

Individual Differences in Response to Early Interventions in Reading: The Lingering Problem of Treatment Resisters

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In this article, studies are reviewed that were designed to improve the early reading skills of students with reading disabilities. The challenge of effectively designing interventions in the public schools that adequately meet the needs of all these students is described.

Abstract. The goal of many recent intervention studies has been to examine the conditions that must be in place for all children to acquire adequate reading skills. Although the ultimate goal of reading instruction is to help children acquire the skills necessary to comprehend text, an important subgoal for early reading instruction is to teach children to identify words accurately on the printed page. Five recent studies of methods to prevent reading difficulties were examined in light of the goal that every child should acquire adequate word reading skills during early elementary school. It was estimated that our best current methods, if applied broadly, would leave anywhere from 2% to 6% of children with inadequate word reading skills in the first and second grades. Several broad characteristics of these "treatment resisters" are identified, and the implications of these findings for future research are discussed.

Over the past decade or so, both researchers and practicing educators have focused with increasing urgency on the goal of teaching all children to read well by the middle years of elementary school. Motivation to achieve this goal arises not only from our increasing understanding of the broad impact that early reading failure has on general cognitive development (Cunningham & Stanovich, 1998) but also from recognition of the increasing demands for literacy in our technological society (Snow, Burns, & Griffin, 1998). Clearly, children who become adults with low levels of literacy are at an increasing disadvantage in a society that is creating ever higher demands for effective reading skills in the workplace.

In recognition of the broad and serious consequences of early reading failure for children's cognitive and affective development, the National Institutes of Health and the U.S. Office of Education, as well as many private foundations, have provided substantial funding for research on the nature, etiology, and effective treatments for children with various kinds of reading difficulties. The clearly stated goal of part of this research, as defined by the National Institute of Child Health and Human Development (Lyon, Alexander, & Yaffee, 1997), is to investigate the conditions that need to be in place for all children to acquire adequate reading skills in elementary school. Of course, answers to questions in this area are likely to depend on many different factors, but two of the most obvious are, What do we mean by adequate reading skills, and what reading skills are we talking about?

As a guide to my own work on the prevention and remediation of reading difficulties in children, I have adopted the following working definition of the reading goal to be achieved by the end of elementary school: Children should be able to comprehend, or construct, the meaning of what is being read at a level consistent with their general verbal ability.

In other words, the ultimate goal of reading instruction is to help children acquire the knowledge and skills necessary to comprehend printed material at a level that is consistent with their general language comprehension skills. The reason that I do not adopt a standard of grade level reading comprehension for every child is that reading comprehension in late elementary school is heavily influenced by general verbal ability. If we were to adopt grade level reading comprehension criteria, this would mean that we would be expecting all children to have at least average verbal ability. Because decades of cognitive intervention research suggests that it is unrealistic to expect all children to attain verbal intelligence estimates within the average range as a result of special instruction (Lee, Brooks-Gunn, Schnur, &

Liaw, 1990), it seems unrealistic to expect reading teachers to accomplish this goal starting as late as kindergarten or first grade.

To comprehend written material, children need to be able to identify the words used to convey meaning, and they must be able to construct meaning once they have identified the individual words in print.

The purpose of this article is to evaluate the extent to which current research on prevention of reading disabilities has identified the conditions that need to be in place for all children to acquire adequate reading skills. In one sense, the article is premature, in that there are not enough well-controlled studies available to examine outcomes in terms of the ultimate goal of adequate reading comprehension for all children by the end of elementary school. However, it is possible to form a relatively precise estimate of the current success of preventive methods in achieving important subgoals in reading growth for all children. In the next section of the article, a rationale for using initial growth in word-level skills as an indicator of success for preventive programs is outlined. Following that, the results from five relatively recent prevention studies are examined, and the article concludes with a discussion of what is currently known about the characteristics of children who have not been successfully taught in current studies, along with a consideration of the most important questions for future research.

USING WORD-LEVEL SKILLS AS INDICATORS OF INITIAL SUCCESS OF PREVENTIVE PROGRAMS

To understand the use of achievement in word-level reading skills as indicators of initial success in the prevention of reading disabilities, one must understand (a) the role of these skills in supporting adequate reading comprehension, (b) the difficulties most children with reading problems have in acquiring these skills, and (c) the consequences of failure to acquire adequate word-level skills during the initial period of reading instruction.

