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Reading: A Research-Based Approach
SoR: What's been Learned. (some condensing and comments by arthurreadingworshop.com)

A body of research has evolved on how children learn to read and why some fail (see Appendix). This research, sponsored at the federal level by the National Institute of Child Health and Human Development (NICHD), has existed for more than thirty years (Lyon 1995; Lyon, Alexander, and Yaffe 1997). It is not the only existing research on the development of reading skills and reading failure, but it does represent a comprehensive research program that has attracted attention because of nationwide concern about children's ability to read. Unfortunately, the NICHD research has not yet significantly affected how children are taught to read in school, so that a gap continues to exist between what we know about reading and how children are taught to read.

As Benita Blachman, a well-known reading researcher, stated in testimony in Washington: "Specifically, the instruction currently being provided to our children does not reflect what we know from research. Direct, systematic instruction about the alphabetic code is not routinely provided in kindergarten and first grade, despite the fact that, given what we know at the moment, this might be the most powerful weapon in the fight against illiteracy." (Blachman 1996, 66-67)

The NICHD research supports a prominent role for explicit instruction in phonics and phonological awareness skills (i.e., alphabetic principle) for beginning reading instruction, particularly for children at risk for reading failure. It also shows how these skills are involved in learning to read for all children, regardless of how they are taught. The NICHD intervention research, however, is sometimes equated with either an exclusive phonics approach or research addressing only children with reading problems.

Both interpretations are inaccurate.

These studies are based on a large body of NICHD research on how children learn to read. The intervention studies apply the findings of this research. If the NICHD had never funded a single study of intervention or learning disabilities, this research on normal processes of reading development would still have major policy implications for teaching children to read. The research that focuses on reading failure was based on earlier ongoing research—also funded in part by NICHD—that critically analyzed the nature of reading skills, how children learn to read, and the bases of reading failure (Lyon et al. 1997). The NICHD also funds research on many aspects of the reading process, such as eye movements in beginning and skilled readers, relationships of language and reading in nonimpaired children and adults, social and biological factors in literacy, and other areas that affect reading but do not involve disability.

During the past thirty-three years, NICHD reading scientists have studied, at thirty-six research sites, the reading development of 34,501 children and adults, including 21,860 skilled readers and 12,641 impaired readers. As the titles of the selected research projects in the appendix indicate, approximately 50 percent of the current NICHD research effort in reading is devoted to research on how language, reading, and reading-related skills emerge in proficient readers; the other 50 percent addresses factors that impede the acquisition of those skills. As the titles of the research projects in the appendix indicate, multiple processes related to reading—phonological awareness, word recognition, reading fluency and automaticity, reading comprehension processes, and social and biological factors in literacy—are currently being addressed by the NICHD-sponsored research. Our report focuses only on findings obtained from NICHD research.

Prevalence and Outcomes

The magnitude of the reading problem is significant. From NICHD and non-NICHD research, we know that at least 10 million school-age children in the United States are poor readers. The prevalence of reading disability is approximately 20 percent of school-age children depending on how disability is defined and where it is studied (Shaywitz et al. 1992). Whether rates of reading failure are increasing or decreasing begs the question of the significance of reading failure rates. The number of children who are identified as disabled or who do not meet basic levels of proficiency on reading assessments such as the National Assessment of Reading Proficiency (more than 40 percent in 1994) should be cause for alarm regardless of whether the rate is changing.

Long-term outcomes of early reading difficulties are poor. In one recent study, 74 percent of children who were poor readers in the third grade remained poor readers in the ninth grade. Of particular interest is the report that, of all children identified as learning disabled by public schools, 70-80 percent are primarily impaired in reading; 90 percent of those children have difficulties with word recognition skills (Lerner 1989). Critical questions are how word recognition skills are learned, and why poor readers have difficulty with single-word skills. The answers to these questions reside in research on the relationship of language and reading.

Language and Reading

What we know about reading and language begins with a simple observation made by the noted speech scientist Alvin M. Liberman, who has long argued that reading is dependent on language but is not a natural outgrowth of language. As Liberman (1997, 4-5) recently observed:

> "A proper theory of speech is essential to an understanding of how people read—the most relevant consideration arises out of the deep biological gulf that separates the two processes. Speech, on the one side, is a product of biological evolution, standing as the most obvious, and arguably the most important, of our species-typical behaviors. Reading/writing, on the other, did not evolve biologically, but rather developed (in some cultures) as a secondary response to that which evolution had already produced. A consequence is that we are biologically destined to speak, not to read or write. Accordingly, we are all good at speech, but disabled as readers and writers; the difference among us in reading/writing is simply that some are fairly easy to cure and some are not."

In other words, oral language, which humans have possessed for millions of years, usually unfolds as a natural biological progression. It is not an automatic unfolding, however, as is commonly believed. Environmental factors also have significant influences on early language development. The difference is that most children develop

language proficiency through interactions that are not explicitly intended to teach the child to talk. In contrast, written language is an artificial construction built on oral language. Thus, reading, which humans have possessed for only about four thousand years, does not reflect a biological process that emerges naturally. Although children vary in how explicitly reading must be taught, even children who seem to learn to read at an early age have a period in which the nature of print and its relationship to language is brought explicitly to their attention (Gough and Hillinger 1980; A. M. Liberman 1997). Given that reading must be taught—how else would we explain illiteracy in literate cultures?—the questions that NICHD and other researchers have puzzled over are, What aspects of reading must be taught? Why do children fail to learn to read? and How do you best teach poor readers to read?

What Must Be Taught

The critical component of reading that must be taught is the relationship of print to speech. Many other components of reading, particularly those that relate to comprehension, are outgrowths of the child's facility for language. For example, in what is described as the "simple view" of reading, Gough and Tumner (1986) proposed that reading consists of two primary components: *decoding,* or word recognition, and language *comprehension,* both of which are necessary for reading proficiency. Children do not become proficient readers unless both components are fully developed. In other words, children who cannot decipher the words on a page in a fluent and accurate manner will struggle to comprehend the meaning of the text; without proficient language comprehension skills, even children who recognize the words may not necessarily understand their meaning. Word recognition skills are intrinsic to reading, reflecting the need to decipher print, whereas language comprehension pervades all areas of literacy. Reading comprehension skills can (and should) be taught (Adams et al. 1997), but word recognition skills are essential for the child to become proficient. Hence, in the simple view, reading proficiency is the product of word recognition and language comprehension skills; some of the controversy among reading professionals is not whether both sets of skills must be mastered but how children master these skills and how explicitly these skills must be taught. The broader underlying issues involve philosophical views on learning and development, such as whether children master skills or construct knowledge. The NICHD research clearly stems from a skills perspective.

