

Practitioner Review: Reading disorders: what are the effective interventions and how should they be implemented and evaluated?

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Background: Two developmental reading disorders, dyslexia and reading comprehension impairment, are identified by different behavioural characteristics and traced back to different underlying cognitive impairments. Thus, reading interventions designed to address each of these reading disorders differ in content. **Method:** This review summarises the nature of dyslexia and reading comprehension impairment, and current understanding of best practice in associated reading interventions. **Conclusion:** There is strong evidence for the effectiveness of phonological-based reading interventions in supporting children with dyslexic difficulties, and a growing understanding of how to meet the needs of children with reading comprehension impairment, with vocabulary instruction offering a promising approach. Although the content of interventions must be tailored to an individual's reader profile, general principles regarding the implementation and evaluation of intervention programmes can be extracted. **Keywords:** Dyslexia, education, evaluation, comprehension, intervention, reading, reading disorder.

The ultimate goal of reading is the comprehension of texts (Torgesen, 2002). In turn, reading comprehension is critical for academic learning. According to the simple view of reading (Gough & Tunmer, 1986), reading comprehension is the product of two necessary sub-components: decoding (word recognition) and linguistic comprehension (understanding the meaning carried by spoken language). Individual children vary in their levels of decoding and linguistic comprehension. Consequently, different profiles are observed across children (Figure 1). Most children display typical reading development, as represented by the top right quadrant: good decoding coupled with good linguistic comprehension. However, a small but significant minority of children have reading disorders associated with the remaining quadrants in Figure 1.

Developmental dyslexia, affecting around 3–10% of school children, is characterised by primary difficulties with decoding (Bishop & Snowling, 2004). Thus, children whose reader profiles fall into the upper or lower left quadrants (poor decoding with either good or poor comprehension) are likely to be experiencing dyslexic difficulties¹ (Department for Children, Schools, and Families [DCSF], 2009). Specific reading comprehension impairment, affecting around 10% of children, is identified in those who can decode print accurately, but have comprehension difficulties (Stothard & Hulme, 1992). This profile is

captured in the lower right quadrant. As the underlying cognitive deficits differ for dyslexia and reading comprehension impairment, the content of intervention programmes that aim to address these reading disorders must also vary.

Reading interventions for children with dyslexic difficulties

Developmental dyslexia is formally defined as 'a specific learning disability that is of neurobiological origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling' (Lyon, Shaywitz, & Shaywitz, 2003). The disorder is best understood in terms of a continuum of dyslexic difficulties, ranging in severity (e.g., DCSF, 2009; Snowling, 2000). The most substantiated theory asserts that dyslexic difficulties are caused by a core deficit in phonological processing (Lyon et al., 2003; Snowling, 2000; Stanovich, 1986, 1988; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Before exploring the implications of this theory for intervention, let us first consider the role of phonological skills in the typical development of word recognition.

The role of phonological skills in learning to read

Phonological skills involve the use of information about speech sounds. Wagner and Torgesen (1987) identified three aspects of phonological skill – phonological awareness, phonological memory, and naming. Phonological awareness refers to the ability to attend to and manipulate the sounds in words (Stanovich, 1986), and it is the phonological skill

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¹ The term 'dyslexic difficulties' will be used to refer to older children with a diagnosis of dyslexia (or specific reading disorder), and younger children deemed at risk of dyslexia due to weaknesses consistent with the characteristics of dyslexia.

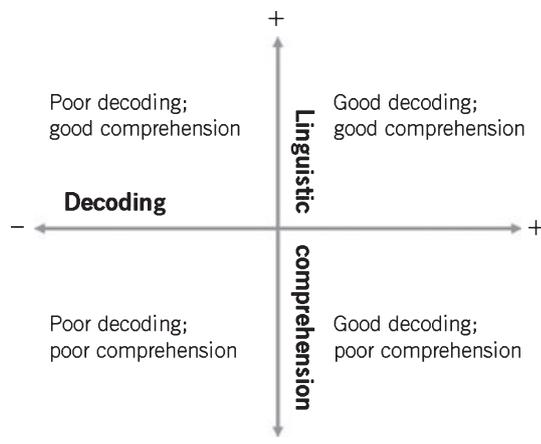


Figure 1 Various reader profiles captured within the Simple View of Reading (DCSF), 2009; Gough & Tunmer, 1986)

most closely associated with learning to decode (Castles & Coltheart, 2004; Wagner et al., 1997). Awareness of phonemes (individual speech sounds, e.g., *b-l-a-ck*) is particularly important for learning to read in an alphabetic script such as English (Castles & Coltheart, 2004; Hulme et al., 2002; Muter, Hulme, Snowling, & Stevenson, 2004; cf. Goswami & Bryant, 1990).