What Is Required for Good Reading Comprehension?

Even if one's ultimate reading goal is defined as narrowly as I proposed previously (i.e., ability to comprehend written material at a level consistent with one's

general verbal ability), it is still a complex goal, because reading comprehension is an extremely complex cognitive, motivational, and affective activity. In terms of the skills required for good reading comprehension, however, it is possible to divide them roughly into two broad families. To comprehend written material, children need to be able to identify the words used to convey meaning, and they must be able to construct meaning once they have identified the individual words in print. Gough (1996), in his "simple view" of reading, highlighted these two skill dimensions:

Reading consists of two parts. One is recognizing the words on the page, the other is understanding those words once you have recognized them. We have called this the Simple View of reading. According to the Simple View, reading equals the product of decoding (D) and comprehension (C), or $R = D \times C$. (p. 4)

Although this simple formula may not capture some of the subtle interactions between decoding (word reading) and comprehension processes during reading, it does do a very good empirical job of describing how these two broadly different kinds of skills combine to produce good reading comprehension. That is, if measures of word reading ability and listening comprehension are taken separately on the same group of children, and then scores on each test are multiplied together, the resulting product correlates about .84 to .91 (from first through fourth grades) with measured reading comprehension (Hoover & Gough, 1990). This finding indicates that both types of skills are essential for good reading comprehension. It is difficult to comprehend the meaning of a text in which many of the words are not accurately identified. Likewise, limited knowledge of a subject or lack of understanding of many of the words in a text will limit one's comprehension no matter how accurately the specific words are pronounced.

What Skills Are Particularly Difficult for Children in Learning to Read?

Given the foregoing analysis of the skills required for good reading comprehension, it is important to establish whether either of these sets of skills is particularly difficult for children with reading disabilities to acquire. Perhaps the most important single conclusion arising from the last 20 years of research on children who have specific difficulties learning to read is that these children experience a major bottleneck to reading growth in the area of skilled word identification (Share & Stanovich, 1995).

The preponderance of children who are identified with reading difficulties in elementary school experi-

ence two important difficulties in learning to identify words on the printed page. First, they experience difficulties from the very beginning of reading instruction in understanding the way words in their oral language are represented in print. They have trouble making the connection between the sounds in words and the letters used to represent those sounds in print (Siegel, 1989). Difficulties in learning to "sound out" words, or to use phonetic cues to help decipher them, limit the ability of these children to read independently and accurately throughout first grade, and these difficulties usually extend into late elementary school and even adulthood (Bruck, 1990).

So, from the earliest stages of reading acquisition, children destined to become poor readers have a more difficult time learning to easily recognize words by sight, and when they come to a word they cannot recognize, they are not able to productively use phonetic cues to help decipher it.

Current theories about the growth of word reading ability (Ehri, 1998; Share & Stanovich, 1995) suggest that phonemic decoding skills play a critical supporting role as children begin to acquire the orthographic reading skills that enable relatively fluent and effortless identification of words in text. To recognize a word *orthographically* is to recognize it by sight, as a whole word unit. The second kind of word reading difficulty shown by most children with reading problems is a serious limitation in the number and range of words they can recognize as orthographic units (Manis, Custodio, & Szeszulski, 1993). So, from the earliest stages of reading acquisition, children destined to become poor readers have a more difficult time learning to easily recognize words by sight, and when they come to a word they cannot recognize, they are not able to productively use phonetic cues to help decipher it. These word reading difficulties constitute a major impediment to the growth of their ability to comprehend printed material.

Another major discovery from research on reading in the last 2 decades has been that the word reading difficulties of children with reading disabilities are caused primarily by weaknesses in the ability to process the phonological features of language (Lieberman, Shankweiler, & Liberman, 1989). These weaknesses have been demonstrated on a variety of nonreading tasks, including measures of phonological awareness, verbal short-term memory, speed of access to phonological information in long-term memory, and some forms of speech perception (Stanovich & Siegel, 1994; Torgesen, 1995). In particular, individual differences in phonological awareness and rapid automatic naming ability have been shown to exercise unique causal influ-

ences on the rate at which children acquire important early word reading skills (Wagner et al., 1997).

