The Impending Demise of the Discrepancy Formula

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This article calls into question the validity and utility of classifying poor readers into learning disability (LD) and non-learning disability (non-LD) categories on the basis of the discrepancy between their IQs and reading achievement scores (the Discrepancy Model). This form of classification of poor readers is based on two premises. First, the etiologies of these two forms of reading disabilities are different; therefore, there are qualitative differences in the cognitive makeups of these two groups of poor readers. Second, and consequently, the two categories of poor readers require different kinds of remedial treatment. The present review of research indicates that neither of these two premises is valid. In contrast, many research studies indicate that instructional methods which have disregarded the LD–non-LD distinction and focused their remedial efforts on the cause of the reading problem are generally successful in improving reading achievement. It is suggested that the practice of utilizing the discrepancy formula to classify poor readers into the LD and non-LD categories be abandoned and that a pragmatic approach which identifies the source of the reading problem for all children and focuses remedial efforts on that source be adopted (the Reading Component Model). The impact of the adoption of such a model on the learning disability field is discussed.

For nearly a century it has been recognized that some children find it nearly impossible to master academic skills such as reading and spelling. Within this group, a few children manifest no recognizable signs of mental or sensory handicaps; nor are they encumbered with impoverished home conditions that could explain their learning problems. These children manifest a unique and perplexing educational problem that eludes easy explanation and has therefore been a major challenge to educators. Since 1963, when the Association of Children and Adults with Learning Disabilities was formed, this condition has come to be referred to as learning disability (LD). As an educational phenomenon, LD gained official status in 1975 when Public Law 94-142, the Education for All Handicapped Children Act, was passed. Under this law, a poor reader who has an intelligence score in the average or higher range but a reading score that is significantly lower than would be warranted by the intelligence score is identified as having LD. In the area of reading, LD is also referred to by terms such as dyslexia, specific reading disability, and specific reading retardation.

In contrast, poor readers who have below-average intelligence scores and correspondingly low reading achievement scores are considered not to have LD.
(I will refer to such individuals as non-LD poor readers, though they are sometimes referred to by descriptive terms such as low achievers, slow learners, and children with general reading backwardness). Many of these individuals are also considered to be mildly mentally handicapped because their intelligence scores fall below 75, which is the low end of the average range.

The absence of readily recognizable causal factors of reading problems has left educators with a singular marker for identifying LD: a depressed reading score that is strikingly lower than would be expected based on an IQ score in the average or above-average range. In contrast, non-LD poor readers have below-average IQ scores and are expected to read at levels that are congruous with those IQs, which they almost always do. This rationale has led to the practice of utilizing the discrepancy between IQ score and reading achievement score as a means of identifying individuals with LD and distinguishing them from non-LD poor readers. Efforts to quantify the IQ-achievement difference as a marker of LD have led to the development of discrepancy formulas. For the sake of brevity, the discrepancy-based conceptualization of LD is referred to in this article as the Discrepancy Model.

By means of discrepancy formulas, more than two million school-age children and adolescents were identified as having LD during the academic year 1983–1984. This figure is constantly increasing (Coles, 1987; Mercer, 1987). About 80% of the students identified as having LD have difficulty in learning to read (Kirk & Elkins, 1975; Lerner, 1993; Lyon, 1985; Ysseldyke & Algozzine, 1995). Because reading disability is the most prevalent form of LD and because reading is an extensively researched cognitive process, the present article will evaluate the validity and the utility of the discrepancy formula in categorizing poor readers into LD and non-LD categories with reference to reading disability. As noted earlier, poor readers with LD are also often described as having specific reading disability. For the sake of clarity, however, the present article will use the label LD poor readers instead. The classification of children with reading problems into LD and non-LD castes would be of little consequence were it not for the fact that millions of dollars are being spent in efforts to identify and teach children with LD even though such practices have not been shown to have any educational value.

Implementation of the discrepancy formula in the diagnosis of children with LD has run into several conceptual and practical problems. One of the difficulties arises from certain statistical problems and computational difficulties associated with the formula itself (cf. Reynolds, 1985). During the past few years, some of these statistical bugs have been removed, and the formula has been patched up (Reynolds, 1985). Nevertheless, a major problem of a practical nature remains. The correlation between IQ and reading achievement seldom exceeds .50, which indicates that IQ scores do not account for more than 25% of variance seen in the reading performance of children from elementary grades (Stanovich, Cunningham, & Feeman, 1984). This means IQ is not a potent predictor of reading potential. Another conceptual problem arises from the likelihood that the relationship between IQ and reading ability is not unidirectional but rather reciprocal, in the sense that in addition to the influence of IQ scores on reading ability, reading experience can affect IQ. For instance, over the course of a few years, good readers tend to build large vocabularies and therefore show gains in verbal IQ scores. In contrast, poor readers tend to show noticeable decline in their verbal IQ
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scores (van den Bos, 1989). Stanovich (1986) calls this phenomenon the Matthew effect, after the verse “To every one who has will more be given, and he will have abundance; but from him who has not, even what he has will be taken away” (Matthew 25:29). Conversely, it has been documented that poor readers who show improvement in their reading achievement also show a corresponding gain in their verbal IQ scores (Bishop & Butterworth, 1980; Share, McGee, & Silva, 1989). These observations undermine the adequacy of the IQ score as a predictor of reading achievement score.

A problem of a practical nature is that the IQ-achievement-discrepancy-based diagnostic procedure does not provide guidance for making decisions regarding remedial instruction. Citing these and some additional reasons, Siegel (1989) has challenged the use of IQ scores in the diagnosis of LD. These problems notwithstanding, the discrepancy formulas continue to be used “despite the lack of empirical evidence of their utility and despite a preponderance of evidence that many are even statistically flawed” (L. Brown & Bryant, 1985, p. 37).

Even if we were to disregard these limitations of the IQ-achievement-discrepancy-based diagnosis of LD, a formidable problem—indeed, the most serious problem surrounding the discrepancy formula—remains. It is the questionable validity of the premises on which the concept of LD has been founded. The reading difficulties of children with LD are thought to be unexpected because these children have average or higher IQ; for this reason, the cause of their reading difficulty cannot be attributed to low intelligence. In contrast, the reading problem of non-LD poor readers is not a surprise because it is consistent with their overall deficient intellectual ability. It follows, then, that intelligence cannot account for the reading difficulties of children with LD, whereas it can explain the poor reading performance of non-LD poor readers. Consequently, the causes of the two groups' reading problems cannot be the same, a deduction that leads to the first premise on which the Discrepancy Model is based: There is a qualitative difference in the etiology of the reading problems of the two groups. A consequence of the presumed qualitative difference is the second premise, namely, that children with LD are not likely to respond favorably to instructional procedures that are used to teach poor readers who do not have LD, nor can they be expected to profit from conventional classroom instruction. After all, these children are in the LD program because they failed in the regular classroom. This belief has led to the development of an incredible variety of specialized methods of instruction such as perceptual-motor training, visual phonics, the visual perceptual method, whole word instruction, the neurological impress method, the Frostig method, applied behavior analysis, behavior modification, psycholinguistic procedures, and Fernald’s multisensory approach. (For a discussion of the rationale on which these assumptions are based, see Fletcher, Francis, Rourke, Shaywitz, & Shaywitz, 1992; Swanson, 1993).

The first part of the present article examines the validity of the premise that there are qualitative differences between LD poor readers and non-LD poor readers. The second part examines the assumption that these two groups of poor readers respond differently to different remedial instructional strategies. Finally, the third part of this article proposes an alternate procedure for diagnosis and remediation of reading problems for all children in the elementary schools.
Are There Qualitative Differences in the Cognitive Makeups of LD Poor Readers and Non-LD Poor Readers?

The first series of articles to report that qualitative differences exist among poor readers was published by Rutter and Yule (1973, 1975) and Yule (1973). These British investigators used the labels specific reading retardation and general reading backwardness to describe poor readers who showed IQ-achievement discrepancy and poor readers who did not show such a discrepancy, respectively. These labels therefore correspond to LD and non-LD reading disabilities. In a study of more than 3,000 British children who constituted the entire elementary school population of one district, Rutter and Yule (1975) found that the IQ scores of these children were more or less normally distributed but that the reading scores were not. At the extreme lower end of the distribution of the reading scores these investigators noticed a hump indicating the presence of a larger number of poor readers than would be expected when the reading scores were predicted from IQ scores, after adjusting for regression effects. This hump at the lower end of the reading score distribution was taken as evidence for the existence of a group of children whose reading scores were not in line with their IQ. That is, the IQ scores of these children were significantly higher than their reading scores. Children represented by this hump were described as having specific reading retardation because their problem was limited to, or specific to, the reading process. In a subsequent publication, Rutter (1978) reiterated the differences between these children and non-LD poor readers by noting that in addition to the IQ scores, these two groups differed from each other also in distribution of gender, prevalence of neurological disorders, and prognosis for reading progress.

A number of studies published since then, however, have challenged this interpretation of the Rutter-Yule data and the idea that there are qualitative differences between these two groups of poor readers. For instance, Wissel and Zegers (1985) have argued that the hump in the distribution of reading achievement scores could be an artifact resulting from ceiling and floor effects of the reading tests used by Rutter and Yule. They have also argued that the difference in sex ratios between the two poor reader groups can be explained away, because it was no different from the difference in reading score distributions seen between boys and girls in the general population, and that the difference in reading progress seen between the two groups was no greater than the difference between the reading scores seen during the initial identification of the two groups five years earlier.

The criticisms raised by Wissel and Zegers (1985) are in agreement with an earlier report by Rodgers (1983), who in a study of over 8,000 British children failed to find any evidence of the hump when these children were tested individually with tests that were controlled for ceiling and floor effects. Similarly, Shaywitz, Escobar, Shaywitz, Fletcher, and Maduch (1992) also failed to find the hump in a large sample of American children. These investigators examined the issue of nonnormal distribution of reading scores of children with LD in a sample of 414 schoolchildren followed from Grade 1 until Grade 6. These children were given tests of reading in each of these grades, and IQ was assessed in Grades 1, 3, and 5. Results showed that both IQ and reading scores of these children were normally distributed. The investigators could not find the hump described by Rutter and
Yule and concluded that “dyslexia goes along a continuum that blends imperceptibly with normal reading ability” (p. 148).

