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Language and Reading Disabilities

Alan G. Kamhi Hugh W. Catts

Third Edition

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Researchers have also examined the relative contribution of attentional factors to reading achievement (Shaywitz et al., 1995). In an investigation of children from the Connecticut Longitudinal Study, Shaywitz and colleagues found that measures of attention failed to explain significant variance in word recognition once language measures had been considered (see also Felton & Wood, 1989). Attention variables did, however, account for a small but significant percentage of the variance in silent reading comprehension over and above that explained by language variables.

In summary, research indicates that attentional deficits are not a primary cause of reading disabilities. Although reading disabilities and ADHD may occur together in children, they appear to be distinct developmental disorders, each with its own set of causal factors. In cases where reading disabilities and ADHD co-occur, attentional deficits (especially inattention) may contribute to reading problems.

Language-Based Deficits

Reading disabilities are best characterized as a developmental language disorder. From a theoretical perspective, such a claim is well founded. Reading is first and foremost a language activity. Reading relies heavily on one's knowledge of the phonological, semantic, syntactic, and pragmatic aspects of language. As such, deficiencies in one or more of these aspects of language could significantly disrupt one's ability to read. Not only is a language-based account of reading disabilities theoretically sound, but considerable evidence has also accumulated over the last thirty years to support this view.

LONGITUDINAL STUDY OF LANGUAGE-IMPAIRED CHILDREN. The relationship between language deficits and reading disabilities has been examined from several different perspectives. One approach has been the longitudinal study of children with early spoken language impairments (Aram, Ekelman, & Nation, 1984; Bishop & Adams, 1990; Catts, 1993; Catts, Adlof, Hogan, & Ellis Weismer, 2005; Catts, Bridges, Little, & Tomblin, 2008; Catts, Fey, Tomblin, & Zhang, 2002; Conti-Ramsden & Durkin, 2007; Silva, McGree, & Williams, 1987; Stothard et al., 1998; Tallal, Curtiss, & Kaplan, 1989). In this work, children displaying significant impairments in language (generally in semantic-syntactic aspects) have been identified in preschool or kindergarten and tested for reading and academic achievement in the later grades. Evidence that children with language impairments (LI) are more likely than typically developing children to have subsequent reading disabilities indicates that language deficits precede and play a causal role in reading disabilities.

The results of longitudinal studies have consistently shown that children with LI often have reading disabilities. In general, research indicates that 50 percent or more of children with LI in preschool or kindergarten go on to have reading disabilities in primary or secondary grades. In the most comprehensive study to date, the first author and colleagues (Catts, Fey, Tomblin, & Zhang, 2002) investigated the reading outcomes of 208 kindergarten children with LI. These children were a subsample of children who participated in an epidemiological study of developmental language impairments in children (Tomblin' et al., 1997).

Results indicated that the group of children with LI in kindergarten read well below expected levels in second and fourth grades. Approximately 50 percent of the children with LI performed one or more standard deviations (SDs) below the mean on a composite measure of reading comprehension. Although the remaining children with LI did not meet this criterion, many were, nevertheless, poor readers. When the criterion for a reading disability was changed

to below the 25th percentile, nearly 70 percent of children with LI were classified as poor readers. Furthermore, analyses showed that children with low nonverbal abilities in addition to language problems performed significantly less well in reading than those with normal nonverbal IQs. Those children who continued to have language deficits in second and fourth grades were also at a much higher risk for reading disabilities than those whose language abilities had improved by the early school grades. A subsequent study that followed these children through 10th grade found that the children with kindergarten language impairments continued to perform more poorly than typically developing children on measures of reading (Catts et al., 2008).

