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Reading Disability: The Role of Language Deficiencies

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This article summarizes the role of language deficiencies in reading disability, focusing on two areas that appear particularly critical to reading skill: language processing abilities and the awareness of phonological structure. The distinguishing characteristics of disabled readers are shown to be consistent with theoretical and experimental findings about skilled reading. These characteristics also provide direction for the remediation of reading problems.

Learning to read presents a considerable obstacle for 4–10% of the children in normal elementary school classrooms. This reading disability hinders their educational progress and can have long-term effects on self-esteem, social status, and occupational choice. Important new discoveries are showing that many instances of reading disability are rooted in problems in the language domain (for recent reviews, see I. Y. Liberman & Shankweiler, 1985; Mann, 1986b; Perfetti, 1985; Stanovich, 1982a, 1982b; Wagner & Torgesen, 1987). Our goal is to review the theoretical and experimental evidence for this position to see how it informs our understanding of reading disability and directs the way toward effective treatment of this very prevalent form of learning disability.

Background

Following from the assumption that reading is primarily a visual skill, many investigators sought to blame early reading difficulty on some malfunction in the visual domain, such as a tendency to reverse letters or sequences of letters (as first noted by Orton, 1937). Scientific research, however, has shown that children deficient in visual–motor or visual–perceptual skills do not encounter reading difficulty any more frequently than do matched control subjects (Robinson & Schwartz, 1973). Indeed, only a few instances of reading difficulty can be traced to a difficulty in visual processing (cf. Rayner, 1985; Stanovich, 1985; Vellutino, 1979). Rather than being the hallmark of children with reading problems, reversal errors are made by almost all children at some point in their development (Gibson, Gibson, Pick, & Ossler, 1962). They neither predict reading problems (see Mann, Tobin, & Wilson, 1987) nor account for the majority of the reading errors made by young children, including those who are dyslexic (e.g., Fischer, Liberman, & Shankweiler, 1977). As we shall discuss later, a linguistic explanation offers a more adequate account of the types of errors commonly observed.

Other theories have regarded poor readers' problems as the consequence of poor cross-modal integration or as a general intellectual deficit. Careful investigation of the ability to integrate information presented to different modalities has revealed that cross-modal integration difficulties are almost always accompanied by intramodal integration problems. Both integration difficulties are now regarded as symptoms of poor readers' problems with linguistic coding (for a review of this literature, see Vellutino, 1979). In a subsequent section of this article, the linguistic coding problem and its ramifications will be discussed.

The evidence with respect to IQ and reading disability is a little less clear-cut. Rutter (1978) reported a 0.6 correlation between IQ and reading and noted that, for some children, reading acquisition will be limited by low intelligence. Yet, a low IQ cannot be the sole basis of reading problems because dyslexic children, by definition, are backward in reading ability but average in intelligence (Rutter & Yule, 1975) and because some hyperlexic children are precocious readers despite below-average IQ scores (Healy, Aram, & Horowitz, 1982). For children of normal IQ, the interrelations between various subskills of reading and intelligence increase with age, probably as a result of mutual facilitation (Stanovich, Cunningham, & Freeman, 1984). However, measures of certain language abilities show a much greater association with reading ability and account for as much as 70% of the variance between good readers and poor readers (e.g., Mann, 1984; Pratt & Brady, in press; Stanovich et al., 1984).

A crucial link between deficient language processes and reading disability is further suggested by two observations. First, children who are speech- and language-retarded encounter reading problems at least 6 times more often than do control subjects (Ingram, Mason, & Blackburn, 1970), in contrast to the lack of correspondence between reading and other sorts of handicaps (Rutter, 1978). Second, a telling pattern of cognitive strengths and weaknesses for poor readers has emerged from a variety of studies. Disabled readers consistently do worse than

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excellent readers on many language tasks but generally do as well on tasks that do not involve the use of language. This dichotomy between poor readers' linguistic difficulties and their success on nonlinguistic tasks is consistent with some newer theories hypothesizing that reading is predicated on spoken language skills. We preface our review of those theories by considering the overlap between spoken and written language processes and the special linguistic requirements of alphabetic writing systems.

