

Language skills, learning to read and reading intervention

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The paper outlines a framework for the development of reading that shows it is heavily dependent upon spoken language processes. Within this view, reading difficulties can follow from difficulties with speech processing (decoding problems) or from broader language processing impairments (comprehension problems). The paper describes the literacy development of children at high-risk of reading failure and shows how their reading outcome depends on the interaction of the phonological and language skills they bring to the task of reading. Findings have implications for the development of theoretically motivated reading interventions. The evaluation of such interventions is described.

Children vary in the age at which they first start to talk. For many families, late talking might go unnoticed, particularly if the child in question is the first born of the family and no comparisons can be made. Later in the pre-school years, a child may be difficult to understand; he or she might have a large repertoire of their 'own words' that others find unintelligible. Often such babble is endearing and no one worries much because an older sibling can translate. But speech or language delay can be the first sign of reading difficulties, difficulties that will only come to the fore when the child starts school.

Language is a complex system that requires the coordinated action of four interacting subsystems. *Phonology* is the system that maps speech sounds onto meanings, and meanings are part of the *semantic* system. *Grammar* is concerned with syntax and morphology (the way words and word parts are combined to convey different meanings) and *pragmatics* is concerned with language use. An assumption of our educational system is that by the time children start school, the majority are competent users of their native language. This is a reasonable assumption. But those

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with poor language start out at a disadvantage in learning to read because written language builds on a foundation in oral language skills.

It is useful to distinguish *speech skills* from *language abilities* when considering literacy development. Learning to read in an alphabetic system, such as English, requires the development of mappings between speech sounds and letters—the so-called *alphabetic principle* and this depends on speech skills. Wider language skills are required to understand the meanings of words and sentences, to integrate these in texts and to make inferences that go beyond the printed words.

More formally, the relationship between oral and written language skills has been simulated in computational models of the reading process. In the triangle model of Plaut and colleagues (shown in Figure 1), reading is conceptualized as the interaction of a *phonological pathway* mapping between letters and sounds and a *semantic pathway* mapping between letters and sounds via meanings (Plaut *et al.*, 1996). In the early stages of learning to read, children’s attention is devoted to establishing the phonological pathway (*‘phonics’*). As they get older children begin to rely increasingly on word meanings to gain fluency in their reading. We can think of this as an increase in the role of the semantic pathway, something which is particularly important for reading exception words in English (words such as *yacht* and *pint* that contain atypical letter sound associations) that cannot be processed efficiently by the phonological pathway. (English is unusual in having many exception words, for more regular languages, such as Welsh, which contain many

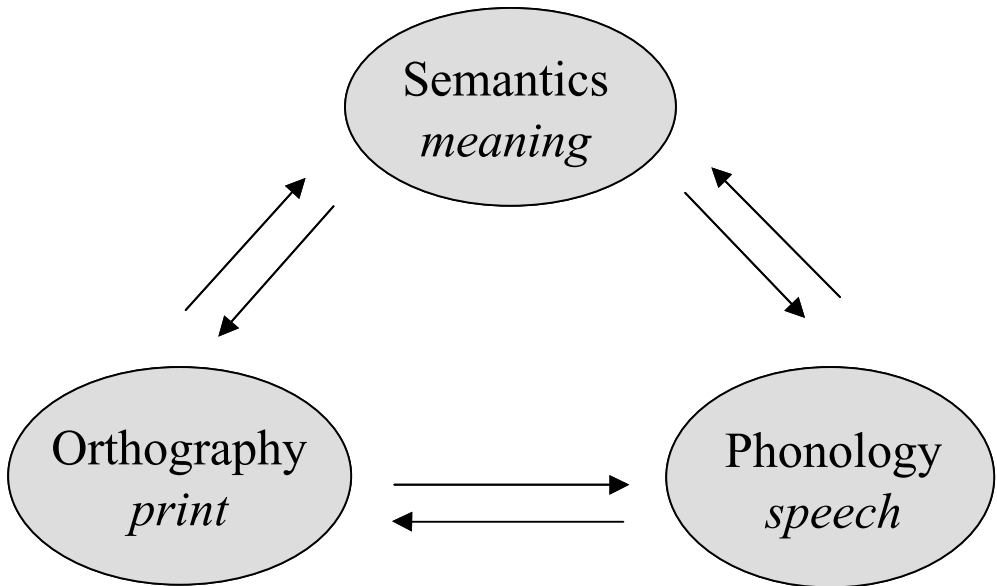


Figure 1. Triangle model of reading (after Seidenberg & McClelland, 1989). In this model, the mappings between orthography to phonology comprise the phonological *pathway*; mappings between orthography and phonology via semantics comprise the *semantic pathway*.

spelling-sound irregularities, learning to read appears to be an easier process; see Hanley *et al.*, 2004). Arguably, however, this model is limited for considering the risk of reading difficulties among children with spoken language impairments; the model is of single word reading but most reading takes place in context (words occur in the context of meaningful sentences and paragraphs). Language skills beyond phonology that encompass grammar and pragmatics are needed for making use of context.

