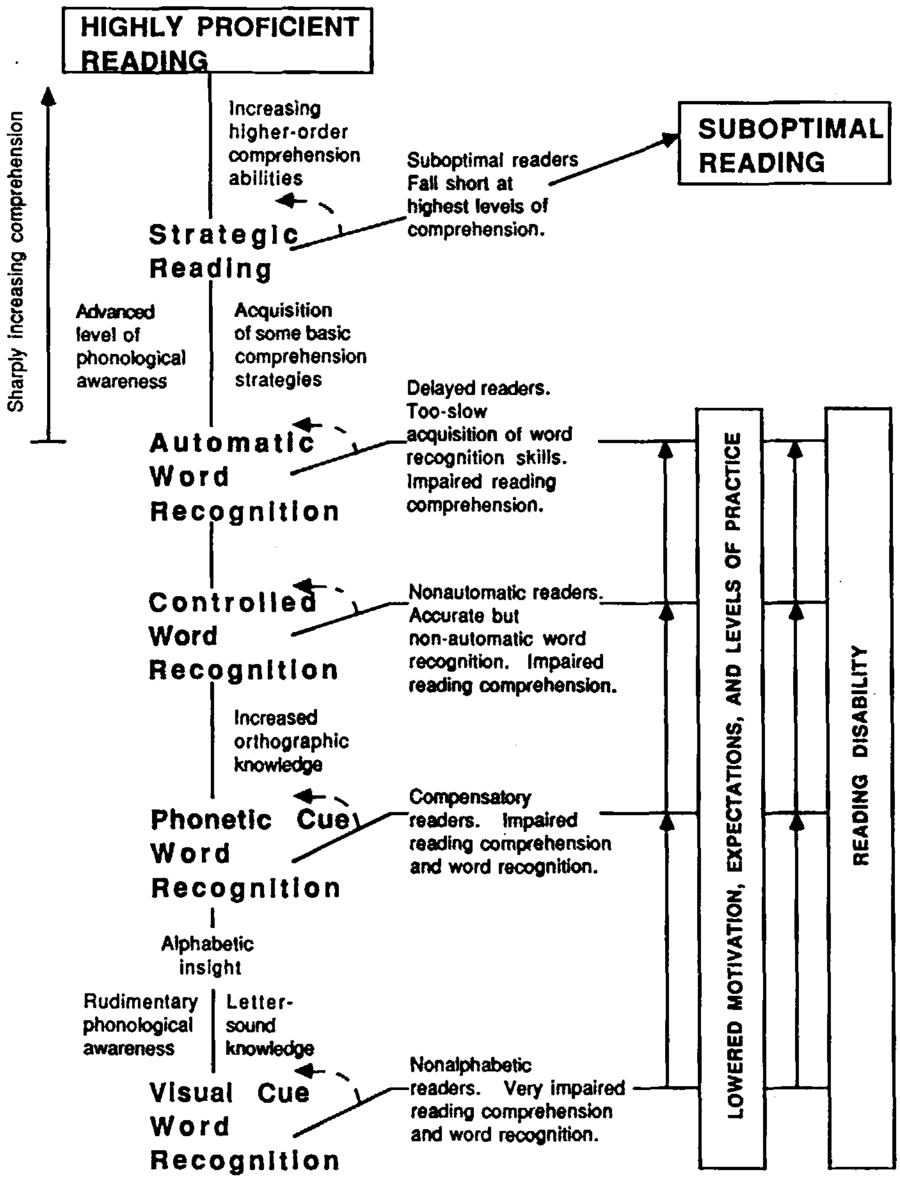

FIGURE 1. Diagram of Spear-Sternberg model of reading disability.

TABLE 1
Characteristics of Each Phase of Normal Reading Acquisition

Characteristic	Phase					
	Visual cue	Phonetic cue	Controlled	Automatic	Strategic	Highly proficient
Uses primarily visual cues in word recognition	x					
Has partial or full letter-sound knowledge		x	x	x	x	x
Has a rudimentary level of phonological awareness		x				
Has a relatively advanced level of phonological awareness			x	x	x	x
Has achieved alphabetic insight		x	x	x	x	x
Uses only partial phonetic cues to recognize words		x				
Relies heavily on context to aid or speed word recognition	x	x	x			
Makes full use of orthographic information to recognize words			x	x	x	x
Has acquired complete word-decoding skills			x	x	x	x
Has automatic word-recognition skills				x	x	x
Routinely uses some strategies to aid comprehension					x	x
Has higher order comprehension abilities						x

road is shown on the left side of Figure 1. Although investigators might disagree about the exact nature of this route, we think it is difficult to claim that there is more than one *major* path to highly proficient reading. For instance, normally achieving readers may adopt a parts-to-whole phonetic strategy in word recognition, or a more analytic whole-word strategy (comparing unfamiliar words to known words), a choice that appears to be influenced by the method of reading instruction (Vellutino & Scanlon, 1991). However, in either case, word-recognition processes are central to beginning reading acquisition, and these processes are linked, in part, to phonological processes (Ehri, 1992; Perfetti, 1992). One cannot become a highly proficient reader by eschewing phonological skills in favor of purely visual skills (Ehri, 1992) or by using contextual abilities to compensate for faulty word-decoding skills (Perfetti, 1992; Stanovich, 1986).

Like many other investigators (e.g., Adams, 1990; Chall, 1983; Chall et al., 1990), we view reading acquisition as a developmental process in which the nature of reading changes with development; the cognitive processes implicated in reading are not the same in a 6-year-old beginning reader as they are in a proficient adult reader. Thus, our model of normal reading acquisition is framed in terms of developmental phases in which the cognitive processes most crucial to reading acquisition shift over time. Although adjacent phases may share some characteristics, the defining features differ from one phase to another. For example, readers in the first two phases of the model tend to rely on context to facilitate word recognition, but in the first phase, visual cues are employed in word recognition, whereas in the second phase, phonetic cues are employed.

We view transitions between phases as somewhat gradual, rather than as abrupt or sharply defined. Because the cognitive processes most central to each phase differ, the processes involved in transitions between phases vary accordingly. For instance, as elaborated below, a rudimentary level of phonological awareness and some letter-sound knowledge are needed to achieve alphabetic insight, which is necessary for entering the phase of phonetic-cue word recognition. On the other hand, reaching the phase of strategic reading requires automatic word-recognition skills, sufficient metacognitive development, and probably also a certain level of academic demand (e.g., reading challenging text).