In all, there are strong indications that the relationship between phonological awareness and reading is causal: gains in phonological awareness lead to gains in reading (e.g., Hulme, Snowling, Caravolas, & Carroll, 2005; National Reading Panel [NRP], 2000; Schneider, Kuspert, Roth, Vise, & Marx, 1997; cf. Castles & Coltheart, 2004). The relationship also seems to operate in the opposite direction (Burgess & Lonigan, 1998; Muter et al., 2004; Perfetti, Beck, Bell, & Hughes, 1987). The most persuasive account for the relationship between phonological awareness and learning to read concerns building links between phoneme awareness and letter knowledge (Byrne, 1998; Byrne & Fielding-Barnsley, 1991; Hulme et al., 2002). Learning to read and spell in English depends on grasping the alphabetic principle (Byrne, 1998) – namely, that particular graphemes (letters) are represented by particular phonemes. The benefit of acquiring the alphabetic principle rests in its productive nature: if the individual grapheme–phoneme correspondences (GPCs) for the letters <*t*> <*a*> and <*p*> are known, this knowledge can be applied to decode the words ‘*tap*’, ‘*apt*’ and ‘*pat*’.

In sum, phoneme awareness and letter knowledge provide the foundations for learning to read (e.g., Bowey, 2005; Muter et al., 2004; Share, 2008). In acquiring links between the two (the alphabetic principle), children are endowed with a systematic approach for trying to read (decode) novel words. Furthermore, as children with dyslexic difficulties demonstrate weaknesses in all these skills (e.g., Scarborough, 1990; Snowling, 2000; Vellutino, Scanlon, & Spearing, 1995), it follows that training

in these areas should form the basis of reading interventions.

Phonological-based reading interventions

With respect to improving word-level reading skills, there are two main phonological-based approaches: phonological awareness training and phonics instruction (NRP, 2000). Two sizeable meta-analyses have evaluated phonological awareness training (Bus & Van IJzendoorn, 1999; NRP, 2000, and both concluded that it was associated with a significant and positive effect on reading. The size of this effect was statistically equivalent (Bus & Van IJzendoorn, 1999), if not better (NRP, 2000) for children with dyslexic difficulties, compared to typically developing children. There is some evidence from the (NRP, 2000) report that phonological awareness training is more effective when delivered in small groups of 2–7 children ($d = .83$)² compared with on a one-to-one ($d = .45$) or whole class basis ($d = .35$). In line with the alphabetic principle, the meta-analyses also demonstrated that gains in reading were greater when phonological awareness training incorporated letter knowledge (ds of .18 vs. .66, respectively – Bus & Van IJzendoorn, 1999; ds of .38 vs. .67, respectively – NRP, 2000). However, analyses by the NRP (2000) showed that only 6.5% of variance in reading outcomes was explained by phoneme awareness instruction, increasing significantly to 10% when training included letter knowledge. Thus, although training in phonological awareness is an important component of reading interventions, it is by no means sufficient.

While phonics instruction is similar to phonological awareness training that includes letter knowledge, it is characterised by focusing more on teaching the alphabetic principle (GPCs) and how this can be applied to the tasks of reading and spelling (Ehri et al., 2001). When GPCs are taught in an explicit, organised and sequenced way, this is referred to as ‘systematic phonics’ (Torgerson, Brooks, & Hall, 2006).