In order to discuss the risk of reading difficulties among children with language difficulties it is important to begin by considering what studies of typical development have told us about the role of language skills in learning to read.

Muter *et al.* (2004) followed the early reading development of 90 children between the ages of 4-years and 9-months and 6-years and 9-months, assessing them annually on tests of letter knowledge, word recognition and phonological awareness (rhyme and phoneme). They were also given a test of vocabulary at 4-years, two tests of grammar at 5-years (one requiring the child to order words to make a sentence and one requiring them to inflect words in a morpheme generation task). Finally, reading comprehension was measured at the end of the study.

Figure 2 shows two simplified models (based on a statistical technique known as path analysis) of the developmental relationships that were found between children's early language and phonological skills and their later reading accuracy (word recognition) and reading comprehension skills. As the top model shows, there were two predictors of individual differences in word recognition at age 5:09; these were phoneme awareness and letter knowledge at age 4:09; and from age 5:09 to age 6:09 there were three predictors, phoneme awareness, letter knowledge and earlier word recognition. In short, phoneme awareness and letter knowledge appear to be two critical determinants of how easily children learn to read (in the sense of learning to recognize words) over the first two years of formal education. Thus, children who come to school knowing letters and being able to segment spoken words into speech sounds fare better in the reading stakes. As Byrne (1998) has argued, these two skills are fundamental to the alphabetic principle; but what then is the role of wider language skills beyond phonology?

Some further analyses addressed this question. The second model in Figure 2 shows the relationships between language and phonological skills, word recognition and reading comprehension. For reading comprehension (in contrast to the pattern found for word recognition) both vocabulary and grammatical awareness were important predictors of variations in this skill at age 6:09 together with earlier word recognition. Thus it seems that vocabulary and grammatical awareness together with basic word recognition measured at age 5:09 are the foundations of reading comprehension measured a year later (age 6:09).

With these findings as a back-drop, it is possible to make predictions about the risk of reading impairments in children; since phonological difficulties will affect the development of phoneme awareness and also affect the child's ability to learn letter sounds (a phonological learning task), children with poor phonology will be at risk of poor word recognition. On the other hand, wider language difficulties will place

