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Interventions Aimed at Improving Reading Success: An Evidence-Based Approach

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There is a consensus among researchers about the critical elements for effective reading instruction. These elements are the integration of explicit instruction in the alphabetic principle, reading for meaning, and opportunity to learn. These critical elements are present in classroom instruction that prevents reading difficulties as well as effective small-group and one-on-one interventions. Research on effective classroom instruction and reading interventions is described, and the case is argued that the most effective intervention is provided early—in kindergarten through 2nd grade—rather than after 3rd grade, and allows for sufficient intensity, duration, and supportiveness that no child is left behind. Policy implications for changes in (a) the way learning disabilities are identified and (b) the content of professional development of teachers are discussed.

At the turn of the 21st century the United States has seen a renewed concern about national literacy levels as 38% of fourth graders (and 68% of minority fourth graders) perform below basic on the National Assessment of Educational Progress

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(NAEP; US Department of Education, 1998). In the 20th century we saw brief bursts of concern, from the popular press' *Why Johnny can't read* (Flesch, 1955) to commissioned national reports: *The great debate* (Chall, 1967), *Becoming a nation of readers* (Anderson, Hiebert, Scott, & Wilkinson, 1985), *Beginning to read* (Adams, 1990), *Preventing reading difficulties in young children* (Snow, Burns, & Griffin, 1998), and the National Reading Panel report (NRP, 2000). All of these reports present reviews of reading research and provide consensus on the critical components of learning to read in English. The National Academy of Science's report on *Preventing reading difficulties in young children* (Snow et al., 1998) is emphatic in announcing an end to the Reading Wars of phonics versus whole language and stressing that the goal of reading instruction is the integration of explicit instruction in the alphabetic principle with reading for meaning and opportunity to learn. Our goals in this article are threefold: (a) to summarize the 30 years of reading research upon which this consensus rests; (b) to describe components of effective early reading interventions; and (c) to present policy implications of scaling up successful reading interventions.

THIRTY YEARS OF READING RESEARCH

The Cognitive Revolution and Its Impact on Reading Research

During the 1960s, American psychology shifted away from the behaviorist learning theory of B. F. Skinner toward a consideration of the mediating role of mind and brain in determining human action. Central to this cognitive revolution was a focus on language and the biological basis for its learnability in humans (Chomsky, 1965; Pinker, 1991). The field of psycholinguistics developed to examine the representation, processing, and acquisition of language. A subgroup of psycholinguists worked on the topic of reading acquisition and pointed out that language, which humans have possessed for millions of years, unfolds as a natural biological progression. Reading, which humans have had for only about 4,000 years, is not a natural biological unfolding. Reading is based on language, but it must be taught (Liberman, 1997).

This seemingly obvious point—that reading is an "unnatural act" (Gough & Hillinger, 1980)—became lost to a generation of teachers who were prey to the concept of reading as part of "natural language learning" (Goodman & Goodman, 1979, p. 138). According to this concept, oral and written language is learned in much the same way, and neither requires conscious attention to linguistic units. In their model of reading as a "psycholinguistic guessing game" Goodman (1976) and Smith (1973) described how beginning readers draw upon tacit knowledge of spoken language to guess at words' meanings. Thirty years later this misapplication of psycholinguistic theory is still prevalent in teachers' equal-weighting of the three-cueing systems of (a) syntactic knowledge, (b) semantic knowledge, and

(c) graphophonic knowledge, when teaching children to read. Under the whole language approach that drew upon Goodman's and Smith's theories and dominated American schools for the last two decades of the 20th century, teachers would exhort beginning readers to use context—whether in the form of discourse patterns or picture cues—to guess at the meaning of words. This even went so far as categorizing semantically equivalent errors as correct responses in Goodman and Burke's (1973) miscue analysis system. The least-privileged cue in the three-cueing system was graphophonic knowledge, deemed unreliable by Goodman because of the lack of predictability of English orthography (see Adams, 1998, for a detailed critique of the three-cueing system).

The Alphabetic Principle

The alphabetic principle is the intentional and conventional understanding of how alphabetic letters relate to the segments of sound in speech they represent (Perfetti, 1985). Our ancestors invented this orthography of phoneme-grapheme mappings, and each child in each generation must reinvent this system if literacy is to develop. It is apparent, from the existence of cultures with highly developed oral traditions and no written traditions, that oral language is a necessary, but not sufficient, condition for literacy. However, researchers disagree on the degree of conscious attention to the phoneme-grapheme mappings needed by children learning an alphabetic orthography.

This disagreement is much more theoretical than the argument about how many phonic rules should be taught. The disagreement has to do with the process by which children learn to imbue optical shapes with linguistic meaning. Beyond the perceptual distinctions between the shapes of letters (e.g., *b* vs. *d*) and the categorizations of speech sounds (e.g., *ba* vs. *ga*), there are conscious realizations essential to the development of reading and writing. For example, to take the classic example from the Haskins Laboratory (Lukatela & Turvey, 1998), how does one know that there are three phonemes in *bag*? We pronounce *bag* as one unified burst of air, without any separation between the phonemes. Yet we write *bag* as three separate letters—*b*, *a*, *g*. We know that there are distinct phonemes in *bag* when we compare it with *sag* and recover the difference in initial phonemes. We can then compare *bag* with *big* and with *bat* to recover the medial and final phonemes. Through this process we abstract the notion of phoneme from the coarticulated syllable. It is the ability to consciously use phonemic segments by blending them into words and segmenting words into constituent phonemes, along with the ability to rapidly name alphabetic letters, that predicts successful early reading development (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Neuhaus, Foorman, Francis, & Carlson, 2001). It is this conscious awareness of phonemes in speech—this phonemic awareness—that helps make the blending of phonics instruction an effective strategy.

Unlike contemporary phonics, the phonics of the 1960s taught children that *pat* says /p/-/æ/-t/, or, in the case of the untutored teacher, "puh-ahhh-tuh." What the method of teaching letter–sound correspondences (i.e., phonics) did not teach was the identity of the phonemes /p/, /æ/, and /t/ that are invariant whether they are blended into the words *pat* or *tap* or *apt*. The old phonics instruction also did not help children understand the systematic connections among phonemes and graphemes. Thus, at a basic level, helping children see that the /s/ in *sand* and the /s/ in *sit* are the same sound is important, as is pointing out that this sound is represented by the same letter, *s* (Byrne, 1998). The emergence of children's reinvention of the alphabetic principle is blatantly apparent in their early writing (Castle, Riach, & Nicholson, 1994). Moats (1995, p. 39) provided an example of a first grader's spelling of *think*, across the school year, which reflected increasing appreciation of the complexity of English spelling: TGK, THIEK, TANGK, THINGK, THIGK. As children segment sounds in speech and capture them in print with alphabetic letters, difficulties with phonemic awareness, morphophonemic knowledge, spelling conventions, inflections, derivations, and etymologies readily become apparent, as is shown in Table 1.

