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1103

Comprehension and Decoding: Patterns of Association in Children With Reading Difficulties

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Comparisons of reading measures from a sample of 361 children aged 7.5 to 9.5, including many with reading difficulties, showed high correlations between word reading and nonword reading, and between each of these abilities and reading comprehension. These results, together with other findings from these children, showed that skill in word identification was almost inseparable from the phonologically analytic decoding process that is tapped by nonword reading, and, correspondingly, differences in reading comprehension were closely associated with differences in decoding skill. The findings support the conclusion that bottom-up skills largely drive the reading process in this age group. Only a small number of children departed from the norm in showing better reading comprehension than would be expected from their decoding skills, and those with the opposite discrepancy accounted for even fewer.

INTRODUCTION

The intent of this study was to determine which factors most severely limit comprehension in elementary school readers. To this end, we investigated the relations between measures of word reading skills and measures of reading comprehension in a diverse group of children in the early elementary grades. Based on these and other findings, we maintain that deficient skill in mapping between the alphabetic representations of words and their spoken counterparts is the chief barrier to comprehension of text, at least in learners who are still at relatively early stages of reading. These findings are interpreted in the context of earlier studies that relate word recognition difficulties to lack of awareness of phonological segments in spoken words (Bradley & Bryant, 1983; Brady & Shankweiler, 1991). Lacking such awareness, the beginner and the dyslexic find it difficult to relate the consonant and vowel segments of spoken words to their alphabetic representations. There is reason to believe, moreover, that the difficulty in attaining this awareness that words come apart into phonological segments is a manifestation of a more general weakness in the phonological component of language. Other symptoms of a general phonological weakness include difficulties in reading nonwords, spelling, and short-term memory (Liberman, Shankweiler, & Liberman, 1989).

A second aim of this study was to examine the characteristics of children who deviate from the dominant pattern of interrelation among skills in word reading, nonword reading, and comprehension of connected text. It is important to determine the consequences of lack of synchrony in the development of these components of reading ability. Is it true, as has been claimed, that some readers manage to become fairly skilled in reading words and comprehending text while lacking the ability to decode pseudowords? Conversely, are there children who can read words accurately but fail to comprehend what they read? These questions are straightforward in principle, but surprisingly, they have not often been addressed directly in the research literature on children's reading problems. Instead, investigators have tended to focus selectively on one or another aspect of reading. Thus they have examined either the decoding aspect or the comprehension aspect of reading, but have not looked specifically at their relation.

To investigate these questions, we took advantage of an existing data set from a sample originally obtained for other purposes. The sample included 361 children in the early elementary grades, including many with learning problems. Of these, 168 met conservative criteria for reading disability (Shankweiler et al., 1995). All the children in the sample were studied with multiple measures of word and nonword reading, measures of reading and listening comprehension, and numerous other measures of language and cognitive abilities. These data were used to examine the cohesion between decoding skills and reading comprehension for the whole sample and to identify discrepant readers—children who were deficient in either decoding or reading comprehension, but not in both. Having identified two groups of discrepant readers, we compared them with each other and with the remaining groups of poor readers and good readers in the sample whose skills in comprehension and decoding were fairly evenly matched.

Determinants of Reading Comprehension

Undoubtedly, many things may influence the comprehension of printed material. Following the suggestion of Gough and Tunmer (1986) and Hoover and Gough (1990), we can group them broadly into two classes of variables: (a) those pertaining to skill in reading words and (b) those pertaining to skill in parsing sentences and integrating the results of parsing into the reader's knowledge base. The "simple theory" proposes that these two broad factors, Decoding (D) and Comprehension (L), exhaust all of the variance in reading ability. *Decoding* means the ability to exploit regularities in the mapping between words and their alphabetic representations. The would-be reader who knows how to decode in this sense can read new words and pseudowords, at least those that are regularly spelled. Such a reader is said to have acquired the alphabetic cipher. With decoding ability, the learner can profit from further experience with the printed word and eventually come to acquire the word-specific knowledge needed to read all words, not just those that are regularly spelled. Being able to identify words in their printed form is necessary for reading, but of course it is not sufficient. Comprehension is also required; L encompasses the ability to bring to bear on the reading process knowledge of the language that the new reader has gained from experience with the spoken language. Thus, it is appropriately measured by tests of *listening* comprehension. D and L will each vary continuously, and reading ability, R, is a function of both of these factors.

The simple theory gives us a useful way to think about reading skill, identifying its major components, and indicating the measures that assess them most directly. However, the theory does not tell us in which factor, D or L, we can expect to find the greater contribution to differences in R. This has remained an unsettled matter on which there is continuing debate. For some authorities (Miller, 1988; Smith, 1988), difficulties in reading comprehension for most school children who are past the earliest stages in reading originate at levels beyond the ability to read individual words. Thus, for the great majority of readers—including most of the inadequate ones—this view claims that the common words belonging to the general vocabulary can be read satisfactorily; decoding is not a major problem. Instead, the chief difficulties arise at the level of the integrative processes required for sentence and text comprehension—in the terms of Gough and his associates, factor L is the culprit.

Putting aside for the moment the question of whether and how decoding difficulties may contribute to literacy limitations, there is evidence from a variety of sources that children who are poor readers often prove to be at a disadvantage relative to good readers on difficult spoken-language comprehension tasks. Deficiencies in acting out sentences or in sentence-picture matches with embedded constructions, such as relative clauses, have been noted by Crain, Shankweiler, Macaruso, and Bar-Shalom (1990); Mann, Shankweiler, and Smith (1984); Smith, Macaruso, Shankweiler, and Crain (1989); and Stein, Cairns, and Zurif (1984). Other complexities that have proven difficult for poor readers to handle are sentences with temporal terms, such as *before* and *after* (Macaruso, Bar-Shalom, Crain, & Shankweiler, 1989), and sentences with adjectives with unusual control properties, such as *easy* (Byrne, 1981; Macaruso, Shankweiler, Byrne, & Crain, 1993). Thus, there is evidence that poor readers tend to be deficient on some measures of L.

A contrasting perspective on problems of reading comprehension sees deficient decoding skills as the primary reason for difficulties, at least at the early stages of reading. This perspective maintains that, because discerning the meaning of text must depend on accurately apprehending the individual words of the text, poor comprehension can be expected to result from deficiencies in word recognition. Moreover, some who hold this view maintain that inadequate decoding skills remain a severe limiting factor for many older poor readers, even those who have been exposed to many years of schooling (Bruck, 1990). This perspective on reading problems appeals to a variety of evidence that difficulties in accuracy and speed of word recognition are commonplace among poor readers of all ages (Adams, 1990; Hoover & Gough, 1990; Perfetti, 1985; Share, Jorm, Maclean, & Matthews, 1984; Stanovich, 1986; Vellutino & Scanlon, 1991). Moreover, nonword reading measures taken in the earliest grades are predictive of reading comprehension years later (Beck & Juel, 1995).