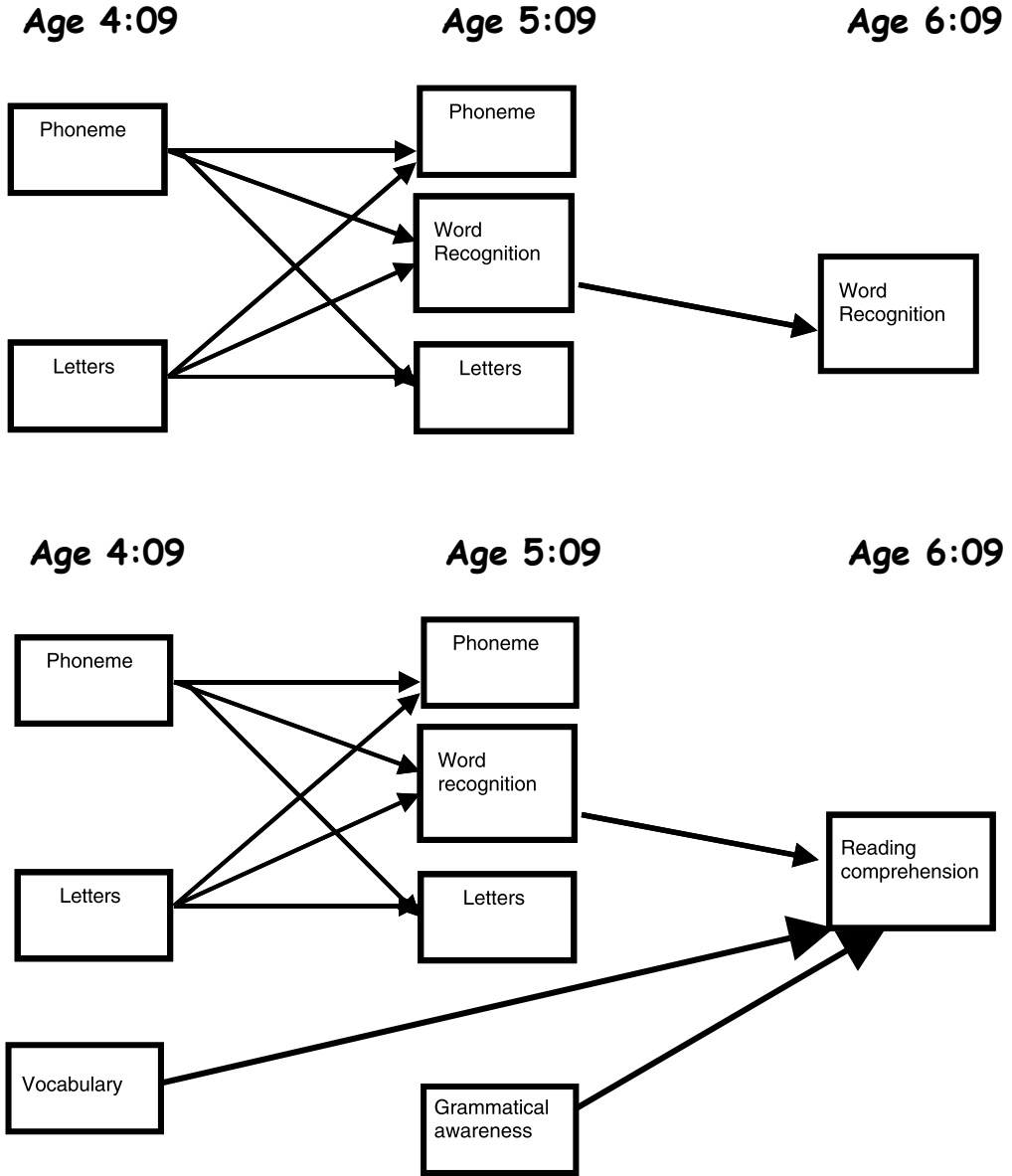


Figure 2. Path diagrams showing (a) the relationships between pre-school phonological awareness and later word recognition skills; and (b) the relationships between pre-school vocabulary, early grammatical awareness and later reading comprehension skills (after Muter *et al.*, in press).

children at risk of reading comprehension difficulties. However, identifying the predictors of reading among typically developing children is not the same enterprise as identifying who will become a poor reader. A range of factors both intrinsic to the child and environmental in origin can modify the outcome of a child who might be

considered 'at risk'. So what is the evidence from atypical populations of the association between different language deficits and different patterns of reading impairment?

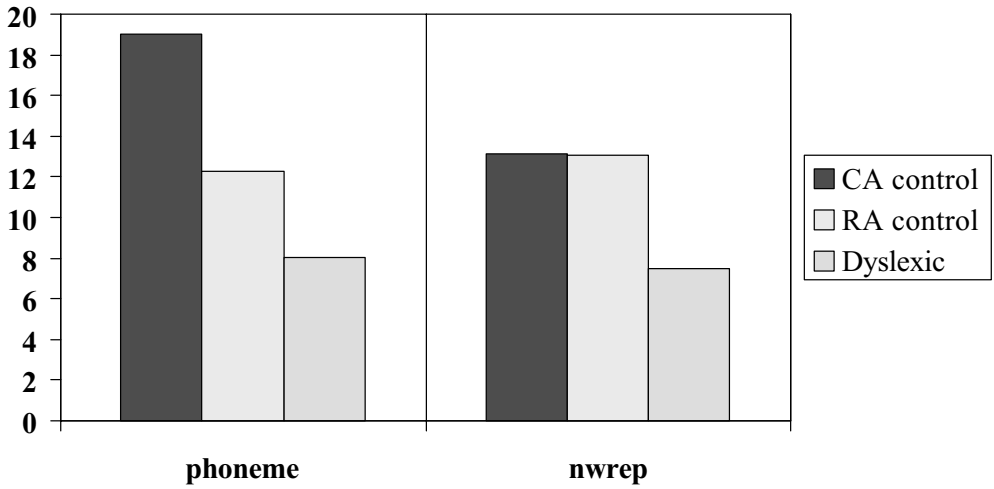
It is now well-established that children with dyslexia (who typically have word recognition deficits in the absence of poor comprehension) have phonological deficits. Figure 3 (panel a) shows the performance of children with dyslexia on a task in which they had to remove a phoneme from a spoken word (phoneme deletion) and in repeating non-words, compared with that of children of the same age (CA-controls) and younger children reading at the same level (RA-controls). The children with dyslexia showed impairments on both tasks in relation to both CA- and RA-matched controls. Perhaps less well recognized are the phonological learning difficulties of these children. Goetz (2005) taught children with dyslexia a set of Greek letter-names. Each letter was shown twice paired with its name, followed by 6 learning trials with feedback. Figure 3 (panel b) shows the performance of the children with dyslexia on the last trial of the experiment and after a short delay. Compared with children of the same age, they learned fewer letters and performed only as well as younger RA controls. Thus, given the problems children with dyslexia have in the two basic components of alphabetic skill (letters and phonemes), it is not surprising that they have difficulties developing decoding skills (the phonological pathway within the triangle model).