One researcher who has done much to help us understand how young children's developing knowledge of English spelling informs their reading is Linnea Ehri (see Ehri, 1998, for a review). Ehri showed that children consolidate alphabetic knowledge so that graphemes become imbued with phonological information in memory and words come to be recognized by sight. Perfetti (1992) referred to this consolidation as a shift from a functional lexicon to an autonomous lexicon. During the partial-alphabetic phase of word recognition, the letter-names of the alphabet provide about 25 of the approximately 40 phonemes of English. Thus, the spelling of *seem* as *sem* is facilitated by letter-names (i.e., "ess," "E", and "emm"; Templeton & Bear, 1992; Treiman, 1993). However, knowledge of vowel spellings requires full alphabetic knowledge. Complete knowledge of the alphabetic system in English is "deep" in the sense that approximately 70 letter-combinations represent the 40 or so phonemes in English. Consider the spellings for /ir/: *eer* as in

TABLE 1
Linguistic Knowledge Sources Relevant to Misspellings in Words

Word	*Misspelling*	*Knowledge Source*
park	prk	phonemic awareness
match	mach	alphabetic
writer	ridr	alphabetic morphemic
vineyard	vinyard	morphophonemic
floss	flos	spelling convention
carried	carried	spelling convention
convention	convenshun	derivational
pneumonia	numonia	etymological

sheer, *ear* as in *shear*, *ere* as in *here*, and *ier* as in *pier*. In this case the process of encoding phoneme-to-grapheme is deep and complex because of the existence of four plausible spelling patterns (Perfetti, 1997). The process of decoding grapheme-to-phoneme can also be complex. For example, consider the multiple pronunciations of *ch* in *church*, *chef*, and *chrome* due to the Anglo-Saxon, French, and Greek origins (respectively) of the words. Also, consider the multiple pronunciations of *ea* in *meat*, *great*, and *congeal*. The pronunciation in *meat* is very common and fits the phonics adage, "When two vowels go walking, the first one does the talking" (see Clymer, 1963). However, *great* appears frequently in texts for beginning readers and, therefore, is likely to be committed to sight recognition fairly easily. The *ea* in *congeal* crosses syllable boundaries and, therefore, is no longer a vowel digraph with a single pronunciation.

With practice, beginning readers become more sensitive to the letter co-occurrence patterns of English, so that units larger than grapheme-phoneme correspondences can be computed in memory. Thus, *track* may be recognized as *tr-ack* rather than as *t-r-a-ck*; and *interesting* as *in-ter-est-ing* rather than *i-n-t-er-e-s-t-i-ng*. Facility with using larger units to recognize words typically develops during second grade, a key factor in the increase in reading fluency that occurs as word recognition skills develop beyond grapheme–phoneme correspondences (Ehri, 1998). Additionally, recognition of orthographic rimes (i.e., *-ack* in *track*) paves the way for decoding by analogy (Goswami, 1998), another key factor in the development of reading fluency. For example, knowing how to read *track* facilitates transfer to *crack*, *stack*, *shack*, and *pack*. Analogies are also commonly based on morphemes, such as prefixes, suffixes, and inflectional endings.

Although English is a deep orthography, much of word recognition can be accomplished through the alphabetic system. According to Hanna, Hanna, Hodges, and Rudorf's (1966) computer program for categorizing spellings by phoneme position, about 50% of English spellings follow phoneme–grapheme correspondence rules, and another 36% follow them with only one error. Only 14% of spellings are "irregular" based on phoneme–grapheme rules. However, of this 14%, the vast majority is spelled correctly when word meaning, origins, and morphology are considered. In fact, only about 4% of words are true oddities, such as *yacht* and *aisle*. The most highly-frequent, irregularly spelled words have been collected into the Dolch List and are sprinkled throughout the lessons in beginning reading programs, such as *of*, *the*, *they*, *said*, *one*, *two*, *does*, *were*, *who*, *their*, *gone*, *done*, and *lose*. Memorizing the 220 words on the Dolch List (Dolch, 1953) is a manageable task for first, second, and third graders. However, memorizing the 400,000 words in a dictionary is not a manageable task. Thus, a primary component of beginning reading instruction is to help children master the alphabetic system for the 86% of words that fit the system, to use other linguistic cues to aid in the recognition of the additional 10%, and to memorize the 4% of words that are true oddities. Mastery of the system typically involves presentation of about 90

phonic elements, instruction in blending of phonic elements to create words, and practice reading in texts controlled for phonic elements.

Given that programs teach only about 90 phonic elements, and given that it is estimated that over 500 rules are needed to teach a computer to read (Gough, Juel, & Griffith, 1992), one wonders how a reader actually masters the alphabetic system. One model for how this is accomplished is Share's (1995) self-teaching hypothesis. Central to this hypothesis is that children attempt to phonologically recode words and are provided feedback on these attempts. The feedback serves to build up the orthographic representations of specific words. Thus, learning is item-based rather than stage-based. Consequently, unlike older approaches to phonics, instruction should be based on what words the child already knows, not on what stage the child is at. Furthermore, automaticity is a characteristic of words, not of readers. Thus the question should be, "On what words is this reader fluent?" rather than, "Is this child a fluent reader?"

The connectionist or neural network model of Seidenberg and colleagues (Harm & Seidenberg, 1999; Seidenberg & McClelland, 1989) simulates learning-to-read on an item-by-item basis. An ordered corpus of words is presented to the computer. As words' orthographic representations—their spellings—are phonologically recoded, feedback is provided via backpropagation from another computer. Thus, exposure to *have* prior to *save* may weight the orthography-phonology connections towards the less regular pronunciation of *–ave*, but this is not the same as saying that *have* is an irregular word and must be learned by a visual route. It is important to remember that the onset of *have*—/h/—generalizes to the pronunciation of the initial phonemes in words such as *hot*, *has*, and *happy*. Thus, words such as *have* (and *pint*, *laugh*, and *said*) are quasi-regular, and learning to read is an example of learning in a quasi-regular domain, where rules are allowed to deviate from central tendencies (Seidenberg & McClelland, 1989).

The problem with Share's (1995) self-teaching hypothesis and the neural network models of learning to read is that they assume one-to-one feedback on each word. In certain households this type of didactic interaction around print occurs (Carlson, Francis, Foorman, Manke, & Fletcher, 2001). However, most children learn to read at school, in classrooms where opportunities for individual feedback are limited due to large teacher–student ratios. For these reasons, computer software that integrates highly accurate child-speech recognition with a well-designed beginning reading program will provide a revolution in beginning reading instruction.

