MIND, BRAIN, AND EDUCATION

Risk Factors for Dyslexia: Addressing Oral Language Deficits

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ABSTRACT— Studies of children at high risk of dyslexia demonstrate that oral language difficulties are a major risk factor for poor reading and that children who enter school with poor language are likely to struggle to become proficient readers. We review findings of studies of oral language intervention against a backdrop of research showing that language skills are the foundation for learning to read. Language screening to identify at-risk children, followed by language intervention delivered as a "pull-out" program, can improve oral language skills with positive effects on later reading and behavior in school as rated by teachers. The fidelity of delivery of such programs depends upon educators receiving appropriate training and support during delivery.

Ever since Vellutino's landmark book in 1979, it has been recognized that dyslexia is characterized by verbal deficits. These deficits have primarily been associated with impairments in the phonological system of language (Melby-Lervåg, Lyster, & Hulme, 2012; Vellutino et al., 2004). In this paper, we argue that this is too narrow a view. Although phonological deficits are the proximal cognitive cause of dyslexia, broader oral language skills set the stage for learning to read and are a critical foundation for all of education. Indeed, children who come to school with poor language are at high risk of difficulties in both word reading and comprehension skills (Bishop & Adams, 1990; Catts, Fey, Zhang, & Tomblin, 1999). We go on to discuss how such language difficulties can be addressed by describing a series of randomized controlled trials (RCTs) assessing the effectiveness of early language intervention. Dyslexia appears to be the outcome of multiple risk factors, and it often co-occurs with developmental language disorder (DLD; Bishop & Snowling, 2004; Adlof & Hogan, 2018). Children's language difficulties must be addressed if they are to learn to read well and succeed in school. Thus, to move forward in designing and implementing reading interventions and early preventive programs to reduce the risk and severity of reading difficulties, language must play a crucial role—not just for prediction but as a critical context and a key factor in the interventions themselves.

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STUDIES OF CHILDREN AT RISK OF DYSLEXIA

Longitudinal studies of children at risk of dyslexia who are assessed in the preschool years prior to reading instruction provide a relatively unbiased method for identifying the precursors of reading disorder (RD). There have now been several such studies following the development of children at family risk of dyslexia because they have a first-degree affected relative (usually a parent). A meta-analysis of these studies indicated that weak language skills, as well as difficulties in phonological processing, can be observed in children of dyslexic parents, predisposing them to reading difficulties (Snowling & Melby-Lervåg, 2016). As a group, these children show large deficits on measures of vocabulary, grammar, phonological memory, and rapid naming, as well as phonological awareness relative to not-at-risk controls. Importantly, language appears to act as a risk factor—the conclusion from this meta-analysis is that when language difficulties persist to the point of school entry, the chance of dyslexia increases significantly.

To investigate more directly the relationship between language development and dyslexia, we conducted a 5-year longitudinal study of children at family risk of dyslexia alongside a group of children with language difficulties who were referred to speech–language therapy clinics (identified

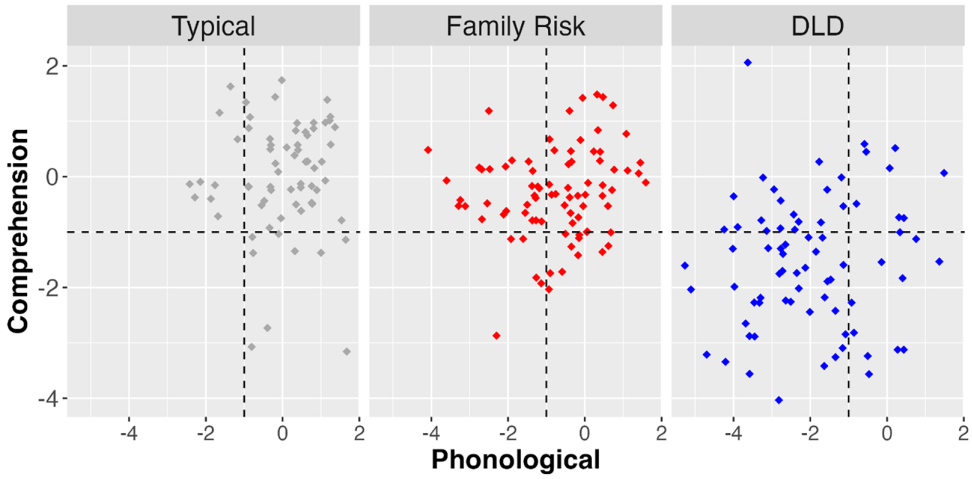

Fig. 1. Language Profiles at 3–4 years for children at risk of dyslexia (middle panel), DLD (Right panel), and controls with typical development (left panel).