In contrast to 'dyslexia', some children show a reading impairment that has a specific effect not on decoding skills but on text comprehension—these children are often referred to as 'poor comprehenders'. Studies conducted by Nation and Snowling (Nation, 2005 for a review) suggest that these children's difficulties are in non-phonological language skills, such as vocabulary and grammatical processes. Thus, although poor comprehenders perform at the normal level on phonological tasks, as shown in Figure 4, they have problems of oral fluency in a task in which they are given a target word and have to generate semantically related words in a 30-second interval. They are also impaired when judging whether pairs of spoken words are similar in meaning, both in terms of accuracy and in the time it takes to make the judgements. Thus, poor comprehenders have an impairment of semantics that, within the triangle model, compromises the use of the semantic pathway. As a consequence they have subtle impairments of exception word reading but their use of the phonological pathway is unimpaired.

Findings from children with dyslexia and children with selective deficits of reading comprehension suggest that there is a degree of modularity in the developing reading system. Furthermore, they confirm that poor phonology should be considered a risk factor for problems of word recognition, whereas semantic impairments (principally poor vocabulary) carry the risk of poor reading comprehension. But pure disorders are rare in development and more commonly children's reading difficulties reflect the balance of their language strengths and weaknesses, modified by any interventions they have received.

The interaction of different language skills in determining the literacy outcomes of children at risk of reading failure can be seen clearly in a family study of dyslexia

Panel A



Panel B

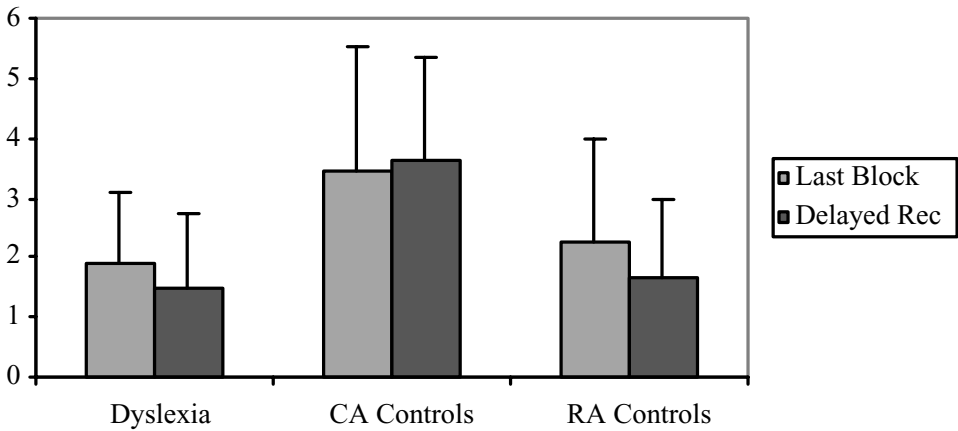
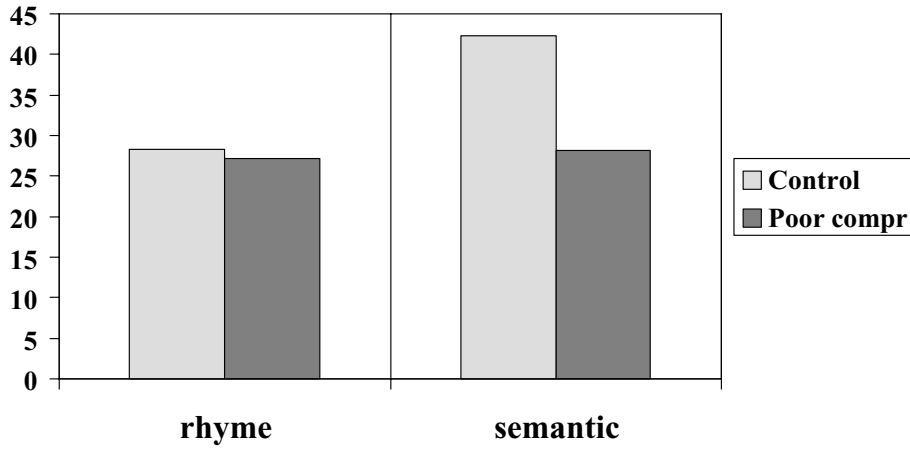