In agreement with the studies that have looked into the pattern of distribution of IQ and reading achievement scores, studies that examined the psychometric profiles of LD and non-LD children also have failed to find any differences. Several studies which have been published by the Minnesota Institute for Research on Learning Disabilities indicate that it would be impossible to differentiate children with LD from non-LD poor achievers on the basis of their psychometric profiles. One of the earlier studies exemplifies this viewpoint. Ysseldyke, Algozzine, Shinn, and McGue (1982) compared a group of LD children identified on the basis of the Discrepancy Model with a group of non-LD low-achieving children on 49 psychometric measures and noted an overlap of scores that ranged from 82% to 100%, with an average overlap of 96%. Summarizing the findings of studies of similar nature, Algozzine and Ysseldyke (1983) concluded that the discrepancy formula failed to differentiate clearly between students classified as LD and non-LD and therefore questioned its validity. However, the conclusions drawn from the Minnesota studies have been criticized because the LD–non-LD classification was made by the schools, which often do not enforce diagnostic procedures rigorously (e.g., Fuchs & Fuchs, 1986; Kavale & Forness, 1994). It should be noted, however, that even LD specialists have no rigorous criterion for identifying LD, and state departments of special education themselves have not been successful in prescribing with precision the extent of discrepancy which marks LD. In work similar to that of the Minnesota group, Kavale and Forness (1994) reviewed individual studies and a meta-analysis of studies of Wechsler Intelligence Scale for Children (WISC) pattern profiles of school-identified LD children and concluded that “the WISC LD profile reveals little that is extraordinary and appears not unlike that found for the average non-LD slow student” (p. 22). In a study that compared several samples of Canadian children with LD, identified on the basis of IQ-achievement discrepancy, McFadden (1990) also found that many children with low IQs exhibited patterns similar to those of children identified as having LD.

Rutter and Yule’s (1975) finding of a disproportionately larger number of boys than girls in the LD group but not in the non-LD group has also not been replicated. In a study of an unselected cohort of 741 children from New Zealand whose reading achievement was assessed at ages 7, 9, 11, and 13 years, Share, McGee, McKenzie, Williams, and Silva (1987) found that there were more boys than girls among poor readers, regardless of whether these poor readers were classified as LD or non-LD. For instance, at the age of 13 years there were 34 poor readers who were classified as LD and 125 poor readers who were classified as non-LD. In the former group, there were 19 boys and 15 girls, and in the later group there were 68 boys and 57 girls—the ratio of boys to girls in the two groups were 1.3:1 and 1.2:1, respectively.

Yet another difference between the two types of poor readers reported by Rutter and Yule (1975) is that the educational prognosis for the LD poor readers was worse than that for the non-LD poor readers. However, Share et al. (1987) could find no differences in the progress made by LD and non-LD poor readers. These authors concluded that there is no evidence to support the validity of the distinction between LD poor readers and non-LD poor readers on the basis of patterns
of reading deficits, etiologies, and prognosis and that “it is best to treat underachievement as a continuum” (p. 42). In a longitudinal study of 32 LD children, 37 non-LD poor readers, and 334 normal readers, Francis, Shaywitz, Steubing, Shaywitz, and Fletcher (1994) administered reading tests to these children at various intervals from Grade 3 until they reached Grade 9. Analysis of the data for individual and group growth curves showed that the two groups of poor readers did not differ from each other in reading performance as a function of age. Thus, the data failed to support the hypothesized difference in prognosis between LD poor readers and non-LD poor readers when the two groups were identified on the basis of the Discrepancy Model. Furthermore, as the individual growth curve analyses indicated, intraindividual changes in reading skills were also not different for the two groups of poor readers.

As this brief review shows, studies which looked for differences between LD poor readers and non-LD poor readers from geographically diverse regions have provided no support for the premise that qualitative differences exist between LD poor readers and non-LD poor readers.

These negative findings have, therefore, prompted many investigators to abandon the efforts to authenticate differences between LD poor readers and non-LD poor readers in terms of extrinsic criteria such as levels of achievement scores, statistical abnormalities in distribution, gender ratio, and educational prognosis. Instead, they have turned to variables that are intrinsic to the reading process to look for differences between LD and non-LD populations. Most of the studies that have pursued this line of investigation have examined differences between these two categories of poor readers in terms of components that constitute the reading process. Even though many skills have been proposed as components of the reading process, word recognition and comprehension have been documented reliably as two major constituents (Frederiksen, 1982; Palmer, McCleod, Hunt, & Davidson, 1985; see also Carroll, 1993).

Word recognition refers to the ability to pronounce the written word or extract its meaning. Generally speaking, beginning readers recognize written words by converting graphemes in words into their corresponding phonemes. Referred to as decoding, this is one of the two strategies used in word recognition, the other being the ability to process words in larger units as sight words. Once decoding skills are mastered, children begin to recognize words quickly and effortlessly and are on their way to becoming skilled readers. It appears that a combination of repeated exposure to print and orthographic memory plays an important role in the development of sight vocabulary. Sight word reading skill, however, does not appear to be fully mastered by children until around Grade 4 (Aaron, 1989) and may not be most accurately considered an independent component because it is built on decoding skills (Ehri & Saltmarsh, 1995). It also appears that direct instruction in sight word reading does not improve word reading skills of children whose decoding skills are very weak (Foorman et al., 1997). Lovett, Chaplin, Ransby, and Borden (1990) also found that third graders with LD did not profit differentially from letter-sound over whole-word training. They therefore concluded that severely disabled readers require extended training in decoding and phonological strategies. Decoding skill is the predominant strategy used when children learn to read, whereas sight word reading marks the stage in which children read to learn. For these reasons, decoding is the focus of attention in the
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Decoding deficiency, as indicated by poor phonological processing skills, is well documented to be a major cause of reading disability in many European languages including English (Bradley & Bryant, 1985; Cossu, Shankweiler, Liberman, Tola, & Katz, 1988; Liberman, 1983; Lundberg, Frost, & Peterson, 1988).

Comprehension, the second component of reading, is a generic process that is common to both reading and listening, even though there are some differences at the surface level that are attributable to the modalities. This is evident from the fact that listening comprehension places an upper limit on reading comprehension (Royer, Kulhavy, Lee, & Peterson, 1986) and from the observation that the correlation between the two forms of comprehension is high, usually in the vicinity of .80 (e.g., Kintsch & Kozminzky, 1977; Palmer et al., 1985).

Of the two major components, decoding is of relevance in the present context. This is so because all poor readers, whether or not identified as having LD, are deficient in reading comprehension. To begin with, all poor readers, regardless of the diagnostic category they are eventually placed in, are identified on the basis of their poor performance on tests of reading comprehension. For this reason, comprehension cannot be expected to distinguish between the hypothesized LD and non-LD poor readers. This leaves decoding as a potential skill in which the two groups of poor readers could differ.

A basic process that underlies decoding skill is phonological awareness, which refers to a sensitivity to phonemes, that is, units of sound in the spoken language. In their attempts to understand the nature of decoding skills, researchers have assessed phonological awareness with the aid of tests that require subjects to manipulate phonemes in spoken words or segment spoken words into their constituent phonemes. In addition to tests of phonological awareness, decoding skills could be assessed with the aid of tasks that require the subject to read lists of pronounceable nonwords such as dake (i.e., pseudowords) or lists of regular and irregular words (i.e., words whose spellings are consistent or inconsistent, respectively, with their pronunciations) and by administering spelling tests. Regular and irregular word tests are thought to be able to distinguish between deficits in decoding skill and deficits in sight word reading skill. Spelling tests are used for assessing decoding skill, because poor spellers invariably are also poor decoders. What do these tests reveal about the postulated differences between LD poor readers non-LD poor readers?

Rack (as cited in Goswami & Bryant, 1990) administered a test of nonword reading to 91 British children who were classified as IQ-achievement discrepant, 91 nondiscrepant poor readers, and reading-age-matched normal readers. It was found that both groups of poor readers were equally worse at reading nonwords than the normal readers with whom they were matched. Felton and Wood (1992) administered nonword reading tests to American children and found that children classified as having LD and children classified as non-LD poor readers were both bad at reading nonwords.

Jorm, Share, Maclean, and Matthews (1986) studied 453 Australian children who were classified into three groups: poor readers whose reading scores were consistent with their IQ scores, poor readers with discrepant scores, and normal readers. Included in their battery were tests of vocabulary, syntax, pseudoword
learning, pseudoword reading, and phoneme segmentation. These investigators found that the two groups of poor readers did not differ from each other on these tests, even though they were inferior to normal readers in pseudoword reading, phoneme segmentation, and spelling. In a British study, Johnston, Rugg, and Scott (1987a, 1987b) studied 8- to 11-year-old poor readers of average and below-average intelligence and compared them with normal readers matched for chronological age and reading age. There were 20 children in each group. The ability of these children to utilize phonology in reading was examined through several tasks that assessed phonological skills. The investigators found that poor readers with average and below-average IQ scores performed very similar to each other, but were inferior to normal readers on tasks which required heavy utilization of phonology. In yet another British study, Fredman and Stevenson (1988) compared the reading strategies used by 38 poor readers with a mean full-scale IQ of 93.95 with strategies used by 63 poor readers with a mean IQ of 79.75. The mean age of these groups of children was 13 years. The performance of the children in reading nonwords, regular words, and irregular words was studied with a view to see if differences in processing styles could be detected between the two groups. The performance of these two groups of children on single word reading tasks showed that when quantitative differences were controlled by matching the two groups for reading age, the two groups of poor readers were not distinguishable from each other in terms of their decoding skills. In a meta-analysis of data collected from a total of 232 dyslexic children and 232 nondyslexic poor readers, Siegel (1992) found no significant differences between dyslexic poor readers and nondyslexic poor readers on measures of reading, spelling, and phonological processing. This led her to conclude that “the distinction between these two groups of disabled readers does not appear to be a meaningful one in terms of the basic processes underlying reading” (p. 624). Stanovich and Siegel (1994) used a regression-based approach to reading-level-match designs to test whether poor readers with and without discrepancy between IQ and achievement differed in their cognitive profiles. Analysis showed that in conformity with the numerous other studies, the groups did not differ from each other in their phonological or orthographic processing skills. Foorman, Francis, Fletcher, and Lynn (1996), using Rasch-scaled decoding scores based on a common metric which disregarded age and grade, also found no differences in reading-related cognitive skills of children from early elementary grades whose reading performance was discrepant or not discrepant with their IQ scores.

In an investigation of British children, Ellis, McDougall, and Monk (1996) studied four groups labeled as dyslexics, reading-age-matched younger normal readers, non-LD poor readers, and precocious readers. In addition to word and nonword reading and text reading tasks, these children were also administered three phonological processing tasks, namely, rhyme discrimination, phoneme deletion, and nonword repetition. Ellis et al. found that the dyslexics did not differ significantly from the non-LD poor readers or the reading-age-matched younger readers on any of the phonological processing tasks. The dyslexic children were no more affected by spelling-sound regularity in naming and lexical decision making (e.g., “Tell me if dake is a real word or not a word”) than were the nondyslexic poor readers, which indicates that the dyslexics were no worse than the nondyslexic poor readers in utilizing phonology for reading.
Share (1996) matched on a one-to-one basis 11 poor readers with a mean IQ of 105.5 with another group of 11 poor readers with a mean IQ of 81.4. The ranges in IQ scores for the two groups were 92 to 119 and 71 to 92, respectively. These two groups were administered 26 tasks including reading real words, reading irregular words, reading nonwords, spelling, processing nonalphabetic symbols, and symbol-word learning. It was found that the two groups differed significantly from each other on only 1 out of the 26 measures, namely, word substitution in reading, with LD children committing more substitution errors than non-LD children. Share concluded that there are no qualitative differences between LD and non-LD poor readers.