Research supported by the NICHD shows that learning to read is a developmental process children go through in acquiring proficiency. Because proficient readers employ processes that are different from beginning readers, research on good readers may not fully apply to beginning readers. Skilled readers do not gloss or skip over words when reading text; they sample nearly every word. Phonological codes that involve the sounds of words and help the reader decipher the words are activated early in word recognition in beginning and skilled readers (Rayner, Sereono, Lesch, and Pollatsek 1995). However, the task for the beginning reader is to move from the early phases of "sounding out" words to the more skilled phase in which word recognition occurs almost instantaneously. This developmental change allows the word recognition process to occur fluently, automatically, and rapidly enough to allow for the abstraction of meaning from text. Without efficient (automatic) word recognition skills, comprehension is impaired even when the underlying comprehension processes are well developed.

How do children learn word recognition skills (i.e., decode)? The answers have their origins in research from the NICHD-supported Haskins Laboratories in New Haven, Connecticut, that extends over a thirty-year period (see Brady and Shankweiler 1991; A. M. Liberman 1996; Lyon et al. 1997). In the late 1960s and early 1970s, investigators at the Haskins Laboratories were studying the relationship of speech and language. Through a series of experiments, they discovered that how speech is articulated influences the relationship between spoken and written language (A. M. Liberman 1996). This relationship involves how the sound structures of language are represented in speech (i.e., phonology). Speech can be broken down into sounds smaller than the word or the syllable called *phonemes*, the smallest parts of speech that make a difference in the meaning of a word. A critical discovery was that phonemes overlap, or are *coarticulated,* in the speech stream (Liberman, Cooper, Shankweiler, and Studdert-Kennedy 1967). As Blachman (1997) reports, the late Isabelle Y. Liberman and her colleagues (I. Y. Liberman 1971, 1973) expanded this discovery to the processing of speech, observing that a fundamental task for the beginning reader is understanding not only that speech can be broken down into phonemic segments but that these segments are represented by the alphabet in printed form. Liberman and her colleagues undertook a series of studies of how children learn to read, showing that beginning readers must become aware of the phonological structure of oral language (i.e., phonological awareness) in order to appreciate how print represents speech (Brady and Shankweiler 1991; A. M. Liberman 1996; I. Y. Liberman et al. 1989). Developing this awareness, however, is not automatic because phonemes are not separated in producing speech, which makes the phonetic structure of speech obscure. Yet being aware of how print represents the phonological structure of spoken words is the key skill specific to reading that children must learn. That awareness is the basis for scaffolding written language onto oral language. [This paragraph is still about what needs to be learned, not how it is learned, especially in instruction]

The early (and continuing) work of investigators at the Haskins Laboratories—the cornerstone of the research supported by NICHD on reading failure—has had international influence leading to a large accumulation of data supporting the key role of phonological awareness. That research also led to non-NICHD-supported longitudinal studies of preschoolers in Great Britain and Sweden showing that early activities involving phonological awareness skills (i.e., rhyming and alliteration games) helped reading skills later in school relative to the reading skills of children who did not receive these activities (Bradley and Bryant 1983; Lundberg, Frost, and Peterson 1988). Other NICHD and non-NICHD studies of children who varied in reading 1evels, socioeconomic backgrounds, and literacy experiences have also shown that explicit training in phonological awareness skills before first grade is associated with better reading skills later (Byrne and Fielding-Barnesly 1995; Torgesen 1997). [how this training is provided is not identified.]

Phonological awareness is only one, albeit large, component of learning to read. Many processes and experiences are critical for the development of beginning reading skills (Adams 1990; Adams et al. in press; Share and Stanovich 1995). These include not only phonological awareness skills but also letter and print awareness, early language experiences, and a literacy background. [The what and the general area] As Adams (1990) pointed out, however, these early processes are only a means to ends, with one goal being efficient word recognition. In addition, as Gough and Tumner (1986) noted, the second goal, comprehension, depends not only on word recognition skills but also on the child's general capacities for language comprehension, as well as other cognitive processes involved in processing text, such as short-term memory.

These processes can be fostered through effective teaching of strategies and can be understood as the construction of meaning, representing an active process in which the reader, teacher, and text interact (Brown, Pressley, Van Meter, and Schuder 1996). Text reading processes, however, do not explain why most children fail to learn to read. In the next section we review NICHD research on reading failure, for it is with poor readers that the importance of word recognition processes and phonological awareness skills are most apparent.

Why Children Fail to Read

Word Recognition Deficits

Fundamental to this question of reading failure is a set of observations that make it possible to approach poor reading scientifically. Although we know that reading problems occur primarily at the level of the single word and involve the ability to decode printed words (Shaywitz 1996; Torgesen 1997; Vellutino 1979, 1991), the basis of this problem was not clearly established until more recently. Research on developing reading skills in nondisabled children, and word recognition skills in poor readers, established that word recognition problems arise from problems breaking apart words and syllables into phonemes. This relationship is apparent in the majority of poor readers, including children, adolescents, and adults at all levels of IQ and in children and adults from linguistically and culturally diverse backgrounds. To reiterate, reading is *alphabetic,* which means that, for languages such as English and Spanish, the code is in the alphabet. Even in languages that are not alphabetic, like Chinese, the code is still based on phonology and relationships of phonemes to the characters (logograms) of Chinese writing.

Simply put, word recognition, or decoding, is looking at a word and cracking a code. The code is in the print but is essentially an alphabetic one whereby the child must learn to relate phonological structures in spoken words to print. Thus, proficient readers can come close to pronouncing words never before heard, much less seen, and can even pronounce pseudowords (i.e., nonsense words) with a phonetic structure, such as *crad*. Hence, when children develop word recognition skills they become aware that words have an internal structure based on their sounds and represented by the alphabet. Comprehension of the word thus becomes almost instantaneous.

When children learn how print represents the internal structure of words, they become accurate at word recognition; when they learn to recognize words quickly and automatically, they become fluent. Many children seem to figure out these relationships regardless of how they are taught. For some children—the actual percentage is difficult to estimate, but it is probably at least 20 percent and most likely more—this relationship is not straightforward and may need to be explicitly taught; hence the problem we have today.