The (NRP, 2000) conducted a meta-analysis which addressed whether systematic phonics instruction improved reading outcomes more than unsystematic or no phonics instruction. The overall effect size of systematic phonics on reading was significant ($d = .41$), and was comparable to the overall effect sizes derived for phoneme awareness ($d = .44$ – Bus & Van IJzendoorn, 1999; $d = .53$ – NRP, 2000). The effect of phonics instruction on reading did not differ across reader groups, suggesting that it is effective for both typically developing children and those with dyslexic difficulties. This general pattern of findings was confirmed in a subsequent meta-analysis by Torgerson et al. (2006). The meta-analysis was

² According to Cohen (1992), effect sizes (d) of .2 are considered small, .5 moderate and .8 large.

limited to randomised control trials (RCTs) and therefore yielded a smaller effect size ($d = .20$, with an extreme positive outlier removed). In contrast to phonological awareness training, the NRP (2000) reported no significant differences in effect sizes according to whether phonics instruction was delivered individually ($d = .57$), in small groups ($d = .43$) or to whole classes ($d = .39$).

It is argued that phonics will only be a feasible method of instruction for children with a serviceable level of phonological awareness (NRP, 2000; Phillips, Clancy-Menchetti, & Lonigan, 2008): the use of GPCs to aid reading will only make sense to the child who understands that a word can be divided into smaller phonological units. Thus, effective reading interventions are likely to be those that train both components. Torgesen (2005) compared the efficacy of various reading intervention programmes which all included explicit training in phoneme awareness and phonics. These interventions were administered to 8- to 10-year-old children with moderate to severe dyslexic difficulties. The metric of standard score points gained per hour of intervention was used to assess effectiveness. Standard scores have a mean of 100 and a standard deviation of 15, and any increase in standard scores reflects progress at a faster pace than typical development. The interventions had a meaningful effect on both word reading and reading comprehension (.20 and .19 standard scores gained per hour, respectively). In real terms, children's word reading standard scores rose from approximately 73 (below average) to 85 (low average). Torgesen (2005) demonstrated high consistency across all the intervention programmes, suggesting that it is not the use of a specific reading intervention programme that is important, but the inclusion of phoneme awareness and phonics.

Furthermore, Torgesen et al. (2006) noted that phonics instruction tends not to occur in isolation but in the context of a broader literacy curriculum, which might include elements of meaning-focused instruction, group reading, and writing activities. This has led researchers to re-analyse the initial NRP (2000) report on the effectiveness of phonics instruction. In their re-analyses, both Camilli, Vargas, and Yurecko (2003) and Stuebing, Barth, Cirino, Francis, and Fletcher (2008) support the conclusion that systematic phonics is effective in improving reading, though the size of its effect may have been overestimated originally. Moreover, their results suggest that the effectiveness of systematic phonics is increased when it occurs in the context of a broad literacy curriculum. Indeed, many effective reading interventions for children with dyslexic difficulties embed phoneme awareness training and phonics instruction in a wider literacy programme (e.g., Brooks, 2007; Torgesen et al., 1999; Vellutino et al., 1996). The content of one particular programme, *Reading Intervention*, is summarised in the online resources. This programme has been

noted for its methodological rigour (Troia, 1999), and its efficacy is well established (Bowyer-Crane et al., 2008; Hatcher, Hulme, & Ellis, 1994; Hatcher et al., 2006). Summaries and evaluations of other reading intervention programmes are readily accessible (e.g., Brooks, 2007; What Works Clearing House, 2007), and we encourage practitioners to consult them.

In addition to tackling weaknesses in word reading accuracy, it is also important to address dysfluent reading, which is often seen in children with dyslexic difficulties (e.g., Lyon et al., 2003). Torgesen (2005) observes that reading fluency is difficult to remediate, particularly for older students who, over the years, have missed out substantially on reading practice. Nonetheless, there is some evidence that fluency interventions may improve reading rate. A favoured approach is that of repeated reading, the essential ingredient of which is multiple readings of the same texts (e.g., Vadasy & Sanders, 2009). A meta-analysis by the NRP (2000) of 14 experimental studies found that the average effect size of repeated reading interventions was .41 (weighted for sample size). This effect was significant for both average and poor readers (weighted d s = .33 and .50, respectively). It should be noted, however, that the effects of fluency training were observed in the context of a broader programme of reading instruction.