by the research team as having DLD) and a group of low-risk typically developing children who acted as controls (the Wellcome Study of Language and Reading; Snowling, Nash, Gooch, Hayiou-Thomas, & Hulme, 2019). We followed the children from 3½ to age 8 years, at which time they were classified as reaching criteria for dyslexia or not (defined as scoring 1 SD below the mean of the control group on a composite measure of reading and spelling).

Following recruitment, each child was assessed on a comprehensive battery tapping expressive and receptive language skills as well as phonological processing (as measured by tests of word and nonword repetition), and speech production (accuracy of naming pictures). These tests were used to confirm the classification of the groups: children with DLD (described at the time as specific language impairment (SLI) (Bishop et al., 2017)) had scores at least 1 SD below the mean in two out of four language tests (vocabulary, sentence repetition, language comprehension, or past tense generation); children at family risk of dyslexia varied in their language skills and were therefore divided into two groups—children at family risk (with or without language impairment); and the children in the control group were free of language difficulties. The preschool language profiles of these groups differed as shown by the scatterplots in Figure 1 where language skills are plotted against performance on phonological processing. In these plots, we pooled data across the two groups with language disorder (those with or without family risk of dyslexia) because essentially, they showed no differences at this stage of development.

Figure 1 shows that there is considerable variability among the children in the three groups in this preschool period. The majority of the typically developing children have average phonological and language skills, with only a few outliers; in contrast, there are a substantial number of children with phonological difficulties in the group at family risk of dyslexia. Finally, the children in the group with DLD also had phonological processing difficulties. If the core deficit in dyslexia is in phonological processing, then it follows that both the family risk and the language disorder groups are likely to develop reading difficulties.

In line with this hypothesis, assessments of reading and spelling at age 8 indicated that 7% of the typically developing group, 26% of children at family risk of dyslexia, and 66% of the DLD group were identified as dyslexic. It is notable that the risk of dyslexia was greatest for the DLD group, who had both phonological and wider language difficulties; it can be concluded that, in addition to phonological deficits, oral language difficulties place a child at high risk of dyslexia.

LANGUAGE AS A FOUNDATION FOR LEARNING TO READ

Bishop and Adams (1990) proposed that poor language at school entry may work as a synergistic factor increasing the risk of poor reading when present in addition to phonological difficulties. While this idea fits with the data from our family-risk study, how can we conceptualize the mechanisms that are involved?

To understand the predictors of individual differences in learning to read, we pooled data from the three groups (260 children) and modeled the developmental relationships between language at 3½ years (t1), prereading skills at 4½ years (t2), word reading at 5½ years (t3), and reading comprehension at 8 years (t5) using latent variable models (Hulme, Nash, Gooch, Lervag, & Snowling, 2015).

Language as a Predictor of the Foundations of Reading

At time 1 (t1) we had measures of seven language-related skills (the four used to classify the children plus word and nonword repetition, and speech articulation); these all loaded onto a single language factor with particularly strong loadings for the four nonphonological tasks. Residual variance from tests of word and nonword repetition and speech articulation loaded onto a secondary factor which we labeled as a speech factor. We found that the language factor at time 1 (but not the speech factor) was a strong predictor of phoneme awareness, letter knowledge, and rapid naming at age 4½ years. That is, language at age 3½ years predicts the three most well-established predictors of the growth of decoding skills at the point of entry to school.

Predictors at School Entry of Individual Differences in Reading

In the United Kingdom, children enter school in the year before their fifth birthday. We examined the role of prereading skills at age 4½ as predictors of later reading. Two of the three prereading skills (phoneme awareness and letter–sound knowledge) that form a "triple foundation" of reading predicted word reading (including measures of decoding) a year later. Finally, we tested the role of language and word reading in predicting reading comprehension at age 8. As expected, based on the Simple View of Reading (Gough & Tunmer, 1986), word reading at age 5½ years and language skills at 3½ years were strong predictors of reading comprehension at age 8 years.