Language Requirements for Reading

Written language is not a wholly different communication system but is based on spoken language and, thereby, recruits linguistic processes that the reader already possesses (I. Y. Liberman, Liberman, Mattingly, & Shankweiler, 1980). Both written and spoken communication require accessing the words of the vocabulary, analyzing the phrases and sentences that those words comprise, and comprehending the message. Experimental evidence has shown us that many of the same processing skills are recruited for reading and listening alike.

A central component of the processing system that serves language is a working memory that holds linguistic material momentarily, pending analysis of the input. Of special significance are findings that, whenever the processing of a sequence of letters or words places demands on temporary memory, the information is encoded into some kind of "silent speech," or phonetic representation. Interestingly, this is equally true for users of English and for users of nonalphabetic scripts (e.g., Chinese), suggesting that phonetic coding in working memory is mandatory for verbal information (for a review, see Mann, 1986b).

In addition to recruiting language processing abilities, written language can also place a special demand on the language faculty, depending on the units of spoken language that are represented in the script. In alphabetic systems, such as English, the units represent consonant- and vowel-sized segments referred to as *phonemes*. In such a system, any word or possible word can be represented by combining a relatively small number of characters. Learning these, together with a set of grapheme-to-phoneme conversion rules, a person can read not only highly familiar words but also previously unencountered words. However, this virtue will only be realized if the reader has a conceptual framework for understanding what the letters represent. Unless he or she appreciates the fact that words are composed of ordered sequences of phonemes, the alphabet will make no sense as a transcription of utterances and reading will not be mastered (see I. Y. Liberman, Liberman et al., 1980).

However, appreciation of the phonological structure of spoken words (also termed *metalinguistic awareness* or *phonological awareness*) may be difficult to achieve because phonemes are abstract units of the speech stream that cannot generally be produced in isolation or be physically separated (A. M. Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). Although speakers and hearers produce and perceive phonemes, they need not be explicitly aware of such things as the fact that *cat* and *hat* each have three phonemes and differ in the first. Readers must achieve this awareness, and developmental studies have demonstrated quite clearly that this poses a problem for many young children (e.g., I. Y. Liberman, Shankweiler, Fischer, & Carter, 1974).

Reading Disability and Difficulties With Language Processing

The importance of spoken language processes to skilled reading ability suggests that language processing problems might be a factor in reading difficulty. During the past decade, many studies have uncovered associations between early difficulties in learning to read and impairment in one or more aspects of spoken language processing. This link has been observed in poor readers of English as well as in disabled readers of a number of other languages (cf. Mann, 1986b, for a review). Four major areas of language processing have been studied: linguistic working memory, phonetic perception, the mental lexicon, and sentence comprehension.

Much of the evidence we will be citing derives from studies of children in the early elementary grades, although we note that many of the special characteristics of disabled readers at this age appear to remain in adolescence (e.g., McKeever & van Deventer, 1975) and beyond (e.g., Read & Ruyter, 1985). These studies have typically compared good and poor beginning readers who, by either selectional constraints or statistical manipulations, have been equated for IQ, familial background, and educational experience. The poor readers have tended to be reading one or more grade levels below expectation and the good readers one or more grade levels above.

Questions concerning deficiencies in working memory have given rise to one of the more fruitful lines of research in this field. Although memory impairment has long been recognized as a characteristic of children with reading problems, only in the last decade has the nature of the impairment been better understood. Poor readers generally recall fewer items from short lists of linguistic material than do children who are good readers. This result has been obtained with a variety of stimuli including letters, digits, nonsense syllables, words, sentences, and pictures of nameable objects (for a review, see Brady, 1986; Torgesen, 1985).

Two findings help to pinpoint the locus of the memory problem. First, recall that deficiencies for poor readers are evident regardless of whether the items are heard or seen. Thus, the deficit is not restricted to reading or to visual tasks but reflects a more extensive memory problem. Second, when recall tasks are given that carefully avoid the possibility of verbal labeling (e.g., by using nonsense doodle drawings), the performance of good and poor readers is comparable (e.g., Katz, Shankweiler, & Liberman, 1981). Thus, the memory impairment is specific to verbal memory processes.