Implications for Reading Instruction

Not much of the science regarding the alphabetic principle has impacted the reading programs used in primary grade classrooms. Hence, reading programs vary

widely in how well phonics is taught. Most programs teach from the traditional perspective of grapheme-to-phoneme correspondence rules. Accordingly, their phonic lessons consist of instruction in initial and final sounds of consonants; short and long vowel sounds; consonant blends (e.g., *cr-, srp-,-nd*); consonant digraphs (e.g., *ch, th, ng*); silent consonants (e.g., *wr, kn, -mb*); and syllabication. This grapheme-oriented organizational perspective can lead to confusion. For example, the following keywords are used in one basal to teach *o: orange, of, on, once, open, off, out*. Moats (2000) warned that "if children are shown that words starting with the letter *o* begin with as many as six different sounds, including the /w/ in *once*, they may surmise that letters are irrelevant to sound and must be learned by some magical memory process" (p. 150). One program (i.e., Open Court) that does organize its phonics from a phoneme-to-grapheme perspective introduced "short *o*" with two keywords—*Bob* the *Frog*—in its 1995 edition. Words consistent with the *–ob* pattern were presented (e.g., *sob, mop, hot, stop*) and words consistent with the *–og* pattern were presented (e.g., *dog, hog, cost*). Then the two patterns were contrasted. Establishing this "set for diversity" (Gibson & Levin, 1975) for spelling patterns and then contrasting them is good contemporary pedagogy. However, in the 2000 edition of the program, the keyword is simply *fox*. The *–og* and *–ost* patterns are still contrasted with *–ox* within the lesson; however, for simplicity's sake, a single keyword is used. But beyond simplicity, there's another reason for dropping *frog* as a keyword: dialect. The short *o* in *fox* is the common Midwestern pronunciation, whereas the *–og* pattern is typically taught as part of the *–aw* phonic element represented in words such as *saw, pause, call, water, caught, thought*. In New England *fox* and *frog* have the same vowel phoneme, as does *card*. But just as telephone companies use Midwestern speech as the voice of directory assistance, it makes sense for reading programs to do the same and to provide information for teachers about how regional variations in speech may affect the pronunciation of the speech sounds targeted in each lesson.

Another example of phonics confusions created by organizing programs around grapheme-to-phoneme correspondences rather than phoneme-to-grapheme correspondences is presentation of the past tense morpheme *–ed*. Should the /t/ pronunciation be presented in the final consonant *t* lesson, with examples such as *walked*? Should the /d/ pronunciation be presented in the final consonant *d* lesson, with examples such as *spoiled*? Or should both pronunciations be presented in a lesson on past tense, where *walked* is contrasted with *spoiled*? If the organizing principle is phoneme-to-grapheme, then the answer is clear: Present each pronunciation in the /t/ and /d/ lesson, then contrast the two to establish the set for diversity. However, even phoneme-to-grapheme organizational principles cannot solve the problem of teaching the nondistict vowel called schwa found in unstressed syllables in English (e.g., ***a**bout, less**o**n, circ**u**s, def**i**nition*). None of the basals teach schwa. They expect children to "flex" their phonological recodings to match pronunciations in speech. The exhortation in the *Reading Mastery* program to "Say it

fast!" seems to help students blend phonemes to approximate coarticulated syllables in speech.

Research on Reading Instruction

The real debate in teaching beginning reading is not whether phonics should be taught but rather how phonics should be taught—how explicitly, at what phase of reading development, whether synthetically, analytically, or analogically, and with what kind of supporting text. Answers to some of these questions were provided in the National Reading Panel Report (NRP, 2000) commissioned by the U.S. Congress. The NRP reviewed research on alphabetics (phonemic awareness and phonics), fluency, comprehension, teacher education and reading instruction, and computer technology and reading instruction. Significantly, the only topic for which the committee felt a meta-analysis could be conducted was alphabetics. For phonemic awareness, 1,962 studies were reviewed, 52 met the criteria, and 96 comparisons were made. For phonics, 1,373 studies were reviewed, 38 met the criteria, and 66 comparisons were made. With respect to phonemic awareness, meta-analyses revealed that (a) phonemic awareness causes improvement in student's phonemic awareness, reading, and spelling (with effect sizes in spelling for students with reading disabilities being weak); and (b) phonemic awareness instruction is most effective when alphabetic letters are included, when there are fewer rather than more manipulations of phonemic units, and when instruction is conducted in small groups. In the area of phonics, meta-analyses revealed that (a) direct systematic phonics instruction produces significant benefits for students in kindergarten through Grade 6 and for students with reading disabilities, regardless of socio-economic status; (b) the impact is strongest in kindergarten and Grade 1; and (c) phonics must be integrated with instruction in phonemic awareness, fluency, and comprehension.

Thus, the NRP report (NRP, 2000) adds to the previous nationally commissioned reports—the NRC report (Snow et al., 1998), Adams (1990), and Chall (1967)—in supporting direct, systematic phonics instruction in beginning reading. But what about the issues of (a) the type of phonics (analytic, synthetic, or analogic), (b) the unit of instruction (whole word, onset-rime, or phoneme), and (c) the type of text (controlled or not controlled for phonic elements taught)? The type of phonics and the unit of instruction become one and the same issue in practice. According to analytic phonics—the predominant form of phonics from the 1930s until the 1970s—100 or so words are taught holistically, then used analytically to teach letter-sound patterns. For example, a teacher might group words by similar initial letters (e.g., *sand, sit, sound,* and *snail*) to stimulate a discussion of the sound of s. In contrast to the whole-to-part approach of analytic phonics, synthetic phonics moves from part-to-whole. Phoneme–grapheme correspondences

are taught, then used strategically to decode and blend the letter-sounds in words from left to right. Synthetic phonics is the predominant form of phonics instruction today and has been for the past 30 years. Phonics based on onset-rime analogies saw a brief commercial appearance in the Silver-Burdett reading program in the 1990s but mostly has been a topic of experimental study (Foorman et al., 1998; Hiebert, Colt, Catto, & Gary, 1992). A review of the limited experimental evidence (Ehri, 1998; Foorman, 1995; Haskell, Foorman, & Swank, 1992) suggests that a threshold of letter–sound correspondences needs to be learned before orthographic rimes can become the basis of productive analogies.