Although it is recognized that language is fundamental to literacy (Adlof & Hogan, 2018), the long-term prediction of reading comprehension at age 8 from language skills, assessed well before school entry, is quite remarkable. Our findings underline the fact that language is a critical foundation for learning to read. Thus, the unitary language factor (and not the speech factor) predicted variance in prereading skills, and most strongly for phoneme awareness. Next, phoneme awareness and letter–sound knowledge together predicted word reading accuracy—in fact, the effects of language on word-level reading were entirely mediated by these two skills, and language had a longer-range effect on reading comprehension.

What implications do these findings have for the identification and treatment of reading difficulties? More specifically, could early screening for language skills help to identify children at risk of developing dyslexia later?

To address this question, it is important to go beyond group data and to assess the risk of dyslexia in individual children. Thompson et al. (2015) examined this issue in the same sample, including many children at family risk of dyslexia, using different combinations of risk factors, measured at different ages, to predict the probability of a dyslexic outcome. Here, we focus on family risk and language-related skills as predictors of dyslexia at 8 years. At all ages, family risk of dyslexia was a strong risk factor. At 3½ years, children with poor language had a 60% risk of developing dyslexia, and this was elevated further if they were also at family risk. Importantly though, by 6 years of age, language was an extremely strong predictor, with poor language being associated with an almost 95% risk of dyslexia. At the same time point, a composite score of letter knowledge, phoneme awareness, and rapid automatized naming (RAN) also gave an almost perfect prediction. These findings underline the close coupling between measures of oral language and more widely recognized proximal risk factors for dyslexia (letter knowledge, phoneme awareness, and RAN).

If language is the foundation for literacy, a natural question which follows is why early (preschool) language is not a stronger predictor of dyslexia outcome at age 8? The answer to this depends upon an appreciation of language trajectories through the preschool years. Snowling, Duff, Nash, and Hulme (2016) reported four different developmental trajectories from 3½ through 8 years that were observed in the children in the Wellcome study: While some children showed "flat" profiles with either typical development or persistent language difficulties, there were also two other patterns of development. One group who were classified as having DLD at time 1 (age 3½ years) resolved their language difficulties by age 5½ years while another group started out with language skills in the typical range, but their language skills declined to as low a level as the group with persistent DLD at age 5½ years. Data are not available as to whether those who resolved their difficulties did so as a result of intervention. Regardless, it was children who presented with language difficulties at school entry (whether early or late arising) who were at higher risk of poor reading. Arguably then, there is a short window of opportunity around school entry when language intervention is needed to ensure the vital building blocks are in place for learning to read. Such interventions, if well implemented, are likely to reduce the later risk of both decoding and reading comprehension difficulties (see Vaughn & Compton, this issue).

COMORBIDITY AND CUMULATIVE RISK

Although it is now well established that the core deficit in dyslexia is in phonological processing, our findings suggest that, for many children, these impairments have their origin in oral language delays and/or difficulties. Similar findings were reported many years ago (Rutter & Yule, 1975) as characterizing the early developmental milestones of children with specific reading difficulties. More broadly, theories of dyslexia now posit that the RD is the outcome of multiple deficits (e.g., Pennington, 2006); a key question within this

view is whether the risks associated with poor phonology can be separated from the risks associated with poor language.

To elucidate these issues, we investigated the developmental pathways taken by children in our sample who had different outcomes: namely dyslexia, DLD or comorbid DLD and dyslexia (Snowling et al., 2019). Here, we focus on the differences between these three outcome groups compared with a comparison group of controls without reading or language problems during the preschool and early school years.