Causes of Poor Reading

The NICHD research has *not* found the processes underlying reading disability to be *qualitatively* different from those processes associated with early reading proficiency. Reading problems occur as part of a natural, unbroken continuum of ability. What causes good reading also leads to poor reading when the processes are deficient (Shaywitz et al. 1992). Many factors underlie the cognitive deficiencies associated with reading failure. Although these causes are multiple, most children's problems occur at the level of the single word. The NICHD has evaluated the following factors:

Neurological. Brain activity when reading for the sounds of words, such as whether they rhyme, is different in good and poor readers (see Lyon and Rumsey 1997). Specific areas of the brain are involved, but a distinct neural signature has not yet been defined. Research on brain structure in poor readers shows subtle variations that are not consistent across studies. Much of this research has been done with adults who have a history of reading problems. Needed studies of young readers are under way. Recent studies using new technologies for measuring brain functions are promising but only beginning to emerge (Shaywitz 1996). A key question is whether improved reading may actually result in changes in brain functions.

Familial. Reading problems run in families and cut across all sociocultural groups. These problems can have a genetic component, but several different genes are involved (Cardon et al. 1994; Grigorenko et al. 1997). In addition, genetic factors account for only about half of the variability in reading skills, which means that the environment has a significant influence on reading outcomes. For example, adults who read poorly may be less likely to read to their children. The quality of reading instruction may be more critical for children when there is a family history of poor reading.

Cultural and Linguistic Diversity. Both NICHD and nonNICHD studies show that print exposure, levels of parental literacy, and reading to the child are important (Adams 1990). Recent research, however, suggests that these influences are somewhat overestimated because intervention studies have been successful in culturally and linguistically diverse populations where home literacy experiences are often limited (Foorman et al. 1997a, 1997b, 1998; Torgesen 1997).

Instructional. The influence of instruction in reading has been underestimated, as we will see when we turn to intervention studies. What is important is that the skills that prevent poor reading must be taught early—in kindergarten, grade 1, and grade 2. For many children, these skills may need to be taught explicitly over several years.
[all very broad and vague information, just giving direction but not the how.]

Teaching Poor Readers to Read

The NICHD has supported several studies of how to prevent reading failure and how to intervene with poor readers. These studies have been coordinated by centers at Bowman-Gray Medical School, Florida State University, the State University of New York at Albany, the University of Colorado, and the University of Texas-Houston Health Science Center. The studies have taken place in multiple settings and include children with identified reading problems (Felton 1993; Torgesen 1997; Wise and Olsen 1995), children served in Title I programs (Foorman et al. 1998), kindergarten children at risk for reading failure (Foorman et al. 1997a; Torgesen 1997), and children reading poorly in populations that are predominantly middle class with relatively good literacy experiences (Scanlon and Vellutino 1996; Vellutino et al. 1996). In addition, more-recent NICHD-supported investigations have been initiated at Georgia State University, Tufts University, Syracuse University, the Hospital for Sick Children in Toronto, and the University of Washington.
The primary goals of the intervention studies have been to (1) identify the conditions, abilities, and processes that must be available for a child to develop robust word recognition and reading comprehension skills and (2) identify for which children with reading difficulties are different instructional factors and components most beneficial and at which stages of reading development (Lyon and Moats 1997). With these goals in mind, these studies share common features, including the assessment methodologies. The studies are based on research (described above) showing how normal children learn to

read and applying this research to the study of reading failure. Hence, the studies share an emphasis on the effectiveness of teaching word recognition skills, usually through phonics or phonological awareness training or both. In many studies, the research was designed to evaluate the degree of explicitness required to teach word recognition skills. Instruction in word recognition skills, however, occurs along with opportunities for applications to reading and writing, exposure to literature, and other practices believed to facilitate the development of reading skills in proficient readers. This reflects one of the oldest observations of any form of teaching or training—a targeted skill cannot be learned without opportunities for practice and application. Because of the interest in these studies, each NICHD site will be discussed separately.

The Bowman-Gray Reading Intervention Studies   Brown and Felton (1990) and Felton (1993) compared the efficacy of interventions defined as *code-based,* which emphasized identification of words based on letter-sound associations and patterns, and *meaning-based*, which emphasized identification of words based on context supplemented by partial letter-sound cues (i.e., beginning and ending sounds). The children were identified at the end of kindergarten as at risk for reading failure based either on deficient phonological awareness skills from tests administered by the researchers or by teacher identification or both. In addition, children were also followed who received the school's standard instructional program. Thus, kindergarten children were randomly assigned to one of two reading instruction programs for first and second grade, along with a third group who received the school's standard curriculum. Children were taught in small groups in regular classrooms within the child's home school.

The meaning-based approach used a basal reading program, whereas the code-based approach explicitly taught phonics. These programs were selected because they taught similar word recognition skills in the first- and second-grade curriculums but varied as to whether the instruction in word recognition skills was explicitly presented by the teacher. At the end of the second grade children who had received the code-based instruction earned significantly higher mean scores than children who had received the meaning-based approach on measures of word recognition and spelling. Felton (1993) concluded that five elements were critical to a beginning program for children at risk of reading failure: (1) direct instruction in language analysis; (2) explicit teaching of the alphabetic code; (3) reading and spelling must be taught simultaneously; (4) reading instruction must be sufficiently intense for learning to occur; and (5) using decodable words and texts enhanced automaticity.

The Florida State University Reading Intervention Studies   Torgesen et al. (1997) identified 180 children in kindergarten who were at the bottom twelfth percentile in phonological processing skills. Those children, who varied widely in their general verbal ability and home literacy environments, were randomly assigned to four instructional conditions, two of which were experimental and two of which were control conditions. The most important way the two experimental instructional programs differed from each other was in the amount and explicitness of instruction in phonological awareness and phonemic reading strategies. In the explicit approach, phonological awareness was taught by helping children discover the articulatory positions and mouth movements associated with each of the phonemes in English (Lindamood and Lindamood 1975). These children also received extensive practice in applying phonemic decoding strategies to individual words. In the other approach, phonological awareness was stimulated during writing activities, and children were taught letter-sound correspondences as they learned new sight words. A much higher proportion of time was devoted to reading and writing meaningful text. In both conditions, children began reading and discussing connected, meaningful text as soon as they could read just a few words. That component is critical because children who

are poor readers tend to spend less time actually reading and writing (Allington 1991; Juel 1988), yet more time on these activities is critical for skill mastery.