Although agreement regarding the precise nature of normal reading acquisition is far from universal (e.g., Adams et al., 1991), the evidence is compelling suggesting that normally achieving readers do go through qualitatively distinct phases in reading acquisition, and that the sequence of these phases is similar across children—at least across those who are learning an alphabet (Adams, 1990; Chall, 1983; Chall et al., 1990; Ehri, 1991, 1992; Gough & Juel, 1991). The phases are linked in part to the changing task demands of schooling; for example, as children progress through the elementary grades, they are expected to read increasingly difficult text. However, the phases also appear to be linked to certain cognitive prerequisites implicated in reading acquisition itself.

Our view of normal reading acquisition is similar in many respects to that of Chall (1983). Like Chall, we view reading acquisition as a developmental process involving qualitatively distinct phases, and some, although not all, of our phases map roughly onto Chall's. However, Chall's model emphasizes the academic skills necessary at each phase, and how those skills are acquired at home and through schooling, whereas our model emphasizes the cognitive processes that are important to the different phases. Each model has a different focus. We now turn to a discussion of the phases contained in our own model of reading acquisition.

Visual-Cue Word Recognition. A number of researchers (e.g., Ehri, 1991, 1992; Gough & Juel, 1991) have demonstrated that normal reading acquisition begins with a phase of paired-associate learning, in which children do not make use of letter-sound correspondences. We use Ehri's (1991) term, *visual-cue word recognition,* for this phase. Children in this phase tend to rely on some salient visual cue, such as color or a distinctive logo, to recognize words. An example of visual-cue word recognition would be recognizing the Dunkin' Donuts sign based on the pink and orange color of the letters, but not recognizing the words if they were printed in a different context, such as in plain black letters on an index card. Visual-cue word recognition is characteristic of children who are just beginning to recognize words, such as preschoolers and some kindergartners.

Phonetic-Cue Word Recognition. Ehri (1991, 1992) identified a second phase of reading, phonetic-cue word recognition. In this phase, readers begin to use phonetic cues to recognize words, but their use of these cues is not complete and frequently (although not always) involves only the first or last letters in a word. For example, a child might recognize the word *boat* based primarily on the initial *b* and final *t* and so confuses *boat* with *boot, beat,* and so on. Thus, children in this phase are not capable of fully decoding words but need to rely heavily on context to aid with their word recognition.

To reach the phase of phonetic-cue word recognition, it appears that children must first achieve several things. First, they must have at least a rudimentary level of phonological awareness, or awareness of phonemes in the stream of speech they hear around them. For instance, in the *boat* example, the child must realize that the spoken word *boat* begins with the sound /b/ and ends in the sound /t/. Most children in this phase will be able to do other relatively easy phonological awareness tasks, such as rhyming. In addition, children must know at least some letter-sound correspondences. In the *boat* example, they must know that the letter *b* can represent /b/ and the letter *t* can represent /t/. Finally, and perhaps most crucially, the child must have discovered the alphabetic principle that letters and sounds map onto each other in some systematic way. Like Byrne (1992), we think it appropriate to call this discovery an insight. Attaining alphabetic insight does not necessarily mean that the child instantly knows *how* all letters and sounds map onto each other, only that they do. Alphabetic insight is essential for reaching the phase of phonetic-cue word recognition.

Some children, especially those from highly literate homes, may enter school already in the phase of phonetic-cue word recognition. Children who have been exposed extensively to word games, letters, and books may achieve alphabetic insight outside of school and may be able to apply it in recognizing words. However, for many youngsters, this insight will be achieved only through formal schooling. In addition, some children in the earlier phase of visual-cue word recognition may also know some letter-sound correspondences, and may also have a rudimentary level of phonological awareness, but they cannot apply these skills in reading words because they lack alphabetic insight.

Controlled and Automatic Word Recognition. In the third phase of reading, controlled word recognition, children have fully attained word-decoding skills. In recognizing the word *boat,* for example, they utilize the *oa* as well as the *b* and the *t,* and so do not confuse similarly spelled words. To reach this phase of accurate decoding, children must acquire a great deal of orthographic knowledge because English cannot be decoded letter by letter. However, at this point, decoding still requires considerable effort; it is not until the fourth phase, automatic word recognition, that children can recognize most common words in a manner that is not only accurate, but also relatively effortless. A number of investigators (e.g., LaBerge & Samuels, 1974; Perfetti & Lesgold, 1977; Sternberg & Wagner, 1982) have emphasized the importance of automatic word recognition for proficient reading. Automatization of word recognition sets the stage for rapidly increasing reading comprehension because children can now devote their mental resources to understanding the meaning of the text rather than to recognizing words, and they can begin to use reading as a tool to acquire new concepts and information.

Tracking the development of automatization in reading has proven problematic for researchers because the different tasks that have been used to measure automatization do not yield the same developmental curves. Researchers have tended to equate different aspects of automatization, such as obligatory execution, speed, and processing that consumes few mental resources, which in fact appear to be separable (Stanovich, 1990). In recent years, some reading researchers (e.g., Ehri, 1992; Perfetti, 1992; Stanovich, 1990) have deemphasized the idea of automatization of word recognition in favor of reading models framed in other terms that are related to, but not synonymous with, the concept of automatization. These other terms include the quality of mental representations of words, the number of connections to words in memory, and modularity.

Although we favor the concept of automatization over the other terms mentioned, we recognize the importance of defining what we mean by automatization. We define automatic word recognition as word recognition that consumes few mental resources. Other characteristics tend to co-occur with automatization, and one of the most important of these is modularity, the central feature of which involves independence from higher level processes, such as the use of context or prior knowledge. Children with automatic word recognition do not need to rely on sentence context or prior knowledge to guess at words, because their ability to recognize words, in or out of context, is highly efficient. We should further note that automatization can be domain specific. In other words, controlled and automatic word recognition may vary, depending on the types of words being read. For instance, a good first-grade reader might be able to read many short words automatically, but still need to rely on controlled processing for multisyllable words. A proficient adult reader might recognize the vast majority of words automatically, but still use controlled processing for unusual words from an unfamiliar domain.

Although tracking the development of automatization in normally achieving readers has been complicated, one can still hazard some generalizations about when automatization of familiar words occurs. Perfetti (1992) suggested that when the measure of automatization is resource allocation, automatization in normally achieving readers is acquired primarily between first and second grade, although it may continue to develop through adulthood. Chall's (1983) model places achievement of fluency in word recognition at a second- to third-grade level. By a middle-elementary level, if not earlier, normally achieving readers appear to have acquired basic word-recognition skills (Anderson, Hiebert, Scott, & Wilkinson, 1985) and probably will be able to recognize most words that are in their spoken vocabularies automatically.