As noted earlier, studies with adults have indicated that linguistic material in working memory is stored via a phonetic representation. Noting this fact and the specifically verbal memory deficits of poor readers, Liberman and Shankweiler hypothesized that the linguistic memory difficulties of poor readers might reflect a problem with the use of phonetic representation. This interpretation has been supported by numerous experiments. One approach has been to show that poor readers are less sensitive to manipulations of certain phonetic properties such as rhyme (e.g., Shankweiler, Liberman, Mark, Fowler, &

Fischer, 1979). Another has been to analyze the errors that poor readers make when attempting to recall a list of spoken words (e.g., Brady, Mann, & Schmidt, 1987). Like good readers, poor readers tend to recombine the phonetic information from adjacent items in the list, especially when items have phonetic features in common. Although this confirms their use of phonetic coding, a greater frequency of errors suggests that poor readers have less effective coding processes.

These results collectively point to poor readers having a difficulty in working memory that is not limited to the task of reading and that appears related to phonetic coding ability. Because the differences between good and poor readers' use of phonetic representation in memory can be documented before they learn to read (e.g., Mann & Liberman, 1984), ineffective use of phonetic representation appears causally related to reading difficulty.

Some attention has been devoted to the possibility that poor readers' working memory deficits are based in poor perception. A number of studies have reported inferior performance by poor readers on speech perception tasks (for discussion, see Brady, 1986; Snowling, Goulandris, Bowlby, & Howell, 1986). Furthermore, in experiments examining performance on both verbal and nonverbal auditory perception, the perceptual difficulties for poor readers have only been observed for the linguistic stimuli. For example, Brady, Shankweiler, and Mann (1983) reported no reading group difference in accuracy with environmental sounds (e.g., frogs croaking) but obtained significant group differences when words were presented. These findings contradict a claim that general auditory processes are responsible for the perceptual deficits (Tallal, 1980) and replicate the pattern in memory research of a specifically linguistic impairment.

The role of phonological processes in verbal memory functioning has been further supported by recent findings that, in normal development, there is a close link between the efficiency of phonetic skills and recall capacity in verbal working memory (e.g., Case, Kurland, & Goldberg, 1982). When third-grade good and poor readers were tested on a number of phonological and memory tasks, a significant correspondence between the accuracy of phonetic processes and the capacity of verbal memory (but not nonverbal memory) was demonstrated, with poor readers less skilled at both (Brady, 1986). Correlations between digit span and naming speed have also been observed in similar populations (e.g., Spring, 1976). All of this is consistent with the possibility that working memory is a limited capacity system in which the available resources for memory are affected by the efficiency of initial phonological encoding (for a discussion, see Perfetti, 1985).

A phonological impairment has also been implicated in the naming abilities of disabled readers. Although naming deficits have long been observed among poor readers (e.g., Denckla & Rudel, 1976), the role of vocabulary size has not been clear. In younger children, vocabulary size bears some relation to reading ability (see Stanovich et al., 1984), and as individuals get older, reading experience itself contributes to superior word knowledge for better readers. However, recent research has demonstrated that poor readers have more trouble retrieving the sound structure of words than do good readers, even if they know the meaning of the word (Katz, 1986). This finding implies that phonological information for words in the lexicons of poor readers may be less accurately represented or less easily accessed.

A likely outcome of a lower level difficulty with phonetic representation in working memory would be difficulty repeating and comprehending sentences that place heavy demands on memory. Accordingly, reading group differences have been obtained in experiments requiring sentence repetition (Mann, Liberman, & Shankweiler, 1980) and sentence comprehension (for a review, see Smith, Mann, & Shankweiler, 1987). Not surprisingly, listening comprehension problems have also been noted for children with reading disability (e.g., Berger, 1978). Some of the more recent research in this area has asked whether poor readers have difficulty just on those sentences that are long and place demands on memory operations or also on those that are syntactically complex. By carefully controlling for both sentence length and syntactic complexity, it has been found that reading groups do not appear to differ in their syntactic knowledge so much as in their ability to use that knowledge when the sentence stresses memory limitations (e.g., Mann, Shankweiler, & Smith, 1985; Smith et al., 1987).

To summarize, poor readers have been found to have a wide scope of language deficits. On various tests of working memory, speech perception, naming ability, and sentence comprehension, poor readers have often been found to have difficulty processing language. Although the language deficits may be multifaceted, evidence points to a difficulty with phonological representation as the basis for many instances of poor reading (see Wagner & Torgesen, 1987, for a discussion).