Discovery of the core phonological problems associated with specific reading disability has had at least one unanticipated consequence. Whereas it has long been assumed that the word reading difficulties of children with low general intelligence were caused by factors (e.g., their low general intelligence) different from those responsible for the reading difficulties of children with average or high intelligence, recent research has shown that the word-level reading problems of both kinds of poor readers are associated with difficulties in the phonological language domain (Fletcher et al., 1994; Share & Stanovich, 1995; Stanovich & Siegel, 1994). In fact, several recent studies have shown that general intelligence, or general verbal ability, does not predict individual differences in rate of growth in word reading skills when phonological abilities are controlled (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Torgesen, Wagner, Rashotte, Rose, et al., 1999; Vellutino et al., 1996).

In other words, weaknesses in phonological processing skills characterize children with reading problems across a broad span of general verbal ability. Given the simple view of reading (Gough, 1996) outlined previously, one might characterize poor readers as falling within one of at least two broad groups. First, many children enter school with adequate general verbal ability and cognitive weaknesses limited to the phonological-language domain. Their most important difficulty in learning to read involves acquiring accurate and fluent word identification skills. Another large group of poor readers, who come primarily from families of lower socioeconomic or minority status, enter school significantly delayed in a much broader range of language and prereading skills (Whitehurst & Lonigan, 1998). These children are delayed not only in phonological but also in general oral language skills. Thus, they are deficient in both of the critical kinds of knowledge and skill required for good reading comprehension (Gough, 1996). Even if these children can acquire good word reading ability and a set of comprehension strategies specific to reading, their ability to comprehend the meaning of what they read will be affected by weaknesses in general verbal skills such as vocabulary. It seems clear that children with general oral language weaknesses will require special instruction in a broader range of knowledge and skills than will those who come to school impaired only in phonological ability.

Consequences of Failure to Acquire Adequate Early Word Reading Skills

However, it is also clear that both groups of children will require special support in the growth of early word reading skills if they are to make adequate progress in learning to read. If these children are allowed to lag significantly behind in the development of critical early

word reading skills, they will receive less practice in reading than will other children (Allington, 1984), they will miss opportunities to develop reading comprehension strategies (Brown, Palincsar, & Purcell, 1986), and they will acquire negative attitudes about reading itself (Oka & Paris, 1986). Furthermore, if children do not acquire good word reading skills early in elementary school, they will be cut off from the rich knowledge sources available in print, and this may be particularly unfortunate for children who are already weak in general verbal knowledge and ability.

Thus, school-based preventive efforts should be engineered to maintain growth in critical word reading skills at roughly normal levels throughout the elementary school period. Although adequate development of these skills in first grade does not guarantee that children will continue to maintain normal growth in second grade without extra help, to the extent that we allow children to fall seriously behind at any point during early elementary school, we are moving to a "remedial" rather than a "preventive" model of intervention. Once children fall behind in the growth of critical word reading skills, it may require very intensive interventions to bring them back up to adequate levels of reading accuracy (Allington & McGill-Franzen, 1989; Vaughn & Schumm, 1996), and reading fluency may be even more difficult to restore because of the large amount of reading practice that is lost by children each month and year they remain poor readers (Rashotte, Torgesen, & Wagner, 1997).

Programs to Prevent Reading Disabilities Must Have Strong Instruction in Word-Level Skills

The discussion thus far has underscored the fact that most children who are poor readers in elementary school (regardless of whether they have strong or weak general language comprehension skills) experience critical difficulties acquiring the skills necessary to identify words in print accurately. Thus, one important focus of programs to prevent reading problems in young children should be to prevent children from lagging seriously behind in the development of these critical early skills. Although preventive programs may contain many important instructional elements, such as stimulation of vocabulary, appreciation of the value of reading, or building language comprehension, if they do not successfully address the task of helping children learn to read printed words accurately and fluently, they cannot be judged successful.

Admittedly, it is possible for children to read the words in a passage accurately and not be able to construct its meaning. Reading comprehension is influenced by a broad range of factors, such as vocabulary,

knowledge of content areas, appreciation for text structure, thinking and reasoning skills, ability to apply reading comprehension strategies, and motivation and interest, in addition to word reading ability. Thus, any complete instructional program needs to provide support for the growth of these skills as well as for instruction in word reading skill. However, all that we currently understand about the growth of reading skills in young children suggests that, at a minimum, preventive instructional programs need to be effective in helping children acquire the ability to identify words on the printed page efficiently. Thus, in this article, *treatment resisters* are defined as those children who, despite participating in a preventive instructional program, fail to acquire word reading skills within the "normal" range.