Strategic Reading. Children in the phase of automatic word recognition do not make efficient, routine use of strategies to aid comprehension. However, with developing metacognitive abilities, with reading experience, with an increasing knowledge base, and with automatic word-recognition skills, children become more capable of acquiring strategies to increase comprehension. When they begin to routinely use a number of these strategies, they are in the phase of strategic reading. For instance, when comprehension fails, there are a variety of "fix-up" strategies that children may use, such as rereading, reading ahead to see if an inconsistency may be resolved, or looking up a word with an unfamiliar meaning in the dictionary (Anderson et al., 1985). Fix-up strategies are general strategies that can be applied across a wide variety of tasks and domains, but these strategies can also be domain specific (Alexander & Judy, 1988; Garner, Alexander, & Hare, 1991). Like the previous transition from controlled to automatic word recognition, the transition from automatic word recognition to strategic reading may occur quickly in many nondisabled readers. Furthermore, as appears to be the case with automatization, strategy acquisition continues throughout life.

Depending on the nature of the comprehension strategy and the experimental procedure, investigators usually find nondisabled readers beginning to use strategies at a middle- to ending-elementary level. For instance, Myers and Paris (1978) compared second- and sixth-grade nondisabled readers and found that the older children had much more knowledge about reading strategies, such as how to skim a text, than did the younger children. In addition, certain kinds of strategic abilities may be weak even in normally achieving readers beyond an elementary level. For example, although older and more-skilled readers engage in better comprehension monitoring (the ability to detect inconsistencies in a text), even these readers display faulty monitoring at times (Garner, 1987; Markman & Gorin, 1981).

One factor that is important in the transition to strategic reading involves the nature of the academic demands that children experience. Chall (1983, 1990) noted that typically there is a sharp increase in these demands at the fourth-grade level, when children are expected to read text that involves much more challenging concepts and vocabulary than the text used at earlier grade levels. According to Chall, even normally achieving readers experience a temporary "fourth-grade slump" in reading as they adjust to the increased text demands. However, these demands may be critical in encouraging readers to generate strategies to aid comprehension. For example, if children read only very easy text, so that their comprehension never fails, there is little need for them to generate or use many fix-up strategies. Furthermore, because prior knowledge and strategy use interact (Alexander & Judy, 1988; Chan, Burtis, Scardamalia, & Bereiter, 1992), the rapidly expanding knowledge base of successful readers in the middle- to ending-elementary years may also aid strategy acquisition.

Proficient Adult Reading. Older elementary youngsters who are normally achieving readers and nondisabled adult readers both make use of strategies to aid comprehension. However, most of us would not characterize a sixth grader as a highly proficient reader in the same way that a college student is a highly proficient reader. So, what is the difference between the phase of strategic reading—beginning to consistently use strategies to aid comprehension—and proficient adult reading?

The defining feature of proficient reading is highly developed comprehension abilities, which in turn depend on automatic word-recognition skills. Highly proficient readers are readers who are insightful, reflective, and analytical. They can make higher order connections within and across texts and can integrate knowledge from many sources. These comprehension abilities might be thought of as a form of higher order "selective combination" (Davidson & Sternberg, 1984) or, alternatively, as higher order integration within a schema (Rumelhart, 1975). Strategic readers lack these higher order comprehension abilities, although their comprehension may be perfectly adequate for many of the kinds of texts that one encounters in school. The attainment of proficient reading is facilitated by increases in knowledge base and vocabulary (Stanovich, 1986). In addition, the higher order abilities involved in proficient reading are linked in part to overall intelligence (Chall, 1967; Stanovich, 1986). Clearly, proficient adult reading is not a static end state, but a set of comprehension abilities that continue to develop throughout life.

We should also note that as one advances in reading acquisition, the various phases may become more domain specific. One may be a highly proficient reader in some domains but only a strategic reader in others. For instance, we would consider ourselves proficient readers in the domains of psychology, education, and literature, but would probably be strategic readers (at best!) in the domain of nuclear physics.

Roads to Reading Disability

Table 2 presents the characteristics of the various patterns of reading difficulty predicted by our model. However, before discussing these patterns, we should make one particularly important point about this aspect of our model. The patterns of reading disability that we propose may have a variety of causes, including both biological and environmental ones. Thus, we are not proposing an etiological typology of reading disability (e.g., Boder, 1973, which proposed three subtypes involving a visual deficit, a linguistic deficit, and a mixed deficit). Although the possibility of subtypes certainly cannot be ruled out, overall, the evidence for discrete etiological (and especially biological) subtypes strikes us as weak, as it has other investigators in the RD field (e.g., Shankweiler, Crain, Brady, & Macaruso, 1992; Stanovich, 1988; Torgesen, 1991).

Nonalphabetic Readers. In our model, the first point at which a child may go astray is in the phase of visual-cue word recognition. Children who wander off the road to proficient reading at this point have no knowledge of the alphabetic principle, and thus we

TABLE 2
Characteristics of Various Patterns of Reading Difficulty

	Characteristics			
Pattern	Word-recognition skills	Reading-comprehension skills	Use of comprehension strategies	Disabled reader
Nonalphabetic	No phonetic skills. Relies heavily on visual cues to recognize words.	Reading comprehension is very low because word-recognition skills are so limited.	None	Yes
Compensatory	Has limited phonetic skills. Relies heavily on compensatory abilities, such as use of sentence context or sight-word knowledge.	May do well with relatively undemanding materials. Has difficulty when comprehension demands escalate because word recognition consumes too many mental resources.	None	Yes
Nonautomatic	Has word decoding skills, but these are effortful, not automatic. May use sentence context to speed word recognition.	May do well with relatively undemanding materials. Has difficulty when comprehension demands escalate because word recognition consumes too many mental resources.	None	Yes
Delayed	Has automatic word recognition, but lags far behind cohort in acquisition of these skills.	Impaired comprehension. Was not "ready" for comprehension instruction at the time it was delivered.	Impaired strategy use.	Yes
Suboptimal	Has automatic word-recognition skills.	Lacks higher-order comprehension skills.	Has at least some basic strategies, but may lack higher level strategies.	No

refer to these youngsters as *nonalphabetic* readers. Without the ability to use phonetic skills in recognizing words, these kinds of readers are severely limited. They may use other cues, such as pictures and word shape, to aid in word recognition, but these cues will not take them very far in an alphabetic orthography such as English. Because their word-recognition skills are so poor, reading comprehension will be very low.