From preschool (t1, t2) through the transition to school (t3), there were similarities and differences between the three outcome groups. Children with DLD showed impairments in language skills throughout this period, whereas children with a dyslexic outcome (without DLD) had language skills within the typical range. The pattern was different for phonological skills: On tests of phonological memory and phoneme awareness, the children who went on to be dyslexic were impaired—though more mildly than the group with DLD and dyslexia—this was also true of performance on rapid naming tasks (RAN). Over this time period, there was an interesting difference between the two DLD groups: While the DLD-only group was as impaired as the comorbid DLD + dyslexia group on phonological tasks and RAN in preschool, their impairments appeared to lessen around the time of school entry. In short, a stable pattern of phonological impairment and RAN deficits was seen in the children who went on to fulfill diagnostic criteria for dyslexia, whereas a resolving pattern was observed among children with DLD who experienced only mild decoding difficulties.

Similarly, a dissociation between the groups was observed on measures of reading comprehension at age 8 years (Snowling, Hayiou-Thomas, Nash, & Hulme, 2020). Perhaps surprisingly, the group with dyslexia-only experienced relatively mild difficulties with reading comprehension, in contrast to children with DLD who showed relatively severe reading comprehension difficulties, with the most severe difficulties experienced by the comorbid DLD + dyslexia group who had both decoding and language difficulties. Reading comprehension difficulties were particularly likely among children who had language difficulties at school entry (irrespective of whether DLD emerged early or late). They were much less common among children whose language difficulties had resolved.

Together these findings suggest a modified version of the Simple View of Reading. Arguably, the view is too simple (Lervåg, Hulme, & Melby-Lervåg, 2018) because language is the foundation of decoding *as well as* reading comprehension. Its effects on word decoding are mediated by phoneme awareness and letter knowledge (components of the alphabetic principle), whereas it has a direct effect on reading comprehension. Within this view, the developmental trajectories of language skills differentiate dyslexia and DLD and determine which children succumb to poor reading comprehension.

However, while difficulties in language and phonological skills are major risk factors for dyslexia, they differ in the timing and severity of their impact (Thompson et al., 2015). School entry is a critical phase for literacy development; children with persistent speech–language difficulties, including DLD, are at high risk of poor reading (Bishop & Adams, 1990; Snowling et al., 2016). Furthermore, there is little evidence in our view that common comorbidities, such as executive or motor deficits, are direct causes of dyslexia (e.g., Malone, Pritchard, & Hulme, 2022).

Together these findings provide a strong rationale for the early identification of children's language difficulties and interventions to better prepare them for learning to read. Speech and Language Pathologists can play a key role. Thus, we turn to consider the efficacy of oral language interventions and whether they can make a difference to the language and literacy outcomes of "at-risk" children (see also Gilliam, Gilliam, vanDijk, Robert's, Capin & Vaughn, this issue). We begin by discussing the development and evaluation of an intervention for delivery to children with poor language shortly after school entry, the Nuffield Early Language Intervention (also known as NELI), and proceed to consider a preschool intervention.

The NELI Program

The NELI program is a 20-week oral language intervention that was initially developed for children entering school with poor oral language skills (Bowyer-Crane et al., 2008). Children are identified to receive the program following whole class screening. NELI is delivered by trained teaching assistants (TAs, referred to as Teacher Aids, in the United States) in small group and individual sessions; it is a fully scripted program designed to promote the development of narrative, vocabulary, and listening comprehension skills. In the second half of the program, training in letter–sound knowledge and phoneme awareness is incorporated into the sessions to help provide a foundation for phonic reading instruction (it should be noted that in England, systematic phonics teaching is mandated as part of the mainstream primary school curriculum); the NELI program was designed to help support phonics reading instruction, but the program does not include any direct reading instruction.

Arguably, a RCT provides the clearest evidence for the efficacy of an intervention and evidence for the average casual effect (Tipton & Patton-Terry, this issue). In an RCT, participants are randomly assigned to either receive the intervention being evaluated or to a no treatment (business-as-usual) or alternative treatment condition. Random assignment of participants to treatment arms controls for any differences between the groups in known