TREATMENT RESISTERS IN RESEARCH ON THE PREVENTION OF READING DISABILITIES

Earlier in this article, I pointed out that answers to questions about the conditions that need to be in place for all children to acquire adequate reading skills will depend on what we mean by *adequate* and what we mean by *reading skills*. We have seen that the ultimate goal of reading instruction is to help children acquire all the skills necessary to comprehend printed language at the same level they can comprehend language in general. In addition, I have argued that a critically important subgoal is to ensure that children do not lag seriously behind in the development of critical word reading skills. So, in examining a number of recent studies that have investigated methods to prevent reading disabilities in young children, reading skills are narrowly defined to include phonetic decoding skills (the ability to "sound out" words) and ability to recognize real words without the aid of context. These are direct measures of the type of word reading skills that have been shown to be most difficult for children who become identified as poor readers in elementary school.

Although there is a clear, research-based rationale for focusing on word-level reading skills as one important criterion for the success of preventive instruction in reading, the issue of what constitutes adequate skills in this area cannot be decided on the basis of available research. We do not know, for example, the absolute level of growth in phonetic decoding skills that is required to support growth in orthographic reading and comprehension, and this likely will vary across children depending on many factors. However, it seems that the outcome we set for all children should lie within the normal range of growth, rather than outside of it. Thus, a standard of achievement above the 30th percentile (within .5 standard deviation of the mean) seems a realistic benchmark against which to judge our intervention success.

Although I feel comfortable proposing the 30th percentile as a standard based on currently normed reading tests, I realize that, if effective prevention programs become commonplace and the general standard of reading instruction improves, the actual performance level required to be above the 30th percentile will change. There always will be individual differences in the rate at which children learn to read, so that in any given norming sample, 30% of the children must lie below the 30th percentile. What we really need are absolute performance standards (Good, Kaminsky, & Shinn, 1999), but these are not widely available at present, and they are certainly not available across the studies to be examined in this discussion.

We now consider five large-scale prevention studies in which sufficient data are available to make an estimate of the proportion of the population who can be identified as resistant to the best instructional condition in each study. Of course, these five studies do not represent a comprehensive sampling of all prevention research. They were selected for discussion here because (a) they used common outcome measures, (b) their most effective interventions reflect what is currently known about best instructional practices for children with phonologically based reading disabilities, and (c) their samples and outcomes were described in enough detail to allow estimation of population-level effects. This analysis is meant to show the distance we still must travel to understand the conditions that must be in place for all children to acquire adequate word reading skills. The studies are discussed in the order they appeared in the research literature.

Specific Intervention Studies

The first large-scale intervention study to be conducted within the context of recently acquired knowledge about the nature of reading disabilities was reported by Brown and Felton (1990). They identified a sample of children in kindergarten who were in the bottom 16th percentile in their phonological processing abilities, as measured by tests of phonological awareness, rapid automatic naming, and verbal short-term memory. Children with general intelligence levels below 80 were excluded from the sample.

These children were randomly assigned to two instructional conditions and taught by specially trained teachers in groups of eight during first and second grade. The two instructional methods differed in the extent to which they emphasized the use of phonemic decoding strategies as an aid to early reading growth. One of the programs provided systematic and explicit instruction in phonemic elements (letter-sound correspondences) and blending strategies, whereas the other method taught the children to rely first on context cues and to use analysis of the sounds in words to confirm contextually based guesses. In other words, the

code-oriented condition provided significantly more instruction and practice in applying phonetic analysis and blending skills to reading words in text than did the context-oriented instructional condition. Over the first- and second-grade years, the children received approximately 340 hr of instruction in each condition. The group was approximately 50% minority children, and their average score on a measure of general intelligence in kindergarten was 97.5.

At the end of second grade, children in the code-oriented condition showed generally stronger word reading and phonetic decoding skills than did children in the context-oriented group, although the differences between groups on these measures were not statistically reliable. It is encouraging to note that, as a whole, the word-level reading skills of children in the code-oriented condition were well within the average range for their grade placement.