Pennington, Gilger, Olson, and DeFries (1992) approached the issue of reading disability subtypes from a genetic perspective. Among other tests, they administered tests of phonological and orthographic coding to 150 pairs of monozygotic (identical) twins and 170 pairs of dizygotic (fraternal) twins with IQ-achievement discrepant and nondiscrepant profiles. They found that the heritability indexes were similar in both groups of poor readers, regardless of the presence or absence of discrepancy. They interpreted this finding as providing no support for the view that the reading-related problems of the two types of poor readers have different etiologies.

Studies that have compared the two groups of poor readers on other basic processes related to reading also have failed to find differences between the two groups of poor readers. For instance, Fletcher et al. (1992) administered tests of speech sound perception, auditory closure, sentence memory, and verbal fluency to 1,069 children ranging in age from 9 to 14 years. This study revealed no significant differences between poor readers with and without discrepancy, a finding that led the investigators to question the validity of segregating children with reading deficiencies on the basis of IQ-achievement discrepancies. On the basis of his own findings and those of others, Fletcher (1992) concluded that the differences between children who meet discrepancy formula requirements and poor readers who do not meet the discrepancy requirements are either nonexistent or small and of questionable significance.

Investigators with an educational orientation have attempted to see if children with LD differ from non-LD poor readers in their performances on tests of a broad range of reading-related skills. Ysseldyke et al. (1982) administered a battery of psychoeducational tests to a group of 50 school-identified LD children and 49 low achievers. The battery of 19 tests included tests of spatial relations, visual matching, calculation, vocabulary, memory for sentences, word attack, and letter and word identification. These investigators found that there were considerable similarities between the two groups, that an average of 96% of the scores were within a common range, and that the performances of LD and non-LD children on many subtests were identical. These observations led to the conclusion that on the basis of these test performances, it would be impossible to individually classify these children correctly as LD and non-LD. It should, however, be noted that this conclusion was challenged by Wilson (1985) for being the result of possible sampling bias which resulted from not strictly applying all the exclusionary criteria recommended by the U.S. government. This criticism, in turn, met with a rebuttal from Algozzine (1985), who reiterated his view that the LD concept has not resolved children’s learning difficulties but rather has created a host of new
problems.

A few investigators, however, report differences between LD and non-LD poor readers on tests of achievement. Merrell (1990) compared 152 children from Grades 2 through 8 identified as having LD with 93 children classified as non-LD low achievers. Administration of the Woodcock-Johnson Psychoeducational Battery revealed that the achievement scores of the LD group were lower than those of the low-achieving group. However, the IQ-achievement discrepancies did not correlate as highly with the maximal separation of the two groups as some of the academic achievement variables did. In another study, Merrell and Shinn (1990) found that while LD and non-LD low-achieving students differed in academic achievement levels, the two groups were in many ways similar with respect to performance on cognitive tests. Thus, these studies have failed to uncover qualitative differences between the LD and non-LD groups, even though quantitative differences between the two groups were seen. A similar remark can be made about studies which compared children with LD and children classified as mildly mentally retarded (MMR). For instance, comparing the performance of children belonging to these two categories on the “oddity task” and a “semantic information task,” Scott and Perou (1994) reported differences between the two groups. It has to be noted that such quantitative differences are not altogether unexpected, considering the fact that the lowest IQ score in the LD group was 85 and the highest IQ in the MMR group was 69. This difference in IQ scores would predict a corresponding difference in their performance on the oddity and semantic tasks, which most likely tap the same cognitive processes that the IQ test does. Because tests of academic achievement and some cognitive tasks assess many of the same abilities tested by IQ tests (e.g., vocabulary, comprehension, information), it should come as no surprise that non-LD subjects whose IQ scores are substantially lower than those of LD subjects perform worse than the LD subjects on achievement tests and cognitive tasks. When the performances of the two groups of poor readers are compared after controlling for IQ, these differences usually disappear, as they did in the study by Fredman and Stevenson (1988). Using differences in performance on tests of achievement as evidence of qualitative difference between low-IQ and higher-IQ groups of subjects amounts to circular reasoning.

The studies reviewed so far overwhelmingly undermine the validity of the premise that there are qualitative differences between LD and non-LD poor readers in cognitive processes that are intrinsic to reading. Even reversal errors in reading and writing, once considered a marker for developmental dyslexia, are reportedly equally prevalent among LD and non-LD poor readers (Fischer, Liberman, & Shankweiler, 1978; Liberman, Shankweiler, Orlando, Harris, & Berti, 1971; Taylor, Satz, & Friel, 1979). The very precepts on which the edifice of LD has been constructed therefore stand challenged.

Kavale and Forness (1994), who have examined this issue closely, conclude that the notion of discrepancy...has led to a confounding among concepts. The confounding is most clearly seen in the suggestion that there are more similarities than differences between LD and low achieving students. Such a suggestion calls into question the very notion of LD.... (p. 43)

In spite of the findings of these quantitative research studies, many LD teachers would feel that it is counterintuitive to claim that there are no qualitative differ-
ences between students of low IQ and garden-variety poor readers. After all, the children with LD are able to grasp what they are taught more quickly than the non-LD poor readers! Genuine as it is, this impression is based on a circular argument. It amounts to saying that intelligent children are intelligent. Furthermore, from an educational-philosophical perspective, can’t the same question be raised about children of differing IQs in the regular classroom? Should a child with an IQ of 120 be treated differently from a child with an IQ of 100?

This is not to say that poor readers do not have a weakness in phonological processing skills. Numerous studies have shown that a weakness in phonological processing skills is associated with reading problems—so much so that weak phonological skill is generally accepted to be an etiological factor in developmental reading disabilities (Bradley & Bryant, 1985; Lundberg et al., 1988). What the present review shows is that within the population of poor readers, subgroup distinctions based on IQ-achievement discrepancy cannot be maintained with reference to etiology, statistical distribution, educational prognosis, or cognitive processes that underlie the reading process. The validity of the first premise—that there is qualitative difference between poor readers with LD and poor readers without LD—cannot therefore be sustained.

**Do LD Poor Readers and Non-LD Poor Readers Respond Differently to Different Remedial Instructional Strategies?**

The Discrepancy Model of LD holds that the nature of the reading problem of the LD poor reader is different from that of the non-LD poor reader. Consequently, it dictates that the remediation procedures should also be different for these two groups (Rutter & Yule, 1975). Because children with LD are thought to have average or above-average levels of general intelligence, remedial strategies that are somewhat different from the traditional instructional methods have been tried. These remedial strategies include a wide assortment of techniques, such as perceptual-motor training, perceptual training (as in the Frostig method), cognitive style matching (as in teaching to the left cerebral hemisphere), modality processing (as in visual phonics), and Fernald’s multisensory method.

The second premise—that children with LD will respond favorably to special remedial procedures that are different from those used to teach non-LD poor readers—will be examined by raising the following two questions.

1. Do poor readers with LD make significant progress in the acquisition of reading skills after being placed in special LD remedial programs?
2. Do poor readers with LD and poor readers without LD show different degrees of progress following special instructional treatments?

**Poor Readers With LD in Special LD Remedial Programs**

Even though some school systems do not separate poor readers into the LD and non-LD categories, a majority of schools in the United States carry out a differential diagnosis by applying the discrepancy formula and provide special remedial instruction to children with LD. The remedial instruction is carried out in one of four different settings by teachers specially trained or designated to deal with LD. The settings are (a) the resource room, (b) the self-contained special classroom, (c) the regular classroom (inclusion), and (d) special tutoring outside of school hours. Poor readers without LD are taught in the regular classroom or may receive
instruction from non-LD teachers in a Title 1 program. Of the few studies that have examined the effectiveness of LD programs, a majority have investigated the effectiveness of placement in a resource room in improving reading achievement. Many research reports, however, do not provide information about the nature of placement of children investigated, nor do they furnish clear descriptions of instructional strategies used in resource rooms. This is particularly true of studies that have investigated children drawn from different schools in large school systems that leave LD teachers to their own resources for teaching children with LD. It is worth noting that the resource room is a proxy for the use of special LD instructional methods and does not represent a duplication of regular classroom reading instruction in a privileged setting. Consequently, when the effectiveness of resource room placement is examined, it is the diagnostic and instructional procedures that are being evaluated.

McKinney and Feagans (1984) compared the reading comprehension and word recognition skills of 63 six- and seven-year-old children with LD and 66 normally achieving children over a period of 3 years. The study showed that children with LD maintained the same relatively low status with reference to word recognition skill and fell even farther behind in reading comprehension on standardized tests such as Peabody Individual Achievement Test (PIAT) when compared to their normally achieving peers \((p < .002)\). These investigators suggested that the pattern of services to students with LD needs rethinking.

In an attempt to answer the question “Do separate categories of students profit from distinctly different educational programs?,” Epps and Tindall (1987) reviewed five studies of nonretarded poor readers conducted after 1970 and concluded that although it has not been clearly established that resource room programs are generally effective in improving the academic performance of all populations, in some studies they have been found to be superior to full-time placement in regular classes. However, after reviewing a larger number of studies which involved children with behavioral disorders, mental retardation, and learning disability, these authors concluded that “little evidence exists supporting the efficacy of special education or the development of differential programs as a result of the assessment-placement process” \((p. 243)\).

Wang and Baker (1986) conducted a meta-analysis of 11 studies which set out to examine the efficacy of mainstreaming versus special classes. Of a total of 541 students of preschool, elementary school, and middle school ages, 3% were learning disabled. The investigators concluded that meta-analysis provides empirical evidence supporting mainstreaming and that, regardless of exceptionality, the mean effect sizes for mainstreamed handicapped students were consistently higher than those for students taught in special settings. This would mean that separating some poor readers on the basis of IQ-achievement discrepancy is no better than teaching these children in the regular classroom without resorting to any special method of instruction.

Short, Feagans, McKinney, and Appelbaum (1986) studied 110 children from Grades 1 and 2 who were classified into (a) an IQ-achievement discrepant group, (b) a slow learner group without IQ-achievement discrepancy, and (c) a normal reader group. The researchers tested these children over the next three years. On the basis of their findings, these authors concluded that children identified as having LD made little improvement in reading recognition, as assessed by the
PIAT standardized test, during the three-year period. They further noted that

the stability data for the LD target achievers were especially discouraging when
considering that all LD students were receiving special education services. In
spite of such services, these subtypes tended to become more disabled across the
three-year period of the study. (p. 223)

Haynes and Jenkins (1986) studied 117 children from Grades 4, 5, and 6 who
were receiving reading instruction in 23 resource rooms. After one academic year,
the pre- and posttest scores of these children on the Wide Range Achievement
Tests were 52.8 and 58.6, respectively, which indicates little progress in word
recognition. On the Slosson Oral Reading Test, the pre- and posttest scores were
69.3 and 88.0, respectively. However, in reading comprehension, as assessed by
the California Achievement Test, pre- and posttest scores were 407.9 and 407.6,
respectively. These authors concluded that “the level of instruction was insuffi-
cient to close the gap between handicapped students and their peers” (p. 187).