Reading Difficulty and Difficulties With Phonological Awareness

Reading an alphabetic script requires an explicit awareness of phonemes that is not obligatory for speaking and listening, and this requirement appears to pose an additional problem for many disabled readers. The lack of phonological awareness among poor readers is intimated by the nature of their reading errors. Poor readers, and beginning readers in general, tend to be correct about the pronunciation of the first letter in a word but to have increasing difficulty with subsequent letters and a particular problem with vowels as opposed to consonants. Although these errors relate to the orthographic complexities of English, they also indicate a lack of awareness about phonological segments within words (Fischer et al., 1977; Shankweiler & Liberman, 1972).

Other forms of evidence corroborate the relation between phonological awareness and success at learning to read. Children who are poor readers perform poorly on a variety of tasks that require spoken words to be broken down into syllables or phonemes. These include syllable and phoneme counting games (e.g., I. Y. Liberman et al., 1974), detection of rhyme (e.g., Bradley & Bryant, 1978), and phoneme or syllable manipulation (e.g., Calfee, Lindamood, & Lindamood, 1973).

That children's awareness of phonemes actually determines their reading ability has been supported by at least three lines of evidence. First, phonological awareness skills have been found to predict later success in reading. Thus, when the metalinguistic skills of 4- and 5-year-olds were measured and related

to reading ability more than 3 years later, a significant portion of the variance in reading ability was accounted for by prior phonological awareness (Bradley & Bryant, 1985). Second, research has suggested that training in phonological awareness facilitates reading acquisition. For example, using a program that combined explicit training about the phoneme-sized units in spoken words followed by training in letter–sound correspondences and decoding, Williams (1980) found significant improvement in learning disabled children's decoding skills compared with the skills of an untreated control group. Third, the use of path analysis techniques has shown that phoneme segmentation skills are directly related to reading performance (e.g., Lundberg, Oloffson, & Wall, 1980).

Although this and other (see Wagner & Torgesen, 1987) evidence suggests that acquiring metalinguistic awareness of the phonological units of language is a necessary precursor to learning to use an alphabet, some investigators have argued that phonological awareness is a consequence of reading instruction, particularly of phonics-oriented reading instruction. This position is supported by findings that phoneme segmentation is lacking among adults who cannot read an alphabetic script (Morais, Cary, Alegria, & Bertelson, 1979; Read, Zhang, Nie, & Ding, 1986). Further support accrues from a study which demonstrated that phonics-oriented reading instruction was strikingly more effective in developing phoneme awareness than was sight–word instruction (Alegria, Pignot, & Morais, 1982). Apparently, awareness of phonemes is enhanced by methods of instruction that direct attention to the phonetic structure of words and may even depend on it.

Yet, the experience of learning to read an alphabet cannot be the only determinant of phonological awareness. Some children become aware of phonemes without being taught to read an alphabet (Mann, 1986a), and others fail to become aware despite years of educational experience. This latter point is aptly shown by a contrast between a group of 6-year-old skilled readers and 10-year-old disabled readers who were matched for reading ability: The disabled readers performed significantly worse on a phoneme awareness task, even though they had been given considerably more reading instruction than the younger children (Bradley & Bryant, 1978). Studies of adults who were functionally illiterate despite years of instruction (many were high school graduates) have made the same point (Pratt & Brady, in press). In such populations, reading ability is still linked to phonological awareness, and illiterate subjects who possess phonological awareness are more likely to achieve literacy than those who do not (e.g., Read & Ruyter, 1985).

In sum, the relation between phonological awareness and reading ability may best be viewed as a complex, two-way street. Awareness of the phonological elements in spoken words clearly facilitates the task of learning what letters symbolize. On the other hand, reading instruction, particularly a phonics approach, generally does augment metalinguistic awareness. However, for some individuals, there is a fundamental difficulty achieving phonological awareness that is not due to a lack of educational experience.