Standard, or percentile, scores were not available for children in this study, although Brown and Felton did provide frequency distributions of grade equivalent scores at the end of second grade. From these distributions, and using the distributions of grade equivalent and standard scores on similar measures from children in our own studies who were tested at the same time of year (i.e., end of second grade), it was possible to estimate the proportion of children in the code condition who fell below the 30th percentile on measures of sight word reading and phonetic decoding. Approximately 32% remained below the 30th percentile on the Word Attack (phonetic decoding) measure, and 26% remained below this point on the Word Identification (sight word reading) measure. If we assume that the children in this study came from the 16% of children most at risk for reading failure, then multiplying .32 by .16 allows us to estimate the proportion of children in the entire population who would remain impaired in phonetic decoding skill if this intervention were applied to large numbers of children. This proportion would be 5%. In a similar manner, the proportion of children remaining impaired in sight word reading at the end of second grade would be 4%.

Vellutino et al. (1996) recently reported a prevention study in which the children were selected in November and December of first grade on the basis of both teacher nominations and low performance on measures of word reading ability. Children who obtained a score in the bottom 15th percentile on either the Word Attack or Word Identification subtest of the Woodcock Reading Mastery Test-Revised (Woodcock, 1987) and a score of 90 or higher on either the Verbal or Performance subscale of the Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974) were eligible for participation in the study. The children came from middle to upper middle class homes, and the average Full Scale IQ of the sample was 103.6.

In all, 74 children received one-to-one tutoring in reading in 30-min sessions every day for approximately 15 weeks during the second semester of first grade. Those children who still obtained scores below the 40th

percentile in word reading skills at the beginning of second grade received an additional 8 to 10 weeks of tutoring. Overall, the amount of tutoring received by children in the sample varied between 35 hr for those who responded well in first grade to 65 hr for those who were judged to require extra tutoring. Instruction was provided by 14 tutors who were experienced teachers but received special training for the study. The tutoring they delivered was tailored to each child's need, but typically it included approximately 15 min per session of reading connected text. The children were explicitly taught a variety of strategies for word identification, including sight word instruction, phonetic decoding, and use of sentence context and pictures to help identify words, with the amount of time spent on various skills being determined by each child's specific needs.

Approximately half the children in the study showed either good or very good growth in their word reading abilities as a result of the tutoring. However, at the end of second grade, 41% of the total sample still performed below the 30th percentile on the Word Identification subtest, and 46% fell below this mark in their phonetic decoding skills (Word Attack subtest). If we assume that the sample represented the 15% of children most at risk for reading failure (of those whose intelligence falls within the average range), we can estimate that the intervention tested in this study would reduce the proportion of children in the general population having weak sight word reading ability to about 6%. The proportion with weak phonetic reading skills would be about 7%.

Both studies we have considered thus far selected students for participation on the basis of low phonological abilities or poor development of early word reading skills. Foorman, Francis, Fletcher, Schatschneider, and Mehta (1998) recently reported a study in which the children were selected because they were economically disadvantaged and they performed poorly on their school district's emergent literacy survey at the beginning of first or second grade. The sample used in this study represented economically disadvantaged children (they qualified for Title I services) who scored in the bottom 18% on the literacy survey. In addition, there was a high proportion of minority children in the sample; the proportions were 60% African American, 20% Hispanic, and 20% White.

Depending on the elementary school they attended, the 285 children participating in the study were assigned to one of four instructional conditions, all of which were delivered within a literature-rich environment. Instruction was delivered at the classroom level in 90-min daily instructional periods. The Direct Code condition provided explicit instruction in phonological awareness, phonics (with particular attention to blending as a key strategy), and literature activities using Open Court's (1995) *Collections for Young Scholars*. The Embedded Code condition also provided instruction in phonemic awareness but used less direct instruction in systematic spelling patterns (onset rimes) embedded in connected text. The Implicit Code condition was delivered in either a district standard format or in a research format

that involved additional training and supervision of teachers. The emphasis of this approach was on the teacher as facilitator rather than as director of learning and on children's construction of meaning. It did not provide systematic instruction in phonemic awareness or phonics.