As part of a major review study, Kavale (1988) examined the findings of
longitudinal studies that dealt with reading disability during the 1950s, 1960s,
1970s, and 1980s. Studies conducted during the 1960s led the author to comment
that reading problems tend to be persistent and represent chronic disabilities. Even
when reading gains were realized, subjects tended to still be retarded in reading.
Kavale reached similar conclusions after reviewing studies conducted in the
1970s. Eight longitudinal studies conducted during the 1980s led Kavale to
conclude that these recent studies affirmed many of the earlier findings and that
reading disability is likely to be associated with long-term negative consequences.
The problem of reading disability is persistent and chronic as well as pervasive,
and even under the best of circumstances reading disabled children do not usually
close the gap in reading ability that separates them from normal readers and may
in fact become worse over time.

Four years after the publication of these findings, Kavale and Reese (1992)
assessed the improvement in reading achievement of 917 children from elemen-
tary grades over a period of two years. Of the 917 children, 86% met the
discrepancy criterion. Even though these students showed improvement in grade
equivalent scores, the overall gain was less than one half of one standard score.
This disappointing outcome led the researchers to conclude again that “LD
remains a pervasive problem that is likely to have long-term consequences” (p.
89).

Finally, a large-scale longitudinal study conducted as doctoral dissertation
research (Wleklinski, 1993) also showed that resource room placement and
special instruction had no appreciable effect on the reading achievement of
students with LD. The study examined the efficacy of special education services
over a period of three years in promoting word recognition and reading compre-
hension skills of 410 elementary school children diagnosed as having LD on the
basis of a discrepancy formula. These children came from 19 different schools,
and the teachers used a variety of teaching methods. Differences between the pre-
and posttest scores obtained after an interval of three years showed that resource
room placement and instruction produced no significant changes in the reading
achievement scores of these children. For word recognition, the mean pretest
score of these children on the Wide Range Achievement Tests (WRAT) was
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75.14, whereas the mean posttest score was 74.98. The mean pretest reading comprehension score of a subgroup of 114 children was 79.55, whereas the mean posttest score was 81.25. These pretest-posttest differences in word recognition and reading comprehension scores were not statistically significant. The smaller number of children assessed for reading comprehension is due to the fact that LD specialists did not even assess reading comprehension in children with LD until recent years.

A negative side effect observed in the study by Wleklinski (1993) was a noticeable decline in full-scale IQ: The mean preplacement IQ was 98.2, and the mean posttest IQ was 94.98. This confirms the earlier mentioned Matthew effect (Stanovich, 1986), often reportedly seen in children pulled out of regular classroom for special instruction. In fact, there was a small but significant negative correlation between the amount of time spent in resource rooms and reading achievement.

Poor Readers With and Without LD Who Receive Special Instructional Treatments

Despite the widespread belief held by LD advocates, special education administrators, and LD teachers that LD and non-LD poor readers require different instructional strategies, very little research is available to support such a premise. A major reason why this erroneous belief persists is the paucity of information about the degree of progress made during an academic year by poor readers, whether they are in resource rooms or elsewhere. Such data are not maintained at the state level or at the school level. Whereas schools are required to monitor the progress made by children in regular classrooms in a systematic way, special education is immune to such requirements. In this sense, LD education is akin to a business venture which, at the end of the year, does not know whether it made a profit or incurred a loss. There may be schools which are exceptions to this statement, but most schools have records only of individual educational plans (IEPs), which represent subjective impressions held by teachers. What little information is available regarding the relative progress made by LD and non-LD poor readers comes from a handful of research studies.

A typical finding comes from a review of 37 studies by Wiederholt and Chamberlain (1989) which evaluated the effectiveness of resource room versus general classroom instruction of LD and non-LD handicapped learners. These authors could not reach a firm conclusion because these studies, in addition to being flawed, yielded conflicting results.

An earlier study which addressed the question of differential treatment and its effect on reading was a meta-analysis conducted by Carlberg and Kavale (1980). This study examined the efficacy question by analyzing the results of 50 studies which involved about 27,000 students with an average age of 11 years. When the data were analyzed on the basis of IQ distribution of the population, the slow learner group (IQs from 75 to 90) declined by 13 percentile ranks, whereas LD children in special classes showed an improvement of 11%, the effect size being .29. Even though these results indicate some gains by children with LD taught in special classes, the .29 effect size means that these children made less than one third the amount of progress expected of normally achieving children during the course of one year.
Stokes and Christopher (1990) addressed the question of whether the degree of progress in reading made by children with reading disability and lower IQs is different from that made by children with average or higher IQs. They examined the WRAT word recognition performance of 110 children whom they classified into three groups on the basis of an index derived by combining word recognition and mean full-scale IQ (mean FSIQ) scores. This resulted in the following three groups: low-IQ poor readers (mean FSIQ = 88.3), moderate-IQ poor readers (mean FSIQ = 91.4), and average-IQ poor readers (mean FSIQ = 98.4). These children were tested at ages 7, 10, and 13. Results showed that over a period of six years children with lower IQs improved in word recognition skill, from a mean of 87.6 to a mean of 96.7, but children with higher IQs declined in word recognition skill, from a mean of 84.2 to a mean of 80.5. These changes in word recognition scores reveal a trend that is opposite of what is expected. This unexpected finding could be explained if decoding is considered to be a skill that is independent of general intelligence. It is also possible that children in the low-IQ group had poor comprehension skill but adequate decoding potential and did not have sufficient reading experience. The Reading Component Model (described later) anticipates the existence of such children. In fact, some of the studies described in the present article involved such children (e.g., Dermody & Speaker, 1995; Lysynchuk, Pressley, & Vye, 1990; Palincsar & Brown, 1988). In spelling and math, the low IQ-group showed no gains.

These few studies indicate that the second premise—that poor readers with LD respond differently to special methods of instruction than do poor readers without LD—also cannot be empirically validated. It is not surprising that resource room instruction has not been found to be beneficial because LD teachers across the nation use no uniform set of instructional methods proven for their effectiveness. A plethora of instructional strategies are used. This surfeit of questionable methods can be traced to university departments responsible for the preparation of LD teachers. A survey of methodological content of teacher education program by Pugach and Whitten (1987) revealed that the most frequently taught methods were, in order of frequency, “direct instruction,” “curriculum based instruction,” “task analysis,” “applied behavior analysis,” “metacognitive strategy training,” “cooperative learning,” “remedial methods for attention deficits,” “psycholinguistic methods,” “psychotherapeutic interventions,” and “visual perceptual methods.” The investigators concluded that what distinguishes special education teachers is their knowledge of the law and the processes of identification, placement, and consultation, none of which is directly relevant to reading instruction.

In conclusion, even though a few isolated studies report some difference in progress between poor readers classified as having LD and children with below-average IQ, no overall, compelling evidence of educational gains has been obtained to warrant the continuation of the policy of classifying poor readers into LD and non-LD categories.

This selective review of studies that dealt with questions relating to classification and instruction of children with LD casts serious doubts on the validity of the very foundations on which the concept of LD rests. There is no convincing evidence to show that children with LD are qualitatively different from non-LD poor readers in terms of reading-related cognitive processes, nor does differential placement and treatment appear to be more effective than leaving children with
LD in the regular classroom. Would it make any difference in the lives of children with LD if the practice of LD education were renounced?

The question “What can be done with children who are not able to learn to read well?” will nevertheless remain. Clearly, alternative approaches to help children who experience difficulty in learning to read need to be tried and evaluated. In this article, the reading component-based model of reading remediation is proposed as one alternative. The reading component–based remedial model does not require that poor readers be categorized on the basis of their IQ, nor does it advocate abandoning the resource room. The objective is to identify the source of the reading problem and address it regardless of the student’s IQ. Consequently, not all poor readers will receive the same kind of instruction under the same roof. Under those circumstances, concepts such as IQ and resource room become irrelevant. Also, it is not expected that all poor readers who receive remedial instruction based on the component model will become skilled readers, only that they will become better readers.

An Alternative Approach for Diagnosing and Treating Reading Problems in the Classroom: The Component Model of Reading Disability

The purpose of the diagnostic procedure based on the Component Model of Reading Disability (henceforth the Reading Component Model) is to identify the instructional strategy that is likely to best improve the reading skills of individuals who encounter difficulties in learning to read. It is not intended to classify, categorize, or label poor readers. The component-based approach for diagnosing and remediating reading problems advocates identifying the proximal cause of the reading problem and selecting the remedial strategy that will best address that cause. This model is founded on the premises that reading is a complex process made up of identifiable components and that a weak component can impede the acquisition of reading skill. In the present context, a component is defined as an information processing operation that has an independent status. As noted earlier, available evidence indicates that at least two major components make up the reading process: word recognition and comprehension. Weaknesses in these components could therefore result in three kinds of poor readers: individuals with decoding deficit only, individuals with comprehension problems only, and those with a combination of these two deficits.

Findings of experimental, neuropsychological, and developmental studies indicate that these two components are modular and therefore independent. In an experimental investigation, Jackson and McClelland (1979) studied undergraduate students and found that comprehension ability and reaction time in a letter-matching task accounted for nearly all of the variance seen in reading ability. Similar results are reported by Palmer et al. (1985). Gough and Tunmer (1986) have expressed the two-component nature of the reading process in the form of a mathematical formula: \( R = D \times L \), where \( R \) represents reading, \( D \) represents decoding, \( L \) represents linguistic comprehension, and the value of each of these variables ranges from 0 to 1. It follows, then, that if \( D \) is 0, then \( R \) is 0. Likewise, if \( L \) is 0, then \( R \) is 0. Thus, different individuals may be unable to read for different reasons. Hoover and Gough (1990) put this hypothesis to test by tracking and assessing 254 English-Spanish bilingual children from Grade 1 through Grade 4. It was found that a substantial proportion of the variance in reading comprehen-
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sion was accounted for by the product of decoding and listening comprehension (Grade 1 = 0.71, Grade 2 = 0.72, Grade 3 = 0.83, Grade 4 = 0.82).

Neuropsychological reports indicate that some patients can comprehend individually presented words much better than they can pronounce them, whereas other patients can decode such words but have diminished ability to comprehend them (Marshall & Newcombe, 1980; Patterson, Marshall, & Coltheart, 1985). These patients—labeled deep dyslexics and surface dyslexics, respectively—indicate that decoding and comprehension skills can be affected independently of each other.

Frith and Snowling (1983) have shown that children with dyslexia comprehend much better than they can read aloud and that some children with autism can read aloud much better than they can comprehend. Dyslexic children and hyperlexic children also show that comprehension and decoding are dissociable skills (Aaron, 1989; Healy, 1982).