The debate over the type of text to use in beginning reading has intensified with the state boards of education in California and in Texas requiring commercial publishers to make texts 80% decodable. This means that 80% of the words in the first grade readers must consist of the accumulating set of phonic elements taught. But (as discussed earlier) does teaching /d/ for *–ed* guarantee that *walked* will be decodable? Must the pronunciation for *–ture* be directly taught in order for *picture* to be decodable? Beyond these issues regarding phoneme-grapheme mappings, there are other features of words that make determination of text decodability difficult, such as their grammatical form class, their oral vocabulary status, and their printed-word frequency. Beyond lexical features, there are discourse features that impact decodability, such as how complex the story grammars are and whether sentences are constructed to build on given information. However, the most important question to ask about a text's decodability is: At what phase of reading development and for which children is a particular text decodable?

No published research is available to address the interaction of child characteristics, lexical features, and discourse elements. However, there are a few classroom studies that indirectly address the issue of text decodability. Juel and Roper/Schneider (1985) found that if the dominant instructional strategy in the classroom was decoding unknown words letter by letter, children learned the strategy quicker and went on to induce untaught letter–sound relations faster if their beginning reading texts had vocabulary that was controlled for letter–sound correspondences. Foorman, Francis, Novy, and Liberman (1991) found that students in three 1st-grade classrooms with more letter–sound instruction practiced in controlled vocabulary texts improved at a faster rate in reading and spelling of words than students in three classrooms with less letter–sound instruction practiced in trade books. Initial scores in phonemic segmentation predicted reading and spelling outcomes for all children. In a recent study of four 1st-grade classrooms, Juel and Minden-Cupp (2000) found that students in the two classrooms where phonemic awareness and phonics were directly taught and practiced in decodable texts performed, on average, were at higher levels in reading at the end of the year than students in the two classrooms where tradebooks were employed. However, in addition to this main effect of curriculum, there was an interaction of child characteristics with curriculum such that children who entered first grade with low

literacy benefited from direct instruction in phonics and children who entered with higher literacy made exceptional progress in trade book classrooms.

Foorman et al. (1998) also looked at how the nature of letter–sound instruction interacted with entering skill in phonemic awareness. They investigated the reading development of 285 first- and second-grade students in 66 classrooms in eight Title 1 schools. Thirteen of the teachers were part of an unseen comparison group that represented the district's implicit-code standard instruction. The other 53 teachers participated, with high fidelity, in one of three kinds of classroom reading programs, all of which included a language arts emphasis on writing and read-aloud from quality literature: direct instruction in letter–sound correspondences practiced in controlled vocabulary texts (direct code), less direct instruction in sound–spelling patterns embedded in trade books (embedded code), and implicit instruction in the alphabetic code while reading trade books (implicit code). Students receiving direct code instruction improved in word-reading at a faster rate and had higher end-of-year scores than students in the implicit code group, and this growth effect was moderated by the level of phonemic awareness at the beginning of the year.

The practical significance of these word-reading effects becomes readily apparent when individual cases are examined (see Figures 1 and 2). Figure 1 displays

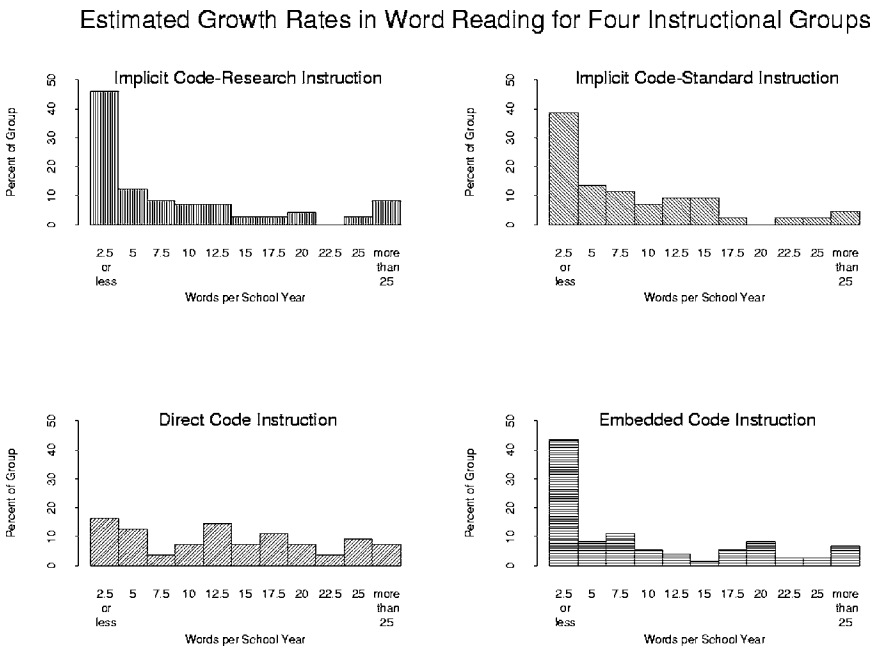

FIGURE 1 Frequency distributions of predicted growth in word reading for four instructional groups.

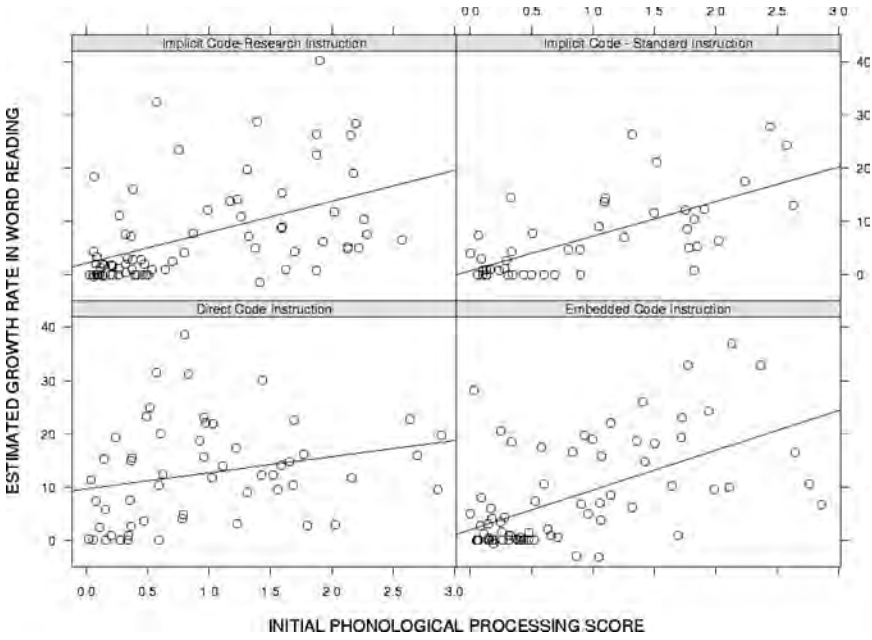

FIGURE 2 Plots of individual growth estimates in word reading by initial phonological processing scores for four instructional groups.

frequency distributions of predicted growth in April on the 50-word experimental list that consisted of words matched for frequency of occurrence (Carroll, Davies, & Richman, 1971), representing a diversity of linguistic features, and drawn from first through third grade cumulative vocabulary lists. As is apparent in the top row and bottom right quadrant in Figure 1, approximately 46% of the implicit-code research students, 44% of the embedded-code students, and 38% of the implicit code-unseen control students learned at a rate of 2.5 words or less per school year on the 50-word list, compared to 16% of students in the direct code group. The flatter distribution for the direct code group relative to the large positive skew for the other three groups is consistent with the interpretation that direct code instruction picks up the floor of poor decoders and allows a more normative picture of growth in word recognition. Normative word-reading growth was accompanied by standardized word recognition and reading comprehension scores that approximated national averages at the end of the year for the direct instruction group.