At the end of 1 year of instruction, which involved approximately 174 hr in each condition, children in the Direct Code condition showed stronger outcomes on measures of sight word reading, phonetic decoding, and passage comprehension, and their average standard scores ($M = 100$, $SD = 15$) on these measures were clearly in the average range: 96.1 for a combined measure of word-level reading skills and 96.7 for passage comprehension. However, approximately 36% of the children in the Direct Code condition obtained scores in phonetic decoding below the 30th percentile, whereas 35% fell below that standard in sight word reading. If we assume that the children taught in the study were the 18% most at risk for reading failure, this would mean that about 6% of children in the whole population would remain below the 30th percentile in word reading skills if this intervention were applied to all children.

The last two studies I describe were both conducted by me and colleagues at Florida State University (Torgesen, Wagner, & Rashotte, 1997). In the first study (Torgesen, Wagner, Rashotte, Rose, et al., 1999), participants were children who scored in the bottom 12th percentile on measures of letter knowledge and phonological awareness administered in kindergarten. All children in the sample also obtained estimated Verbal IQ scores above 75, with an average score on this measure of 92. The children came from a wide range of socioeconomic backgrounds and were 53% minorities (primarily African American).

The children were randomly assigned to one of four instructional conditions: (a) *Phonological Awareness Plus Synthetic Phonics*, which involved very explicit instruction in phonological awareness using articulatory cues plus extensive practice in decontextualized phonetic decoding; (b) *Embedded Phonics*, which also provided explicit instruction in phonics but placed more emphasis on applications to reading and writing connected text, along with acquisition of a functional sight vocabulary; (c) *Regular Classroom Support* group, which received direct tutorial support for the reading instruction provided in the regular classroom; and (d) *No Treatment Control* group. Children in each of the instructional conditions received one-to-one tutoring in 20-min sessions 4 days a week for 2.5 years beginning in the second semester of kindergarten. Half the sessions were led by well-trained teachers, and half were led by less well trained instructional aides: Over the entire period of instruction, the children received an average of 47 hr of instruction from teachers and 41 hr from aides.

At the conclusion of instruction, children in the Phonological Awareness Plus Synthetic Phonics condition were the strongest readers, on average. For example, their average score on the Word Attack measure was

99.4, and on the measure of Word Identification it was 98.2. However, there was substantial variability in response to the instruction, and the percentage of the group scoring below the 30th percentile on Word Attack and Word Identification was 30% and 39%, respectively. Because the children in this study were selected to be the 12% most at risk for reading failure, we can estimate that, if the strongest condition from this study were applied more broadly, approximately 4% of children would remain weak in phonetic reading ability, and 5% would perform below the 30th percentile in sight word reading at the end of second grade.

The last study described here used computer software to provide supplementary instruction and practice to small groups of first graders selected to be the 18% most at risk for reading failure (Torgesen, Wagner, Rashotte, & Herron, 1999). At the beginning of first grade, children were screened using measures of letter knowledge, phonemic awareness, and rapid automatic naming for digits. Participants were selected from the 18% of children obtaining the lowest scores on an index of risk status derived from the screening measures, who also obtained an estimated Verbal Intelligence score above 80. The sample represented a wide range of socioeconomic status and contained 35% minorities (primarily African American). Their average verbal intelligence was approximately 95.5.

Children were randomly assigned to two instructional conditions and to a no-treatment control group. One of the programs was Auditory Discrimination in Depth (ADD; Lindamood & Lindamood, 1984), which provided the core instruction methods for the Phonological Awareness plus Synthetic Phonics condition in our previous prevention study, and which involves very explicit instruction and practice in acquiring phonological awareness and phonemic decoding skills. In this program, children spend a lot of time practicing word reading skills out of context, but they also read phonetically controlled text to learn how to apply their word reading skills to passages that convey meaning. The other program was Read, Write, and Type (RWT; Herron, 1995), which provides explicit instruction and practice in phonological awareness, letter-sound correspondences, and phonemic decoding, but does so primarily in the context of encouraging children to express themselves in written language. In this program, children spend a greater proportion of their time processing meaningful written material, and they are encouraged to acquire "phonics" knowledge to enable written communication.

Instruction in both conditions was provided in 50-min sessions 4 days a week from October through May of the first-grade year. Children were taught in groups of three. The first 25 min of each session involved teacher-led activities and instruction to prepare children for work on the computer, and the last half of the session involved individual work on the computer using software specifically designed to support the program of instruction.