It is apparent even from so brief a review that there is no dearth of findings that can be cited in support of the conclusion that reading problems are commonly associated with some degree of deficit in each of the factors named by the simple theory. The theory is neutral, however, on the issue of which of the two perspectives comes closer to the truth in the diagnosis of reading problems.

To approach this question, we should reconsider the association of different measures of reading skill in the light of the foregoing discussion. Among those who count as good readers, we find indications of a close correspondence between decoding ability and reading comprehension. In them, both skills are usually strongly developed. Nevertheless, for skilled readers, there is evidence that skill in decoding is autonomous; words can be read nearly as well in list form as in the context of connected text (Nicholson, 1991). Likewise, in the case of poor readers, a pattern often noted as typical is one in which both decoding and reading comprehension are correspondingly weak. But this association is open to more than one interpretation, because listening comprehension is usually not measured. Moreover, as we noted, there are unsettled questions concerning those individuals who depart in one direction or the other from the dominant pattern by a discrepancy between decoding and reading comprehension. How numerous are these discrepant readers, and what are their characteristics with regard to listening comprehension and other abilities relevant to reading?

Interpretation of Individual Differences in Reading Pattern

In the population at large, we can anticipate discrepancies of varying degree between decoding and reading comprehension. At one extreme is hyperlexia, a rare condition in which decoding skills are developed to an advanced degree but language comprehension both in listening and in reading is very poor (Healy, 1982). At the opposite end of the spectrum is severe dyslexia, in which decoding skills are characteristically weak but oral language comprehension may be superior (Gough & Tunmer, 1986). Most readers will fall somewhere between these extremes.

Children whose decoding abilities and reading comprehension are out of step have received some attention in the literature on reading problems (Adams, 1990; Share, 1995). One type, sometimes referred to as "word callers," have well-developed skills in decoding but are relatively poor at comprehending what they read. Their difficulties remind us that apprehending all the words in a passage does not inevitably lead to comprehension of the intended meaning. Barring a rare case of extreme hyperlexia, the incidence of this pattern among school children with reading problems remains to be ascertained. In contrast, most studies of children with difficulties in reading comprehension have found associated difficulties with word reading. The scant information that exists concerning children with normally developed decoding skills but poor comprehension indicates that the observed comprehension difficulties are not restricted to reading but represent a general limitation in language comprehension that extends to listening comprehension as well. That was the result obtained in a well-controlled study by Stothard and Hulme (1992).

Disparity between decoding and reading comprehension may also go in the opposite direction, creating a second type of discrepant reader in whom reading comprehension is relatively good, despite difficulties in decoding isolated words or nonwords. Readers of this type seem to be able to rely on well-developed top–down strategies to overcome their limitations in analyzing the phonological structure of printed words. Learners who display this discrepancy are sometimes called "compensators," because they seem to compensate—up to a point—for their relatively poor decoding skills.

Case reports of compensation in well-educated dyslexic adults have appeared from time to time. To illustrate, Campbell and Butterworth (1985) presented detailed findings on a bright university student who decoded nonwords poorly yet had managed to build up a large sight word vocabulary and was able to comprehend printed material well. Owing to a few well-publicized cases such as this one, in which someone with a history of severe dyslexia managed to develop serviceable reading skills, it is widely believed, despite the paucity of evidence, that decoding can be successfully bypassed by some readers.

Clearly, such a belief is not well supported at present. If differences in reading strategy do indeed present real options for learners, then it is important for assessment and diagnosis to take account of that possibility. Alternatively, if compensation has its limits—if it is found to operate within rather severe bounds—then it is equally important for the limitations to be recognized. We can anticipate that the relation between decoding and reading comprehension will change as a beginning reader gains experience. The rank beginner who cannot yet identify even the most familiar words in printed form will, of course, be unable to comprehend anything on the printed page. As the learner gains word recognition skills, there is increasing potential for other factors to influence comprehension, hence for a loosening of the link between decoding and comprehension. Thus, as reading skill advances, we could expect a decrease in the correlation of decoding with reading comprehension and a corresponding increase in the correlation of listening and reading comprehension. This, in fact, is the trend of most correlational studies reviewed by Hoover and Gough (1990). The group we studied were aged 7.5 to 9.5, and all of them were in Grade 2 or above. Given that these children were beyond the earliest stages of learning to read and had sufficient reading experience for sharp individual differences to emerge, they were a particularly appropriate group for addressing the questions of this study.

We examined the relation between the two aspects of reading skill—decoding and comprehension—and how to decide who counts as a discrepant reader. There is a practical problem in classifying individuals with respect to word level skills and reading comprehension. How do you choose criteria that will ensure a disparity in skill levels that is educationally significant and clinically meaningful? Perhaps the simplest way to proceed would be to use the difference between a child's score on reading comprehension and that child's score on nonword decoding (or, alternatively, word reading) as the criterion for forming the discrepancy groups. However, this method fails to distinguish between (a) a subject who is below normal on one score and normal or above normal on the other and (b) a subject who exhibits the same absolute discrepancy but is actually above (or below) the group average on *both* measures. Thus our goal of identifying individuals who are truly deficient on one of the dimensions of reading skill but not on the other would not necessarily be met.

This goal could be achieved with an absolute cutting score. So, for example, if an individual's z score on either comprehension or decoding is less than some critical value, we would count that individual as deficient on that measure. An individual is considered discrepant only if the score on the other measure is at or above the cutting score. The cutting score method comes closer to achieving our objective, but it is open to the objection that individuals in the sample whose scores place them just above or just below the cutting score will fall into different groups, even though their decoding and comprehension performances are quite similar.

Having rejected a simple difference score and an absolute cutting score as unsuitable, we dealt with the problem of how to partition a continuous distribution of scores into meaningful classes by creating a buffer zone separating the two regions defined by a cutting score. We stipulated that a score must lie beyond the buffer zone in order to be considered poor. Placing a buffer between the normal and extreme scores ensures that any participant who counts as extreme does not just miss being normal by a hair, and vice versa. The buffer method mitigates some of the arbitrariness of a cutting score.