In Figure 2, growth estimates for word reading are plotted against October scores in phonemic awareness for students in each instructional group. Generally, word reading and phonemic awareness are positively related for all groups. However, one immediately notices the cluster of data points representing students with

low word-reading growth and low phonemic awareness in the embedded code and two implicit-code groups. In contrast, the data points in the lower left quadrant have more vertical spread. This means that students in the direct-code group who started the year with poor phonemic awareness often exhibited considerable growth in word reading. Additionally, the least-squares regression line is flatter for the direct code group compared to the other groups. This is what one would expect if phonemic awareness is a determinant of growth in word reading and direct-code instruction is effective in improving phonemic awareness. We expect phonemic awareness ability at the beginning of the year to be less related to outcome in the direct code group, because more explicit instruction in the alphabetic principle is effective in developing phonemic awareness skill in all children, which thereby minimizes the impact of the level of this skill that students bring to the classroom in the fall.

Foorman et al. (2003) found a similar interaction of child characteristics with instructional strategies in an investigation of 4,872 kindergarteners in 114 classrooms in 32 Title 1 schools where reading curricula varied in the degree of teacher choice and in the degree of incorporation of phonemic awareness and phonics but were all informed by ongoing professional development. Basal readers with less teacher choice and more explicit incorporation of phonemic awareness and phonics had less variable teacher-level means in letter knowledge and phonemic awareness at the end of kindergarten and in reading achievement at the end of the first grade. On the other hand, a basal with more teacher choice and a moderate number of phonemic awareness activities (mostly in the form of letter-sound instruction) had more variable teacher means but more outliers representing high-scoring children at the end of kindergarten and first grade.

Thus, the clarity and organization of research-based components in the curriculum make a difference to reading outcomes. However, "out-of-the box" implementations of basal reading programs are not likely to be maximally effective. Instead, professional development that provides the rationale for each component and provides classroom coaching to deal with pacing of instruction, classroom management, and grouping of students is what helps teachers develop successful readers. Expecting teachers to put aside their basals and create their own curriculum is not realistic, given the lack of resources and knowledge base to do so (Moats, 1994). Future classroom studies need to focus on how teachers' content knowledge impacts the instructional delivery of research-based curriculum for students at varying stages of reading development.

COMPONENTS OF EFFECTIVE EARLY READING INTERVENTIONS

In the last decade researchers have defined critical components of effective reading interventions. These components are (a) the intensity, duration, and supportiveness

of intervention; (b) the timing of intervention; (c) student-teacher ratio, requisite knowledge level of intervention teachers, and the content of intervention. We argue that early intervention—in kindergarten and Grades 1 and 2—is more effective than later intervention because of the intensity and duration of treatment required if later intervention is to be effective and the difficulty of remediating fluency rates. We argue that small-group intervention is just as effective as one-on-one intervention and that well-trained para-professionals can be as effective as certified teachers. Moreover, we argue that the content of effective reading interventions, like that of effective classroom reading instruction, is explicit instruction in the alphabetic principle integrated with reading for meaning and opportunities to read and write that are based on what is being taught. Finally, we address the variable differences underlying treatment resisters.

Intensity, Duration, Support, Teacher-Student Ratio, and Training

The work of Torgesen and others is highly relevant to the issue of intensity, duration, and supportiveness of reading intervention. Torgesen and others have studied the effectiveness of interventions for older children (between the ages of 8 and 10) with identified reading disabilities. In a recent study, Torgesen et al. (2001) randomly assigned 60 students with severe reading disabilities—in the bottom 2% in word decoding skills—to one of two treatments. One treatment was the *Auditory Discrimination in Depth Program* (ADD; Lindamood & Lindamood, 1984). The other treatment was Embedded Phonics (EP), and consisted of direct instruction in phonemic awareness and alphabetic coding practiced in the writing and reading of text. Note that this EP condition is more similar to the direct-code rather than the embedded-code instruction of Foorman et al. (1998). The difference between the ADD and EP treatments was that EP provided more practice in writing and reading of text, whereas ADD provided more practice with phonemic awareness (down to the articulatory level) and phonological recoding.

The 60 students in Torgesen et al.'s (2001) study received 67.5 hr of one-on-one instruction in two 50-min sessions per day, for 8 weeks. All of the intervention teachers had at least one year experience teaching ADD or EP in clinic settings. Both interventions produced large effect sizes on reading achievement (4.4 and 3.9, respectively) that were stable 2 years later. Although average scores in reading accuracy and comprehension were in the average range at follow-up, average reading rates continued to be severely impaired. Nonetheless, 40% of children returned to regular education, well above the 5% typical of special education programs.

There are a few studies that have had results similar to Torgesen et al.'s (2001) with severely impaired older readers using ADD (Alexander, Anderson, Heilman, Voeller, & Torgesen, 1991; Truch, 1994; Wise, Ring, & Olson, 1999). Torgesen et al. (2001) pointed out that their somewhat larger rates of growth relative to

these studies is directly attributable to the longer duration of their treatment. Because the EP method was just as effective as ADD, Torgesen et al. (2001) felt that teachers well trained in components of scientifically-based reading programs delivered with sufficient intensity, duration, and supportiveness can bring older students with reading disabilities to national averages in reading accuracy and comprehension, although reading fluency rates still lag behind. The supportiveness provided by the teacher is of two kinds (Foorman & Torgesen, 2001). One kind involves the careful sequencing of instructional steps so that students are always building on prior knowledge. The second involves teacher–student dialogue that demonstrates the type of processing or thinking necessary for problem solution (e.g., "That's right—/s/, /t/, /a/. Now what's that chunk at the end? That's right—*station*"). Teachers' scaffolding of students' thinking-through prompts and feedback allows for learning in advance of development, in contrast to the development-constrained constructivism of Piagetian psychology (Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997; Wood, Bruner, & Ross, 1976).