A rudimentary level of phonological awareness and some letter-sound knowledge are both necessary for children to grasp the alphabetic principle (Byrne, 1992; Ehri, 1991). Many nonalphabetic readers seem to be especially lacking in phonological awareness. For instance, phonological awareness has been shown to predict early reading skill, independent of IQ (Mann & Liberman, 1984; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987). When matched to younger, normally achieving readers on word-recognition level, children with RD have repeatedly been found deficient in phonological awareness (e.g., Snowling, 1980, 1981). Furthermore, there is evidence that phonological awareness can be trained and that training can have a positive effect on reading skill (Bradley & Bryant, 1983; Vellutino & Scanlon, 1987); thus, improvements in phonological awareness apparently can cause improvements in reading.

However, the relationship between phonological awareness and reading acquisition is complex. For instance, reading acquisition itself increases phonological awareness (Byrne & Ledez, 1986; Perfetti, Beck, Bell, & Hughes, 1987). In other words, the causal relationship between phonological awareness and reading skill appears to be bidirectional (Stanovich, 1986): A certain level of phonological awareness is needed for the acquisition of early reading skill, but learning to read also causes improvements in phonological awareness (which may in turn facilitate further gains in reading—e.g., Perfetti et al., 1987; Stanovich, 1992).

Although a rudimentary level of phonological awareness and letter-sound knowledge are both necessary for children to attain alphabetic insight (Byrne, 1992), they may not always be sufficient for enabling children to grasp the alphabetic principle. In other words, it is possible that some nonalphabetic readers may demonstrate some phonological awareness, as well as letter-sound knowledge, yet still fail to realize that letters and sounds map onto each other in a systematic way—for example, because of the nature of the reading instruction they received. Children who continue on this road will have very limited reading skills. Even adults with dyslexia can be nonalphabetic readers (Byrne, 1992).

Compensatory Readers. Children who go astray in the next phase, phonetic-cue word recognition, have more skills at their disposal than do nonalphabetic readers. We call these youngsters *compensatory* readers because they tend to use other abilities, such as sight-word knowledge or contextual skills, to compensate for weak word-decoding skills. For instance, some researchers (e.g., Perfetti, 1985; Stanovich, 1986) have found that poor readers make use of sentence context to facilitate word recognition more than do normally achieving readers. Normally achieving readers have little need to rely on contextual facilitation because their word recognition is accurate and rapid.

A critical difference between nonalphabetic and compensatory readers is that the latter have attained alphabetic insight, whereas the former have not. Nonalphabetic readers may have some limited phonetic skills, such as a rudimentary level of phonological awareness, but they cannot employ these phonetic skills in word recognition because they have not yet experienced alphabetic insight. On the other hand, compensatory readers, who have grasped the alphabetic principle, can make partial use of phonetic cues in word recognition. Compensatory readers also may have acquired some orthographic knowledge, although not enough to permit them to decode words completely. However, we would argue that without at least some phonetic word-recognition skills, it is simply not possible for compensatory skills to be useful. For instance, consider again the compensatory skill of using sentence context to aid with word recognition. Nonalphabetic readers probably do not lack the *ability* to use sentence context; rather, their word-recognition skills are so limited that there is little opportunity for their ability to use sentence context to come into play.

The major problem with the compensatory approach to reading is that it eventually results in impaired reading comprehension. For example, children who have to use sentence context to facilitate word recognition are diverting mental resources that normally achieving readers, who recognize words accurately and automatically, devote to comprehension (Stanovich, 1986). Some compensatory readers may appear to be doing well in the early grades, when demands on comprehension are relatively low and reading vocabulary more restricted. However, without accurate decoding skills, these youngsters' performance will deteriorate rapidly in the middle-elementary grades, when greatly increasing demands are made on comprehension and on the ability to recognize a large number of unfamiliar words (Chall, 1983; Mason, 1992).

Nonautomatic Readers. Some children appear to diverge from the road to proficient reading in the third phase—controlled word recognition. These children can decode words accurately, but only with effort; they are *nonautomatic* readers. Like compensatory readers, these youngsters may rely on sentence context to speed word recognition, but this recognition strategy comes at a cost to comprehension. The main difference between compensatory and nonautomatic readers is that the latter can fully decode words, whereas the former cannot.

Normally achieving readers may pass quickly from the phase of controlled word recognition to automatic word recognition, but this passage seems to present a major stumbling block for youngsters with RD (Sternberg & Wagner, 1982). In teaching children with reading disability, we find that many of them do appear to acquire word-decoding skills with direct instruction, but decoding words automatically in connected text is a separate hurdle. A number of factors could account for the automatization problems of children with reading disability. For example, some children with RD have naming difficulties, particularly on rapid naming tasks (Wolf, 1984, 1991), which could explain their failure to automatize word recognition. Rapid-naming difficulties may be due to a variety of phonological deficiencies (Katz, 1986; Wagner & Torgesen, 1987).

Children with a general deficit in naming speed may have intrinsic difficulties with automatization. However, there are also many extrinsic factors that could impair automatization. For instance, practice appears to be very important in the development of automatization (Sternberg, 1985, 1986), and children with RD get less practice in reading than do normally achieving readers. Furthermore, the effects of differential practice may begin very early. Even at a first-grade level, substantial differences exist between high- and low-reading groups in amount of reading practice in school (Stanovich, 1986). Thus, a youngster need not be classified as having RD to be affected by lowered levels of practice. Moreover, Anderson et al. (1985) noted that practice in reading *outside* of school consistently relates to gains in reading achievement, yet most youngsters, and especially those who are poor readers, spend much more time watching television than they do reading at home.

Another factor related both to practice and to automatization is motivation. The more motivated children are to read, the more practice they will get in reading. Levels of motivation may vary even among youngsters without obvious reading difficulties. Of course, children who are struggling in reading will be especially likely to lose motivation for reading.

Delayed Readers. Finally, there are some children with reading disability who, with great effort and at a much slower rate than normally achieving readers, finally do seem to acquire accurate and automatic word-recognition skills. However, these youngsters lag so far behind others of their age that they get lost, wandering off the road to proficient reading at the point of automatic word recognition. We refer to these children as *delayed* readers. When other children are ready to use reading as a tool to acquire new concepts, delayed readers are not because they are still struggling to learn basic word-recognition skills. Although they have the potential to learn more-advanced comprehension skills, they are not ready for the comprehension instruction at the time it is being delivered. These readers never make it to the phase of strategic reading because they lack the kinds of classroom and reading experiences that would encourage them to generate and use strategies.