METHOD

The sample (N = 361) comprised all 7.5- to 9.5-year-olds who were recruited in response to our call for children with learning problems, excluding only those with Wechsler Intelligence Scale for Children (WISC) Verbal and Performance IQ scores lower than 80 (N = 10). A total of 51 of the 361 were normal controls without reading or learning problems. Recruitment and selection procedures are described in Fletcher et al. (1994) and Shankweiler et al. (1995). Children were considered reading-disabled if they met either a criterion of discrepancy between IQ and reading or a criterion of low achievement. Composite measures of word and nonword reading were used to identify children with reading disability, based on a criterion of discrepancy of 1.5 *SE* between word and nonword reading and Full Scale WISC IQ, or, alternatively, word and nonword achievement level below the 25th percentile. Applying these criteria to the sample yielded 168 reading-disabled children (Shankweiler et al., 1995).

For this study, we made new groupings based specifically on the relations among measures of the different aspects of reading. In addition to tests of word and nonword reading, the children in the sample had been tested on multiple measures of reading comprehension. These measures were used in conjunction with the word-level reading measures to form a regrouping of the children.

The specific reading measures are listed in Table 1, separated by type. The different measures representing each individual reading skill were well correlated with one another.[1] Each measure was age adjusted and converted to standard form. Composites for word reading, nonword reading, and passage comprehension were obtained by simple averaging of the age-adjusted z scores representing each variable.

In addition to the measures of reading skills, listening comprehension was assessed by adapting a parallel form (Form C) of the Formal Reading Inventory, one of the instruments we employed to test reading comprehension (using Form B). This task consists of paragraphs graded in difficulty, with questions after each paragraph. The children were also assessed on a variety of experimental language and cognitive tasks described in Fletcher et al. (1996). Analysis of the results from these tasks yielded cognitive profiles of reading disability and other learning difficulties, including arithmetic disability and attention-deficit disorder (ADD), that were represented in the sample (see Fletcher et al., 1996; Fletcher et al., 1994; Shankweiler et al., 1995).

Data from the language and cognitive tasks were used in this study to investigate the characteristics of children whose word–nonword reading and reading comprehension abilities were found to be poorly matched. Applying the principles described in the Introduction, we identified children who scored differently on decoding and on reading comprehension composite scores. To identify these children, we used scores on nonword reading as the measure of decoding in the first set of analyses because of the evidence that finds performance on nonwords to be diagnostic of reading difficulties. A second set of analyses used word reading as an alternative basis for computing discrepancies with reading comprehension.

The classification of the sample undertaken by Shankweiler et al. (1995) was based purely on word and nonword reading measures. To form new groupings for this study that would take account of reading comprehension performance, the first step was to establish a reference group for determining what scores constitute low performance on reading comprehension and decoding (or, in the alternative method, word reading). We used the results of the earlier classification of the sample to define the reference group. It comprised those children in the sample, 193 in all, who did not meet the criteria of Fletcher et al. (1994) for reading disability (i.e., those with arithmetic disability only, ADD only, and normal controls). Using the means from the reference group as the criterion, we treated any child's score greater than $z = -0.67$ as an unimpaired score; for a child to be considered deficient, we required a score of less than $z = -1.0$. Thus, in effect, we created a buffer zone of unclassified scores between z scores of -0.67 and -1.0.

[1]For nonwords, the two measures were correlated with $r = .82$; for words, the correlations ranged from .88 to .92; for passage comprehension, they ranged from .76 to .78.

TABLE 1
Scores by Group on Individual Reading Measures and Reading Composites

	Type A (N = 32) (mean age 8.7 years)		*Type B (N = 17) (mean age 8.3 years)*		*Low (N = 127) (mean age 8.2 years)*		*Unimpaired (N = 114) (mean age 8.5 years)*		*Unclassified (N = 71) (mean age 8.4 years)*	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Nonword reading										
WJ–14[a]	84.19	7.17	102.35	4.53	78.80	9.18	108.23	8.92	95.61	6.16
DST–NONW[b]	10.56	6.03	21.12	11.48	2.88	3.80	36.77	14.00	13.56	9.24
Composite *z* score	–0.63	0.33	0.48	0.25	–0.92	0.40	1.15	0.67	–0.04	0.38
Word reading										
WJ–13[a]	93.06	7.82	93.94	6.70	81.39	9.23	112.12	11.14	94.76	7.48
WRAT–R[c]	93.42	6.82	96.41	9.23	80.42	7.74	114.54	13.09	93.77	7.71
DST–WORD[b]*	25.59	10.11	25.88	15.11	4.98	6.07	48.32	12.28	22.17	14.69
Composite *z* score	–0.18	0.40	0.04	0.37	–0.93	0.44	1.17	0.65	–0.10	0.44
Comprehension										
WJ–15[a]	96.63	8.08	91.65	5.96	79.66	11.17	113.87	11.96	95.06	8.92
GORT[d]	9.72	1.85	6.18	0.73	4.79	2.18	11.34	2.93	7.85	1.93
FRI, Form B[e]	97.88	9.48	74.76	7.03	73.56	8.38	112.53	15.77	85.13	12.83
Composite *z* score	0.33	0.30	–0.54	0.15	–0.95	0.46	1.11	0.68	–0.11	0.46

Note. DST–NONW and DST–WORD are raw scores; all others are scaled scores.

[a]Woodcock–Johnson Psycho-Educational Battery: Nonword Reading (WJ–14), Word Reading (WJ–13), and Passage Comprehension (WJ–15) subtests (Woodcock & Johnson, 1978). [b]Decoding Skills Test: Nonword Reading (DST–NONW) and Word Reading (DST–WORD) Scores (Richardson & DiBenedetto, 1985). [c]Wide Range Achievement Test–Revised (Jastak & Wilkinson, 1984). [d]Gray Oral Reading Test: Paragraphs (Gray, 1967). [e]Formal Reading Inventory, Form B (Wiederholt, 1986).

The groups created by application of these criteria are: concordant "low readers," defined as below $z = -1.0$ (based on the reference group) on both the decoding and comprehension composites; "unimpaired" readers, defined as greater than $z = -0.67$ on both reading composites; and discrepant readers who met the deficiency criterion on one aspect of reading but were unimpaired on the other. It is apparent that two discrepant groups can be isolated by this procedure, according to the direction of the discrepancy. Those with better comprehension are designated Type A, and those with better decoding are called Type B. Individuals with scores falling within the buffer zone and between the cutoffs on either measure were unclassified for the purposes of this study and excluded from further analyses. The results of applying this procedure to the sample are shown in the following section.