It is generally recognized that a substantial number of poor readers are deficient in decoding skills but have adequate comprehension skills, as determined by their performance on tests of listening comprehension (Aaron, 1989; Crain, 1989; Shankweiler et al., 1995). Children described in research literature as dyslexic usually present this profile. The existence of children who can decode fairly well but cannot comprehend what they have read is less well publicized, even though educators have recognized the existence of this type of poor reader for a long time and described them as “word callers.” Research studies indicate that about 15% of poor readers fall into this category (Cromer, 1970; Stothard, 1994; Stothard & Hulme, 1992; Yuill & Oakhill, 1991). Compared to these two categories, a vast majority of poor readers have deficits in both decoding and comprehension (Gough & Tunmer, 1986). These children are sometimes referred to as “garden-variety poor readers.”

Targeting remedial instruction at the weak subskill requires first that the weak component be identified. It was noted earlier that reading is composed of independent cognitive processes, also referred to as components, and that word recognition and comprehension have been reliably identified as two major components of reading. The remainder of this article will examine the outcomes of studies that have focused on improving decoding skills or comprehension skills.

It is possible to identify the weakness that causes a reading problem by administering selected standardized tests. As noted earlier, reading comprehension and listening comprehension skills are thought to be mediated at the deeper level by the same cognitive mechanisms. Consequently, the levels of reading comprehension and listening comprehension of normally achieving children can be expected to be very similar. Comprehension skills can be assessed with the aid of tests such as the listening comprehension subtests from the Woodcock Language Proficiency Battery or the Wechsler Individual Achievement Tests. Children who score in the average or higher range on tests of listening comprehension but fail to achieve in a similar range on tests of reading comprehension are usually hampered by poor decoding skills (Spring & French, 1991). This initial diagnosis can be confirmed by evaluating their performance on standardized tests of word attack skill, which invariably will be poor. These children are likely to benefit from remedial instruction that focuses on the improvement of the decoding skill. Children whose performance on tests of word attack is within normal range but
who nevertheless fail to achieve at a similar level on reading achievement tests invariably have weak comprehension skills. The performance of these children on tests of both reading and listening comprehension is likely to be equally low. It would be logical to expect that improving comprehension skills of these children should be the goal of remedial instruction. Poor readers who perform poorly on tests of both word attack and comprehension are likely to be weak in both components of reading and therefore require training in both decoding and comprehension. These theoretical expectations have been empirically verified in a study by Aaron (1991). In this study, tests of listening and reading comprehension were administered to 180 children from Grades 3 through 8. A regression equation was then derived to predict reading comprehension from listening comprehension. The regression equation was then applied to the listening comprehension scores of seven poor readers, and their reading comprehension was predicted. Based on the discrepancy between their listening comprehension and reading comprehension scores, their reading difficulty was attributed to poor decoding, poor comprehension, or a combination of the two deficits. An independent assessment of these children’s decoding skills showed that 6 out of the 7 predictions were correct.

But do we have any evidence to show that an instructional approach based on the component model is effective? Evidence indicating that instructional strategies which have targeted weak subskills of poor readers are reasonably effective in improving the reading achievement of these children is persuasive. In the following section, studies that investigated the outcome of decoding instruction are presented first. Subsequently, the results of efforts to improve reading comprehension are presented.

**Improving Decoding Skills**

During the past two decades, a number of research studies have identified a strong association between phoneme awareness and beginning reading skills (Juel, 1991; Liberman & Shankweiler, 1979; Rosner, 1974). Phoneme awareness is also a good predictor of future reading achievement of beginning readers (Alegria, Pignot, & Morais, 1982; Lundberg, Olofsson, & Wall, 1980; Mann & Liberman, 1984; Stanovich, Cunningham, & Cramer, 1984). The observation that training in phoneme awareness improves future reading achievement is taken as evidence that phoneme awareness is a facilitator of word recognition skill, even though the relationship between phoneme awareness and reading achievement could very well be reciprocal (Adams, 1990).

A large body of research findings documents the effectiveness of phonological awareness training in promoting reading skills in beginning readers (e.g., Ball & Blachman, 1988, 1991; Bradley & Bryant, 1985; Byrne & Barnsley, 1995; Felton, 1993; Felton & Pepper, 1995; Lie, 1991; Lovett et al., 1990; Lundberg et al., 1988; Torgesen, Wagner, & Rashotte, 1997; Wagner & Torgesen, 1987; Williams, 1980). (More details of some selected studies are shown in Appendix A.) In one of the earlier studies, Williams (1980) taught children at risk for reading failure to segment syllables into phonemes (which is one aspect of phoneme awareness training) and blend phonemes into syllables. After this auditory training was complete, decoding skills were introduced. Williams found that the children so taught improved in both phonemic skills and reading one-syllable real
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and nonsense words. In a study of the effectiveness of phoneme awareness, Ball and Blachman (1991) randomly assigned 90 kindergarten children, who were at risk for reading failure, to one of three conditions: (a) a phoneme awareness group that received training in segmenting words into phonemes along with training in sound-letter correspondences, (b) a group that received training in sound-letter association only, and (c) a control group that received no special instruction. After seven weeks of training, it was noted that the phoneme awareness group performed significantly better on measures of reading and spelling than either of the other groups. In a British study, Bradley and Bryant (1985) examined the effectiveness of phoneme awareness training on 65 six-year-old children. These children were divided into two experimental and two control groups. Children in one of the experimental groups received training in sound categorization, which was carried out by teaching alliteration and rhyming skills first and then creating phoneme awareness with the help of pictures of objects (e.g., “In what way do these words sound alike: cat, car, cup; cat, rat, hat?” Answer: sounds of beginning or ending letters). Children in the second experimental group received the above training in addition to practice in constructing the words with plastic letters. Children in the two control groups received either a concept categorization task or no training. Concept categorization for the control group involved teaching of concepts (e.g., “In what way are these words alike: bat, cat, rat?” Answer: These are animals). The training was given one session per week for a period of two years. At the end of the training period, children who received phonological training obtained higher scores on standardized tests of reading and spelling than control subjects. Children in the second experimental group did better than those in the first experimental group. These advantages persisted over a period of five years, at the end of which these children were retested.

Positive results of phoneme awareness training have also been reported for Danish children (Lundberg et al., 1988). These investigators gave preschool children auditory training which included exercises such as listening to nursery rhymes, clapping hands in harmony with phonemes in words, and being able to identify initial and final phonemes in words. These investigators found a positive and significant effect of such training on the reading and spelling achievement of these children when they reached second grade. In Norway, Lie (1991) followed some 200 children from the beginning of Grade 1 to the end of Grade 2. One group of experimental children received phoneme identification training; another group of experimental children received phoneme segmentation training. Children in the control group looked at pictures and carried on discussions of those pictures. At the end of the experimental period, the two groups of children who had received phoneme awareness training scored significantly higher in reading and spelling than children from the control group; students of lower ability profited the most from phonological training.

In a study of American children, Felton (1993) assessed the impact of beginning reading instruction on children in kindergarten considered to be at risk for reading disabilities. One group of children was given code-based instruction which emphasized sound-symbol relations as well as basic phoneme segmentation. The second group of children received context-based instruction which emphasized meaning and context. At the ends of first and second grades, children in the code condition performed significantly better on all measures of reading
Evidence for the advantage of phoneme awareness-based remedial reading also comes from a small-scale four-year-long quasi-experimental study which involved a total of 16 children (Aaron & Boyd, 1995). In this study, small groups of children from Grades 2 through 5 were taught decoding skills starting with the creation of phoneme awareness with the aid of Auditory Discrimination in Depth (Lindamood & Lindamood, 1975) followed by training in grapheme-phoneme associations. All these children were experiencing difficulty in learning to read and had been identified as having LD by their schools. These children received training in two 90-minute sessions per week, for a period of one semester. The teacher-pupil ratio was about 1:2. Analysis of the differences between pre- and posttest performances, as measured by Woodcock Reading Mastery tests, showed that about 70% of the children made significant improvement in both decoding and comprehension skills. Almost identical results were obtained for all four batches of children, which indicates that the results are replicable. The combined results of the remedial instruction on four different batches of children were as follows: pretest decoding score = 81.3, posttest decoding score = 92.1, pretest comprehension score = 86.6, posttest comprehension score = 91.3. The differences between the pre- and posttest scores were statistically significant. One of the most interesting findings of this study is that children who showed improvement in decoding skills also showed a corresponding improvement in reading comprehension. Children who did not improve in word-attack skills also failed to improve in reading comprehension. Poor decoding skill, therefore, appears to function as a factor that limits reading comprehension in many, if not all, elementary children. Once decoding skills improve, reading comprehension of many children also improves, even though it is not directly taught.

Phoneme awareness training also appears to have prophylactic effects on later reading performance of children. Byrne and Barnsley (1995) taught phoneme awareness to preschool children and tested them at the ends of Grades 1 and 2. The preschoolers were taught for 30 minutes per week for 12 weeks. There were 64 children in the treatment group and a similar number in a nontreatment group. At the ends of first and second grades, children in the treatment group were significantly better than children in the nontreatment group on nonword reading ($p > .01$) and in reading comprehension ($p > .05$). They were marginally better in real word reading ($p > .06$). There was, however, no difference between the groups in speed of reading.

In a recently published study, Torgesen et al. (1997) describe a two-and-one-half-year prevention study in which 138 children in kindergarten received one of the following three treatments: phoneme awareness plus decoding, regular classroom reading support, and no treatment. These children were selected on the basis of their poor letter-name knowledge and phoneme awareness. At the end of the second grade, the phoneme awareness group was significantly better than the other groups on standardized measures of word attack ($p < .05$) and marginally superior on word identification ($p < .051$). Even though the mean reading comprehension score of the phoneme awareness group was the highest among the three groups, it failed to reach significance. Torgesen et al. note that even though the results were positive, nearly 2.4% of the children from the phoneme awareness group had below-average scores on word attack and word identification, in spite
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of the training. Scanlon and Vellutino (1997) observed that the failure of some children to make progress in reading acquisition can be attributed to underdeveloped linguistic skills. However, Vellutino et al. (1996) found that many children identified as severely impaired in reading in first grade can attain average levels of reading ability if they are provided with early and intensive remedial instruction.

Phoneme awareness training appears to benefit poor readers from a wide age range. Truch (1994) provided 80 hours of phonological awareness and decoding training using the Auditory Discrimination in Depth program (Lindamood & Lindamood, 1975) to 281 poor readers ranging in age from 6 to 18 years. When they were tested at the end of the two-year training period, significant gains had been achieved by these subjects in word identification, spelling, and decoding in context.

It is sometimes reported that phoneme awareness training and phonics instruction may not produce uniformly successful results with all poor readers. Torgesen and Morgan (as cited in Truch, 1994), for instance, observed that while a group of kindergarten children gained much from phoneme awareness training, nearly 30% of these children failed to show improvement in reading skills. Could it be that the children who failed to show improvement might have been deficient in comprehension skills also?