In summary, a good understanding has been reached regarding how to ameliorate word-level weaknesses in children with dyslexic difficulties. Such interventions should entail training in phoneme awareness, letter knowledge, explicit and systematic instruction in phonics, and the application of these skills to the tasks of reading and writing. Notwithstanding this, there is a growing appreciation that even interventions that honour best practice are not effective for all children (e.g., Torgesen, 2000). Ongoing work is needed in order to understand the profiles of non-responders, and how interventions can be adapted to suit their needs (e.g., Al Otaiba & Fuchs, 2006; Duff et al., 2008; McMaster et al., 2005).

Cognitive profiles of children with specific reading comprehension impairment

Comprehending text is a challenging task which involves many complex skills and processes. The cognitive and metacognitive demands of these processes are high; it is therefore not surprising that some individuals find it difficult to extract meaning from text efficiently.

Researchers have investigated the cognitive profiles of children with specific reading comprehension impairment, with a view to identifying the possible causes of their difficulties understanding text. Evidence suggests that these children frequently have difficulties that extend beyond text to the spoken

language domain. Weaknesses have been observed in listening comprehension (Nation, Clarke, Marshall, & Durand, 2004), vocabulary (Nation, Clarke, & Snowling, 2002; Stothard & Hulme, 1992), oral expression (Nation et al., 2004), narrative production (Cain & Oakhill, 1996, 2006; Cragg & Nation, 2006), figurative language (Cain, Oakhill, & Lemmon, 2004; Cain & Towse, 2008; Nation et al., 2004) and grammar (Nation & Snowling, 2000; Nation et al., 2004). Furthermore, studies have shown that these children have impairments in higher levels of processing, such as making inferences (Cain & Oakhill, 1999; Oakhill, 1984) and metacognitive skills, such as comprehension monitoring (Cain, Oakhill, & Bryant, 2004; Ehrlich, Remond, & Tardieu 1999; Oakhill, Hart, & Samols, 2005; Yuill, Oakhill, & Parkin, 1989) and verbal working memory (Cain, 2006; Cain & Oakhill, 2006; Nation, Adams, Bowyer-Crane, & Snowling, 1999). With such a large number of difficulties documented and considering the complex nature of reading comprehension, it seems likely that multiple causal factors will explain these children's reading comprehension impairment. Intervention studies serve a dual purpose of testing theories about the causes of impairments while also providing practical guidance on the best methods of support.

Evaluation of interventions

Only a small number of studies have evaluated support for children with specific reading comprehension impairment; these have largely investigated single strategy approaches and focused on text-level processing.

Two studies have reported gains in reading comprehension as a result of inference training. Yuill and Oakhill (1988) employed inference training that comprised lexical inferencing tasks in which children were required to pick out words from passages and explain how the words contributed to the overall meaning of sentences or stories. In addition, children generated questions about text and made predictions by trying to guess the content of hidden sentences using clues from the surrounding text. Yuill and Oakhill (1988) found that children with reading comprehension impairment aged 7 to 8 years made an average improvement of 17 months on a standardised measure of reading comprehension (Neale Analysis of Reading Comprehension, 1966) after receiving six 45-minute sessions of inference training delivered to small groups. A comparison group who received standard comprehension activities (question answering and peer discussion) also made significant gains in reading comprehension (on average 14 months). However, children who received a third training programme, which consisted of reading words and passages at speed, showed no significant improvement in reading comprehension. The inclusion of a skilled comprehender control

group (non-discrepant reading accuracy and comprehension) enabled the authors to examine whether certain types of training were particularly effective for those with specific reading comprehension impairment. A significant group difference was found only in the inference training condition in which the children with reading specific comprehension impairment benefited more than the skilled comprehenders. Yuill and Oakhill's (1988) findings suggest that inferencing difficulties may be a causal factor in the development of specific reading comprehension impairment; however, they also point to other factors (those captured by the standard comprehension training) as being of potential causal importance.

McGee and Johnson (2003) replicated this study, using the same design but without the rapid decoding training, and demonstrated improvements of 20 months (Neale Analysis of Reading Comprehension Revised Edition [NARA-R], 1989) in 6- to 10-year-olds with specific reading comprehension impairment.