RESULTS

We first looked at the correspondence of nonword decoding, word reading, and reading comprehension for the entire group of participating children. Pearson product–moment correlations among the three reading composite measures, listening comprehension, and WISC IQ are shown in Table 2. All the correlations are significant with $p < .0001$. Scatter plots showing the relations among the three age-adjusted composite reading measures are presented in Figure 1. It may be seen that word reading plotted against nonword reading (Figure 1a) shows the tightest clustering of points, $r = .91$. Remarkably, among the children in this sample, there were no children who succeeded well in reading words who could not also decode nonwords. Second, word reading plotted against passage comprehension (Figure 1b) yields a correlation nearly as high, $r = .89$, although there is appreciable scatter in the word reading skills of high comprehenders. The plot of nonword reading

TABLE 2
Pearson Product–Moment Correlations Among Reading Composite Scores, Listening Comprehension, and Wechsler Intelligence Scale for Children IQ

	Nonword Reading	*Word Reading*	*Reading Comprehension*	*Listening Comprehension*
Nonword Reading[a]	—			
Word reading[a]	0.92	—		
Reading comprehension[a]	0.79	0.89	—	
Listening comprehension[b]	0.45	0.50	0.58	—
Full scale IQ[c]	0.56	0.58	0.62	0.56

Note. $N = 361$. All correlations are significant at $p < .0001$.
[a]See Table 1 for formation of reading composite scores. [b]Formal Reading Inventory, Form C (Wiederholt, 1986); age adjusted. [c]Wechsler Intelligence Scale for Children–Revised (Wechsler, 1974).

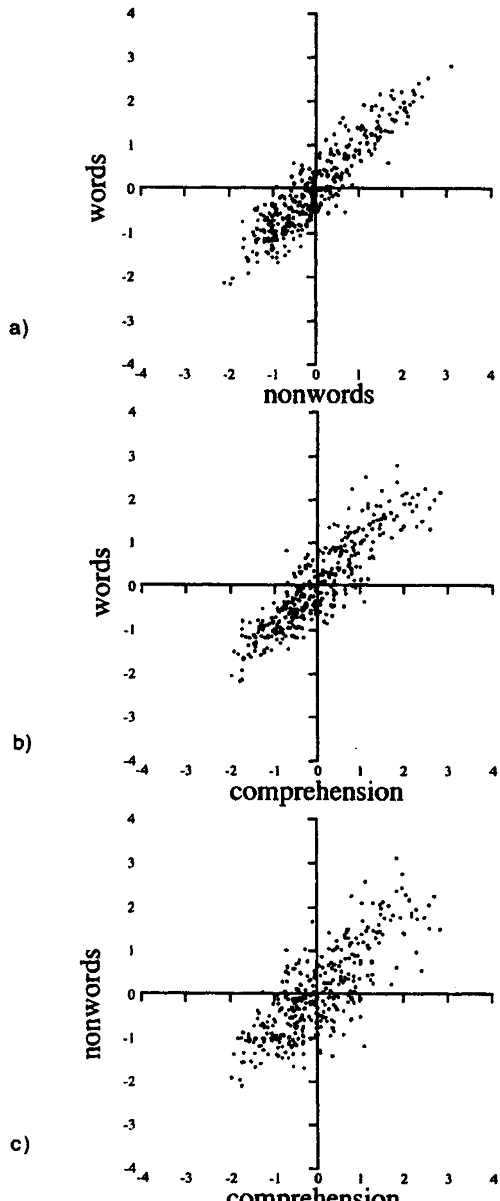

FIGURE 1 Scatterplots of *z* scores for (a) word reading composite versus nonword reading composite, (b) word reading composite versus reading comprehension composite, and (c) nonword reading composite versus reading comprehension composite.

against passage comprehension (Figure 1c) shows slightly greater scatter, yielding a correlation of $r = .79$. Thus, within the range of ages present in this sample, a child's level of skill in passage comprehension is highly associated with skill in reading isolated words out of context, and almost as highly associated with ability to decode novel nonwords.

In contrast to the high correlation of decoding with reading comprehension, the correlation of listening comprehension with reading comprehension, $r = .58$, though substantial, is clearly secondary. This imbalance in the relative contribution of the two factors to individual differences in reading comprehension is consistent with the findings of earlier studies carried out with children of this age group (see Hoover & Gough, 1990). In contrast to the findings reported by Hoover and Gough, it may be seen from Table 2 that decoding and listening comprehension were positively correlated with each other, $r = .45$, not negatively correlated. However, in the group composed exclusively of low readers obtained by applying the cutoff scores, the correlation between these factors was nonsignificant, approaching zero, $r = .16$.

A way to assess more accurately the relative contribution of each of the two factors to reading comprehension is to partial out of the correlation the contribution of a third, overlapping measure. The correlation of listening comprehension with reading comprehension, "partialled" on decoding, is .37, whereas the correlation of decoding with reading comprehension, partialled on listening comprehension, is .65. These analyses confirm the indications of the simple correlations.

Although the three types of reading measures—words, nonwords, and passage comprehension—are highly intercorrelated, there is enough scatter to raise the possibility of meaningful discrepancies between level of achievement in decoding and comprehension in some of the children in the sample. We applied the principles introduced at the end of the Introduction to identify the discrepant readers and proceeded to address the questions raised earlier regarding the relative frequencies of each kind of discrepant reader and the associated patterns of cognitive performance.

Identifying Readers Who Are Discrepant in Decoding and Comprehension

The next step was to apply the stated criteria for identifying discrepant readers, as plotted in Figure 1c. In effect, the plot is divided into quadrants. Lower left and upper right quadrants include subjects who are concordant on both measures: concordant low readers who had low scores on both decoding and comprehension measures, and nonimpaired readers who were strong on both. Because decoding and comprehension were highly correlated, most of the subjects fell into one of these two quadrants. The upper left and lower right "off-diagonal" quadrants include the scattering of subjects who are discrepant.

The results of applying the criteria are shown in Figure 2. This figure reproduces Figure 1c, adding ruled lines to represent the upper and lower cutting scores that define the buffer zone. The ruled lines represent the cutting scores. As noted, the cutoffs were equal to –0.67 *SD* and –1.0 *SD*, respectively, with respect to the reference group. These cutoffs translate into different *z* scores on the *combined* bivariate distribution (which includes *both* the reference group and the disabled readers). Accordingly, for nonword reading, the cutoff is .10662, above which decoding scores are considered unimpaired, and –.17033, below which they are considered deficient. For reading comprehension, the cutoffs are –.00913 and –.30206, respectively.