In conclusion, studies that have focused on improving the decoding skills of children who were weak in this component have reported overall success. However, it has to be noted that not all children become successful decoders; a small percentage of children continue to be severely disabled in this component. Also, improvement in decoding skills does not automatically appear to transfer to word reading skill or to accelerate word reading speed. It would appear that decoding is a necessary but not sufficient skill for reading and that once decoding skill is mastered, further progress in the acquisition of reading skill is dependent on continuous reading on the part of the reader. Such a requirement is not entirely unexpected when the reciprocal relationship between phoneme awareness and reading skill is taken into account. The possibility that poor decoding skill is one manifestation of a broader and deeper linguistic problem should also be considered, because children who eventually experience difficulty in learning to read show deficits in pronunciation and object naming even before they encounter written language (Scarborough, 1990).

Improving Comprehension Skills

A number of studies which focused on improving the comprehension skills of children who know how to decode the written language but cannot comprehend it well show that their comprehension skills could be improved. (Details of selected studies are shown in Appendix B.) Methods that have been developed explicitly to teach comprehension skills are known by labels such as transactional strategy instruction (Pressley et al., 1992), self-regulated strategy development (Graham & Harris, 1993), and reciprocal teaching (Palincsar & Brown, 1984). Cognitive strategy instruction attempts to improve comprehension by teaching the reader to mobilize selected strategies, to monitor his or her own use of these strategies, and to take corrective action when comprehension fails.
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A survey of literature indicates that the following instructional strategies have been tried and found to be promising. Examples of cognitive strategy instruction are enabling the reader to (a) become aware of the purpose of reading, (b) develop a sensitivity to story grammar elements while reading, (c) activate relevant schemata, (d) develop story maps that represent the material being read, (e) build mental imagery of the text, (f) generate questions while reading a text, (g) predict the idea that would follow a current statement, and (h) summarize what has been read. Strategy instruction also trains the reader to monitor his or her own comprehension and take corrective action when he or she fails to comprehend. Corrective measures would include guessing the meaning from context, referring to the dictionary, or seeking the help of a peer or the teacher (Symons, McGoldrick, Snyder, & Pressley, 1990).

A number of studies have shown that training in these strategies improves the reading comprehension of poor readers. For instance, Duffy et al. (1987) reported that the test performance of low-ability readers who were taught metacognitive skills by explaining what strategies should be used while reading and when these strategies should be used was superior to that of a group of normal readers who were taught to read in the traditional way without the strategy instructions. In this study, 71 children from third grade were taught for 6 months, and at the end of that period their performance on graded paragraphs was compared with that of 71 children who had not received the special instruction. The differences in performance between the two groups of children on word recognition and comprehension were significant. Bednarczyk (1991) taught many of the above-mentioned strategies to fifth and sixth graders with LD, along with procedures for regulating those strategies such as self-instruction, self-monitoring, and goal setting. Bednarczyk reported that the reading comprehension of the five students with LD who received strategy instruction improved significantly.

Following are brief descriptions of studies that have implemented instruction in the use of specific comprehension strategies.

*Enabling the reader to become aware of the purpose of reading.* The assumption that without explicit instruction most children are knowledgeable about the purpose of reading may be unwarranted. Many children seem to think that the goal of reading is to pronounce the words correctly and to read at a fast rate rather than to comprehend the text (Palincsar & Brown, 1988). A number of studies show that giving LD students explicit instructions about the purpose of their reading improves their comprehension of the material that is being read (O'Shea, Sindelar, & O'Shea, 1987; Roberts & Smith, 1980; Wong, Wong, & LeMare, 1982).

*Enabling the reader to develop sensitivity to story grammar.* In a study of 40 average and 40 LD children from Grades 5 through 7, Wong et al. (1982) found that providing explicit knowledge of the purpose of reading helps all students, including the LD students, to comprehend better. In a study of remedial readers from fourth and fifth grades, Schunk and Rice (1989) found that children who received instructions to set up a goal of locating the main idea in the text, by going through a list of questions before starting to read, demonstrated better perceptions of their own reading capability. These children also demonstrated significantly higher comprehension skills than the ones who received no such instruction. The subjects of the study were 33 children from fourth and fifth grades whose teachers thought they did not experience decoding problems but did encounter difficulty
in comprehending written materials. These students were divided into two groups, with one group serving as controls. Children in the treatment group received 35 minutes of training each day for 15 days. Pre- and posttests were designed to evaluate reading comprehension by having the students answer questions after reading the passages. In a small-scale study, Idol-Maestas (1985) found that when LD students were provided guidance in comprehension by requiring them to look at the story title and new words, think about what the story is about, decide if it is fact or fiction, and form questions about the material to be read, the ability of the students to answer comprehension questions improved. This study involved only four children from Grades 4 and 6. The investigators also note that when teacher support was withdrawn, the children’s performance regressed to pretreatment levels.

Teaching the reader to activate the relevant schemata. Reading comprehension can also be facilitated by activating the schema and arousing background knowledge that is appropriate to the material that is to be read. Langer (1984) found prior knowledge to be a significant predictor of reading comprehension of sixth graders of different abilities. Carnine and Kinder (1985) taught low-achieving children from fourth, fifth, and sixth grades how to generate relevant schemata by training them to ask prereading questions about the central characters, their goals, the obstacles they face in reaching the goals, and the resolution of the plot in the story. Instructional training was given in 27 sessions of 20 to 30 minutes each. Following training, it was found that the comprehension scores of the children who had received schema training had improved significantly. Chan (1991) also found that the reading comprehension of LD children from Grades 5 and 6 could be significantly improved by presenting a few selected thematic questions before the text was read.

Another way of activating schemata is to provide advance organizers in which an overview of the text is presented before the subject begins to read. Using a strategy that drew the attention of the learner to key ideas through semantic feature analysis, Anders, Bos, and Filip (1984) found that the 31 high-school-level LD students who received the training showed higher comprehension scores in social studies than a comparable group of LD students who did not receive such training.

Enabling the reader to develop story maps. Many stories written for children have a common structure, in the sense that there is a plot with a beginning and an end. The plot often depicts a conflict; events in the story take place in a certain place at a given time, and the conflict is usually resolved in favor of the good guy. This literary format is referred to as story grammar. In a summary form, these story elements constitute the main idea of the text. Students with LD are known to have difficulty in recognizing main ideas, especially in texts presented in an inductive format (Gold & Fleisher, 1986). Children’s sensitivity to story grammar can be stimulated by training them to ask where, who, when, why, and what questions. Short and Ryan (1984) trained poor readers from Grade 4 to use knowledge of story grammar by asking several wh- and how questions. There were 42 children in the treatment group and 14 in a contrast group. A total of eight narratives were used, one per session. Strategy training produced dramatic gains in comprehension, and there was evidence of generalization of the skill, as well. Weisberg and Balajthy (as cited in Weisberg, 1988) taught 30 high school
students with LD to develop graphic organizers that would help them in summarizing using compare-contrast text structure. After three weeks of instruction, significant posttest improvements were found in the subjects’ performance on tests of reading comprehension, as well as in their ability to use appropriate text structure in order to summarize. Snider (1989) trained junior high school students with LD in activating relevant schemata before reading and in developing sensitivity to text structure and story grammar. The results of the study indicated that students in the training group demonstrated superior reading comprehension performance. Johnson, Graham, and Harris (1997) examined the effect of teaching the story grammar strategy via the self-regulated strategy development (SRSD) model to children from Grades 4, 5, and 6 who were achieving two years below grade level. Among other things, SRSD also included training in self-instruction, self-monitoring, and goal setting. Tests were administered after five stories were read to a criterion of mastery in strategy use. Analysis of test scores indicated that the reading comprehension of students with LD improved to a level comparable to that of normal readers who did not receive strategy instruction.

**Encouraging children to build mental imagery of what is being read.** Teaching strategies involving construction of mental imagery trains children to form mental pictures as they read the text. Gambrell and Bales (1986) trained 62 poor readers from fourth and fifth grades to construct images about information present in sentences and paragraphs. After training, the investigators assessed the effect of mental imagery by testing the children’s ability to detect inconsistencies in new passages. It was found that children trained in imagery construction detected more inconsistencies than children not so trained ($\chi^2$, $p < .02$). Ferro and Pressley (1991) assessed the impact of imagery generation training on paired associate learning by 20 children with LD from Grades 6 and 7. Posttests showed that children who received imagery training, regardless of whether they were in the LD group or the normal group, showed better learning performance than children who did not receive such training.

Idol (1987) taught LD children from third and fourth grades the strategy of utilizing story maps while reading. The story map is a visual representation of the main features of a story grammar that is available to students as they read the text. After assessing comprehension with the aid of a criterion-referenced test of the curriculum, as well as the Nelson Reading Skills Test, the investigator concluded that comprehension could be significantly improved for low-achieving as well as normally achieving children by using a schematic representation of story grammar. The improvement in comprehension, however, did not show evidence of generalization.

**Teaching children how to generate questions and predict upcoming events in the text.** In a study which taught the strategy of self-questioning to small groups of high school LD students, Wong, Wong, Perry, and Sawatsky (1986) found that learning disabled students can indeed be taught such a strategy. Self-questioning was taught by requiring subjects to memorize a self-questioning list, which was used as a guide. Chan and Cole (1986) compared 11-year-old LD students and average readers after training in self-questioning strategies. There were two control groups, one made up of LD children and the other made up of average readers. After four days of training, tests indicated that LD students trained in self-questioning performed significantly better than LD students in the control condi-
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even though the average readers did not show additional gains because of the training. The positive influence of question generation on comprehension is supported by a review of 26 studies by Rosenshine, Meister, and Chapman (1996). The review indicated that overall the question generation strategy resulted in gains in reading comprehension. The median effect size of comprehension was 0.36 on standardized tests and 0.86 on experimenter-developed tests. The authors noted, however, that a traditional skill-based instructional approach yielded similar effect sizes.

Training children to summarize what they have read. Although summarizing is often a routine exercise seen in regular classrooms at the junior and high schools levels, it is not systematically taught to LD children. A summarization exercise could be as simple as asking the reader to identify the main idea contained in a paragraph and express it in the form of a single sentence, or it could require summarizing an entire chapter from a book or even the book itself and expressing it in a paragraph. Weisberg and Balajthy (as cited in Weisberg, 1988) investigated whether training in summarizing expository text improves the reading performance of LD children. It was found that instruction and practice in summarizing helped disabled readers identify main ideas significantly more often than subjects in an untrained group. The trained group, however, had difficulty in separating supporting ideas from unimportant details. Jenkins, Heliotis, Stein, and Haynes (1987) trained 16 LD children from Grades 3 and 4 in summarizing paragraphs by requiring them to write brief statements of what they had read. The control group, which did not receive training, consisted of an equal number of LD children. Training was provided in 20 sessions, each lasting about 20 minutes. The effect of comprehension instruction was assessed with tests that contained questions from the textbook. Tests administered after training indicated that the strategy-trained students demonstrated better comprehension than students in the control group. Gajria and Salvia (1992) taught 15 LD children from Grades 6 through 9 five rules of summarization. These children were orally taught summarization strategies by focusing on main idea, detecting repetitions, and ignoring irrelevant details. The control group, which also consisted of LD children, did not receive such training. Posttreatment evaluation showed that the summarization strategy significantly increased the children’s reading comprehension. Furthermore, these children showed evidence not only of generalization but also of retention of the strategy over time.