Children in both instructional conditions did very well. For example, the average standard score on the

Word Attack measure was 109.7 and 106.3 for the ADD and RWT conditions, respectively. The children had obtained scores of 74.2 and 74.7 on this same measure at the beginning of the year. Corresponding end-of-year standard scores for the Word Identification measure were 107.1 and 105.1. Within the ADD condition, the percentage of children obtaining scores below the 30th percentile on these measures was 12% (Word Attack) and 10% (Word Identification); for the RWT group, the figures were 20% and 16%, respectively. Using calculations similar to those applied in other studies, the estimated proportion of the general population from which these children were selected who would remain weak in phonetic decoding skills if the ADD intervention were applied more broadly is 2% for both phonetic decoding and sight word reading skills.

DISCUSSION AND CONCLUSIONS

One of the major risks of an article like this is that it emphasizes the empty part of the glass and does not focus sufficiently on the fact that most of the glass has been filled. In other words, the studies considered in this article have made a fundamental contribution in showing that a large proportion (always more than 50%) of children who are most at risk for reading failure can be helped to learn at roughly normal rates in early elementary school by applying the best of what we know right now about reading instruction. Although the analyses reported in this article show that approximately 2% to 6% of all children would remain poor readers in spite of the application of these interventions, this estimate is immeasurably better than the 30% to 60% failure rate in reading that often is cited for entire school populations that have similar risk factors operating (Snow et al., 1998). Thus, there is no need for discouragement at this point, only a need to recognize that we do not yet understand the conditions that must be in place for all children to become adequate readers through early intervention.

I also point out that, although the studies were presented together, it was not my intention to compare them to one another directly but rather to estimate a range for the proportion of treatment resisters likely to occur in preventive instructional programs. The studies cannot be compared directly, because they all addressed somewhat different populations. For example, of the two prevention studies my colleagues and I conducted, the first one involved a more difficult population—not only did the children come from the bottom 12% in phonological abilities, but they also had a higher proportion of children who came from homes with lower socioeconomic status. When we studied what predicted growth in word-level reading skills (Torgesen, Wagner, Rashotte, Rose, et al., 1999), we found that phonological abilities were clearly important, but they were not more important than socioeconomic background and

teachers' ratings of behavior and attention in the classroom. In other words, when we measured a broad range of cognitive, language, behavioral, and demographic characteristics of the children participating in our study, we found that children who showed the poorest growth in word reading ability had the lowest pretest levels of phonological language skills, came from homes in which the parents had the lowest levels of education and income, and were rated by their regular classroom teachers as showing the broadest range and highest frequency of behavior problems in the classroom. As long as any of the phonological variables were in the prediction equations, general verbal or nonverbal ability did not make an independent contribution to explaining individual differences in the growth of word reading skills. In other words, as in the findings of Vellutino et al. (1996), differences in general intelligence were not an important independent factor in explaining differences in response to our interventions.

We have not yet discovered the conditions that need to be in place for children with the most serious disabilities to acquire adequate word-level reading skills in early elementary school, although we clearly know how to reduce sharply the number of children who leave first and second grades with weak skills in this area.

The samples in the studies reviewed here also were selected by different methods. For example, the study by Vellutino et al. (1996) probably contained the fewest children falsely identified as "at risk" for reading failure, because they used an actual reading skill criterion administered in the middle of first grade to select children for their study. For two reasons, such a criterion will be more accurate in identifying at-risk children than will phonological predictors administered in kindergarten. First, the criterion was administered later in development when children have had an initial opportunity to respond to actual reading instruction and the entire complex of phonological and orthographic skills that contribute to reading growth have become more stable (Torgesen & Burgess, 1998). Second, the selection criterion used by Vellutino et al. (1996) is much more similar in its task demands to the reading outcome than were the identification measures used in some of the other studies. Thus, it is likely to have assessed a broader range of the individual differences in cognitive and social development that contribute to reading growth than did the measures of phonological processing and letter knowledge that were used in some studies.