> Five groups resulted from this breakdown of the total sample, as may be seen in Figure 2. There were 127 concordant low readers whose *z* scores on both decoding and comprehension placed them at least 1.0 *SD* below the reference group on both decoding and reading comprehension. These are represented in the lower left quadrant. In addition, there were 114 unimpaired readers (upper right quadrant); 32 children with Type A discrepancy, having better comprehension than decoding; and 17 with Type B discrepancy, having better decoding than comprehension. The classification procedure left 71 children unclassified (those that fell between the ruled lines of Figure 2), in order to ensure that all of the children classified as having a discrepancy in decoding and comprehension differed nontrivially from all those classified as nondiscrepant. The numbers of children falling into each group are given in Table 1 at the head of each column, together with the means and standard deviations of the age-adjusted reading composite *z* scores by group.[2]

As a consequence of applying this classification procedure, more than half of the total sample of children were designated low, discrepant, or unclassified readers, indicating that the recruitment procedures were successful in attracting a high proportion of children with at least moderately severe reading problems. It is important to note, however, that the basis for recruiting the children in the study does not force a correlation between the two types of reading measures. It is apparent that most of the readers in the sample are closely matched on decoding and reading comprehension measures (i.e., they belong either to the group that we designate concordant low or to the unimpaired group) and that relatively few of the children diverged as Type A or B.

[2]The total of disabled readers identified in this study—127 concordant low readers plus 32 Type A discrepant and 17 Type B discrepant for a total of 176—does not correspond exactly with the number from this sample identified in Shankweiler, Lundquist, Dreyer, and Dickinson (1995), which was 168. The reason is that the classification criteria adopted in the two studies were different, reflecting the different purposes of each. The aim of Shankweiler et al. (1995) was to examine the cognitive profile associated with reading disability defined in terms of word-level reading, whereas the aim of this study was to examine the relations between word-level reading and reading comprehension, and to determine the characteristics of children whose reading skills are poorly matched.

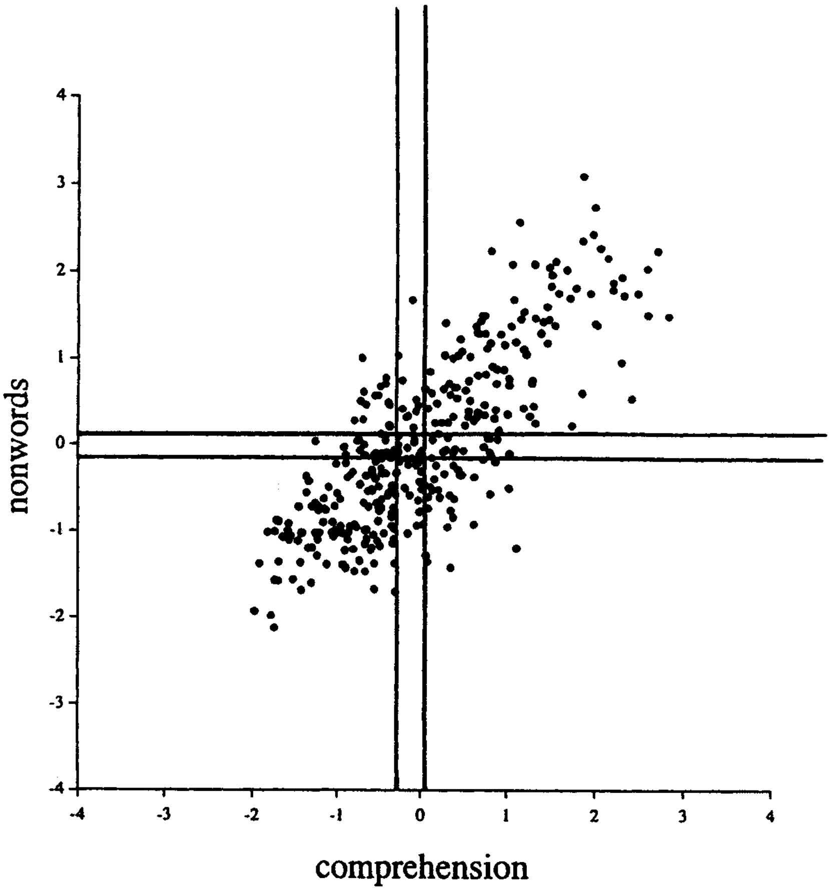

FIGURE 2 An enlargement of Figure 1c, showing plot of nonword reading composite versus reading comprehension composite, ruled to display the cutoffs for classification of the children into Type A (lower right) and Type B (upper left) discrepancy groups. Children whose scores fall between the ruled lines are considered unclassified.

Characteristics of Discrepant Readers

Having identified the discrepant readers, the next step was to ask how those with high reading comprehension relative to decoding differed from those with high decoding relative to reading comprehension. Some of the information in Table 1 is presented in graphical form in Figure 3. The figure brings out a finding concerning these discrepant readers that could easily be missed: Both decoding and comprehension are below par on average (i.e., below the mean of the children who count as unimpaired). Thus the better of the two critical reading scores in each discrepant subgroup is well below the corresponding score for the unimpaired group. In other words, these discrepant readers should be considered poor readers, even though they have relative strengths that distinguish them from the more numerous poor readers who are uniformly low on both decoding and comprehension.

From Figure 3 we also discover that the discrepant groups differed less on word reading than on nonword reading (which was the basis for classifying them as discrepant). On nonwords, Type A and Type B differed by 1.1 standard scores, whereas on real words, the difference was only 0.2 standard scores. The high correlation between word reading and nonword reading, which applies to the sample as a whole, $r = .89$, does not apply to the discrepant readers. Thus, the discrepant readers are in fact doubly discrepant: Their performances not only deviate from the majority in the relations between nonword reading and reading comprehension, they also deviate in the relation between reading nonwords and reading words.

It remains to compare the performances of the discrepant children on other language and cognitive measures that have been used to characterize reading-disabled children from this sample (e.g., Shankweiler et al., 1995). The additional measures are listed in Table 3 in clusters based roughly on similarity of content. Each cluster was examined separately to facilitate interpretation. The clusters are as follows: *language and comprehension, phonology and word-level processes in reading, naming and lexical retrieval,* and *visuo-spatial and arithmetic abilities.* Multivariate analyses of variance (MANOVAs) revealed significant differences between the Type A and Type B discrepant reader groups on the language and comprehension cluster, $F(7, 40) = 2.31$, $p = .0450$, and on the phonology and word-level processes cluster, $F(4, 43) = 4.16$, $p = .0062$. Specific tasks within each cluster that yielded significant MANOVA results were further examined through univariate analyses of variance (ANOVAs). Inspection of the canonical structure coefficients supported the univariate interpretations.