LANGUAGE PROBLEMS IN POOR READERS. The fact that many children with LI exhibit reading disabilities does not necessarily mean that most children with RD have a history of language impairments. To better investigate such a claim, studies have directly examined the language abilities of children with RD. In one body of research, investigators have selected school-age children identified as reading disabled (or in some cases, learning disabled) and studied their performance on traditional measures of language development. This work has shown that children with RD often have problems in receptive and/or expressive vocabulary (e.g., Fry, Johnson, & Muehl, 1970; Wiig & Semel, 1975; Wise, Sevcik, Morris, Lovett, & Wolf, 2007) or in the use and/or comprehension of morphology and syntax (e.g., Doehring, Trites, Patel, & Fiedorowitcz, 1981; Fletcher, 1981; Rispens, Roeleven, & Koster, 2004; Stanovich & Siegel, 1994; Vogel, 1974). Deficits have also been reported in the production and/or comprehension of text-level language (e.g., Hagtvet, 2003; Roth & Spekman, 1986; Stothard & Hulme, 1992; Yuill & Oakhill, 1991).

Although this research clearly shows that children with RD have language deficits, it does not necessarily indicate that these deficits are causally related to reading disabilities. A major problem for the interpretation of this work is that in most cases language abilities were examined in children who had reading problems for several years. This makes it difficult to determine if the observed language deficits were the cause or the consequence of a reading problem. Earlier we argued that Matthew effects can lead to language deficits in children with RD. Thus, at least some of the language problems observed in children with RD will be a consequence rather than the initial cause of their reading difficulties.

Not all studies of language problems in children with RD have examined reading and language abilities concurrently. Some studies have investigated language deficits in children with RD prior to their learning to read. Scarborough (1990, 1991), for example, investigated the early language development of children who later developed reading disabilities. In this study, the language abilities of children with a family history of dyslexia ($N = 34$) and children without a family history ($N = 44$) were assessed at age 2½ years, and at 6- or 12-month intervals through age 5. Language assessments included measurements of receptive and expressive vocabulary, sentence comprehension, and grammatical production (not all measurements were administered at each age). In second grade, children's reading abilities were assessed. Of the 34 children with a family history of dyslexia, 22 were themselves diagnosed as dyslexic in second grade. The early language abilities of these dyslexic children through 4 years of age were found to be significantly poorer than those of the children without a family history of dyslexia. By age 5, however, only expressive vocabulary differentiated the two groups. Several other studies employing the same design have reported early language deficits in children at risk for reading disabilities (Boets et al., 2010; Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001; Snowling et al., 2003).

In another study, the first author and colleagues (Catts, Fey, Zhang, & Tomblin, 1999) investigated the language abilities of a large group of poor readers. The study identified 183 second-grade children who performed at least one SD below normal on a composite measure of

reading comprehension. We did not exclude children on the basis of low IQ (except for those with mental retardation), as others have done in the past. The latter practice may bias results concerning language deficits in poor readers because IQ tests often measure verbal abilities. We compared the poor readers' performance on a battery of kindergarten language tests to that of a normal control group. We also used weighted scores based on epidemiological data (Tomblin et al., 1997) to better ensure that our results were representative of poor readers from the population at large. Our findings indicated that the poor readers performed significantly less well than the good readers on tests of oral language. In addition, a large percentage of poor readers performed at least one SD below the mean on tests of vocabulary (39 percent), grammar (56 percent), and narration (44 percent).

Our results further indicated that the poor reader's early language deficits extended beyond vocabulary, grammar, and narration. Poor readers were also found to have difficulties in phonological awareness and phonological retrieval in the kindergarten assessment. Specifically, 56 percent of the poor readers performed at least one SD below that of the normative sample on a measure of phonological awareness (syllable/phoneme deletion), and 45 percent performed below that level on a test of phonological retrieval (rapid naming). These deficits, however, rarely occurred in isolation from problems in vocabulary, grammar, and narration.