Reading comprehension deficits, even on material controlled for decoding level, are well documented in children with RD (Garner et al., 1991; Smiley, Oakley, Worthen, Campione, & Brown, 1977; Wong, 1991). These deficits do not appear to be due to poorer general language comprehension, provided that IQ is controlled (Vellutino, 1979). Rather, they appear to be at least partially linked to strategic abilities. Although children with reading disability are not completely lacking in strategic knowledge, they display less-sophisticated strategic knowledge than do their nondisabled peers (Paris, Jacobs, & Cross, 1987; Wong, 1991). For instance, Garner and Reis (1981) found children with RD to be less efficient than nondisabled readers at scanning text; Wong and Wong (1986) found children with RD to be less sensitive to passage organization than were nondisabled readers.

A number of lines of evidence support the view that although strategy deficiencies are common among individuals with RD, they are not causally central to RD. First, strategy training tends to benefit both children with reading disability and nondisabled readers (Worden, 1983), and does not necessarily eliminate group differences in reading comprehension. In addition, children with RD do not necessarily differ from nondisabled readers in strategy knowledge when a reading-level match design is used (e.g., Taylor & Williams, 1983). Finally, and perhaps most important, as we and others have noted (e.g., Spear & Sternberg, 1987; Stanovich, 1986), strategic abilities are too closely linked to higher level intellectual abilities to serve as a good explanation for RD. Wong (1991) suggested that the strategic deficits of children with RD are a secondary problem produced by a loss of motivation to read, learned helplessness, and deficient reading experiences.

Delayed readers are the kinds of students that one frequently sees in learning disabilities programs at a middle- or secondary-school level. Although some children at this level still have difficulty with basic word-recognition skills, others do not. However, even the latter may have a *history* of word-recognition problems; ironically, even though they finally acquire basic word-recognition skills, they missed out on the equally critical higher level aspects of reading because it took them so long to acquire the lower level skills. It is possible to teach some of these higher level skills, such as the use of certain strategies, directly (Paris et al., 1987; Worden, 1983). However, delayed readers are further handicapped by three factors that affect all children with RD negatively (two of which we have touched on in discussing automatization): limited practice, low motivation, and low expectations. Next, we will discuss these negative factors at length.

Negative Factors That Affect All Children with Reading Disability. This set of factors is represented on the right-hand side of Figure 1, cross-cutting all of the paths to reading disability. One might think of these factors as a kind of swamp; once children become mired it is extremely difficult for them to escape. Stanovich (1986, 1989, 1992) has written extensively about the importance of factors such as decreased motivation and limited practice in accounting for the plethora of deficits that researchers have found in children with RD. He uses the term *Matthew effects* to describe the rich-get-richer, poor-get-poorer phenomenon that tends to differentiate good from poor readers. Children who do well in reading are more motivated to read, get more practice reading, have greater expectations placed on them, and acquire certain cognitive skills, such as vocabulary, through reading; all of which rapidly helps them to become even better readers. Of course, the reverse occurs for poor readers: Initial failure in reading sets in motion a group of factors that can lead to a cascade of academic problems. These factors, such as lowered motivation for reading and lowered expectations, are probably set in motion as soon as the children are perceived by others as having a problem in reading, or as soon as the children themselves begin to find reading unpleasant. (It should be noted, however, that teacher expectations may matter less than what the teacher actually *does* in instructing and interacting with children—e.g., Goldenberg, 1992).

Poor reading itself tends to limit youngsters with reading disability in a wide variety of ways. For instance, children with RD usually do not contend with the same kinds of academic demands that nondisabled readers do. One example of an ability that may be affected by these limited academic demands involves the use of reading strategies, which we have just discussed. Many normally achieving readers appear to acquire such strategies not so much through direct instruction as in the service of meeting certain academic demands (Paris & Lindauer, 1982). If these demands are never made of children with RD, then there is little need for them to generate or use many strategies. Lack of strategy knowledge might accrue from lack of certain academic experiences or demands rather than from an innate difficulty in generating or using strategies.

Leaving One Road for Another. In our model, it is possible for children with RD to start out on one path to reading disability and end up on a different path. In Figure 1, this mobility is represented on the right side of the figure by the two solid vertical lines with arrows pointing upward. For instance, a youngster might initially wander off the road to proficient reading in the phase of visual-cue word recognition, becoming a nonalphabetic reader. Eventually he or she might grasp the alphabetic principle (e.g., through direct instruction). However, if the child still has difficulty acquiring accurate word-decoding skills, then he or she might become a compensatory reader. On the other hand, if accurate but nonautomatic decoding skills were acquired, the child would become a nonautomatic reader; if both accurate and automatic decoding skills were eventually acquired, but this acquisition lagged far behind the norm, the child would become a delayed reader. In other words, a child might fit into multiple categories over time. However, in our model, children with reading disability can only move upward, not downward. For example, a child cannot be a compensatory reader but "forget" the alphabetic principle and then become a nonalphabetic reader.

In addition, it is possible for children with RD to get lost on one of the roads to reading disability but eventually find their way back to the path of normal reading acquisition. (In Figure 1, this path is represented by the dashed lines.) However, we would claim that this path is not likely to be formed without active educational intervention. In particular, once children have entered the "swamp" of negative expectations, lowered motivation, and limited practice, it may be very difficult for them to get back to the right road, and active educational intervention will almost certainly be required.

Suboptimal Readers

In our model of normal reading acquisition, there is at least one more point at which readers may go astray. This point is in the phase of strategic reading. Readers who go astray here have acquired automatic word recognition and effective use of at least some comprehension strategies; however, they fall short at the highest levels of comprehension. We term these readers *suboptimal*, because they have not quite attained highly proficient reading, even though their reading achievement is usually not impaired enough for them to be considered disabled. Because suboptimal readers would not ordinarily be identified as disabled, we will not discuss them further here.