Type A readers (better comprehenders) were marginally superior to Type B readers (better decoders) on the test of listening comprehension, $F(1, 47) = 3.45$, $p = .070$, a finding that by itself could explain their better reading comprehension. Scores on a test assessing ability to match sentences containing complex syntactic structures with pictures depicting their content (see Shankweiler et al., 1995) clearly did not favor either discrepant group. This would argue against the possibility that a syntactic lag is the basis for Type B readers' difficulties in comprehension.

Language measures that tap phonological processing tended to favor the discrepant readers who were better at decoding, that is, Type B readers. Three measures attained significance. They are Phoneme Deletion (Rosner & Simon, 1971), $F(1, 47) = 9.11$, $p = .004$; Spelling (composite score), $F(1, 47) = 9.22$, $p = .004$; and Digit Span (from the WISC), $F(1, 47) = 5.11$, $p = .028$. It should be noted that the phoneme deletion task, which tests phonological awareness (the ability to analyze

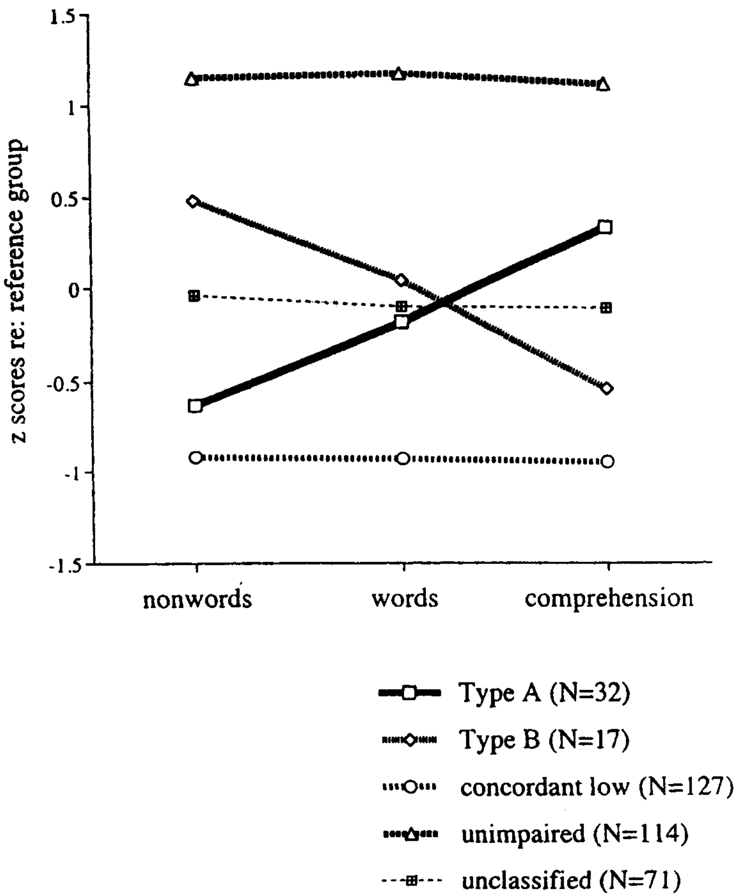

FIGURE 3 Mean z scores of unimpaired, discrepant, and concordant low readers in relation to the reference group for nonword, word, and reading comprehension composite scores.

spoken words into phonological segments) was found in a related study using this sample to be the strongest single discriminator of the reading-disabled children from nonimpaired readers and from children with deficits in arithmetic and attention (Shankweiler et al., 1995). Tests of verbal short-term memory, of which Digit Span is representative, also distinguished children who differed in reading skills, arguably because these tests tax the ability to retain linguistic input in phonological form. In addition to these measures, Type B readers were superior in word reading ability, as would be expected—though the difference was only marginally significant, $F(1, 46) = 3.33, p = .074$.

TABLE 3
Means and Standard Deviations of Type A and Type B Readers on Measures Used in Multivariate Analyses of Variance

	Type A (N = 32)		*Type B (N = 17)*	
	M	*SD*	*M*	*SD*
Language – comprehension				
Listening comprehension[a,b]	0.223	0.933	–0.262	0.733
WISC–R Verbal Scale[c]	105.688	12.496	103.000	14.177
WISC–R Performance Scale[c]	104.125	12.318	102.176	12.851
Peabody Picture Vocabulary Test–Revised[a,d]	–0.078	0.769	–0.009	0.648
Morphological production[a,e]	0.134	0.607	–0.063	0.636
Syntactic comprehension[a,f]	–0.376	0.650	0.231	0.708
WISC–R Digit Span[c]	–0.131	0.609	0.169	0.720
Phonology – reading				
Phoneme deletion[a,g]	–0.258	0.356	0.055	0.320
Embedded phonemes[a,h]	–0.124	0.379	0.079	0.349
Spelling composite[i]	0.067	3.577	–0.139	3.316
Word reading composite[j]	–0.162	0.867	0.039	0.545
Naming				
Rapid automatized naming[a,k]	0.023	1.017	0.356	1.046
Boston Naming Test[a,l]	–0.152	0.885	0.446	0.876
Visuospatial – math				
Corsi Blocks[a,m]	–0.056	1.088	–0.193	0.868
Underlining Test, verbalizable[a,n]	0.104	1.644	–0.065	1.530
Underlining Test, nonverbalizable[a,n]	0.612	1.536	–0.417	1.363
Visual Motor Integration[a,o]	0.108	1.130	–0.166	0.950
WISC–R Block Design[a,c]	0.009	1.033	–0.151	0.849
Direction of Movement Test[a,p]	–0.048	0.791	–0.028	1.084
Woodcock–Johnson, Arithmetic[q]	88.781	12.136	90.706	13.383

Note. Wechsler Intelligence Scale for Children–Revised (WISC–R) Verbal and Performance Scales and Woodcock–Johnson Subtest 16 are scaled scores; all others represent age-adjusted residuals.

[a]Age adjusted. [b]Formal Reading Inventory, Form C (Wiederholt, 1986). [c]Wechsler Intelligence Scale for Children–Revised (Wechsler, 1974). [d]Dunn and Dunn (1981). [e]Adapted from Carlisle (1988). [f]Shankweiler et al. (1995). [g]Auditory Analysis Test (Rosner & Simon, 1971). [h]Fowler (1990). [i]Based on Test of Written Spelling–2 (Larsen & Hammill, 1986) and Spelling Subtest from Wide Range Achievement Test–Revised (Jastak & Wilkinson, 1984). [j]See Table 1. [k]Adapted from Denckla and Rudel (1974). [l]Kaplan, Goodglass, and Weintraub (1976). [m]Corsi (1972). [n]Doehring (1968). [o]Beery (1989). [p]Lindgren and Benton (1980). [q]Woodcock and Johnson (1978).