Combinations of strategies. Several studies have investigated the effect of a combination of strategies on reading comprehension. Anderson, Chan, and Henne (1995) instructed 10 sixth graders who scored two years below grade level on the reading comprehension subtest of the Stanford Diagnostic Reading Test. These children were trained over the course of one year on strategies such as discussing the background of the text, locating the main idea, raising questions, and answering the questions raised. The authors described this combination of strategies as a “problem-solving approach” to reading. The reading comprehension performance of the students who received comprehension training was significantly higher from that of 7 LD students who did not receive training in the problem-solving approach to reading.

A package of comprehension-fostering strategies known as reciprocal teaching has also been found to be successful in enhancing the reading comprehension of
poor readers (Rosenshine & Meister, 1994). It is a combination of four metacognitive strategies: questioning, predicting, clarifying, and summarizing. According to Palincsar and Brown (1984), reciprocal teaching focuses upon teaching students specific comprehension-fostering strategies which the students can apply when they read new text. The vehicle by which these strategies are implemented is dialogue between teacher and students, as well as between students and other students. During the early stages of reciprocal teaching, the teacher assumes the major responsibility for instruction by explicitly modeling the reading process using the four strategies. After some guided practice, the students themselves assume the responsibility of utilizing these strategies while reading.

Rosenshine and Meister (1994) performed a meta-analysis of studies that used reciprocal teaching and found effect sizes of .30 when standardized comprehension tests were used and .86 when experimenter-developed tests were used. Four studies discussed in the meta-analysis investigated children who were good decoders but poor comprehenders (Dermody, 1988; Lysynchuk et al., 1990; Palincsar & Brown, 1984; and a 1987 study by Palincsar, as cited in Rosenshine & Meister, 1994).

Dermody (1988) and Dermody and Speaker (1995) investigated the effects of metacognitive strategy instruction and reciprocal teaching on 41 fourth graders with reading problems. On the basis of their performance on the Stanford Diagnostic Reading Test, these children were classified into the three following categories: average decoding and comprehension, above-average decoding but below-average comprehension, and below-average in both decoding and comprehension. The children were then trained in four strategies—predicting, clarifying, questioning, and summarizing—for a period of nine weeks. The results of the training procedure indicated that the group with above-average decoding but below-average comprehension had the highest gain in the reading comprehension subtest of the Stanford Diagnostic Reading Test.

Lysynchuk et al. (1990) used reciprocal teaching to instruct 36 fourth and seventh graders who had adequate decoding skill but poor comprehension skill, as determined by standardized reading tests. Another group of 36 children were placed in a “reading practice” condition and did not receive the special training. Expository passages were used to teach comprehension strategies. After 13 sessions of teaching, it was found that children who received strategy training showed significantly larger gains on a standardized test of reading comprehension (the Gates-MacGinitie test) than did the children in the control “reading practice” group. The treatment effect size was 0.55. A study by Marston, Deno, Kim, Diment, and Rogers (1995) compared the effectiveness of teaching strategies such as direct teaching, peer tutoring, and computer-assisted instruction, as well as reciprocal teaching. Thirty-seven special education teachers and 176 students with mild disabilities were involved in the study. After 10 weeks of instruction, it was found that the reading performance of the students was highest among those who received computer-assisted instruction and those who were taught through reciprocal teaching.

Palincsar and Brown (1984) trained children who had adequate decoding skills but weak comprehension skills to use the four metacognitive strategies included in reciprocal teaching. Children taught to use the reciprocal method were able to generalize the use of these strategies and did significantly better on tests of
reading comprehension than a control group, which had not received training.

Writing skills of students with LD can also be improved by providing strategy instruction during the prewriting planning period and by developing awareness regarding composition and revision (Welch, 1992). Similar results were obtained by Sawyer, Graham, and Harris (1992), who trained students with LD from Grades 5 and 6 found that providing training in self-regulated goal setting and self-monitoring resulted in significantly greater schematic structure scores of written composition.

Even though vocabulary instruction has its own set of instructional strategies, such as semantic mapping and cluster analysis, it is reasonable to expect growth in vocabulary knowledge to lead to an improvement in reading comprehension. This expectation was confirmed by one study (Bos & Anders, 1990) of 61 junior high school students with LD. One third of these students received vocabulary instruction through semantic mapping, one third through semantic feature analysis of words, and the remaining one third through definitions of words. The duration of vocabulary teaching was seven weeks. Tests of vocabulary and reading comprehension developed by the investigators showed that the first two groups outperformed the group that was given vocabulary instruction through definitions both in vocabulary knowledge ($p < .003$) and in reading comprehension ($p < .001$).

The outcome of strategy instruction studies conducted up to 1989 that examined the effectiveness of this approach on reading comprehension is reviewed by Pressley, Johnson, Symons, McGoldrick, and Kurita (1989). The authors of this review found reason for expressing optimism about strategy instruction, even though many of the studies they examined were conducted on normally achieving children. A review of research based on strategy instruction with a particular focus on reading disabilities is provided by Weisberg (1988), who concluded that children with reading disabilities need explicit instruction in understanding what the task is and how to use appropriate metacognitive strategies.

A selective synthesis of intervention studies of students with LD was recently published by Swanson, Carson, and Saches-Lee (1996). These investigators reviewed 78 studies which met certain selection criteria (the studies had to deal with LD, present quantitative data, and include control groups). Of the 78 studies which met these criteria, 30 focused on reading comprehension. After reviewing these studies, the authors concluded that cognitive instructional procedures produced the highest effect sizes (1.07), followed by direct instruction (.91). Cognitive procedures included many of the strategy instructions described in this article. The review also found that word recognition and spelling skills were not improved by cognitive instruction.

This brief review indicates that instructional methods that have incorporated deliberate comprehension strategy instruction have generally yielded encouraging results. It has to be noted, however, that improvement in comprehension is more difficult to achieve than improvement in decoding skills. It also appears that long-term instruction and sustained efforts are necessary to achieve significant improvement in comprehension. Many of the studies reported in the present article were of short duration and used experimenter-designed assessment tools. In general, better outcomes are reported when experimenter-designed tests are used than when standardized tests are used. Although it may be premature to claim
that we have devised fail-safe tools for improving comprehension, currently available comprehension instructional strategies are more promising than the teaching methods based on the Discrepancy Model.

Conclusions

Studies presented in the present article indicate that word recognition skill improves when instructional strategies such as phoneme awareness training are used and that comprehension skills improve when comprehension strategies are taught to children. It appears, then, that remedial instruction that addresses the source of the reading problem is more effective than an undifferentiated global approach which disregards the source of the reading problem. There is some evidence to support the effectiveness of such a differential treatment approach. Aaron, Grantham, and Campbell (1982) classified poor readers as dyseidetics (weak in sight vocabulary reading) and dysphonetics (deficient in sound-symbol association) and trained them in the phonetic-sequential method or the whole-word reading method. After a month’s training, posttests of word recognition showed that dyseidetics did better under the phonetic-sequential method and that the dysphonetics did better under the whole-word method. Lovett, Ransby, and Barron (1988) classified poor readers into an “accuracy-disabled” group and a “rate-disabled” group. The accuracy-disabled subjects were deficient in decoding accuracy, whereas the rate-disabled children were able to recognize words at grade level but were slow in reading. These two groups of children were randomly assigned to three treatment conditions: (a) a decoding/spelling skills program, (b) an oral and written language stimulation program, and (c) a classroom survival skills program. The intervention, which lasted a total of 40 hours, showed that significant improvements in word recognition accuracy were obtained for both groups. However, the rate-disabled children demonstrated treatment-specific gains only in reading exception words, whereas the accuracy-disabled readers showed improvement in reading both regular and exception words.

In conclusion, a review of research in the area of reading disabilities indicates that classifying poor readers on the basis of a discrepancy formula into LD and non-LD categories lacks validity on both theoretical and empirical grounds. In contrast, encouraging results have been reported by investigations that attempted to deal specifically with weak components of reading such as word recognition or comprehension.

It is time to abandon the discrepancy-based classification of poor readers into LD and non-LD categories and expand the boundaries of LD to include all children who experience difficulties in learning to read. This would require replacing the Discrepancy Model with the Reading Component Model, which identifies the sources of different children’s reading problems and tailors instructional strategies to fit specific weaknesses. Under the Reading Component Model, the answer to the question of whether children with learning problems should be instructed in a resource room or in the regular classroom depends on the nature of the reading instruction provided to the child. Comprehension instruction can be carried out in the regular classroom within the framework of reciprocal teaching. First, the teacher models comprehension strategies to all children in the classroom. Then, when these strategies have been mastered, children continue to use them in small groups. Depending on his or her educational policy, the teacher
would establish groups of homogeneous or heterogeneous abilities. Children who encounter difficulties in learning to decode the printed word would require decoding instruction, which can be provided during the summer months before school starts or delivered in the form of tutorial help during the school year. Whatever the form in which instruction is delivered, it has to be noted that word recognition is a precursor to reading comprehension. This means that for a child who has difficulties in both word recognition and comprehension, improvement of the former skill should become the priority.

Considering the fact that nearly 80% of the children in LD programs have reading disabilities, it is reasonable to expect the LD teacher to be an expert in remedial reading techniques. As the study by Pugach and Whitten (1987) indicates, the courses offered in many universities that prepare LD teachers have little to do with reading instruction. Even if prospective teachers are well trained in remedial reading instructional methods, it does not follow that poor readers with LD and those without LD have to be taught differently. In fact, they are not. Ysseldyke, O’Sullivan, Thurlow, and Christenson (1989) investigated the methods used in teaching children with LD and children who are classified as educable but mentally retarded and found that “there are few qualitative differences in the nature of reading and math instruction received by different categories of handicapped learners” (p. 27). Why, then, classify children into these two categories?

In the Reading Component Model, methods of instruction will be determined not by the IQ score of the child, but on the basis of the component that is responsible for the reading problem. Ideally, the teacher of children with reading problems would be a reading teacher with special training in remedial reading methods that are designed to improve skills such as phoneme awareness, decoding, vocabulary knowledge, and comprehension strategies.

As this article shows, clear alternatives are available to the existing Discrepancy Model of remedial education. The theory behind the Reading Component Model is not entirely new; others have advocated views similar to this one (e.g., Swerling & Sternberg, 1996). Nor is the thought of abandoning the Discrepancy Model revolutionary. Allington and McGill-Franzen (1990) as well as Christensen (1992) have made pleas for stopping the unnecessary labeling of children who encounter difficulties in learning to read and providing them with responsive and effective instructional programs. As Swerling and Sternberg state, the concept of learning disability belongs in the history of science, not at the forefront of contemporary educational practice and research. When the discrepancy formula disappears from the educational scene, so will the concept of LD. After 40 years of wandering in the wilderness of learning disabilities, we are beginning to get a glimpse of the promised land.