These few studies show what is possible outside the public school delivery system for students identified with reading disabilities. Poor outcomes are apparent for special education students both in resource room settings (Foorman, Francis, Fletcher, Winikates, & Mehta, 1997; Kavale, 1988; McKinney, 1990; Moody, Vaughn, Hughes, & Fischer, 2000; Schumaker, Deshler, & Ellis, 1986; Vaughn, Moody, & Schumm, 1998) and in inclusionary settings (Klingner, Vaughn, Schumm, Hughes, & Elbaum, 1997; Zigmond, 1996). Given the difficulty of normalizing older, impaired readers once they have fallen behind, researchers have turned to early reading interventions with children in kindergarten, first, and second grades.

The Timing of Reading Interventions: Early is Better

Children's status as readers is established early. Francis, Shaywitz, Steubing, Shaywitz, and Fletcher (1996) found that 74% of children who are reading disabled in the third grade remain reading disabled because of poor decoding skills in the ninth grade. This relationship is apparent even before the third grade, as is evident in studies by Juel (1988) and Torgesen, Wagner, and Rashotte (1997). Juel found that almost 9 out of 10 children who were impaired in word recognition skills in the first grade were poor readers in the fourth grade. Torgesen et al. (1997) showed that over 8 of 10 children with severe word reading problems at the end of the first grade performed below the average at the beginning of the third grade. Such evidence supports the view that early reading problems are the result of deficits rather than delay. In other words, the early childhood mantra "Just wait; they'll catch up" has no empirical base (Foorman, Francis, Shaywitz, et al., 1997).

But which children are candidates for early intervention and how soon should they start? Kindergarteners can be identified as at risk for word recognition difficulties

based on their skill in phonemic awareness and rapid naming (Scarsborough, 1998; Schatschneider, Francis, Fletcher, & Foorman, 1999). The kinds of tasks used to predict reading difficulties are oral blending of sounds into words, identifying the sounds of letters, and, at the end of kindergarten, the ability to rapidly name letters. By first grade it is word recognition skill that best predicts success in reading. The screens in the Texas Primary Reading Inventory (TPRI) consist of phonemic awareness, letter-sound identification, and word reading in kindergarten through second grade (TEA, 2003). By the beginning of Grade 2, the word-reading screen (consisting of 8 words selected on the basis of an item response model) predicts end-of-year reading with a false positive rate below 15% and a false negative rate below 10% (Foorman, Fletcher, & Francis, in press). Higher false positive rates in kindergarten and at the beginning of Grade 1 may be due to lack of literacy opportunities as well as to deficits in language processing. Thus, the best use of the results of early reading assessment in kindergarten and Grade 1 is to set instructional objectives for small-group intervention rather than to diagnose reading disabilities. However, by the beginning of Grade 2, a 5-minute word-reading screen, such as that provided by the TPRI, can indicate the need for more intensive intervention and possible further evaluation for reading disabilities.

With the ability to reliably identify kindergarteners as at-risk for reading difficulties, researchers developed early interventions to prevent reading failure. Several effective studies are described by Torgesen (2000) and are listed in Table 2 with respect to hours of instruction, teacher–student ratio, percent of the sample that remained below the 30th percentile, and the percentage of the population remaining below the 30th percentile. For example, in the Foorman et al. (1998) study described earlier, the 285 first and second graders served by Title 1 represented the bottom-achieving 18% of students in the 8 participating schools. At the end of a year of direct-code instruction, 35% of these students remained below the 30th percentile in achievement. By multiplying 35% by 18%, the figure of 6% is obtained, which represents the percentage of students in the overall population that would remain poor readers with widespread implementation of this classroom intervention. Given that the national percentage for students with reading disabilities from epidemiological studies is approximately 17.5% (Shaywitz, Fletcher, & Shaywitz, 1995) and the percentage of fourth graders reading below basic on the NAEP is 38%, a reduction in the percentage of poor readers to 6% is significant.

Note in Table 2 that the percent of the population remaining below the 30th percentile decreases as the teacher–student ratio decreases. The Brown and Felton (1990) study listed in Table 2 consisted of small-group instruction in either systematic phonics or meaning-oriented strategies in first and second grade. Children in the bottom 16th percentile were identified in kindergarten, and were randomly assigned to the phonics or meaning groups or to a standard control in first grade. At the end of second grade the children who had received the explicit phonics instruction scored significantly higher on word recognition and spelling compared

TABLE 2
Percent of Students Scoring Below the 30th Percentile in Various Studies

Study	*# Hrs Instructed*	*T-Stu Ratio*	*% Delayed*	*Overall % Delayed*
Foorman et al. (1998)	174	class	35	6
Brown & Felton (1990)	340	1:8	32	5
Vellutino et al. (1996)	35–65	1:1	33	5
Torgesen, Wagner, Rashotte, Rose et al. (1999)	88	1:1	30	4
Torgesen, Wagner, Rashotte, & Herron (2000)	92	1:3	12	2

to the children who had received the meaning-based instruction. As shown in Table 2, 32% were left below the 30th percentile, which translated to a population rate of 5%.

In the Vellutino et al. (1996) study, 74 children from middle to upper middle class homes received 1:1 tutoring 30 min daily for 15 weeks in the spring of first grade. These children's word-reading scores at baseline were in the bottom 15th percentile. Those children whose scores were below the 40th percentile at the end of first grade received an additional 8 to 10 weeks of tutoring in second grade. Thus, the amount of tutoring ranged from 35 to 65 hr. The percent of children who scored below the 30th percentile in reading after one semester of remediation was 33%, which when multiplied times the 15th percentile baseline scores yields a population rate of 5% remaining below the 30th percentile.

Two of Torgesen's early intervention studies are listed in Table 2. In the first one, Torgesen, Wagner, Rashotte, Rose, et al. (1999) identified kindergarteners in the bottom 12th percentile in letter knowledge and phonemic awareness. The children were randomly assigned to one of four conditions: Either the ADD or EP conditions described earlier, Regular Classroom Support, or No Treatment Control. Children in the first two conditions received one-to-one tutoring in 20-min sessions, 4 days a week, for 2.5 years, beginning in the second half of kindergarten. Half the sessions were conducted by well-trained teachers and half by less-trained aides. Over the course of the study the children received an average of 47 hr of instruction from teachers and 41 hr from aides. At the conclusion of the study, the children in the ADD group performed higher in word recognition skills, such that 30% remained below the 30th percentile on word attack and 39% on word identification.