In summary, the results from comparison of groups of readers with uneven abilities show a pattern of differences that are in the expected direction. Given that one of these groups (Type B) is small, we should not make too much of the statistical comparison.

Consequences of Adopting Word Reading, Rather than Nonword Reading, As the Criterion for Identifying Reading-Discrepant Individuals

The decision to make nonword reading the proxy for analytic reading skill and the basis for determining the frequencies of discrepant individuals was based on our belief that nonword reading is the purest measure of skill in converting print to phonological structures, that is, skill in decoding. Notwithstanding, we acknowledge that not all of the abilities relevant for reading words are tapped by tasks that employ nonwords. Because word-specific knowledge is also an important facet of reading ability, a case can be made for using measures of word reading as the basis for determining discrepancy with reading comprehension. Therefore we applied subject classification criteria again, this time using the composite word reading score as a substitute for the nonword score. In general, this alternative way of partitioning the sample shows the same trends as the findings based on nonword reading.

There was one difference worth noting, however. When the discrepancy groups were determined on the basis of real word reading, the numbers of discrepant cases were fewer. This proved true for each of the two discrepancy groups. Type A students (better comprehenders), who made up 8.9% of the sample using the nonword criterion, dropped to 6.1% with the real word criterion. Type B students (better decoders), who made up 4.7% of the sample using the nonword criterion, were reduced nearly by half, dropping to 2.5% using real words as the basis for determining discrepancy. These differences may signify the existence of diversity in strategies of word recognition—diversity that, in this sample of children, is concentrated in the discrepant groups. Thus, for Type B subjects, processes used in word and nonword reading may be abnormally dissociated.

One may wonder to what extent the same individuals are captured by the alternative procedures for detecting discrepant readers. A cross-tabulation reveals that the overlap is greatest for Type A students (the better comprehenders). Of the 32 children identified by computing discrepancy with nonwords, 19 of these are also identified by the alternative procedure with words. For Type B students (the better decoders), the overlap between the two criteria is small. Seventeen participants are identified with nonwords, but only 7 are also identified by real words. This difference in stability is a further indication that Type A is a more robust diagnostic entity than Type B.

DISCUSSION

One purpose of this study was to investigate the pattern of association among word reading skills and reading comprehension within a diverse sample of children. It was found that measures of the different aspects of reading skill tended to co-vary strongly in this sample. In addition, listening comprehension was also correlated with reading comprehension, as would be anticipated, but to a lesser degree than skill in either word or nonword reading. Taken together, these results support the view that differences in reading comprehension during the critical years of early elementary school are largely determined by variations in the skills that enable a reader to identify the individual words of the text.

Finding that word and nonword reading were so highly correlated with each other should lead us to infer that skill in word identification, at least for most of the children in the sample, is almost inseparable from the phonologically analytic decoding process that is tapped by the nonword reading measure. Moreover, this is exactly what would be predicted from the body of research that regularly finds deficient phonological awareness in children who are experiencing difficulty learning to read (Byrne & Fielding-Barnsley, 1995) and in adult dyslexics (Bruck, 1992). Phonological awareness is the insight that spoken words can be analyzed into sequences of consonant and vowel segments. A would-be reader who does not appreciate that words come apart in this way cannot easily apprehend the identity of the same phoneme when it recurs in different words. For such a learner, spellings must surely seem arbitrary and opaque. If difficulties in learning to read stem ultimately from insufficiencies of phonological awareness, we would expect to find (as we did) tight intercorrelations between the three types of reading measures.

Reading theorists have often supposed that there is more than one way for readers of an alphabetic system to arrive at the entry in the mental lexicon that corresponds to a word's printed form. It is argued that, in principle, words can be read in these two ways: (a) in a phonologically analytic way that entails decoding the letter string and assembling the corresponding phonological form from its alphabetic representation, and (b) by some visual means of mapping between the orthographic form of the printed word and the stored memory representation of the lexical item (Coltheart, Curtis, Atkins, & Haller, 1993). Nonwords, which presumably are not contained in lexical memory, are exempt from such ambiguity about the mode of reading. The presumption is that nonwords can be given a phonologic interpretation only in the first way. In view of this, we can interpret the high correlation between performance on real words and nonwords as evidence that, by and large, these children were not using divergent strategies in their attempts at word recognition but were attempting to use, with varying success, a phonologically analytic strategy. In short, they were attempting to decode. This result is in keeping with the view propounded by

Gough and Walsh (1991) that phonological decoding and word-specific knowledge are more closely related than is often assumed.

Although the results of this study underscore the central importance of skill in decoding for reading comprehension, the lesser correlation of listening comprehension with reading does not mean that general linguistic comprehension is of lesser importance for reading. Both factors are necessary. The relative strength of the correlation of either L or D with reading will surely vary with the characteristics of the reader, as Gough and Tunmer (1986) maintain (see also Rack, Snowling, & Olson, 1992). As skill in decoding advances, D will predictably account for less and less of the variance in R, and as the variety of reading matter increases, differences in general linguistic comprehension, L, will contribute progressively more. However, it does not follow that measures of D may be expected to lose predictive value in the case of experienced readers. Studies by Bruck (1990, 1992), Perfetti (1985), and Shankweiler, Lundquist, Dreyer, and Dickinson (1996) found that the level of attainment in basic phonologic skills accounted for unique variance in reading comprehension in secondary school and college, especially for students with a history of reading problems.

As we noted earlier, however, the perspective on children's reading problems that stresses difficulties with bottom–up processes has not achieved universal acceptance. Moreover, teachers and remedial specialists have long insisted that some children can read the words but comprehend poorly, and, contrariwise, some readers seem to be able to compensate for weak decoding skills. To confirm the existence of children whose reading skills are out of synchrony and to address questions raised by such dissociations, we initiated a search for children in the sample with meaningful discrepancies between decoding (or, alternatively, word reading) and reading comprehension.

Word-level reading skills and reading comprehension were indeed partially decoupled in some of the children. Discrepancies in both directions were found. The number of discrepant individuals was greater when nonwords, instead of words, were the basis for determining a discrepancy. The findings of this study confirmed the existence of children whose reading skills are marked by unevenness in word or nonword reading and comprehension. Such discrepancies may be temporary, as Freebody and Byrne (1988) showed. Second-grade children were tested on nonwords and exception words. Most of the children were concordant on the two measures, in keeping with the present results. Two groups of discrepant children were followed longitudinally. Those who were initially relatively strong in sight word recognition of exception words and weak on decoding nonwords were also initially better comprehenders than those who were stronger on decoding and weaker on exception words. However, on measures of comprehension taken in later elementary grades, the relative standing of the two groups was reversed: The early decoders now were the better comprehenders. The authors concluded that the long-term prognosis for children who do not learn to decode well in the early grades is unfavorable, even if they initially have above-average word skills.