APPENDIX A
Summary of selected studies of decoding training

**Williams (1980)**
Subjects: 63 children from Title I; 7–12 years old
Instructional method and duration: segmentation, blending, and decoding; 20 minutes per day for 26 days
Results: significant gains in phonological skills ($p < .01$) and word reading ($p < .01$)
Comments: Gains remained stable after 6 months.
Aaron

**Bradley & Bryant (1985)**
Subjects: 65 six-year-old children
Instructional method and duration: sound categorization, rhyming, phoneme awareness, relating letter sounds to plastic letters; 1 session per week for 2 years
Results: Treatment group superior to control group on standardized tests of reading and spelling ($p < .05$).
Comments: Gains persisted beyond 5 years.

**Ball & Blachman (1988)**
Subjects: 90 kindergarten children from inner-city schools
Instructional method and duration: phoneme awareness (PA) training; 20-minute sessions, 4 times a week for 7 weeks. A second group was trained in letter naming, and a third group received no special reading instruction.
Results: Phoneme segmentation and word identification skills of treatment group significantly better than control group ($p < .05$) as tested by Woodcock Reading Mastery Tests (WRMT).
Comments: Only phoneme awareness training produced positive results.

**Lundberg, Frost, & Peterson (1988)**
Subjects: 235 unselected Danish preschoolers
Instructional method and duration: rhyming, phoneme segmentation; 8 months
Results: Posttests given in Grades 1 and 2. Phonological ($p < .001$) and word reading ($p < .01$) skills of treatment group significantly better than control group.

**Lovett, Ransby, & Barron (1988)**
Subjects: LD children, 8–13 years old; 66 were accuracy disabled, 46 were rate disabled.
Instructional method and duration: decoding skills training; 40 sessions in 10 weeks
Results: Accuracy-disabled children showed significant gains in reading regular and exception words ($p < .03$); rate-disabled children showed gains only for exception words ($p < .001$).
Comments: Decoding may improve word reading skills without a concomitant improvement in speed.

**Lie (1991)**
Subjects: 212 Norwegian first grade children; 60 assigned to phoneme identification group, 52 to phoneme identification, segmentation, and blending; 100 received no special training
Instructional method and duration: phoneme manipulation and blending, 10–15 minutes per day for a year
Results: Posttests given at ends of Grades 1 and 2 showed greater gains in reading comprehension and spelling for the two experimental groups than the control group ($p < .05$ and $p < .01$, respectively).
Comments: Children with lower IQ showed the greatest gain.

**Felton (1993)**
Subjects: 41 kindergarten children identified as being at risk by their teachers
Instructional method and duration: 14 children received code emphasis (PA) training, 14 received context emphasis training, 13 were placed in control group. Training continued through Grades 1 and 2.
Results: Posttest (WRMT) at the end of Grade 1 showed 58% in PA training group, 13% in context emphasis group, and only 4% in control group reached grade level in word attack and word identification skills. At the end of Grade 2, the differences were even more pronounced.
Comments: In spite of PA training, about one fourth of the children remained a year behind in decoding skills.
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**Hurford et al. (1994)**
Subjects: 53 first graders with decoding problems and 46 with decoding and comprehension difficulties. A third group constituted the control group.
Instructional method and duration: phoneme segmentation and blending; 15–20 minutes, twice a week for 20 weeks
Results: Both treatment groups outperformed the control group in word attack and word reading on WRMT tests ($p < .03$).
Comments: Classifying poor readers into LD and non-LD categories is not necessary for instructional purposes.

**Truch (1994)**
Subjects: 281 school-age adult subjects
Instructional method and duration: PA and decoding instruction following the Auditory Discrimination in Depth program (Lindamood & Lindamood, 1975); 80 hours of total instruction
Results: significant gains in decoding and word identification skills ($p < .001$)
Comments: no control group

**Aaron & Boyd (1995)**
Subjects: 4 groups of children taught in 4 consecutive years; a total of 21 LD children from Grades 2–5, all weak in decoding skills (below 85 standard score on WRMT word attack subtest)
Instructional method and duration: decoding training using the Auditory Discrimination in Depth program; 90 minutes per session, 2 sessions per week, for a semester
Results: 80% of the children reached average levels in word attack skills (above 90 standard score on WRMT).
Comments: About 20% of the poor decoders failed to improve.

**Byrne & Barnsley (1995)**
Subjects: preschool children; 64 in treatment group, 64 in control group
Instructional method and duration: PA taught in preschool; 30 minutes per week for 12 weeks; instruction in small groups of 4–6
Results: Tested after 2 years using standardized tests, treatment group was superior to control group in nonword reading ($p < .01$) and regular word reading ($p < .06$).
Comments: no difference in reading speed

**Olson, Wise, Ring, & Johnson (1997)**
Subjects: poor decoders from Grades 2–5; 58 received PA training, 45 received comprehension strategy training. Both groups had previously received 25 hours of decoding support in story reading.
Instructional method and duration: decoding training through explicit instruction in PA; 50 half-hour sessions over 4 months
Results: On standardized tests administered 1 and 2 years after training, PA group was superior to comprehension strategy group in nonword reading ($p < .01$).
Comments: no differences between the groups in reading real words

**Torgesen, Wagner, & Rashotte (1997)**
Subjects: 138 kindergartners with poor letter naming skills. One group received explicit training in PA; another group received phonics training in the context of reading text; a third group received regular classroom support; a fourth group served as control.
Instructional method and duration: Explicit phonics training was given through Auditory Discrimination in Depth for 80 minutes in the form of one-on-one supplemental instruction. The duration of the training was 2 ½ years, for a total of 88 hours.
Results: At the end of Grade 2, the explicit phonics group was superior to the other three groups in word attack ($p < .05$) and was marginally better in real word reading ($p < .051$)
Comments: The explicit phonics group attained standard scores of 99.4 and 91.7 on WRMT tests of word attack and word identification. The corresponding scores of the control group were 81.6 and 86.3. There was a similar though not statistically significant difference in reading comprehension scores.

APPENDIX B

Summary of selected studies of comprehension strategy training

**Short & Ryan (1984)**
Subjects: 42 poor readers from Grade 4, and a contrast group of 14 normal readers
Instructional method and duration: creating sensitivity to story grammar; 8 narratives used in 7 sessions
Results: significant gains by treatment group (p < .05) on comprehension subtest of Stanford Diagnostic Reading Test (SDRT)
Comments: long-term effects unknown

**Carnine & Kinder (1985)**
Subjects: 27 poor comprehenders from Grades 4–6
Instructional method and duration: 14 children received sensitivity training in story grammar and activating schemata (schema training); 13 children received training in identifying idea units (generative instruction). Training was given 20–30 minutes a day for 2 weeks.
Results: significant gains by both groups (p < .05) on comprehension subtests constructed by the investigator
Comments: no control group

**Gambrell & Bales (1986)**
Subjects: 62 poor readers from Grade 4, 62 poor readers from Grade 5, 14 normal readers from Grade 5. One half of these subjects were in treatment group; the other half made up a contrast group.
Instructional method and duration: mental imagery instruction given in small groups in 30-minute sessions
Results: significant gains by treatment group (p < .02) on teacher-made tests which required children to detect inconsistencies in passages
Comments: It is not known what effect this strategy will have on standardized tests.

**Jenkins, Heliotis, Stein, & Haynes (1987)**
Subjects: 32 LD children in Grades 3–6. Half of these children received experimental instruction; the other half constituted the no-treatment group.
Instructional method and duration: instruction in identifying main ideas in passages; 20 minutes per day for 20 days
Results: treatment group significantly better than no-treatment group on questions from textbook (p < .05)
Comments: Generalizability of the treatment effect is unknown, because standardized tests were not used.

**Snider (1989)**
Subjects: 26 junior high students with adequate decoding but weak comprehension skills; students divided equally into treatment and control groups
Instructional method and duration: schema activation training with added emphasis on vocabulary learning; 50 minutes per day for 13 days
Results: significant gains by treatment group (p < .01) on comprehension tests developed by the experimenter
Comments: Use of standardized tests would have strengthened the finding.
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Bos & Anders (1990)
Subjects: 61 junior high students with LD divided into 3 instructional groups
Instructional method and duration: vocabulary instruction; 1 group taught through
semantic mapping, 1 group through semantic feature analysis, and 1 group through
definition instruction
Results: The first two treatment groups were significantly better than the group that
received definition instruction on vocabulary \( p < .003 \) and comprehension \( p < .001 \)
as assessed by experimenter-made tests.
Comments: The semantic instructional benefits were found to have long-term effects.

Lysynchuk, Pressley, & Vye (1990)
Subjects: 72 poor readers in Grades 4–7. One half of the students received instruction in
comprehension strategies; the other half was not given special comprehension
instruction.
Instructional method and duration: the four strategies used in Reciprocal Teaching; 13
sessions
Results: significantly greater gains by treatment group \( p < .05 \) on Gates-MacGinitie
reading test
Comments: This study supports the view that remedial instruction should identify the
weak component and address the weakness.

Gajria & Salvia (1992)
Subjects: 30 LD children from Grades 6–9. One half of the children received the
experimental treatment; the other half constituted the control group.
Instructional method and duration: training in summarization skills in small groups of 3–
4 students; 40 minutes per session for a total of 11 hours
Results: Students in treatment group showed significant improvement in reading
comprehension between pre- and posttests \( p < .001 \). The Gates MacGinitie reading
test was used for assessment.
Comments: The control group was not given Gates-MacGinitie as posttest.

Schunk & Rice (1992)
Subjects: 21 poor readers from Grade 4, 12 poor readers from Grade 5; a strategy
instruction group, a strategy instruction feedback group, and a control group
Instructional method and duration: strategy instruction in small groups of 5–6 students;
35 minutes per day for 15 days
Results: significant differences between treatment groups and the control groups on
teacher-made tests of comprehension, with strategy instruction feedback group gaining
the most \( p < .01 \)
Comments: Not utilizing standardized reading tests limits the generalizability of the
study.

Dermody & Speaker (1995)
Subjects: 41 poor readers in Grade 4, classified into 3 groups: adequate decoding–poor
comprehension, adequate comprehension–poor decoding, and poor decoding–poor
comprehension
Instructional method and duration: the 4 Reciprocal Teaching strategies; 8 thirty-minute
sessions over 9 weeks
Results: Adequate decoding–poor comprehension group gained the most on comprehen-
sion subtest of SDRT \( p < .05 \)
Comments: This study also supports the component-based reading remediation model.

Brown, Pressley, Van Meter, & Schuder (1996)
Subjects: 60 low-achieving children in Grade 2, divided into 2 groups. The treatment
group was given comprehension training through “transactional strategy.” The control
Aaron group received regular instruction.
Instructional method and duration: Transactional strategy instruction involved activating schema, locating main idea, etc. Instruction was carried out in small groups and through dialogues among students. Study lasted 1 year.
Results: Reading comprehension of the treatment group, as assessed by the Stanford Achievement Test, was significantly higher (p < .05).
Comments: This study demonstrates that the effects of comprehension strategy instruction could generalize when the duration of instruction is long.

References
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