or unknown variables that might affect response to treatment. The efficacy of NELI has been assessed in four RCTs (Snowling et al., 2022); in three of these, following a screening of children entering school with poor oral language, children were randomly assigned either to intervention or to business-as-usual conditions, each with ethical permission from the appropriate research board. The fourth compared the impact of NELI with that of a program aimed at developing strong prereading and word decoding skills. Each of these trials showed that NELI is effective and produces moderate to large gains in oral language skills for children who receive it. Such replication increases confidence in the efficacy of the findings (Leung, Logvinenko & Schmalz, this issue). In addition, an independent evaluation of the implementation of NELI at scale found that children receiving the program made 5-month progress in language skills over the 20 weeks, with larger effects for disadvantaged children in receipt of free school meals (Smith, Staunton, Sahasranaman, & Worth, 2023). Moreover, the trial reported by Fricke, Bowyer-Crane, Haley, Hulme, and Snowling (2013) found that children who received the NELI intervention both in preschool (10 weeks, small groups) and after school entry (20 weeks in alternating small group and one-to-one teaching) showed better reading comprehension than controls who received business as usual, at follow-up some 6 months later. Furthermore, the gains in reading comprehension were fully mediated by gains in language skills.

Arguably, the success of NELI depends on two factors. First, the availability of a language screening tool to identify children who will benefit from the program (e.g., Hulme et al., 2024). Second, access to training for teachers and other professionals, not only to deliver the intervention but also to better understand the structure of language and, importantly, how their own use of language can promote richer dialogue. Related to this, a critical aspect of NELI is its emphasis on encouraging and supporting children's own language production and narration using scaffolding and recast strategies (e.g., Cirrin & Gillam, 2008; Gilliam et al., this issue). Another important feature is its emphasis on active listening and sitting quietly while others are talking. We found that children who receive NELI were rated by their teachers as having improved their behavior (West et al., 2022). It appears that these improvements in behavior result from the time children spend in the highly structured but enjoyable NELI sessions. These improvements in behavior were unexpected, but important, as they should increase a child's ability to learn in the mainstream classroom, over and above that of improved language.

THE SUSTAINABILITY OF LANGUAGE CHANGE

A key issue for education is the uptake of interventions following effectiveness trials. Implementation science is increasingly turning attention to how external factors, such as government policy and community engagement, together with factors internal to an intervention; for example, the availability of quality resources, the confidence of the educators delivering it, and its cost-effectiveness are predictors of how well an intervention will be sustained (e.g., Komesidou & Hogan, 2023; Newbury et al., 2022). Further, a significant factor not only in adopting but also in sustaining an intervention will be its longer-term effects. Generally, the outlook in the longer term might be considered pessimistic in that many successful educational interventions "fade-out" over time (Bailey, Duncan, Cunha, Foorman, & Yeager, 2020; Bus & van IJzendoorn, 1999). Thus, an outstanding issue for the delivery of NELI was whether its impact would be maintained over time.

To address this issue, we used data from a 2-year follow-up of children who participated in an effectiveness trial of NELI in some 100 schools (West et al., 2021). Although the follow-up suffered substantial sample attrition, this affected intervention and control groups equally, and an appropriate statistical technique (nearest-neighbor matching) was applied to minimize bias (Hulme et al., 2025). Findings showed that 2 years after the intervention was completed, there remained educationally significant effects of intervention on language skills ($d = 0.23$), and smaller effects on word reading and reading comprehension skills ($d = .16$).

Thus, NELI not only improves the oral language skills of its beneficiaries, but these effects appear to endure for at least 2 years and to generalize to improvements in reading skills. Although its short-term effects are different from those of more conventional support with early reading (e.g., Bowyer-Crane et al., 2008; Clements, Vaughn, Robert's & Barnes, this issue), we speculate that when delivered alongside systematic structured phonics, it can boost the efficacy of such approaches as children move from simple decoding through learning to read words to reading to learn (cf Steacy. Kellenberger, Dozier & Compton, this issue).

Finally, a key question for policy makers is whether the very positive effects of an intervention generalize beyond the RCT when delivered at scale in regular classrooms. Since 2020, with funding from the UK Government's Department of Education, over 40,000 educators have received training, 600,000 LanguageScreen assessments have been conducted, and approximately 100,000 children have received NELI in England. This rollout provided the opportunity to evaluate this wider implementation of NELI. This was completed in a quasi-experimental study using a Regression Discontinuity design. The findings were positive and in line with those of the controlled studies: Children who received NELI showed improvements in language skills of similar size to those found in the West et al. (2021) RCT.