Readers with appreciable discrepancies between decoding and comprehension were a small proportion of the total, even within a sample in which poor readers were greatly overrepresented in comparison with a random sample. Moreover, the numbers of children that fell in each of the discrepancy groups were unequal. By each of the alternative procedures for identifying them (performance on nonwords and real words, respectively), Type A readers, with better comprehension than decoding, were nearly twice as numerous as Type B readers, with the opposite discrepancy. Moreover, it appears that Type A is a more stable entity than Type B, showing greater consistency across both nonword and word identification criteria.

We noted earlier that Type A readers are sometimes called "compensators," under the supposition that good top–down skills may compensate to a degree for poorly developed decoding skills. The existence of Type A individuals in the sample suggests that a degree of compensation for weak bottom–up skills can occur. Clearly, however, any compensation that operated among these children did so only within rather narrow limits. Type A children, as Figure 3 indicates, were high in comprehension only relative to Type B readers. Their reading comprehension skills were not as good as those of the unimpaired reading group. It should also be borne in mind that if word level skills were below some minimum level, no compensation would be possible, and reading comprehension would approach zero.

What about cases of high-functioning dyslexic adults, such as the individual discussed by Campbell and Butterworth (1985)? The fact that this individual was poor at reading nonwords suggests that the primary deficit persisted into adulthood, but the fact that she was educationally successful argues that considerable compensation is possible for some older individuals with a history of severe reading difficulty. Other successful adult dyslexics studied by Bruck (1990, 1992) and Gallagher, Laxon, Armstrong, and Frith (1996) showed the same pattern of core phonological deficits that are typical of children with severe reading problems. Our impression is that such well-compensated individuals are fairly uncommon and reflect unusual educational circumstances. Unfortunately, a more frequent scenario was described by Stanovich (1986), who documented a downward spiral of negative educational consequences that ensued from early failure to learn to decode. Further study of successful compensators is needed to discover the basis for the favorable outcome in these cases (see also Elbro, Nielsen, & Petersen, 1994; Liberman, Rubin, Duques, & Carlisle, 1985; Pratt & Brady, 1988; Scarborough, 1984).

Type B readers, who did comparatively well at decoding, but whose comprehension was unexpectedly low, sometimes receive the name "word callers." This term may be somewhat misleading. For one thing, the Type B readers in our sample did not resemble hyperlexics, either in having an extreme disparity between decoding and comprehension or in having comprehension scores that were extremely low. Indeed, we found no children in the entire sample who would meet the criteria for hyperlexia. Listening comprehension scores and verbal IQ scores for Type B readers were not deficient relative to general norms, being within the average range. Moreover, their decoding skills, though clearly better than those of Type A, were not exceptional. Indeed, they were not as good as those of the unimpaired group. These facts about discrepant readers dictate caution in applying terms such as "word caller" and "compensator."

In addition to the comparisons based on reading measures, the discrepant readers were studied using a variety of other language and cognitive tasks. They were found to differ chiefly in ways that would be anticipated from earlier findings regarding the cognitive characteristics of children with reading disability (for reviews, see Brady & Shankweiler, 1991; Share, 1995; Stanovich, 1986). It could be expected that the better decoders would exceed the other group in phonological awareness and verbal short-term memory, and they did.[3] Also it would be anticipated that the better comprehenders would exceed the better decoders in listening comprehension, which they did. However, the sources of Type A's superiority with text are not entirely evident and merit further study using more sensitive measures of working memory (e.g., Ni, Crain, & Shankweiler, 1996; Yuill, Oakhill, & Parkin, 1989) and more analytic, time-sensitive comprehension measures (e.g., Macaruso et al., 1993; Williams, 1993). Likewise, regarding the comprehension difficulties of Type B readers, we can probably rule out the possibility that these reflect a lag in syntactic development, given that the test of syntactic comprehension failed to distinguish the discrepancy groups (see Shankweiler, 1989; Shankweiler et al., 1995).

Although we have stressed that the numbers of children from our sample that proved to be nontrivially discrepant in one or the other aspect of reading are not large, we do not wish to imply that the problem of uneven development of reading skill is insignificant. Teachers and remedial specialists who are concerned with devising the most suitable remedial approach for an individual problem reader will surely need to know if the child in question belongs to one of the discrepant minorities. Therefore, it is important that reading diagnosticians be prepared to identify such children by informed use of appropriate criteria, such as those we adopted in this study.

Faced with a Type A reader (better comprehension), the remedial teacher will need to provide extra help to strengthen word attack skills through a program that

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[3]Short-term memory for verbal materials has often been found to distinguish between groups of good and poor readers, although not as consistently as tests of phonological awareness (see Brady, 1991). Two studies of adequate decoders who were deficient in reading comprehension—one by Oakhill, Yuill, and Parkin (1986), the other by Stothard and Hulme (1992)—report no differences between poor comprehenders and skilled comprehenders on various tests of verbal short-term memory. Although neither study made the same comparison as this study, both results are compatible with ours because we too find no evidence of memory superiority for the better comprehenders. Instead, higher digit span performance was present in the subjects who were the better decoders.

promotes phonological awareness, followed by instruction and practice in recognizing and using the major spelling patterns of the language (see Brady & Moats, 1997). For Type B readers (better decoding), the difficulties extend beyond phonology and decoding, embracing broader aspects of language use and background knowledge. In this connection it is well to bear in mind that of the two factors that contribute to reading comprehension, only one of them, D, is specific to reading. L reflects general language abilities that reading shares with spoken language. Certainly it is the responsibility of schools to address these wider educational needs, but it is surely unreasonable to hold the reading teacher accountable for imparting the entire substance of a general education.

To summarize, this study demonstrated strong cohesion among the different kinds of measures of reading ability in a diverse sample of 7.5- to 9.5-year-olds that included many children with reading difficulties. Reading comprehension was highly correlated with measures of both word and nonword reading. In contrast, listening comprehension was only moderately correlated with reading comprehension. These findings, in conjunction with other background data and a theory about the determinants of successful reading acquisition, led us to argue that, over this age span, skill in phonological decoding is critical in distinguishing readers at different levels of ability to comprehend text. Some children were identified who diverged in each direction from the dominant pattern of association among reading-related abilities. Their deviations were weighed in degree and in kind. It was argued that, whereas meaningful individual differences exist that warrant the attention of the remedial teacher, the findings do not encourage continued use of such concepts as "word caller" and "compensator."

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