These studies report impressive gains as a result of relatively little training. They demonstrate how a single strategy can have measureable impacts on reading comprehension ability and they employ techniques that can, as Yuill and Oakhill (1988) acknowledge, be applied to a wide variety of text types with relatively little preparation. However, these studies have some methodological features that should be carefully considered when interpreting the findings. First, as there was no untreated control group, it is not possible to account for the amount of improvement that may have occurred as result of maturation, standard classroom literacy practice or repeated assessment. Second, the groups being compared were not equivalent in terms of reading comprehension ability at pre-test; the children with specific reading comprehension impairment had more scope to improve than the skilled comprehenders. Finally, improvements were expressed as reading ages, which are imprecise indicators of ability that introduce considerable error variance to the data. On a more practical note, the interventions in these studies were delivered by highly trained researchers rather than teaching staff within school; it is therefore unclear whether the results would generalise to everyday school contexts.

Beyond inferencing, the other single strategy to receive research attention is the ability to visualise events being described in text (mental imagery). Oakhill and Patel (1991) evaluated an approach that encouraged children to use representational and transformational drawings, and to picture stories and answers to comprehension questions in their minds. They found that 9-year-old children with specific reading comprehension impairment benefited more from imagery training than a control training condition (reading and question answering).

This difference was not observed in a skilled comprehender comparison group. The authors suggest that ‘the ability to use imagery strategies may give poor comprehenders a way of helping to circumvent their memory limitations...’ (p. 114) and that imagery training ‘... enables them, or forces them, to integrate information in the text in a way that they would not normally do’ (p. 114). These interpretations remain untested; however, they offer important insights into the nature of a possible causal link between visualising difficulties and reading comprehension impairment.

Johnson-Glenberg (2000) evaluated a form of visualising training (Visualising/Verbalising [V/V]; Bell, 1986) alongside a multi-componential programme (Reciprocal Teaching [RT]; Palincsar & Brown, 1984). The V/V programme combined mental imagery activities with the creation of verbal summaries. In contrast, the RT programme centred on peer and tutor discussion that encouraged the use of four key strategies (Clarification, Summarisation, Prediction and Question Generation). Children with specific reading comprehension impairment aged 9 to 10 years were assigned to either one of the training programmes or an untreated control group. The RT group demonstrated significantly larger gains than controls on tests of word recognition, question generation and answering factual questions, whereas the V/V group made significant improvements relative to the controls on a measure of inferencing. An extension of this study evaluated a web-based training programme that combined visual and verbal strategies (Johnson-Glenberg, 2005) and compared it to a control intervention (unscrambling anagrams) using a within-subjects design. Children with specific reading comprehension impairment (teacher selected) aged 11 to 13 years made significant improvements on bespoke measures of comprehension and reading strategy use. This study suggests that computerised activities can support reading comprehension but it is limited in terms of sample size and it remains unclear whether the improvements demonstrated will generalise to standardised measures of reading comprehension.

A recent meta-analysis of studies seeking to improve passage-level comprehension has highlighted the benefits of vocabulary instruction (Elleman, Lindo, Morphy, & Compton, 2009). Thirty-seven studies were analysed and vocabulary instruction was shown to have a greater effect on bespoke ($d = .50$) than standardised ($d = .10$) measures of text comprehension. The authors suggest that vocabulary instruction is particularly effective for struggling readers. However, it remains unclear precisely which training method is the most useful.

A recent study considered the impact of vocabulary training within a multi-componential programme. Clarke, Snowling, Truelove, and Hulme (2010) examined the effectiveness of three training

programmes on reading comprehension in children with reading comprehension impairment aged 8 to 9 years. The approaches trialled were: a text-level programme (TC) comprising metacognitive strategies, RT, inferencing and written narrative; an oral language programme (OL) consisting of vocabulary, listening RT, figurative language and spoken narrative; and a combined programme (COM) which included all components from the TC and OL programmes. Importantly, the progress of children in the intervention groups was compared with that of a waiting control group, and the study adhered to the CONSORT guidelines (Moher, Schulz, & Altman, 2001) for conducting RCTs. Children in the intervention groups each received 30 hours of support over 20 weeks, delivered by trained teaching assistants, rotating between paired and individual sessions. All intervention groups made significant improvements in reading comprehension relative to the control group immediately following training. Unlike previous studies, Clarke et al. (2010) included a maintenance testing point, which demonstrated that gains maintained significance for the TC and COM groups but increased significance for the OL group, 11 months after training. In all, the OL group made approximately an 8 standard score improvement from pre-test to maintenance test. The OL and COM groups also made significant progress in expressive vocabulary and this was a mediator of these groups’ improved reading comprehension. This evidence supports a causal relationship between oral language and reading comprehension and suggests that specific reading comprehension difficulties reflect (at least partly) underlying oral language weaknesses.