The children in each instructional condition received eighty minutes of individualized (one to one) supplemental instruction each week over a two-and-a-half year period beginning in mid-kindergarten. Half the instructional sessions for each child were led by well-trained teachers, and half were led by instructional aides. The children also received regular classroom instruction, which varied widely depending on whether teachers viewed the instructional program as emphasizing phonics or as more context or literature based. The results indicated that, at the end of the second grade, children who received explicit instruction in the alphabetic principle had much stronger reading skills than children in all the other groups. In addition, children who received the most explicit instruction showed the lowest need to be held back a grade (9 percent), with hold-back rates in the other three conditions ranging from 25 percent (implicit phonics) to 30 percent (classroom support condition) to 41 percent (no-treatment comparison group). As a group, children in the explicit condition demonstrated word-level reading skills that were in the middle of the average range. In this same group, however, 24 percent of the children were still well below average. Extrapolated to the entire population, this would lead to an overall failure rate of 2.4 percent. This figure, of course, is far below the 20 percent reported for children with reading disabilities (based on word recognition definitions) reported above. Other analyses showed that growth in reading skills was mediated by improvements in phonological processing skills.

In a study of older children with identified reading disabilities in grades 3-5, intervention conditions used either the same explicit alphabetic instructional program (articulatory awareness plus synthetic phonics) as in the kindergarten prevention study or an alternative curriculum in which phonics was explicitly taught but in which the emphasis was on reading and writing connected text (Torgesen 1997). These two groups received eighty hours of individualized remediation over an eight-week period. Both groups showed a large improvement in word reading ability, but the more explicit program produced greater gains in phonological decoding skills (as measured by the ability to read pseudowords). At the end of the program, few children in the more explicit program remained poor phonological decoders. The improvements in word-reading accuracy made by children in both groups were accompanied by growth in reading comprehension to the extent that, at the end of the study, the children comprehended written material at a level consistent with their general verbal ability. A remaining concern was that gains in reading fluency were not nearly as dramatic as increases in reading accuracy.

Based on the results of these studies, Torgesen (1997) provided some general principles of instructional programs that are effective with children who have problems with word recognition. Specifically, he suggested that instruction be more explicit and comprehensive since the evidence shows that children who fail to learn to read must be explicitly taught. In addition, he observed that instruction must be more intensive because children with word-level reading problems acquire skills more slowly, need more repetition, and need more experience in different contexts. Finally, instruction must be more supportive at both the emotional and the cognitive level, using encouragement, feedback, and positive reinforcement, because learning is more difficult, proceeds more slowly, and is generally more frustrating.

The State University of New York at Albany Reading Intervention Studies Vellutino et al. (1996) identified children who scored below the fifteenth percentile in real-word and pseudoword reading skills at the beginning of the second semester of first grade. These children were selected from schools with a high probability of the children having strong literacy backgrounds (largely middle class and above and predominantly Caucasian). These children received thirty minutes of daily individualized tutoring. Approximately half this tutorial was devoted to explicit code-based activities, as well as word recognition and writing activities; the other half was devoted to activities involving decoding and other strategies for word recognition. At the end of only one semester, approximately 70 percent of the children were reading within or above the average range based on national norms. These results translated to a reading failure rate of approximately 1.5 to 3 percent of the overall

population, depending on whether severely impaired and moderately impaired readers were both included in the tally (3 percent) or only severely impaired readers (1.5 percent). Further, children who responded well to remediation, and caught up to their normal reading peers, generally maintained these performance levels once the intervention was discontinued. Most of these children required only one semester of remediation; the children who were still having difficulty when the intervention was discontinued received two semesters of remediation. Thus we see that early intervention helps reduce the number of children who will require protracted remediation to become independent readers and writers; some, children, however, will continue to need such services.

In a related study, Scanlon and Vellutino (1996) observed that kindergarten teachers spent much less time on reading practices involving code-based skills relative to time spent on comprehension activities. In classes where kindergarten teachers spent more time on activities that sensitized the children to the phonemic structure of language, students had better reading skills in first grade, particularly if they entered school lacking in rudimentary literacy skills, such as letter identification

The University of Colorado Reading Intervention Studies   Concerns about whether training leads to improvement in reading skills once the intervention is discontinued were confronted in studies from the University of Colorado (Olsen et al. 1997; Wise and Olson 1992, 1995). In an earlier study (Wise and Olson 1992), children with identified reading disabilities in grades 2-6 who were below the local tenth percentile in word recognition skills received an intervention of three to four days a week for approximately thirty minutes during one semester. The intervention, taking advantage of recent advances in the development of speech synthesizers to pronounce words for the child, involved a computer-based program in which children read interesting stories that targeted difficult words. The performance of this group was compared with that of children who remained in their regular remedial classes. After approximately fourteen hours of instruction, the group that received the computer training showed substantially greater gains in phonological awareness skills and word recognition than the standard remediation group. Children with the lowest pretest levels of phoneme awareness, however, gained only half as much as those with higher phoneme awareness, suggesting that explicit training in phoneme awareness might support greater gains in reading.

In a subsequent study (Wise and Olson 1995), second- to fifth-grade children with reading problems were put in groups of three and given training in phoneme awareness similar to some of the training employed by Torgesen et al. (1997). The initial training was grounded in the development of children's awareness of the oral-motor patterns associated with different phonemes (Lindamood and Lindamood 1975). Children then worked on computer programs where they (1) practiced manipulating letter symbols in response to syllables spoken by the computer; (2) explored spelling patterns and print-sound relations through spelling exercises in which the computer pronounced correct and incorrect typed responses; and (3) matched printed pseudowords to pseudowords pronounced by the computer. Children also spent about a third of their twenty-five-hour training time reading stories on the computer with decoding support. This group was compared with a second group that received small-group instruction emphasizing comprehension strategies. The comprehension group spent most of their twenty- five hours reading, a third of the time with stories off the computer and two-thirds of the time with stories and decoding support on the computer.