In the second study, Torgesen, Wagner, Rashotte, & Herron (2000) randomly assigned first graders in the bottom 18th percentile to two instructional conditions and to a no-treatment condition. The instructional conditions were either the ADD program described earlier or the Read, Write, and Type (RWT; Herron, 1995) computer program that provides explicit practice in phonemic awareness, letter–sound

correspondences, and phonemic decoding but does so primarily in the context of writing on the computer. Children were instructed in groups of three in 50-min sessions, 4 days a week, from October through May of Grade 1. Children did better in the ADD group compared to the RWT, with only 12% in the ADD group left below the 30th percentile in word attack. This translates to a population rate of 2%—an impressive reduction in the rate of poor readers.

Teacher-Student Ratio, Teacher Training, and Content of Early Intervention

The studies listed in Table 2 leave us with an important message: Anywhere from 2% to 6% of first and second graders remain impaired in reading with well-designed early interventions. In the struggle to discern the critical components of effective early intervention the following are evident: (a) the importance of improving classroom instruction so that schools can afford to do small-group or one-on-one intervention with students who do not respond to effective instruction and early intervention (Foorman et al., 1998); (b) treatments of sufficient intensity and duration can reduce percentages down to 2% (Torgesen, Wagner, Rashotte, Rose, et al., 1999); (c) well-trained aides may provide just as effective intervention as well-trained teachers (Torgesen, Wagner, Rashotte, Rose, et al., 1999); and (d) one-on-one may not be necessary (Torgesen, Wagner, Rashotte, & Herron, 2000). Further support for this finding concerning teacher-student ratio comes from Wise, Ring, and Olson (2000). They found that when second to fifth graders worked on individualized computer programs for part of their group instructional time, gains in word reading were comparable to the gains made in the one-to-one instruction provided in these researchers' research studies without computers. These findings regarding teacher–student ratio and teacher training are also supported in a recent meta-analysis of reading interventions for elementary students at-risk for reading failure (Elbaum, Vaughn, Hughes, & Moody, 2000). This meta-analysis yielded an effect size of 0.41 for the 29 studies when compared with controls. Interventions that used trained volunteers or college students were as effective as those using certified teachers. Two studies that compared one-on-one tutoring with small-group intervention found no advantage for the one-to-one ratio.

There is a lot of agreement regarding the components of effective early intervention: Explicit instruction in phonemic awareness and phonics, reading for meaning, and opportunities to practice reading and writing. But what is not known is the appropriate mix of these components for individual children at varying stages of reading development and with varying cognitive and linguistic abilities and affective dispositions. There is some evidence, however, that children severely impaired in phonemic awareness benefit from more emphasis on phonological

skills than on connected text reading (Scanlon, Vellutino, Small, & Fanuele, 2000; Torgesen, Wagner, Rashotte, & Herron, 2000; Wise et al., 2000). This may be why Elbaum et al. (2000) found in their meta-analysis that the program Reading Recovery (Clay, 1993) was highly effective for students who remained in the intervention until completion (i.e., "discontinued" students) but not for those who had to be dropped after 12 weeks due to insufficient progress (i.e., "not discontinued" students). These dropped students fell into the bottom 12th to 15th percentiles, as were those served successfully by Torgesen, Wagner, Rashotte, and Herron (2000), Torgeson, Wager, Rashotte, Rose, et al. (1999), and Vellutino et al. (1996).

There is little agreement about what to do for the 2% to 6% of children remaining below the 30th percentile after intervention. The fact that Torgesen, Wagner, Rashotte, Rose, et al. (1999) could reduce these "treatment resisters" to 2% with the intense phonological intervention (down to the articulatory level) provided by the ADD program is very encouraging. The success of the phonological skills emphasis with the most severely reading-impaired children supports Stanovich's (1988) phonological core-variable difference hypothesis. In other words, the core deficit in reading disabilities is phonological awareness. Beyond this core are a host of variables that include other linguistic, cognitive, and perceptual factors (Morris et al., 1998). One hypothesis is that deficits at a perceptual level may account, at least in a subgroup of poor readers, for poor development of phonological processing skills (McBride-Chang, 1995), and that perceptual deficits for speech stimuli are secondary to a more fundamental low-level deficit in the auditory system (for reviews see Farmer & Klein, 1995, and Wright, Bowen, & Zecker, 2000).

In our laboratory we assess children's perception of a wide variety of nonlinguistic auditory cues using traditional psychoacoustic paradigms. Preliminary analysis of our findings in approximately 150 children to date suggest that children with reading disabilities (RD) do have mild but consistent deficits in the perception of certain non-linguistic auditory cues, which include interaural temporal and intensity difference thresholds as well as backwards masking of a tone by noise. Importantly, simple detection thresholds are at normal levels. In our studies of phoneme perception (Breier et al., 2001) we find that children with RD appear to be more inconsistent in labeling phonemes along a voice onset time continuum (VOT; /ga/ - /ka/) even when phonetic cues are most salient (e.g., at the smallest and largest onset times) than their age-matched peers with no reading difficulty. We also find a similar deficit in perception of a nonspeech analog of the VOT, a tone onset time series (Pisoni, 1977), indicating that the deficit extends to nonspeech stimuli containing acoustic cues similar to the salient cue in the speech stimulus. In addition, there are significant relationships between phoneme perception and language measures including phonemic awareness, as well as single word and phonological recoding abilities that are independent of RD group effects. These findings provide some support for the hypothesis that, at least in a

subgroup of poor readers, phonological processing deficits extend to the perceptual level, and may co-occur with deficits in basic auditory function.

POLICY IMPLICATIONS OF SCALING-UP SUCCESSFUL READING INTERVENTIONS

During the last decade researchers have learned much about how to create and sustain successful reading interventions. We have learned that *early* interventions, rather than later interventions, are more effective in normalizing children's reading development. We have learned that we can reduce the incidence of poor reading to 2% to 6% of the population, rather than the current 38% of below basic fourth graders or the 17.5% of children with learning disabilities, 80% of which have reading disabilities (Fletcher & Lyon, 1998). Early intervention starts with classroom instruction that prevents reading difficulties by integrating explicit instruction in phonemic awareness and the alphabetic code with reading for meaning and opportunities to practice reading and writing, for all children. This same content is the basis for small-group intervention for those at-risk for reading failure due to low phonemic awareness, letter–sound knowledge, and word reading. The relative emphasis on phonological skills and connected text reading depends on the severity of impairment in phonemic awareness. To reduce treatment resisters to a percentage as low as 2%, sufficient intensity and duration of intervention, as well as instructional support, is required by well-trained adults—either paraprofessionals or certified teachers.