It is clear that progress has been made in recent years in understanding both the nature of the difficulties experienced by children with reading comprehension impairment and the best methods for supporting their reading development. Further research should aim to clarify the factors that influence response to intervention and aim to replicate and extend previous findings in educationally realistic contexts in order to ascertain their feasibility and costs. Recent research highlights vocabulary instruction as a promising approach for ameliorating the comprehension difficulties of children with specific reading comprehension impairment.

Evaluating research evidence

This review has highlighted some of the methodological strengths and limitations of reading intervention studies. Judgements about the effectiveness of training programmes must be informed by careful scrutiny of all available evidence. It is important to recognise that published research varies in the quality of evidence that it provides. Investigations are conducted for a range of purposes and readers

should assess the motivation behind a particular study. Well-motivated studies are grounded in theories of reading development, often addressing causal explanations, and ultimately seeking to improve children's reading and educational attainment.

There are some key aspects of experimental design which need to be in place in order for the aims of such studies to be fully realised. One of these concerns the inclusion of a control group. This must feature if authors wish to conclude that an intervention is more effective than alternatives, such as no additional support or intervention of a different kind. The strongest designs include random allocation of participants from the same sample to intervention and control groups (Torgerson & Torgerson, 2008). Randomisation attempts to control for the effects of additional factors that are beyond the control of the researcher, for example, differences in home environment or school experience. Such factors would then be equally distributed across the groups, and should therefore not distort the effects of intervention. Randomisation of children to groups is a key feature of RCTs. These follow the CONSORT guidelines (Moher et al., 2001) and are considered the gold standard in intervention research. While it should be recognised that it is not always possible to conduct large-scale trials of this kind, many of the scientific principles inherent in RCTs can be applied to smaller-scale research. Careful reporting of trials is vital as it helps the reader to assess the reliability of the study. Although studies are often peer-reviewed by experts in the field, readers should be prepared to evaluate independently the reported results, and pay particular attention to the extent to which conclusions are supported by the data.

As a companion to this review, a checklist has been provided to assist with this process of evaluation (see online resources). This list covers the key questions that should be asked of a piece of intervention research. It has been informed by previous guidance from Bishop (2008), Moher et al. (2001), and Torgerson and Torgerson (2003).

Applying research to practice

Assessment for learning

Assessments are crucial for understanding a child's abilities in order to tailor teaching content to specific needs, and for measuring progress over time to determine whether the teaching programme is effective. Both of these purposes honour the principle of assessment for learning (DCSF, 2008).

Assessments must measure the skills that you aim to improve via the intervention, such as word reading accuracy or reading comprehension, and the foundational subskills that you might also be

training (e.g., phoneme awareness or listening comprehension, respectively). You must include reliable and sensitive tests of these skills. More detailed guidance on assessment, including suggestions of tests, is provided elsewhere (Carroll, Bowyer-Crane, Duff, Hulme, & Snowling, in press).

An appropriate assessment should be administered immediately prior to the intervention. The results of this assessment should be used to derive learning targets for the child, and to tailor the contents of an intervention programme to his or her learning strengths and weaknesses – the principle of personalised learning (e.g., DCSF, 2008; Vellutino & Scanlon, 2002). The same tests should be administered immediately after the intervention finishes, in order to evaluate the child's progress. There is also benefit in assessing children more periodically – for example once a week (Al Otaiba et al., 2008; Compton, Fuchs, Fuchs, & Bryant, 2006). This will provide a detailed picture of whether the child is responding to intervention, and at what rate. In turn, this knowledge informs decisions about whether to persist with current teaching practice or to seek out alternatives. If repeating assessments frequently, it is advisable to alternate between similar tests of equivalent difficulty to avoid improvements in scores due simply to practice (e.g., Fuchs & Fuchs, 2002).