In the sections that follow, we review research that more specifically investigated phonological awareness, phonological retrieval (as well as other aspects of what has come to be known as phonological and processing) deficits in children with RD. However, before moving to that discussion, it is important to review a further body of research that has examined nonphonological language deficits in children with RD. Whereas the aforementioned work investigating the language basis of RD has included children with broadly defined problems in reading including deficits in both word reading and comprehension, other research has examined children with specific deficits in comprehension. These children are often referred to as "poor comprehenders" (e.g. Catts, Adlof, & Weismer, 2006; Nation, Clarke, Marshall, & Durand, 2004). Poor comprehenders tend to perform as well as good readers on tasks assessing the phonological domains of language, including phonological awareness (e.g., Cain, Oakhill, & Bryant, 2000; Nation et al., 2004; Stothard & Hulme, 1995) and phonological memory (Catts et al., 2006; Nation, Adams, Bowyer-Crane, & Snowling, 1999; Nation et al., 2004). However, compared to their same-age typical peers, they show deficits in expressive and receptive vocabulary knowledge (Catts et al., 2006; Nation et al., 2004; Nation & Snowling, 1998; Nation, Snowling, & Clarke, 2005). In addition to knowing fewer words overall, poor comprehenders also appear to have less well-specified semantic representations of the words they do know (Landi & Perfetti, 2007; Nation & Snowling, 1998, 1999). Poor comprehenders also show difficulties relative to good readers on tasks measuring grammar and syntax skills (Adlof, 2010; Cragg & Nation, 2006; Marshall & Nation, 2003; Nation et al., 2004; Nation et al., 2005; Oakhill, Cain, & Bryant, 2003; Stothard & Hulme, 1992) and text-level language (Cain, 2003; Cragg & Nation, 2006).

The existence of poor comprehenders is predicted by the simple view of reading model, in which oral language skills are considered an independent contributor to reading comprehension in addition to word reading skills. Most of the research investigating nonphonological language deficits in poor comprehenders has investigated language and reading skills concurrently, making it difficult to determine the direction of causality. However, recent evidence from longi tudinal studies has revealed that deficits in nonphonological aspects of language can be observed prior to the onset of reading instruction in children who will later become poor comprehenders (Ewer & Samuelsson, 2010; Catts et al., 2006; Nation, Cocksey, Taylor, & Bishop, 2010; Torppa et al., 2007). So far, findings suggest that these nonphonological language

deficits are heterogeneous and not always severe enough to qualify for a diagnosis of language impairment. More research is needed, however, to clarify the role of nonphonological language deficits in poor comprehenders. This work needs to be conducted in conjunction with the examination of deficits outside the language domain. Emerging research suggests that poor comprehenders also may have deficits in other cognitive abilities such as executive functioning and/or attention (Locascio, Mahone, Eason, & Cutting, 2010; McInnes, Humphries, Hogg-Johnson, & Tannock, 2003; Sesma, Mahone, Levine, Eason, & Cutting, 2009).

Phonological Awareness. As reported earlier, children with RD often have deficits in phonological processing. The largest body of research in this area has focused on problems in phonological awareness. Phonological awareness is the explicit awareness of, or sensitivity to, the sound structure of speech (Stanovich, 1988; Torgesen, 1996). It is one's ability to attend to, reflect on, or manipulate the speech sounds in words. Children who are aware of the sounds of speech appear to more quickly and accurately acquire sound–letter correspondence knowledge and learn to use this knowledge to decode printed words. Evidence of a relationship between phonological awareness and reading has been demonstrated across a wide range of ages (Calfee & Lindamood, 1973; Gallagher, Laxon, Armstrong, & Frith, 1996; Storch & Whitehurst, 2002; Swanson & Hsieh, 2009; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997), experimental tasks (Catts, Wilcox, Wood-Jackson, Larrivee, & Scott, 1997), and languages (Cossu, Shankweiler, Liberman, Katz, & Tolar, 1988; Denton, Hasbrouck, Weaver, & Riccio, 2000; Hu & Catts, 1997; Lundberg, Olofsson, & Wall, 1980; Treutlein, Zoller, Roos, & Scholer, 2008).