Practical Applications

One of the benefits of the research described herein is the direction it provides for practical applications. The convergent evidence for the linguistic basis of reading problems provides a valuable guideline for the use of linguistic skills in diagnosis and treatment. As a first step, the research tells us most clearly which cognitive processes are not implicated in reading disability. The various nonlinguistic treatment programs that have been promulgated, such as large-motor activities (e.g., balance-beam walking), drug treatment of cerebellar-vestibular functioning, visual perception training, eye movement practice, and stress reduction, cannot be expected to alleviate the language difficulties involved in reading problems (see Stanovich, 1985, for a discussion). Similarly, instructional programs that incorporate practice in nonlinguistic activities such as labeling environmental sounds or that suggest "teaching to the right hemisphere" are not supported by what is known about the reading process or about the cognitive deficits of disabled readers.

In addition, the research points the way toward effective approaches in the identification of reading problems and toward appropriate instruction and remediation. The two areas reviewed in this article, underlying language abilities and phonological awareness, are both relevant in this regard. We will briefly note some of the practical implications of this literature and some sources for more extensive treatment of this topic.

Tests of phoneme and syllable awareness look particularly promising as a means of identifying children at risk for early reading problems. As noted earlier, several studies have reported that phonological awareness skills in kindergarteners are causally related to the later acquisition of reading. Assessment of other phonological abilities such as verbal short-term memory (e.g., Jorm, Share, Maclean, & Matthews, 1984) and object naming (e.g., Wolf & Goodglass, 1986) have also been found to successfully predict later reading success. It remains to be determined what the interrelations of these language processes are. Nonetheless, the predictive value of assessing early language abilities has been demonstrated and could be advantageous in standard screening procedures as well as in the evaluation of children known to be at risk (e.g., children with familial histories of dyslexia; Vogler, DeFries, & Decker, 1985). Correspondingly, the assessment of school-age children encountering reading difficulty should include measures of phonological awareness and underlying language processing skills in order to determine whether language deficits are implicated or whether the reading problem has other origins in attentional problems, poor motivation, and so forth.

The importance of phonological awareness for reading acquisition also has implications for beginning instruction. As noted in the previous section, a training study obtained beneficial results on reading or reading-related skills from the training of phonological awareness. Such empirical findings, together with the theoretical framework on the importance of phonological awareness for learning to read, lead us to recommend that prereading training incorporate much more systematic introduction to the phonological units of language. (This can involve word play, learning nursery rhymes, and so forth: Some excellent suggestions are available in I. Y. Liberman, Shankweiler et al., 1980. See also Williams, 1980).

When a child is ready for formal reading instruction, the use of a phonics approach is widely advocated as the most direct and facilitative method. Many have argued cogently that phonics-based instruction most effectively meets the cognitive and

language requirements in reading (e.g., Chall, 1979; Calfee et al., 1973; I. Y. Liberman, Shankweiler et al., 1980). We refer the reader to these excellent sources and note also that the Orton Dyslexia Society is a valuable source of information about available techniques and current methods.

Within this framework, there is also strong consensus that decoding ability is critical to reading performance (e.g., Chall, 1967, 1979; I. Y. Liberman, 1982; Stanovich, 1982a, 1982b, 1985; Vellutino, 1979). Research has indicated that the ability to rapidly and automatically translate graphemic symbols into a phonological representation largely accounts for a reader's ability to access word meanings and to make use of context (Stanovich et al., 1984; Perfetti, 1985). Thus, decoding skills need to be emphasized for all beginning readers and especially for poor readers whose memory deficits impede the process.

Remediation recommendations are an extension of the approach described here. Investigations with older children and illiterate adults have found ongoing deficits in phonological awareness, as discussed earlier. The results of experiments that show persistent deficits suggest the need, whatever the age of the would-be reader, for the inclusion of training in linguistic awareness and for the overlearning of decoding skills.

Conclusion

There is a great deal of consensus that many instances of reading difficulty are language-based. We have reviewed the theoretical and experimental findings about the role of language in skilled reading and the evidence that early reading disability tends to reflect problems in one or both of two areas: language processing and the awareness of phonological structure. In future research, it will be important to continue studying the relation between children's reading abilities, metalinguistic abilities, and spoken language processes. Much remains to be ascertained about the normal development of each ability and about their interrelations and their pathologies. Ultimately, clarification of the cognitive abilities that are closely linked to reading skill will have further implications for methods of reading instruction, for the assessment of reading problems, and for prereading activities that may reduce the incidence of reading difficulty.

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