The results showed that the group receiving explicit training in phonological skills made three times more improvement in phoneme awareness and two times more improvement in pseudoword decoding than the comprehension training group. The phonological group had the advantage on a standardized measure of word recognition without time limits, whereas the comprehension group showed significantly greater gains on a measure requiring rapid recognition of words. There were no significant group differences on the measures of word recognition, however, when children were assessed at one and two years after the intervention was completed, even though the phonological group's pseudoword reading was still significantly better than that of the comprehension group after one year (Olson et al. 1997).

Olson et al. (1997) were concerned that the large and persisting gains in phoneme awareness and phonological decoding would only weakly transfer to gains in word recognition at the end of training and follow-up tests. Some transfer to real-word reading did occur when children had ample time and were encouraged to apply their phonological skills in word recognition during the training period. Apparently, however, the children did not use these skills after training to further accelerate their growth in word recognition. Several explanations for the lack of transfer were considered, including the training period being too short, not enough practice in actual reading skills, and too little focus on issues involving automaticity and speed in phonological processing.

The University of Texas-Houston Health Science Center Reading Intervention Studies Foorman et al. (1997a, 1997b, 1998) studied children who were either at risk for reading failure in kindergarten because of social and economic disadvantage, identified with reading disability through special education, or identified as at risk for reading problems and served through Title I programs for children with reduced social and economic circumstances.

In the kindergarten prevention program, the standard kindergarten curriculum was supplemented with activities involving phonological awareness skills for approximately fifteen minutes a day over the school year. Those fifteen minutes led to significant gains in phonological analysis skills relative to children in the same curriculum who did not receive this training (Foorman et al. 1997a).

In another study, children with identified reading disabilities in grades 2 and 3 who were provided services in special education resource rooms received one of two programs in which phonics was taught explicitly. Children in these two groups were compared with a group that received an intervention that involved training to read words on sight (Foorman et al. 1997b). Although children who received one of the phonics programs showed better gains in phonological analysis and word reading skills at the end of one year of intervention, the differences in word reading skills were not apparent when verbal intelligence scores—higher in this group—were controlled in the analysis. In fact, the best predictor of outcomes in all three groups was the child's initial status in word-reading ability, which suggests that the programs were not effective because the child's end-of-year reading ability could be predicted solely on how well he or she read at the beginning of the year. The results of this second study, which contrast with the results from Florida State University and the State University of New York at Albany, may reflect the use of a pullout model in which small groups of children were instructed (Foorman et al. 1997b), rather than receiving instruction in a one-to-one setting. It also may take more intensity to establish the types of gains observed in the Torgesen (1997) and Vellutino et al. (1996) studies.

The third study involved children identified as eligible for Title I services in eight of ten Title I—eligible schools in the district (Foorman et al. 1997a). These children, who were culturally and linguistically diverse and generally economically disadvantaged, received classroom-level interventions in an attempt to evaluate the degree to which the alphabetic principle must be taught explicitly to facilitate gains in reading skills. The 375 children in the eight schools received classroom-based instruction that involved (1) the district's standard context-based, meaning emphasis instructional program, with staff development and supervision provided by district personnel; (2) a context-based, meaning emphasis approach where professional development and monitoring were provided by research staff; (3) a program in which phonological awareness and phonics skills were taught using letter patterns embedded in the reading material; or (4) a program that included explicit instruction in phonics, applications in reading and writing, and exposure to literature. The analyses in Foorman et al. (1998) involved only the 285 children who received tutorial services; Foorman et at (1997b) provided preliminary results on the entire sample.
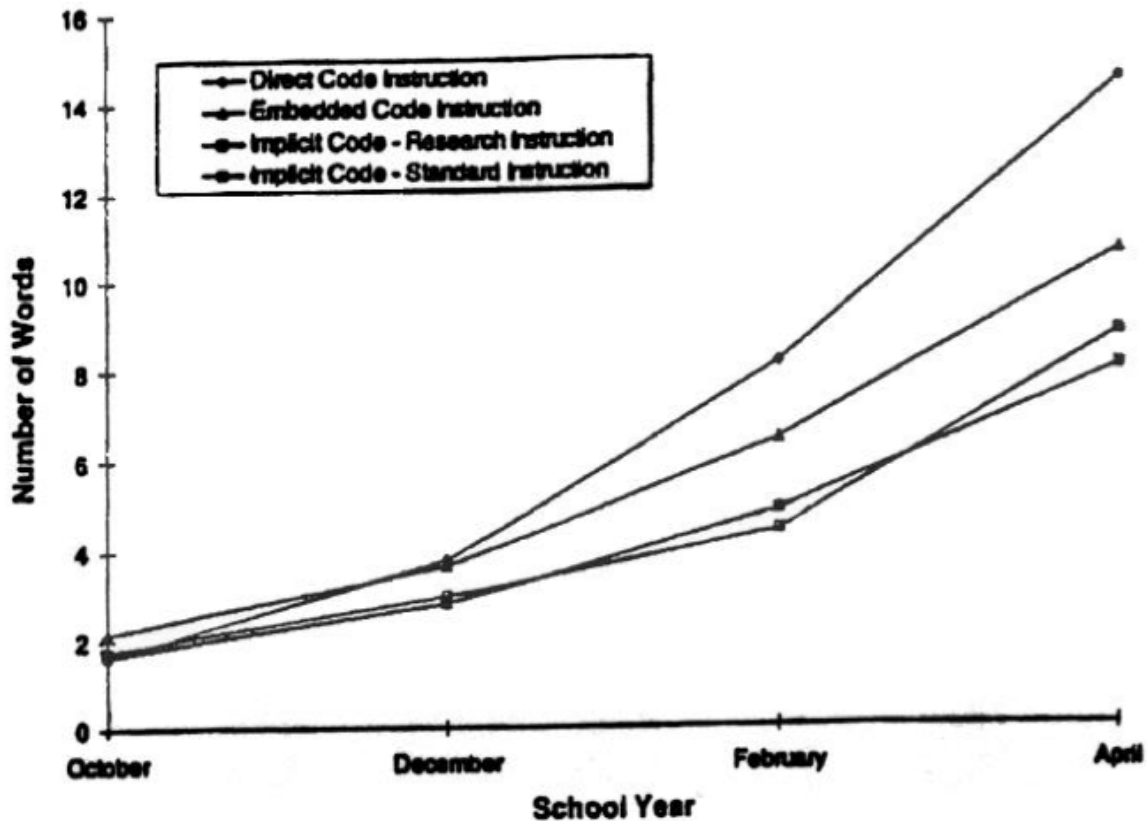
Figure 3. Growth in word reading scores by curriculum for children in a Title 1 program. Children who were taught word recognition skills explicitly (direct code condition) learned more words over the school year than children who received less explicit instruction. Source: Foorman et al. 1998. Reprinted with permission of the American Psychological Association.