Figure 3. *Panel A.* Performance of children with dyslexia compared with CA- and RA- controls on tests of phoneme deletion and non-word repetition, showing that the children with dyslexia are impaired (from Marshall *et al.*, 2001). *Panel B.* Performance of children with dyslexia on the last block of trials of a letter learning experiment and after a short delay; the children with dyslexia learned fewer letters than age-matched (CA) controls (Goetz, unpublished).

recently reported by Snowling *et al.* (2003). This study followed the progress of pre-school children, recruited just before their fourth birthday, who were considered ‘at risk’ of dyslexia. The risk in this case was carried by virtue of the fact that they had a

Panel A.



Panel B

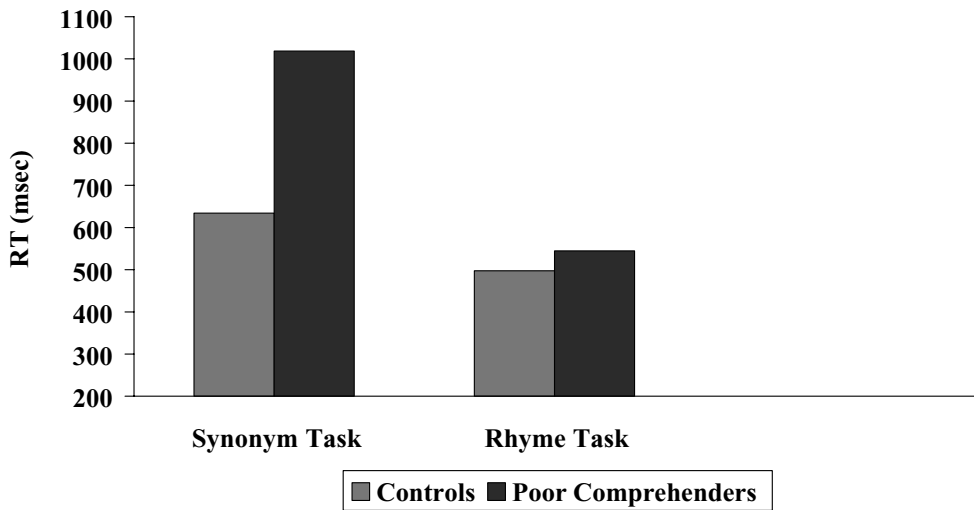


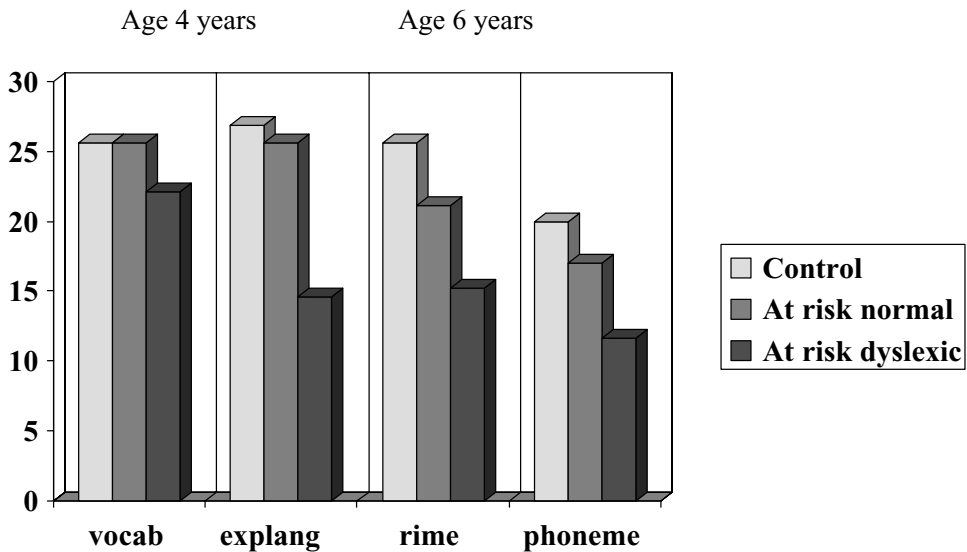
Figure 4. *Panel A.* Performance of poor comprehenders on a test of oral fluency. The poor comprehenders showed normal rhyme fluency but impaired semantic fluency. *Panel B.* Performance of poor comprehenders on aural tests of synonym and rhyme judgement. The poor comprehenders showed normal rhyme but impaired semantic judgements (after Nation & Snowling, 1998).

parent with a history of reading difficulties, although it is interesting to note that some 38% of these children were late talkers. A point of note about the children in this sample was that they did not show the typical highly restricted modular deficit in phonological skills that characterizes research samples of children with dyslexia who are recruited at school age but instead showed evidence of broader language weaknesses (that included phonological weaknesses).