General Comments About Our Model

We would like now to make some general points about our model. The first point is that our model does not necessarily imply more than one basic deficit in individuals with reading disability. (This point is related to the earlier one, that the model does not represent a typology of RD.) For instance, the Haskins Laboratories investigators have advanced a unitary-deficit account of reading disability that involves phonological processing (Liberman, 1989; Shankweiler & Crain, 1986; Shankweiler et al., 1992). Our model can accommodate such a view, and indeed we agree with these and many other investigators (e.g., Bradley & Bryant, 1983; Torgesen, in press; Vellutino & Scanlon, 1987) regarding the centrality of verbal and, especially, phonological processes in reading disability. For example, children with a severe deficit in phonological processing may initially have difficulty attaining alphabetic insight, and so become nonalphabetic readers. On the other hand, an excellent educational program might enable a child with a severe phonological-processing deficit to grasp the alphabetic principle. However, such a child might end up as (a) a compensatory reader if fully accurate word-recognition skills were not acquired, (b) a nonautomatic reader if word-recognition skills were not automatized, or (c) a delayed reader if acquisition of automatic word-recognition skills took an inordinately long period of time. Children with mild phonological-processing deficits, as compared to those with more-severe deficits, might progress farther along the road of normal reading acquisition before going astray. Furthermore, we would argue that with the right kind of educational intervention, many children with phonological-processing deficits might become proficient readers and not be classified as having a disability at all.

We should also say that factors other than instructional ones might influence the path a particular child takes. Another important set of factors involves the child's home environment. For example, a youngster from a home where literacy is stressed, in which there is heavy exposure to letters, books, and so forth, might not be as affected by a less-than-ideal instructional program as a youngster from a less literate home environment. In addition, there is evidence that rather specific types of variables may be associated with optimal preparation for reading—for instance, the types of questions parents ask their children while reading to them (Anderson et al., 1985), or the extent to which the child is involved in rhyming activities (Goswami & Bryant, 1992; Maclean, Bryant, & Bradley, 1987). In other words, even among children from highly literate homes, there is probably some variability in the extent to which they are prepared to learn to read. Of course, individual differences in the children themselves, such as in temperament, motivation, overall intelligence, and specific cognitive abilities, would interact with these environmental differences. For example, a child with high intelligence, relatively strong phonological-processing abilities, or high motivation to succeed might do very well in reading, despite a nonoptimal home environment.

This first point leads us to our second point. Strictly speaking, our model is consistent with biological or more environmental accounts of reading disability, although obviously we lean toward the latter. For example, some of the Haskins Laboratories researchers have attributed the basic phonological-processing deficit that they associate with reading disability to an innate biological deficiency (e.g., Liberman, 1989). Our model, again, could accommodate such a view. However, for the reasons outlined at the beginning of this article, we think that environmental rather than biological variables should be more closely examined as possible explanations for the deficits of many school-identified children with RD. It is worth reiterating that even in cases of reading disability involving a true biological deficit, appropriate intervention and instruction will make a considerable difference in the eventual reading level attained by these youngsters.

Our third point is that although our model links reading disability with developmental deviations from the path of normal reading acquisition, we are not claiming that youngsters with RD are "just like" younger, nondisabled readers. It should be clear from the preceding discussion that we do not view children with reading disability as having a delay in development that may be remedied by the mere passage of time. Yet, there are certain similarities between students with RD and younger, nondisabled readers. The tendency of some children with RD to make reversal errors involving letters such as *b* and *d* is a good example. Reversal errors are common in normally achieving readers at an early phase of reading acquisition (Shankweiler et al., 1992), such as the visual-cue or phonetic-cue word-recognition phase. Because reversal errors are common in younger, nondisabled readers, such errors are not evidence of a visual-processing deficit in children with RD, nor could they be causally central to RD.

Fourth, each of the four patterns of performance that we have proposed in reading disability may be more common at certain grade levels than at others. For instance, one is more likely to find nonalphabetic readers at an early-elementary level than at a secondary level because, over time, many nonalphabetic readers will become compensatory, nonautomatic, or delayed readers. However, theoretically, any of the patterns may be found at any grade level, assuming that the appropriate phase in normal reading acquisition has been passed (e.g., one will not find delayed readers at a beginning-first-grade level). We are reminded of a 56-year-old man who was of average intelligence but functioned at a beginning-first-grade level in reading. With no grasp of the alphabetic principle, and a sight vocabulary of only a handful of words, he was a nonalphabetic reader.

Finally, just as individual differences in temperament, motivation, and overall intelligence may interact with environmental variables to determine which reading path a child takes, the paths themselves may vary, depending on these individual differences. In other words, each of the four roads to reading disability, as well as the road to suboptimal reading, might be visualized as a set of curves, rather than as a single path. (However, to make the figure easier to read, only single paths are shown in Figure 1.) For example, a very bright, well-motivated compensatory reader will do a better job of compensating for weak phonological skills than will a compensatory reader who is less intelligent and less motivated. Nevertheless, both readers are on the way to reading disability because even the brightest and most motivated youngster cannot become a proficient reader without acquiring automatic decoding skills. Only by finding their way back to the path of normal reading acquisition, or by being helped to do so, can either child become a proficient reader.

Comparing Models

Our model of reading disability is compatible with the views of many other investigators who emphasize the role of lower level verbal processes in the genesis of reading disability. Like these investigators, we claim that the higher level deficits seen in many individuals with RD are not necessarily indicative of a true higher level processing deficit. However, although our model can accommodate these other views, it goes beyond them in most instances, to provide a broader picture of RD. For example, the Haskins Laboratories researchers (e.g., Liberman, 1989; Shankweiler & Crain, 1986) intensively studied the phonological deficits of young children with reading disability; LaBerge and Samuels (1974) emphasized the role of automatization in the development of proficient reading; and other investigators, such as Wong (1991), Torgesen (1977), and Worden (1983), studied the strategic difficulties of students with RD. Our model integrates these bodies of work and provides, we believe, a broader picture of reading disability across the age and grade span.

We think that the broader nature of our model will be particularly useful to practitioners. Practitioners frequently work with youngsters of varying ages and levels of skill development; and even when they work with more homogeneous groups of children, it is still important for practitioners to have a broad mental picture of the terrain that children have traversed toward reading development, and of where these children are headed. Another feature of our model that will be useful to practitioners is that it explicitly relates reading disability to normal reading acquisition. Practitioners need to make this comparison in order to recognize the deficits of children with RD, to interpret the meaning of those deficits, and to make sound instructional choices.

Of course, our model is not compatible with all accounts of reading disability. Our view of RD is most different from those associating reading disability with broad cognitive deficits, or with basic nonverbal deficits. Examples of such views include those of Wolford and Fowler (1984), who suggested that RD involves a failure to make use of partial information; Morrison and Manis (1982), who claimed that RD involves a general rule-learning difficulty; and Tunmer (1991), who associated RD with a developmental lag in the ability to decenter.