At the end of one school year, the children who received the approach that included explicit phonics instruction with application in literature showed significantly greater gains in word reading and reading comprehension than children who received the other forms of instruction. The results can be seen in figure 3, which shows the growth in word reading over the school year for the four groups. Unfortunately, many children in the other instructional programs—particularly those with poor phonological awareness skills—showed few gains in reading ability. Children who received the combined approach had word reading and reading comprehension skills that approximated national averages at the end of the year. The overall failure rate of children who received this approach represents 5.5 percent of the population from which these children were selected.

Conclusions: Intervention Studies The promising experimental intervention programs described above provide hope for children who read poorly. More research is needed, including long-term follow-up to see whether the gains are maintained. Much-needed additional research on identifying specific components of effective programs, such as the use of decodable versus predictable text and training in automaticity, is in progress. In many of these studies, phonological awareness training and explicit instruction in phonics lead to improved word recognition skills. The Issue of transfer of the training results to reading ability independently of the training – apparent in some but not all studies – is clearly important, however, and requires additional research. this issue is relevant not only for transfer to real-word reading but also for the development of reading comprehension skills. Skilled reading is more than just efficient decoding.

Development of word recognition skills is a necessary but not sufficient condition, for reading proficiency is defined as the ability to understand reading materials. Once children develop accurate word recognition skills, they must be able to decode words rapidly; comprehension processes are separable and can be taught. It does not seem reasonable, however, to expect proficiency in comprehension, much less literacy, if the child cannot decode words in isolation or in text.

Studies of Reading Failure Can Improve Classroom Reading Practices   In considering how studies of reading failure can lead to improved classroom instruction, we must recognize that the intervention studies described in this brief summary have their origins in studies of beginning and skilled readers; thus the principles derived from these studies tend to focus on processes that are part of the early development of reading skills because beginning reading skills are the level at which most poor readers fail. One goal has been to identify where most poor readers have difficulty (i.e., word recognition and phonological awareness skills) and to use that information as the basis for intervention. As the intervention studies show, applying these findings potentially translates to lower failure rates in overall school populations through classroom instruction and tutorial programs.

When NICHD and other research suggesting an important role for explicit instruction in word recognition skills is examined by some reading professionals and the media, arguments arise over whether children should be taught with phonics methods or through meaning-based approaches (Chall 1967, 1983). In general, the NICHD research does not lead to extreme positions on either side of this debate. Most of the NICHD-supported intervention studies employed programs that include important elements from context or meaning-based (so-called whole-language) programs as well as explicit instruction in the alphabetic code. In fact, the NICHD research supports approaches embedded in both phonics and whole-language approaches. The tendency to interpret the NICHD research, often in the name of "science," as supporting phonics instruction as a panacea for literacy problems is particularly disturbing. For example, materials distributed by the National Right to Read Foundation, as well as a report that purports to summarize NICHD research (Center for the Future of Teaching and Learning 1996), exaggerate the findings of these studies, especially the extent to which the intervention results support the instructional recommendations in the reports. NICHD researchers have used a variety of phonics techniques, [AND WHAT ARE THEY?] often as part of a comprehensive approach to intervention. No NICHD data support a single approach to phonics, much less a specific sequence, number, or set of rules that must be learned, or an essential role for decontextualized drills. We lament the reliance on ideology and invective as opposed to the more difficult task of completing the research that will help educators and policymakers implement effective reading practices. No simple, single message can be obtained from the NICHD research. [ABOUT HOW TO TEACH]

The NICHD studies do support a role for instruction in the alphabetic principle, including phonological awareness skills and phonics, as an essential and necessary (but not sufficient) part of early reading instruction. In addition, the research suggests that for children at risk for reading failure or who are poor readers, phonics knowledge should be presented explicitly and in an orderly progression. Such instruction in the early grades may actually prevent reading failure, which is why we feel it should be part of regular classroom practices for all children. In many classroom settings, obtaining this type of instruction is a problem.

[THIS SEEMS TO CONTRADICT THE PREVIOUS PARAGRAPH. BUT ITS STILL IN VERY BROAD TERMS GIVING BROAD DIRECTONS. TEACHERS ARE LEFT WITH HAVING TO WORK OUT THE DETAILS.]

As Adams and Bruck (1995) and Pressley and Rankin (1994) point out, however, whole- language practices have come to predominate in regular classroom instruction in reading today for some good reasons. For example, the emphases on meaning, comprehension, writing, and the general philosophy of integrating reading and writing to enhance meaning have had positive influences on literacy instruction. Research evaluating whole-language practices shows that some children, who otherwise might not see a reason to read, learn to enjoy reading and writing when provided with these types of programs. The whole-language movement has increased the quality of literature in schools, provided more emphasis on library resources, and shifted the goal of reading instruction toward meaningfulness and enjoyment. ???? Children and their families are encouraged to spend more time reading and writing, which dearly facilitates improved ability and interest. Positive attitudes toward reading are associated with whole-language practices. At the same time, some advocates of whole-language practices who are opposed to putting any emphasis on phonological awareness skills, phonics skills, and word recognition processes have done many students a disservice. To illustrate, Goodman (1986) argues that segmenting words to learn to read was unnatural and hindered learning:

> "Many school traditions seem to have actually hindered language development. In our zeal to make it easy, we've made it hard. How? Primarily by breaking whole (natural) language up into bite-size, but abstract little pieces. It seemed so logical to think that little children could best learn simple little things. We took apart the language and turned it into words, syllables, and isolated sounds. Unfortunately, we also postponed its natural purpose, the communication of meaning, and turned it into a set of abstractions unrelated to the needs and experiences of the children we sought to help." (page 7)

This view is not only incorrect but potentially destructive, particularly for the many children at risk for reading failure because of deficits in phonological awareness skills. Pressley and Rankin (1994) discovered that experienced and highly successful teachers, including many who view themselves as whole language teachers, teach phonics, often explicitly, but tend not to rely on commercial phonics programs. Many who espouse the principles of whole language, however, are openly critical of teachers who teach phonics.