The children in the 'at risk' study were assessed at 4-, 6- and 8-years on a large battery of tests of language and reading-related tasks. At each point in time they were compared with children in a control group who came from families who had no history of reading impairment but were similar in terms of socio-economic circumstances. As predicted, at 8-years, there was an increased risk of poor reading and spelling among the children at family risk of dyslexia. The definition of poor literacy that was used was having literacy skills significantly below the average of the control group of similar SES (by one standard deviation). In relation to this norm, 66% of the family sample was affected. It was then possible to compare the developmental profiles of the at-risk affected children (who will be referred to as dyslexic), those 'at risk' children who became normal readers and the control group (removing four cases of dyslexia). Figure 5 (panel a) shows the performance of the three groups of children on language and phonological tasks at 4- and at 6-years-old. At 4-years, the oral language development of the dyslexic children was slow compared with that of the two normal reader groups. At 6-years, the dyslexic group were already showing difficulty with phonological awareness tasks, particularly phoneme awareness, after only a short time of reading instruction. On phonological awareness tasks, the 'at risk' normal readers were not statistically different from the control group, but it is interesting to note that there was a trend for them to be slightly worse that was not seen for oral language development. Figure 5 (panel b) shows performance of the groups on tests of early literacy skill. Here the picture is somewhat different. As expected, the children with dyslexia were impaired in letter knowledge and on a test of phonic skill (literally the number of words they were able to write correctly in a spelling test). However, the performance of the 'at risk' children who went on to be normal readers was also worse than that of controls; it was midway between that of the controls and the children with dyslexia on the test of letter knowledge and as poor as the affected group on the phonetic spelling test.

In summary, the 'at risk' children who went on to be classified as 'dyslexic' had impairments on a wide range of measures including phonological awareness and letter knowledge and extending to other measures of oral language, such as vocabulary and expressive grammar. The 'at risk' children who went on to be normal readers were as poor as the children with dyslexia in tasks tapping the use of the phonological pathway and they were moderately impaired in letter knowledge, but their (non-phonological) oral language development was normal. Since these children did not succumb to reading deficits at 8-years, it must be assumed that they were able to compensate for the phonic decoding deficit they experienced, possibly by relying on their good language skills. In terms of the triangle model then, the

Panel A



Panel B

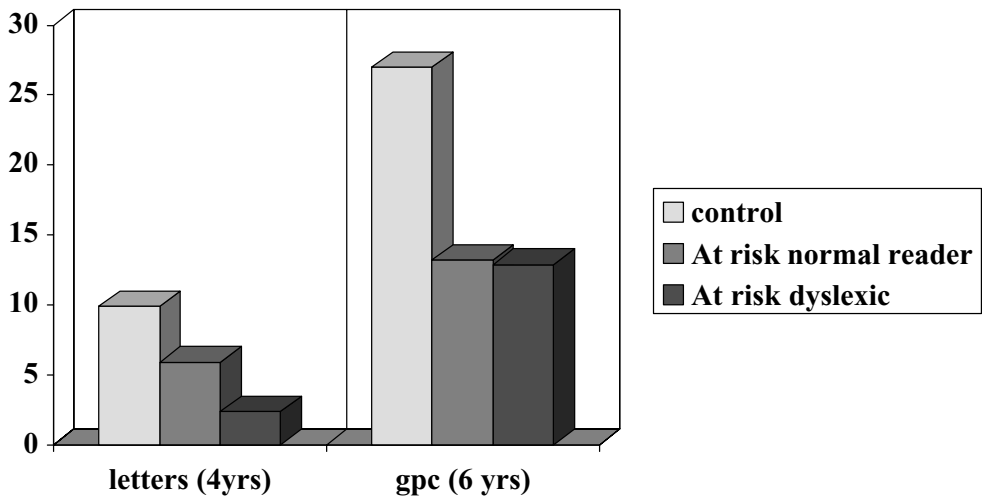


Figure 5. Early language and literacy skills of children at high-risk of dyslexia and controls. *Panel A* shows that the ‘at risk’ children who went on to be dyslexic were delayed in their early language development (at 4-years) and in the development of phonological awareness (at 6-years). *Panel B* shows that the ‘at risk’ children who went on to be normal readers at 8-years showed early literacy problems; their letter knowledge was moderately impaired at 4-years and they were impaired in translating between graphemes and phonemes at 6-years (after Snowling *et al.*, 2003).

at-risk normal readers showed a selective impairment of the phonological pathway at 6-years, which was compensated by the age of 8-years.