Given state and national reading initiatives to "leave no child behind in reading," what are the obstacles to scaling-up effective early reading interventions to meet the national challenge? It is beyond the scope of this article to provide an exhaustive list of obstacles. However, there are two major impediments that, if removed, would facilitate the scaling-up efforts tremendously. One is the wait-for-failure mode of current identification procedures. The second major obstacle is the lack of training in teacher certification programs in how to use the results of assessment to inform instruction.

Wait-for-Failure Model of IQ-Achievement Discrepancy

Currently the way we identify children for reading intervention is by waiting for them to demonstrate achievement one or two grades below level and then administering an IQ test. If the IQ score is within the "normal" range and discrepant by some criterion relative to achievement, then the low achievement is considered "unexpected." The learning disabilities label is then applied and funding for intervention becomes available. There are many problems with this approach. A major

question is whether classifications of children with learning disabilities that are based on the presence or absence of IQ-discrepancy are valid. In fact, there is a substantial body of research that calls into question the validity of these classifications, largely because it is difficult to differentiate children with reading problems who meet an IQ-discrepancy from those with reading problems who don't meet a discrepancy (Fletcher, Francis, et al., 1998). Indeed, research on this classification has shown little difference in terms of cognitive correlates, response to intervention, or prognosis (Lyon et al., 2001). In addition, most definitions of learning disability carry with them a number of exclusionary criteria, including the presence of emotional disturbance, inadequate instruction, and socioeconomic disadvantage. There is little evidence showing that children with reading problems in the presence of emotional disturbance, poor instruction, or socioeconomic disadvantage are different in terms of cognitive characteristics, prognosis, or response to instruction. The sorts of interventions that work with children who experience reading difficulties under these circumstances appear similar to those that work with children who experience reading difficulties under more positive circumstances. Thus, the classification appears to lack validity.

Even if the classification was valid, identifying children based on IQ-discrepancy may be harmful to children. In this respect, it takes time for children to move away from the floors of achievement tests. Many schools do not even evaluate children for possible learning disabilities until the second grade because few would qualify. The average age of identification, partly because of reliance upon IQ-discrepancy, is about 9 years of age (or third grade). As the studies reviewed earlier show, it is difficult to achieve positive intervention results in the reading area with older kids in the absence of intense, highly differentiated instruction (Torgesen et al., 2001). Even in studies that successfully address the accuracy of word recognition skills, children are commonly found to be slow readers and to lack fluency. Torgesen et al. (2001) showed that the failure to remediate fluency may reflect the cumulative effects of not being able to read, estimating that children who begin intervention in third grade would need to read approximately 10 hr per day in order catch up with the amount of exposure to sight words characteristic of their peers. In contrast, preventative interventions show comparable gains in accuracy and fluency of word recognition skills (Torgesen, 2000).

Altogether, current practices for identifying children with reading problems are based on procedures that may well be harmful in as much as they prevent early intervention. These procedures force the age of identification towards older children and also place considerable emphasis on eligibility. Although this facilitates compliance with special education legislation, there is little evidence that IQ tests are either sufficient or necessary for identifying a child with a learning disability (Lyon et al., 2001). Unfortunately, until better approaches to identification are established, and commitments are made towards early identification and prevention, it is likely that the presence of IQ-discrepancy criteria will continue to produce

large numbers of children who maintain chronic reading difficulties throughout their life. The best solution is not to drop services for dyslexics but rather to add early intervention services for all children at risk for reading failure. IQ tests would become irrelevant to the determination of eligibility for reading intervention, freeing up school personnel to focus their time on much needed reading interventions. Diagnosticians could help teachers put in place continuous progress monitoring systems and early reading assessments, such as the Texas Primary Reading Inventory and the PALS instruments used in Texas and Virginia (see Foorman, Fletcher, & Francis, in press). Fewer failures would result.

Professional Development and Instructional Leadership

Coursework in assessment and in diagnosis and treatment of reading difficulties is typically provided at the graduate level rather than as part of teacher certification. This must change. Today's classrooms are culturally and linguistically diverse and contain students whose skill levels widely vary. Many classroom teachers are poorly prepared to address the reading development of children in general, much less those from diverse backgrounds. They often lack adequate knowledge of language and reading development essential to teaching children in beginning reading. Few teachers are well prepared to provide differentiated instruction in the context of a large classroom. Thus, classroom teachers must be taught how to assess their students' skills and how to provide differentiated, small-group instruction. They must be helped to implement continuous progress monitoring systems that highlight differential rates of skill development and provide a basis for reconstitution of groups. New teachers must also be taught classroom management systems and must be assisted with the thoughtful implementation of effective reading instruction. To assist teachers in providing small-group and, if necessary, one-on-one instruction, the principal must hire para-professionals and volunteers and see that they are thoroughly trained and mentored through ongoing professional development.

The importance of the role of the principal as an instructional leader providing systemic reform cannot be overstated. High-achieving schools typically are characterized by outstanding leadership. For example, these schools provide considerable professional development to teachers. They use a variety of reading programs, but they have a curriculum in place. The principal spends considerable time in the classrooms and looks for opportunities to provide more professional development for the teachers. Differentiated instruction, usually in small groups, is commonly provided to children in all grades who demonstrate risk characteristics or less-than-expected progress. Frequent assessments of progress are common, and the assessments are used to identify children who are not making progress as well as to create instructional groupings. Schools that successfully teach reading to all children provide a range of services and are characterized by outstanding

leadership at the district and school level and by commitment to reading development at all levels of instruction.

CONCLUSIONS

There is converging evidence about what the characteristics of effective reading instruction looks like. It consists of the integration of explicit instruction in phonemic awareness and the alphabetic principle, reading for meaning, and practice in fluent reading and writing. Reading for meaning includes explicit instruction in vocabulary, spelling, and comprehension strategies. Practice in reading and writing allows for opportunities to apply the alphabetic principle and comprehension instruction in reading both constructed and authentic materials, and in the incorporation of writing activities as early as possible. These essential elements of effective instruction are part of prevention as well as part of intervention.

Effective classroom instruction can prevent reading difficulties for the vast majority of children, thus potentially reducing the current 38% of fourth graders below the basic level on the NAEP to between 5% and 10%. The goal is to identify those at risk of reading failure early in development, before they actually fail, and to provide them with effective instruction and, if necessary, early intervention. The well-trained teachers and aides who provide these small-group or one-on-one interventions, who target the phonological-core deficit in these children with sufficient intensity and duration of treatment and supportive instruction, will find that only a very small percentage of children (perhaps as low as 2%) will remain treatment resisters, requiring additional work with specialists. There is abundant research evidence to support this model. Now it is simply a matter of removing such major obstacles as the wait-for-failure model of identifying children for learning disabilities and the lack of professional development of teachers. Once these obstacles are removed, it will be possible to better serve all children.

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