Indeed, the view put forth by many whole-language proponents—that reading is a process as natural as learning to speak—is inconsistent with contemporary cognitive science. This inconsistency was clearly outlined in a letter to the commissioner of education in the state of Massachusetts signed by forty well-established scientists from major higher education institutes in Massachusetts, many of whom study language and reading. In that letter, the authors observed that "learning how to decode the speech sounds notated by the writing system ('phonics') is fundamental to reading." The authors also observed that the hypotheses concerning the nature of language central to some whole-language viewpoints are not supported by linguistic research. The authors specifically rejected "the view that the decoding of written words plays a relatively minor role in reading compared to strategies such as contextual guessing. This latter view treats the alphabetic nature of our writing system as little more than an accident, when in fact it is the most important property of written English—a linguistic achievement of historic importance." The state of the science relevant to the role of alphabetic coding in beginning reading was summarized succinctly by Stanovich (1994), who stated

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"That direct instruction in alphabetic coding facilitates early reading instruction is ==one of the most well established conclusions in all of behavioral science....==" Conversely, the idea that learning to read is just like learning to speak is accepted by no responsible linguist, psychologist, or cognitive scientist in the research community. (pp. 285-86)

The most credible solution to reducing reading failure is much like that proposed by Adams (1990) who endorsed a balance between literature-based (meaning oriented) instruction and systematic and explicit instruction in phonological awareness, phonics, and other processes underlying word recognition skills. The extent to which these concepts can be used depends on the level of reading development in an individual child. No reading program is equally beneficial for all children. Successful teachers include elements of code-based instruction with a rich, meaning-based context to develop the skills for reading success.

A major question is how to become a successful teacher of reading. The research summarized in Pressley and Rankin (1994) indicates that teacher preparation is an important component in preventing reading failure. Recent reports have raised concerns about how well teachers are prepared to teach reading, particularly beginning reading and those processes involving language and word recognition skills (Moats and Lyon 1996). These reports have been oriented toward poor readers, and many factors influence outcomes with poor readers that don't involve classroom instruction, such as the amount of time spent on reading, the match of the classroom and the remedial program, and administrative policies (Allington 1991). Many skilled teachers, who often developed their effective approaches to reading instruction after college—through in-service programs, courses, and work with experienced mentors—regard their preparation in reading as inadequate. These issues are important because current evidence shows that effective classroom instruction can prevent reading failure in many children (Blachman 1996, 1997; Foorman et al. 1998).

Conclusions:

Complete Approaches to Reading Instruction

To prevent reading failure, classroom instruction must incorporate what we know about how children learn to read and why children fail to learn to read (Blachman 1996, 1997; Torgesen 1997). As the NICHD research shows, children need to master word recognition skills; many children require explicit instruction in word recognition skills based on early assessments of each child's phonological awareness and reading skills. Such instruction must also be integrated with the rapid processing of words, spelling skills, and reading comprehension skills. This report advocates not an overemphasis on decontextualized phonics but rather an emphasis on ==developing word recognition skills as part of a complete approach to reading instruction.==

==The NICHD reading research shows that many children do not develop adequate word recognition skills and thus supports the important role of explicit instruction in phonics and phonological awareness skills.== Failure rates of the magnitude we observe today are not acceptable. The intervention studies suggest that these failure rates can be reduced significantly with explicit instruction in word recognition skills as part of a complete reading program, but programs that identify and are applied on a child-by-child basis are expensive. The current magnitude of reading failure is too widespread to ~~permit~~ prevent implementing the programs of the sort employed by Torgesen (1997) and Vellutino et al. (1996) unless the failure

rate is initially reduced through effective classroom instruction (Foorman et al. 1998). More research is needed to help develop cost-effective models for early identification, prevention, and intervention. We need to be able not only to distinguish between those who cannot be easily remediated and those who will need prolonged remediation but also to maintain gains in children who respond to intervention. Learning to read is a lengthy and difficult process for many children, and success is based in large part on developing language and literacy-related skills early in life. Reading failure reflects the lower end of reading proficiency; no qualitative characteristics distinguish the poor reader from the good reader. Since reading failure exists on a continuum, we must provide interventions on a continuum and adjust the emphases as the child develops proficiency.

A massive effort needs to be undertaken to inform parents, and the educational and medical communities, of the need to involve children in reading from the first days of life; to engage children in playing with language through nursery rhymes, storybooks, and writing activities; and, as early as possible, to bring to children the wonder and joy that can be derived from reading. Parents must be aware of the importance of vocabulary development and verbal interactions with their youngsters for enhancing grammar, syntax, and verbal reasoning. In addition, preschool children should be encouraged to learn the letters of the alphabet, to discriminate between letters, to print letters, and to attempt to spell words that they hear. Introducing young children to print will increase their exposure to the purposes of reading and writing, their knowledge of the conventions of print, and their awareness of print concepts.

Reading aloud to children is important for language development (Adams 1990). We must understand, however, that reading to children is not a demonstrably necessary or a sufficient means for teaching reading. Again, the ability to read requires a number of skills that, in many children, must be developed via direct and informed instruction provided by properly prepared teachers. In addition, spending more time reading and writing is key to enhancing literacy levels even in children who are disabled in reading.

Effective instruction early in development may ameliorate the effects of poor preschool literacy experiences. The NICHD prevention and early intervention studies speak to the importance of early identification and intervention with children at risk for reading failure. Procedures now exist to identify such children. This information needs to be widely disseminated to schools, teachers, and parents. Kindergarten programs should be designed so that all children will develop the prerequisite phonological, vocabulary, and early reading skills necessary for success in the first grade. More specifically, beginning reading programs should ensure that adequate instructional time is allotted to the teaching of phonemic awareness skills, phonics skills, and spelling and orthographic skills. As the child develops proficiency with word recognition, reading fluency, automaticity, and comprehension strategies should be emphasized. All of these components of reading are necessary but not sufficient components of a complete approach to reading instruction. For children having difficulty learning to read, it is imperative that each of these components be taught in an integrated fashion and that ample practice in reading instructional-level material be afforded.