It follows that the risk of reading impairment is not all or none. Among the children whose parents are dyslexic, there are at least four different outcomes. These include first, a pervasive reading impairment affecting both word recognition and reading comprehension associated with poor language, second classic dyslexia, third a 'hidden' (compensated) reading impairment and fourth a pattern of normal reading. It seems that the developmental outcome for a child at risk of poor reading depends not only on how severe their phonological difficulties are, but also on the other language skills they bring to the task of learning. Those who have good vocabulary and wider language skills are likely to be able to compensate better, modifying the genetic risk they carry of becoming dyslexic.

Another potentially protective factor for children at risk of reading failure is early intervention. Hatcher *et al.* (2004) attempted to circumvent the development of reading problems in children who entered school with poor vocabulary and poor phonological awareness. This study involved 20 schools in which we trained the reception and Year 1 teachers to deliver an intervention that involved teaching reading using a highly structured phonic approach in which children are taught to link letters and sounds in the context of their reading. In addition, some children in the study had the reading programme supplemented with *oral* phonological awareness training.

The design of the study was as follows: there were four matched groups; one received reading intervention comprising phonic reading alone (PR), one received PR together with training about the rhyming relationships between words, one received PR and training in phoneme skills and a final group received PR and training about phonemes and rimes. To clarify, all children received the same reading programme over five terms during the first two years in school; the rhyme group had rhyming activities, the phoneme group phoneme manipulation activities and the combined group worked with both rimes and phonemes.

Two points need to be made about the results. First, for children who were *not* at risk of poor reading, supplementing the phonic reading programme with training in oral phonological awareness made no difference; it was not needed. These children appeared to learn to read very well using the phonic teaching programme that encouraged them to sound out words and to use context without oral training that was used in this study. For these children giving additional oral phonological training was not necessary to ensure they learned to read well. In contrast, for the 'at risk' group, supplementing the programme with phonological awareness training was helpful.

Figure 6 shows the effects of the early intervention for the 'at risk' children by plotting their performance in standard scores at each time point relative to the non-at-risk mean. It shows that children who received only reading tuition show a widening gap between their performance and that of their peers. However, supplementing the programme with phonological training led to a stemming of this decline; this upturn occurred earliest for the programme that involved training phonemes. The

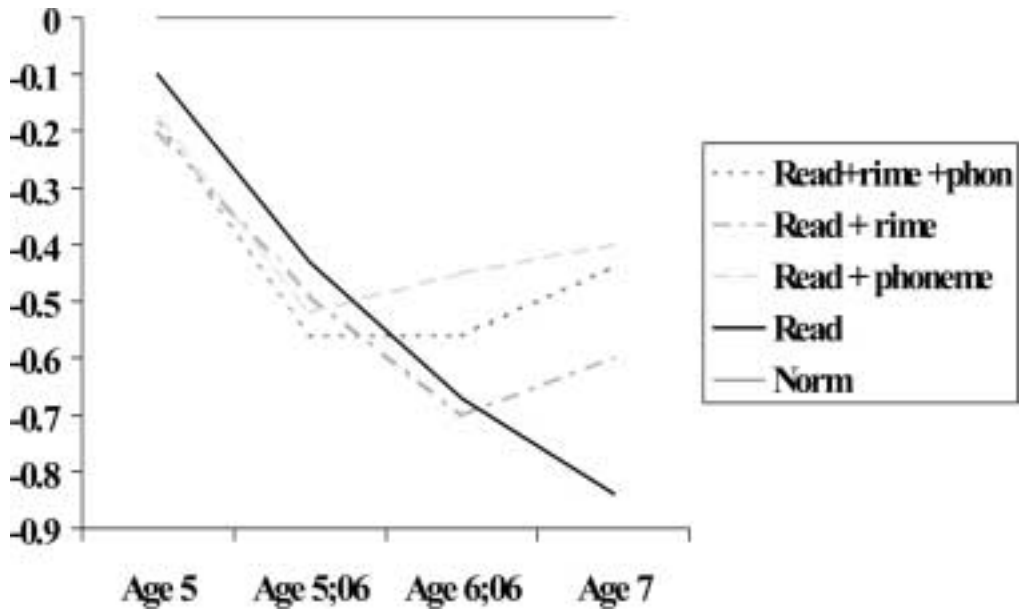


Figure 6. Reading attainments of children at risk of poor reading, relative to controls, during the first two years in school. The graph shows there is a widening gap between the skills of the ‘at risk’ group and their peers. However, the gap is shown as beginning to close in response to a phonic reading intervention supplemented by phonological awareness training (after Hatcher *et al.*, 2004).