Numerous studies have shown that children with RD have deficits in phonological awareness (Bradley & Bryant, 1983; Fletcher et al., 1994; Fox & Routh, 1980; Katz, 1986; Olson, Wise, Conners, Rack, & Fulker, 1989). In fact, Torgesen (1996) argued that "dyslexic children are consistently more impaired in phonological awareness than any other single ability" (p. 6). It is possible that the deficits in phonological awareness observed in children with RD are due, at least in part, to their reading problems (Morais, 1991). Because of the abstract nature of phonology, children are often unaware of some phonological aspects of language until their attention is directly drawn to these features of language. For example, the fact that words are composed of individual phonemes does not become apparent to most language users until these units are explicitly highlighted through instruction and practice in an alphabetic orthography. Support for this view comes from studies that show that preschoolers, as well as illiterate adults, are generally unable to perform tasks that require the explicit segmentation of words into individual phonemes (Anthony et al., 2002; Lundberg & Hoien, 1991; Morais, Bertelson, Cary, & Alegria, 1986; Morais, Cary, Alegria, & Bertelson, 1979; Read & Ruyter, 1985).

Findings such as these suggest that children with RD might be expected to have some deficits in phonological awareness as a result of their poor reading abilities. Because children with RD have less experience and skill in using the alphabet, they may not acquire the same level of speech–sound awareness as their normal reading peers. Not all deficits in phonological awareness, however, are a consequence of reading problems. Research clearly demonstrates that some phonological awareness deficits are apparent in at-risk children prior to beginning reading instruction, and that these deficits are related to subsequent problems in learning to read. As reported earlier, we found that over half of a group of second-grade poor readers had deficits in phonological awareness in kindergarten (Catts et al., 1999). In further analyses, we found that phonological awareness was the best predictor among our kindergarten language and cognitive measures of word recognition abilities in second-grade children in general. Our results also

showed that phonological awareness was significantly related to reading even after kindergarten letter-naming ability, a measure of alphabetic experience, was taken into consideration. Thus, it is not simply limited exposure to the alphabet during the preschool years that causes phonological awareness and subsequent reading problems. Studies of familial risk for reading disabilities provides additional evidence that problems in phonological awareness are a precursor of reading disabilities (Pennington & Lefly, 2001; Snowling et al., 2003). For example, Pennington and Lefly reported that high-risk preschool children who developed reading disabilities performed less well on measures of phonological awareness (as well as other aspects of phonological processing) than did low-risk preschoolers and high-risk preschoolers who did not later show reading disabilities.

The best evidence of the causal role of phonological awareness in reading comes from training studies (see Ehri et al., 2001; Bus & Van Ijzendoorn, 1999; & Troia, 1999; for reviews). In these studies, children are provided with instruction in phonological awareness and are subsequently evaluated for phonological awareness ability and reading achievement. In general, this work has found that phonological awareness training can increase speech–sound awareness and, in turn, improve reading achievement. Because the greatest gains are made when phonological awareness training is combined with explicit phonics instruction, Share and Stanovich (1995) argue that phonological awareness is better described as a corequisite to learning to read.

Phonological Retrieval. Clinical observations have shown that children with RD frequently have word-finding difficulties and are sometimes described as dysnomic (Rudel, 1985). Word-finding problems include substitutions (e.g., "knife" for "fork"), circumlocutions (e.g., "you know, what you eat with"), and overuse of words lacking specificity (e.g., "stuff," "thing"). It is often assumed that because individuals with RD seem to know the words they are looking for, that these naming problems are due to difficulties in remembering phonological information.

The word-finding difficulties observed clinically in individuals with RD have also been borne out in research. Studies have consistently found that poor readers perform less well than good readers on tasks involving confrontation picture naming (Catts, 1986; Denckla & Rudel, 1976; Hanly & Vandenberg, 2010; Scarborough, 1989; Wolf, 1984). For example, Denckla and Rudel (1976) administered the Oldfield–Wingfield Picture-Naming Test to dyslexic, nondyslexic learning disabled (LD), and normal achieving children. Dyslexic children were slower and made more errors on this naming task than nondyslexic LD and normal children. Because the dyslexic and normal children performed similarly on a test of receptive vocabulary, the naming deficits observed in dyslexic children were most likely due to retrieval problems (see also Swan & Goswami, 1997; Wolf & Goodglass, 1986). However, equating reading groups on receptive vocabulary may control for semantic knowledge and name recognition, but it does not ensure that reading groups are comparable in expressive lexical knowledge. Hanly and Vandenberg (2010) investigated this by using a "tip-of-the tongue" task. During a picture-naming activity, when participants reported that they knew the target word but could not remember its name, they were asked to provide semantic information about the word. Dyslexic children experienced more tip-of-the-tongue episodes than controls, but they were equally able to provide semantic infomration about the target word. This supported the hypothesis that their difficulty was not in lexical knowledge, but rather phonological retrieval. In fact, differences in the quality of phonological memory codes (see next section) probably explain a portion of the reading group differences in naming abilities (Kamhi, Catts, & Mauer, 1990; Katz, 1986).