An impediment to serving the needs of children demonstrating difficulties learning to read is current teacher preparation practices in many colleges of education. Many teachers lack basic knowledge and understanding of reading development

and the nature of reading difficulties. Major efforts should be undertaken to ensure that colleges of education possess the expertise and commitment to foster expertise in teachers at both preservice and in-service levels. Strong knowledge and skills-based training programs with formal board certification for teachers of reading should be developed.

The sad irony is that we have known about reading development and reading difficulties for more than the past thirty years. The ophthalmologist Hinshelwood, who was one of the earliest students of reading failure, observed, like most of his colleagues at the time, that people who read poorly had problems at the level of the single word—they called it word-blindness. He was wrong about the basis of the problem—he thought it was attributable to visual deficits when we now know that reading is a language-based skill and that poor reading is primarily due to language-based difficulties. But Hinshelwood was absolutely correct about the importance of understanding why children do not learn to read and about doing something about reading failure: "It is a matter of the highest importance to recognize the cause and the true nature of this difficulty in learning to read which is experienced by these children, otherwise they may be harshly treated as imbeciles or incorrigibles and either neglected or flogged for a defect for which they are in no wise responsible. The recognition of the true character of the difficulty will lead the parents and teachers of these children to deal with them in a proper way, not by harsh and severe treatment, but by attempting to overcome the difficulty by patient and persistent training (1902, p. 99)." That is as true today as it was almost a century ago.

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Appendix

Selected NICHD Studies of Normal Reading Development and Reading Disorders

Research Topic. (NR)=Normal Reading (RD)= Reading Disorder		Principal Investigator
Reading Disability and Early Language Impairments	(RD)	D.M. Aram
Prevention and Treatment of Reading Disabilities	(RD)	V.W. Berninger
Handwriting, Spelling and Composition Skills Development of Reading	(NR/RD)	V.W. Berninger
Curricula for LD Children	(RD)	V.W. Berninger

Teacher Training in Reading Development and Disorders	(NR/RD)	V.W.Berninger
Gestures as Phonological Units	(NR)	C. Best
The Speech Mode and Its Early Development	(NR)	C. Best
Phonologically-Based Remediation for RD Students	(RD)	B.A. Blachman
Development of Word Recognition Processes	(NR)	J.R. Booth
Colored Computer Displays Effects on Reading	(NR/RD)	L.H. Boyd
The Role of Phonological Representation in Phonological Awareness and Literacy	(NR/RD)	S. Brady
Phonological Processes in Sentence Comprehension	(NR)	S. Crain
Neuroimaging Analysis of Reading Disability	(RD)	J.S. Duncan
EEG Studies of Disabled Readers	(RD)	R.A. Dykman
fMRI of Phonological and Sensory Processing in Dyslexia	(RD)	G.F. Eden
Analytic Processes Unique to Phonology	(NR)	L. Feldman
Behavioral Definition and Subtyping of Dyslexia	(RD)	F. Wood
A Longitudinal Study of Normal Reading Development	(NR)	D. Flowers
Early Interventions for Children At-Risk for RD	(RD)	B. Foorman
Phonological Development and Development of Literacy	(NR)	A. Fowler
Phonetic Gestures and Their Perceptions	(NR)	C. Fowler
Language Comprehension and Reading	(NR)	L. Frazier
Cognitively Based Treatments of Acquired Dyslexia	(RD)	R. Friedman
Acquired Dyslexia or Alexia After Stroke	(RD)	M. Friend
Cross-Domain Comprehension Processes	(NR)	P.J. Holcomb
Brain Morphology and Dyslexia	(RD)	G.W. Hynd
Epidemiology of Learning Disability	(RD)	S.K. Katusic
Common Phonology of Speech and Reading	(NR)	L. Katz
Interactive Reading/Spelling and Comprehension Software	(NR/RD)	P. Lindamood
Phonological Effects in the Lexical Access of Words	(NR)	G. Lukatela
Perceptual, Linguistic and Computational Bases of Dyslexia	(RD)	F.R. Manis
Examining the Strategic Processing Of Text	(NR)	S.M. Mannes
Syntactic Processes in Reading Development	(NR)	L. Maurais
Teacher Training for Reading Intervention	(NR/RD)	D. McCutcheon
Neonatal Predictors of Later Language and Reading Development	(NR/RD)	D.L. Molfese
Acoustic Structure of Speech to Young Children	(NR)	J.L. Morgan
Treatment of Developmental Reading Disabilities	(RD)	R.D. Morris

Schooling and Cognitive Development: A Natural Experiment	(NR)	F.J. Morrison
Language and Literacy in Bilingual Children	(NR)	D.K. Oller
Reading and Language Processes	(NR/RD)	R K. Olson
Computer-Based Remediation of Reading Disabilities	(RD)	R.K. Olson
Computer-Speech Feedback for Dyslexic Children	(RD)	R.K. Olson
rCBF and Behavior: Adult and Second Generation Dyslexia	(RD)	D.L. Pauls
Comprehensive Test of Phonological Awareness	(NR/RD)	A.A. Pearson
Social Relationships and Early Literacy Development	(NR)	A.D. Pelligrini
Linguistic Phenotype in Familial Dyslexia	(RD)	B.F. Pennington
Brain Morphometry and Reading-Disabled Twins	(RD)	B.F. Pennington
Language, Learning Ability and Language Development	(NR)	S. Pinker
Genetic Contributions to Learning Disability Subtypes	(RD)	W. Raskind
Foveal and Parafoveal Codes in Reading	(NR)	K. Rayner
Language Processing During Reading	(NR)	K. Rayner
Perceptual and Cognitive Processes in Reading	(NR)	K. Rayner
Emergence of Literacy in Sociocultural Context	(NR)	R. Serpell
Distribution and Typology of RD	(RD)	B. Shaywitz
Developmental Phonological Disorders	(RD)	L. Shriberg
Shape Bias in Children's Word Learning	(NR)	L.B. Smith
Genetic Linkage Analysis for Dyslexia	(RD)	S.D. Smith
Coordinating Information in Sentence Processing	(NR)	M. Tannenhaus
Prevention and Remediation of RD	(RD)	J.K. Torgesen
Phonological Processes in Reading Individual Words	(NR)	M.T. Turvey
Preventing Experientially-Based Reading Disability	(RD)	F. Vellutino
Reading-Related Phonological Processes	(NR/RD)	R.K. Wagner
Information Processing in LD Children	(NR/RD)	P.H. Wolff
Physiological Measures of Dyslexia	(RD)	F.B. Wood