programme that was used in this study was delivered in the first two years of school but on a whole-class basis. The findings, although positive, suggest that whole-class instruction is not sufficient to prevent the development of reading difficulties in children who are at-risk of reading problems. Such children may need more intensive intervention individual or small group teaching to prevent them going on to develop reading difficulties (Torgesen, 2005).

One example of an approach that targets the reading skills of children in their second year in school who are developing reading slowly is the UK’s Early Literacy Support (ELS) programme (DfES, 2001). The programme provides training in phonological and grapheme linkage skills and segmenting and blending words in reading and writing. Children also learn the sounds and names of letters, learn to read and write common words and are encouraged to use phonic and other strategies to check and self-correct words read or written in text. They also undertake guided text reading and writing exercises.

Hatcher *et al.* (in press, a) evaluated the efficacy of the ELS in comparison to a modified version of the reading intervention (RI) programme discussed above (Hatcher *et al.*, 2004). The rationale for this approach was that the RI programme when delivered on an individual basis to reading delayed 7-year-old children had proved highly effective (Hatcher *et al.*, 1994). By modifying this approach for use with younger children, and by combining individual and small group teaching, the

intention was to obtain an intervention that was effective for children struggling with the early stages of learning to read.

At the end of the 12-week intervention, both groups of children (the ELS and the RI groups) had made significant and equivalent gains in letter knowledge, phoneme awareness, reading and spelling skills that were maintained at follow-up three months later. Moreover, the gain in reading skill evidenced in both groups brought the children to the average level for their age. The findings of this study established that a reading intervention programme that combines training in phoneme awareness, letter knowledge and text-level skills in an integrated approach can be effectively delivered by trained teaching assistants who were supported during the intervention. The next issue was whether such an approach could be effective for children with more severe difficulties in learning to read.

The final study that will be reported here examined the efficacy of this approach for 5- to 6-year-old children who were selected for being in roughly the bottom 8% of the population for reading development (Hatcher *et al.*, in press, b). The study used a randomized controlled trial design to provide a rigorous evaluation of this method of teaching. Essentially, children who received the intervention for a 20-week period (20-week intervention group) were compared with children who acted as a 'waiting-list' control group for the first 10-weeks and who then received the teaching during weeks 10–20 (10-week intervention group).

The results of the study were very encouraging. After just 10 weeks of teaching the children receiving the intervention had made gains of nearly four standard score points on a test of single word reading ability, compared to controls in a 'waiting list' control group. In the subsequent 10 weeks of the study when both groups of children received the intervention, the progress of the children who had received the first phase of intervention slowed down and the 10-week intervention group effectively caught up with them, once they were given the intervention.

Although the average gain in reading skills in this intervention was impressive, it is important to stress that it should not be considered a 'quick fix'. Twenty-eight per cent of the 20-week intervention group and 21% of the 10-week intervention group had standard scores below 80 at the end of the intervention. Such children clearly require ongoing support if their literacy skills are to be brought to within the average range. Moreover, children varied in their responsiveness to the teaching they received and a small number of children 'resisted' treatment. Such children will need to be given ongoing support to help improve their literacy skills.

Conclusions

We began by distinguishing the role of speech and of language skills (particularly vocabulary knowledge and grammatical skills) in the development of reading, arguing that speech skills (phonology) are the foundation of word recognition processes in reading while language skills are critical to language comprehension.

The findings from the study of children at risk of dyslexia suggest that speech and language skills work in interaction to determine literacy outcomes. At the core of reading difficulties are phonological problems, but children with good language skills beyond phonology can use these to bootstrap their ineffective phonic skills probably by using context in reading. We propose that this is why interventions that train phoneme awareness and at the same time encourage children to make full use of phonological, semantic and syntactic cues in text are effective for children with reading difficulties. More research is required to address the most appropriate interventions for children who fail to respond to such ‘treatments’ and for those whose reading difficulties affect comprehension rather than decoding (Catts & Kamhi, 2005).

Notes on contributors

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Charles Hulme is a Professor in the Department of Psychology at the University of York. His research interests are in the mechanisms of short term memory, and in reading development and disorders. He was awarded the International Reading Association’s award in 1998 for work on reading intervention.

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