In our model, verbal processes are central to both normal reading acquisition and to reading failure; for instance, children with reading disability do not go astray in the phase of visual-cue word recognition because of an inability to perceive or use visual cues. Rather, they go astray because of verbal, and probably specifically phonological, problems. We believe that the preponderance of the evidence supports this verbal-deficit view, at least in most cases of reading disability (e.g., Vellutino, 1979). Furthermore, in our model, deficits in relatively low-level processes, not high-level processes, are central to reading disability; the four patterns of RD all involve departures from normal reading acquisition at the word-recognition level. However, as we have discussed, deficits in word recognition may eventually lead to deficits in higher level areas, such as comprehension or strategic knowledge.

Educational Implications

Like many other investigators (e.g., Gough & Juel, 1991; Stanovich, 1986), we emphasize the importance of early intervention with children who have reading difficulties. Once children become mired in the swamp of negative expectations, lowered motivation, and lowered levels of practice, it becomes increasingly difficult for them to get back to the road to proficient reading. However, intervening early does not necessarily imply special education placement. Some children with reading problems can remain in the mainstream; other children will need the support of a special education teacher, through a variety of service-delivery models.

Mainstream approaches to reading instruction that have a strong decoding component in the early grades would facilitate inclusion of youngsters with reading disability and might well benefit children without obvious reading difficulties. In some cases, the use of a reading program with a strong decoding component might even help prevent reading disability. Furthermore, evidence suggests that sound decoding instruction in first and second grade is not detrimental to children who are good readers (Adams, 1990; Anderson et al., 1985; Chall, 1967).

With regard to assessment, educators should be aware of the variety of ways in which children may deviate from normal reading acquisition, such as in terms of the four patterns discussed here, and should look for these patterns in assessing children's reading skills. It is especially important to note that in the early phases of reading acquisition, failure to acquire decoding skills "on schedule" is an ominous sign, even for children who otherwise appear to be doing well in reading, as with some compensatory readers. Many tests are available to assess decoding skills. Most group reading achievement tests include measures of word recognition or decoding, and there are many individually administered tests of decoding (e.g., the Word Attack subtest of the Woodcock Reading Mastery Tests–Revised; Woodcock, 1987). Decoding skills might also be assessed more informally.

The patterns described here have numerous implications for instruction.

For instance, nonalphabetic readers would benefit most from activities to promote phonological awareness, letter-sound knowledge, and understanding of the alphabetic principle. Integrating training in phonological awareness with explicit instruction in letter sounds and decoding is one way to promote understanding of the alphabetic principle; examples of these kinds of activities can be found in Blachman (1987) and Alexander et al. (1991). Compensatory readers also need direct instruction in decoding skills, as well as encouragement in applying these skills when reading in context, rather than guessing at words based on contextual cues. Nonautomatic readers could develop automatization of decoding skills through increased practice reading. Motivation, although important for all disabled readers, is likely to be especially crucial for nonautomatic readers, as increased motivation is likely to result in increased levels of practice. Giving children a choice of reading materials and encouraging independent reading may foster both motivation and practice. Finally, delayed readers are likely to require direct instruction in reading strategies and in higher level comprehension skills that they have missed.

There is a seemingly age-old controversy in reading instruction between the advocates of phonics instruction on the one hand and those who have emphasized comprehension in initial reading instruction, such as the advocates of the whole language approach to teaching reading, on the other hand. However, in our view, this debate is over the wrong question. Although we have emphasized the importance of decoding in early reading acquisition and in reading disability, a sound reading program obviously needs to develop *both* fluent decoding and good comprehension. A reading program that consists of having children complete endless phonic exercises, and little else, is likely to be as disastrous as one that fails to teach decoding at all (a characteristic of some whole language programs). Reading instruction that fails to foster higher level comprehension skills not only may result in impaired comprehension, but also may negatively affect children's motivation for reading, which in turn may affect other crucial variables, such as practice.

A combination of whole language techniques with a strong decoding program seems especially appropriate for many youngsters with reading disability, and would probably benefit many nondisabled readers as well. The aspects of whole language that might benefit students with RD include its emphases on early writing, on integrating reading with other subject areas, and on motivational reading materials. We do not mean to suggest that combining whole language techniques and decoding instruction is easy, particularly in the initial phases of reading acquisition, when children's decoding skills are very limited; however, it can be done (e.g., Clay, 1979; Hiebert, Colt, Catto, & Gury, 1992). Without a well-integrated, comprehensive reading program that develops both fluent decoding and higher level comprehension skills, most children with reading disability will never find their way back to the road to proficient reading.

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REFERENCES

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

Adams, M. J., Allington, R. L., Chaney, J. H., Goodman, Y. M., Kapinus, B. A., McGee, L. M., Richgels, D. J., Schwartz, S. J., Shannon, P., Smitten, B., & Williams, J. P. (1991). Beginning to read: A critique by literacy professionals and a response by Marilyn Jager Adams. *Reading Teacher, 44,* 370–395.

Alexander, A. W., Andersen, H. G., Heilman, P. C., Voeller, K., & Torgesen, J. K. (1991). Phonological awareness training and remediation of analytic decoding deficits in a group of severe dyslexics. *Annals of Dyslexia, 41,* 193-206.

Alexander, P. A., & Judy, J. E. (1988). The interaction of domain-specific and strategic knowledge in academic performance. *Review of Educational Research, 58,* 375–404.

Anderson, R. C., Hiebert, E. H., Scott, J. A., & Wilkinson, I. A. G. (1985). *Becoming a nation of readers: The report of the commission on reading.* Champaign, IL: Center for the Study of Reading.

Blachman, B. A. (1987). An alternative classroom reading program for learning disabled and other low-achieving children. In W. Ellis (Ed.), *Intimacy with language: A forgotten basic in teacher education* (pp. 49–55). Baltimore: The Orton Dyslexia Society.

Boder, E. (1973). Developmental dyslexia: A diagnostic approach based on three atypical reading-spelling patterns. *Developmental Medicine and Child Neurology, 15,* 663–687.

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read—A causal connection. *Nature, 301,* 419–421.

Byrne, B. (1992). Studies in the acquisition procedure for reading: Rationale, hypotheses, and data. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 1-34). Hillsdale, NJ: Erlbaum.

Byrne, B., & Ledez, J. (1986). Phonological awareness in reading-disabled adults. *Australian Journal of Psychology, 35,* 185–197.

Chall, J. (1967). *Learning to read: The great debate.* New York: McGraw-Hill.

Chall, J. (1983). *Stages of reading development.* New York: McGraw-Hill.

Chall, J., Jacobs, V. A., & Baldwin, L. E. (1990). *The reading crisis: Why poor children fall behind.* Cambridge, MA: Harvard University Press.