It also should be noted that the population failure estimates provided here are almost certain to be underestimates. This is the case because every sample is likely to

have contained false positives, with the Vellutino et al. (1996) sample containing the fewest. False positives are children who were not really among the 12% or 18% most at risk for reading failure but who were identified through measurement error. Furthermore, each sample that received preventive instruction almost certainly missed some "false negative" children who might actually have been more difficult to teach than those selected for the sample.

In spite of all these caveats, the failure estimates provided from the five studies considered here lead to at least one important conclusion. We have not yet discovered the conditions that need to be in place for children with the most serious disabilities to acquire adequate word-level reading skills in early elementary school, although we clearly know how to reduce sharply the number of children who leave first and second grades with weak skills in this area. Most of the estimates suggest that from 4% to 6% of children still would have weak word reading skills if those interventions were applied to all who needed them. It is interesting that these figures are very similar to the percentage of the population that currently is being served in programs for children with learning disabilities. Thus, it may be the case that most of the interventions tested thus far are simply inadequate to prevent reading disabilities in the children who typically have been served by the public schools with this label. Although one condition in our last study reduced the number of children with weak word-level reading skills to an estimated 2%, there is no guarantee that all these children will continue to make adequate progress in second grade without some form of continuing special support. Of course, we are going to follow the children's development through the next several years of elementary school to examine their long-term reading development. Without such long-term follow-up, we will not really know whether we were able to "prevent" reading problems in these children through intensive early instruction focused on word-level reading skills.

Two preventive programs that are being widely used in the public schools, and for which follow-up data are available, suggest that many children with the most severe risk factors for reading disabilities will require more than just 1 or 2 years of preventive instruction to achieve the goal of adequate reading ability by the end of elementary school. For example, the popular Reading Recovery program is effective with many children in first grade (Shanahan & Barr, 1995). However, it is impossible to estimate the percentage of the population that would remain poor readers if this program were applied universally, because the data of many children who are not successful in the program, or who leave the program for a variety of reasons, are not usually included in evaluation reports. Furthermore, of those children who successfully complete the program in first grade (i.e., attain reading level scores within the average range), at least one third (Center, Wheldall, Freeman, Outhred, & McNaught, 1995) make insufficient progress in subsequent years to maintain adequate reading skills. Even a program such as Success for All (Slavin,

Madden, Karweit, Livermon, & Dolan, 1990), which does provide multiyear interventions for at-risk children, has not yet demonstrated the conditions that need to be in place for all children to acquire adequate reading skills by the end of elementary school. For example, in one extensive evaluation of the program (Madden, Slavin, Karweit, Dolan, & Wasik, 1993) 15.9% of all third graders from elementary schools in which the Success for All model had been applied for 3 years read at least 1 year below grade level, and 3.9% were at least 2 years behind.

Any attempt to understand the conditions that must be in place for children with the most serious disabilities or the most difficult backgrounds to acquire adequate reading skills must address two questions: What is the best method, or combination of methods, of instruction for these children, and how much special instruction will they require? At this point in the development of our field, we have the beginnings of a consensus about the first question but are still far from a consensual answer to the second. For example, we know that approaches featuring systematic, explicit instruction in phonemic awareness and phonetic decoding skills produce stronger reading growth in children with phonological weaknesses than do those that do not teach these skills explicitly (Brown & Felton, 1990; Felton, 1993; Foorman et al., 1998; Hatcher, Hulme, & Ellis, 1994; Lovett, Borden, Lacerenza, Benson, & Brackstone, 1994; Torgesen et al., 1997; Torgesen, Wagner, Rashotte, Rose, et al., 1999; Tunmer & Nesdale, 1985). It also seems clear that these phonemically explicit approaches should include careful instruction to help children apply their phonetic decoding skills to real words and that they should provide many opportunities to read connected text for fluency and meaning (Foorman et al., 1998; Gaskins, Ehri, Cress, O'Hara, & Donnelly, 1997; Lovett et al., 1994; Vellutino, Scanlon, & Tanzman, 1994).

However, to know what kind of instruction is most effective is not the same thing as knowing how much of that instruction, delivered under what conditions, will lead to adequate development of word reading and passage comprehension skills in children with phonological processing weaknesses. Given the results outlined here, it is apparent that, in addition to continuing to refine our knowledge about specific instructional techniques, we must examine the intensity and duration of instruction required to eliminate reading failure in children with the most severe phonological disabilities and most disabling environmental backgrounds.

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