EARLY INTERVENTION IN THE PRESCHOOL YEARS

The NELI program addresses the language needs of children in the first year in school. Arguably, this may be late for some children, particularly those whose home backgrounds are not language-rich or in which a language is different from that of school. As Bishop and Adams (1990) initially proposed, there is a critical age for language development in relation to literacy, and we would suggest, therefore, there is a short window of opportunity to intervene.

As language skills develop rapidly in preschool, this may make it a good time both to enrich language learning for all children and to identify children who are slow to develop. With this in mind, we developed a preschool language intervention that combined whole-class language enrichment and individualized support for "at-risk" children between the ages of 3 and 4 years (West et al., 2024). This intervention is a fully scripted 20-week program built around the principles of shared book reading and guided play. Principles of dialogic reading are used with both fiction and nonfiction books, and related activities include vocabulary instruction and extension. As in NELI, the program builds children's narrative skills and uses both scaffolding and recasting to help them retell the stories they have heard. Children's language skills are screened before the intervention begins, and those with weak language are identified for small group and individual support.

The intervention (with associated online training of those who would deliver it) was evaluated using a cluster RCT in which 70 classes and approximately 1,500 children participated. There were three whole-class enrichment sessions (10–15 min) each week; the children with the weakest language skills in each setting also received additional targeted support in three group sessions (10–15 min each) and one individual session (10 min) for intensive work on the new vocabulary and to encourage the retelling of the stories with related activities to facilitate their communication.

We assessed the efficacy of the intervention separately for the children who received enrichment and for the six children in the classes who received extra targeted support. The intervention was effective for both groups, with the impact being larger for the children who had only received whole-class enrichment ($d = 2.6$) than for the children who received the extra support ($d = 1.59$). While both these gains may be regarded as educationally significant, at first glance this result might seem surprising; the children who got the most important language enriched input made the least progress. Two possible reasons can be offered for this finding: First, the severity of language difficulty is confounded with treatment here, and it may be the case that children with the most severe impairments needed even more support; the second is that the children in the targeted groups were simply insufficiently mature to access the help. Future research will be needed to establish the causes of these differences.

PATHWAYS FOR CHILDREN WITH LANGUAGE DIFFICULTIES

According to the Simple View of Reading, reading comprehension is the product of decoding and language comprehension. We argue for an extension of this view—language is critical for *all* aspects of learning to read. We have shown elsewhere that language screening can provide a reliable tool that teachers can use for identifying children in need of language intervention (Hulme et al., 2024) and that language intervention can improve the language skills of children in the early years of education (West et al., 2021; West et al., 2024). However, we believe that it is unrealistic to imply that a 20-week language intervention can circumvent the difficulties of children with severe language difficulties (e.g., DLD) or prevent dyslexia. Such children are likely to require ongoing support, including more specialized help from speech–language pathologists or reading specialists. For others, it is likely that later oral language intervention may further safeguard the development of reading comprehension (see, e.g., Clarke, Snowling, Truelove, & Hulme, 2010).

CONCLUSIONS AND FUTURE DIRECTIONS

For many years, understandably, reading researchers have focused on the predictors of individual variation in reading and used emerging scientific understanding to develop programs of reading instruction and intervention, increasingly with a global perspective. Arguably, oral language intervention has assumed a secondary role, often reserved for children with special educational needs rather than those who come to school with poorer command of the language of school than is optimal. We propose here a different model of provision in which children with poor language are identified early and provided with intervention—in England, teachers have been found to be able to both screen and intervene effectively. It is only those who fail to respond who will then need to be referred to more specialized services, such as delivered by a speech–language pathologist. Arguably, however, ongoing direct teaching to improve children's oral language skills might do a great deal to improve educational outcomes and reduce the need for specialist reading interventions. Moreover, ideally direct language teaching need not stop for children who respond well to language intervention. These children are likely to remain vulnerable as the demands of learning to read on meta-linguistic, grammatical, and inferential skills increase; we suggest the next steps are reading interventions that extend oral language programs through the process of learning to read

not least to support the development of high-quality lexical representations (Compton, Steacy, Cooper, Borkenhagen, Rigoban & Vasquez, this issue) but also to safeguard reading comprehension.

CONFLICT OF INTEREST

Margaret Snowling and Charles Hulme are directors of OxEd & Assessment Ltd., which markets educational assessments and interventions.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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