Perhaps the best evidence of phonological retrieval deficits in children with RD comes from studies using continuous naming tasks. These tasks, often referred to as *rapid naming* or *rapid automatic naming* tasks, require the individual to quickly and automatically say the name of a series of letters, numbers, familiar objects, or colors. Because the names of the items are quite common, it is assumed that storage factors play little role in these tasks. As a result, rapid naming tasks may be thought of as a "purer" measure of naming retrieval than other confrontation naming tasks.

Children with RD have been found to be slower on rapid naming tasks than normal children (Denckla & Rudel, 1976; Vellutino, Scanlon, & Spearing, 1995; Wolf, 1991).[1] Studies also indicate that variability in rapid naming during the preschool years is predictive of reading achievement during the school years (Badian, 1994; Catts, 1993; Wolf, Bally, & Morris, 1986). Research further indicates that rapid naming explains unique variance in reading achievement beyond that accounted for by phonological awareness (Badian, 1994; Bowers & Swanson, 1991; Catts et al., 1999; Kirby, Parilla, & Pfeiffer, 2003; Pennington, Cardoso-Martins, Green, & Lefly, 2001; Wolf' et al., 2002). Although this contribution is often small and relatively modest compared to that of phonological awareness, it seems to be greatest for measures of orthographic processing and fluency.

The latter findings have led in part to the proposal of a *double deficit* in some poor readers (Wolf & Bowers, 1999). Wolf and Bowers have argued that children with RD may have a "core deficit" in phonological awareness alone, rapid naming alone, or deficits in both areas. The latter is referred to as a *double deficit*. Wolf and colleagues (2002) found that within a group of second- and third-grade poor readers, 60 percent had a double deficit, and 15 to 20 percent had problems in a single area. Wolf and colleagues have also argued that, because children with double deficits often have reading problems that go beyond phonological decoding, including deficits in orthographic processing and fluency, they will have more severe reading disabilities than children with single deficits. Although most studies have shown that children with double deficits do have poorer reading achievement (Doi & Manis, 1996; Sundeth & Bowers, 1997), at least a part of this difference is explained by the fact that as a group these children have more severe problems in each deficit area than children with single deficits (Compton, DeFries, & Olson, 2001; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002). There is disagreement on whether rapid naming is a separate core deficit from phonological awareness (e.g., Vaessen, Gerretsen, & Blomert, 2009; Vukovic & Siegel, 2006); nonetheless, the presence of difficulties in both phonological awareness and naming speed seems to place a child at greater risk for reading failure.

Wolf, Bowers, and Biddle (2000) raised the possibility that the problems many poor readers have in rapid naming may go beyond deficits in phonological retrieval. They stated that rapid naming not only involves accessing a phonological code, but it also includes a demanding array of attentional, perceptual, memory, lexical, and articulatory processes. Catts, Gillispie, Leonard, Kail, and Miller (2002) further suggested that naming speed may also be a reflection of a domain-general speed of processing. Thus, rapid naming may not be a pure measure of phonological retrieval (but see Vaessen et al., 2009), but it is a good approximation of the reading process and a useful tool for early identification and assessment.

Phonological Memory. Children with RD also demonstrate problems in phonological memory (Hulme, 1988; Jorm & Share, 1983; Torgesen, 1985). Phonological memory, or what

[1]Reading group differences in speed of retrieval in discrete trial tasks have been less consistent. For a discussion of this work and its implications for conclusions concerning retrieval problems, see Bowers, Golden, Kennedy, and Young (1994), Catts (1989a), or Share (1995).