Chan, C., Burtis, P. J., Scardamalia, M., & Bereiter, C. (1992). Construction activity in learning from text. *American Educational Research Journal, 29,* 97–118.

Clay, M. M. (1979). *The early detection of reading difficulties.* Portsmouth, NH: Heinemann.

Coles, G. S. (1987). *The learning mystique: A critical look at "learning disabilities."* New York: Pantheon Books.

Davidson, J. E., & Sternberg, R. J. (1984). The role of insight in intellectual giftedness. *Gifted Child Quarterly, 28,* 58-64.

Ehri, L. C. (1991). Learning to read and spell words. In L. Rieben & C. A. Perfetti (Eds.), *Learning to read: Basic research and its implications* (pp. 57-73). Hillsdale, NJ: Erlbaum.

Ehri, L. C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 107-143). Hillsdale, NJ: Erlbaum.

Frost, R. (1949). *Complete poems of Robert Frost.* New York: Holt.

Garner, R. (1987). *Metacognition and reading comprehension.* Norwood, NJ: Ablex.

Garner, R., Alexander, P. A., & Hare, V. C. (1991). Reading comprehension failure in children. In B. Y. L. Wong (Ed.), *Learning about learning disabilities* (pp. 283-307). San Diego: Academic.

Garner, R., & Reis, R. (1981). Monitoring and resolving comprehension obstacles: An investigation of spontaneous text lookbacks among upper-grade good and poor comprehenders. *Reading Research Quarterly, 16,* 569-582.

Goldenberg, C. (1992). The limits of expectations: A case for case knowledge about teacher expectancy effects. *American Educational Research Journal, 29,* 517-544.

Goswami, U., & Bryant, P. (1992). Rhyme, analogy, and children's reading. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 49-63). Hillsdale, NJ: Erlbaum.

Gough, P. B., & Juel, C. (1991). The first stages of word recognition. In L. Rieben & C. A. Perfetti (Eds.), *Learning to read: Basic research and its implications* (pp. 47-56). Hillsdale, NJ: Erlbaum.

Hammill, D. D., Leigh, J. E., McNutt, G., & Larsen, S. C. (1981). A new definition of learning disabilities. *Learning Disability Quarterly, 4,* 336-342.

Hiebert, E. H., Colt, J. M., Catto, S. L., & Gury, E. C. (1992). Reading and writing of first-grade students in a restructured Chapter 1 program. *American Educational Research Journal, 29,* 545-572.

Katz, R. B. (1986). Phonological deficiencies in children with reading disability: Evidence from an object naming task. *Cognition, 22,* 225-257.

LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6,* 293-323.

Liberman, I. Y. (1989). Phonology and beginning reading revisited. In C. von Euler (Ed.), *Wenner-Gren international symposium series: Brain and reading* (pp. 207-220). Hampshire, England: Macmillan.

Maclean, M., Bryant, P., & Bradley, L. (1987). Rhymes, nursery rhymes, and reading in early childhood. *Merrill-Palmer Quarterly, 33,* 255-281.

Mann, V. A., & Liberman, I. Y. (1984). Phonological awareness and verbal short-term memory. *Journal of Learning Disabilities, 17,* 592-599.

Markman, E. M., & Gorin, L. (1981). Children's ability to adjust their standards for evaluating comprehension. *Journal of Educational Psychology, 83,* 320-325.

Mason, J. M. (1992). Reading stories to preliterate children: A proposed connection to reading. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 215-241). Hillsdale, NJ: Erlbaum.

Morrison, F. J., & Manis, F. R. (1982). Cognitive processes and reading disability: A critique and proposal. In C. J. Brainerd & M. I. Pressley (Eds.), *Progress in cognitive development research* (Vol. 2, pp. 59-93). New York: Springer-Verlag.

Myers, M., & Paris, S. G. (1978). Children's metacognitive knowledge about reading. *Journal of Educational Psychology, 70,* 680-690.

Paris, S. G., Jacobs, J. E., & Cross, D. R. (1987). Toward an individualistic psychology of exceptional children. In J. Borkowski & J. Day (Eds.), *Intelligence and cognition in special children: Perspectives on mental retardation, learning disabilities, and giftedness* (pp. 1-49). New York: Ablex.

Paris, S. G., & Lindauer, B. K. (1982). The development of cognitive skills during childhood. In B. Wolman (Ed.), *Handbook of developmental psychology* (pp. 333-349). Englewood Cliffs, NJ: Prentice-Hall.

Perfetti, C. A. (1985). *Reading ability.* New York: Oxford University Press.

Perfetti, C. A. (1992). The representation problem in reading acquisition. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 145-174). Hillsdale, NJ: Erlbaum.

Perfetti, C. A., Beck, I., Bell, L., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. *Merrill-Palmer Quarterly, 33,* 283-319.

Perfetti, C. A., & Lesgold, A. (1977). Discourse comprehension and sources of individual differences. In M. Just & P. Carpenter (Eds.), *Cognitive processes in comprehension* (pp. 141-183). Hillsdale, NJ: Erlbaum.

Rapala, M. M., & Brady, S. (1990). Reading ability and short-term memory: The role of phonological processing. *Reading and Writing: An Interdisciplinary Journal, 2,* 1-25.

Rumelhart, D. (1975). Notes on a schema for stories. In D. G. Bobrow & A. Collins (Eds.), *Representation and understanding: Studies in cognitive science* (pp. 40-82). San Diego: Academic.

Shankweiler, D., & Crain, S. (1986). Language mechanisms and reading disorder: A modular approach. *Cognition, 24,* 139-168.

Shankweiler, D., Crain, S., Brady, S., & Macaruso, P. (1992). Identifying the causes of reading disability. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 275-305). Hillsdale, NJ: Erlbaum.

Smiley, S. S., Oakley, D. D., Worthen, D., Campione, J. C., & Brown, A. L. (1977). Recall of thematically relevant material by adolescent good and poor readers as a function of written versus oral presentation. *Journal of Educational Psychology, 69,* 381-389.

Snowling, M. (1980). The development of grapheme-phoneme correspondence in normal and dyslexic readers. *Journal of Experimental Child Psychology, 29,* 294-305.

Snowling, M. (1981). Phonemic deficits in developmental dyslexia. *Psychological Research, 43,* 219-234.

Spear, L. C., & Sternberg, R. J. (1987). An information-processing framework for understanding reading disability. In S. J. Ceci (Ed.), *Handbook of cognitive, social, and neuropsychological aspects of learning disabilities* (Vol. 2, pp. 3-31). Hillsdale, NJ: Erlbaum.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360-406.

Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The

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