Implementing an intervention

Having chosen a relevant intervention programme with a good evidence base, it is important to remember that the intervention was shown to be effective under specific conditions. Aim to emulate these conditions as far as is practicable in order to replicate success. This may include factors such as receiving appropriate training and continued support, and adhering closely to the programme specifics regarding: the nature and length of teaching activities; the frequency and length of sessions; and the duration of the intervention programme. Within this, learning can be personalised by the differential emphasis you place on the individual components of that programme.

Evidence suggests that certain instructional approaches are equally effective for children with reading difficulties and typically developing children (e.g., NRP, 2000; Torgerson et al., 2006). However, Torgesen (2002) suggests some key ways in which reading intervention for struggling readers ought to differ. Intervention should be more explicit (more skills taught more directly), more intense (more learning opportunities provided, smaller teaching groups), and more supportive (academically, via scaffolded learning, and emotionally). Evidence also suggests that interventions should supplement and not replace general classroom literacy instruction (e.g., Brooks, 2007; Torgerson et al., 2006).

Withdrawing intervention

Withdrawal of a reading intervention may be governed by a number of factors, including the achievement of a certain level of reading or the completion of prescribed material. In addition to repeating the pre-intervention assessment to evaluate the child's immediate progress, it is also advisable to monitor the child over subsequent months, if not years. This will enable you to monitor long-term effects of the intervention, and to quickly identify and address any fallback in progress. You should also consider putting in place a transition phase towards the end of the intervention, which helps children to apply their skills in the classroom context (e.g., Torgesen et al., 2001).

Integrated approaches

Throughout this review, we have treated dyslexia and specific reading comprehension impairment as separate reading profiles that are traced back to distinct cognitive impairments. However, cases of reading difficulties are not always neatly specified and as Figure 1 illustrates, a child may present with weaknesses in both decoding and comprehension. Furthermore, a proportion of children with word reading difficulties characterised by phonological deficits have additional weaknesses in the language skills that underpin reading comprehension, such as vocabulary and grammar (e.g., Catts, Fey, Zhang, & Tomblin, 1999; Snowling, Muter, & Carroll, 2007). Children with dispersed sets of difficulties would likely benefit from more integrated approaches which combine explicit training in oral language and/or text comprehension with phonological-based reading instruction. Preliminary work in this area has begun (e.g., Duff et al., 2008; Wolf et al., 2009) and should continue.

Conclusion

Dyslexia and reading comprehension impairment are rooted in different underlying weaknesses. This review has discussed intervention research that

addresses these profiles. There is good evidence to show that phonological-based interventions are effective in ameliorating dyslexic difficulties. Reading comprehension is a multi-componential process and consequently a variety of approaches have been evaluated. Emerging evidence suggests that vocabulary training is important for addressing reading comprehension impairments. For children with overlapping weaknesses in both areas, integrated approaches may be more appropriate. General principles regarding the evaluation and implementation of intervention programmes were considered. The quality of a study's experimental design and evaluation governs how much confidence should be placed in its findings. Practitioners should be mindful of the evidence which underpins an intervention that they wish to implement. Furthermore, reliable and routine assessments of children's abilities, together with delivering an intervention with fidelity, are vital for successful evaluations of additional reading support.

Supplementary material

The following supplementary material is available for this article:

Table 1: Content of small group and individual sessions in *Reading Intervention*;

Table 2: Checklist for evaluating intervention research (Word document and PDF)

This material is available as part of the online article from: <http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1469-7610.2010.02310.x>

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Key points

- Dyslexia and specific reading comprehension impairment represent different reading difficulties, underpinned by weaknesses in different cognitive skills.
- There is good evidence that phonological-based interventions are generally effective in improving word reading in children with dyslexic difficulties. These interventions typically comprise training in phoneme awareness, letter knowledge, explicit and systematic instruction in phonics, and the application of these skills to the tasks of reading and writing.
- Reading comprehension is a complex process, and impairments may be caused by weaknesses in a variety of cognitive skills. Research into related interventions is still emerging; but vocabulary training seems to offer a promising approach.

References

- Al Otaiba, S., Connor, C., Lane, H., Kosanovich, M., Schatschenider, C., Dyrland, A. K., Miller, M.S., & Wright, T.L. (2008). Reading First kindergarten classroom instruction and students' growth in phonological awareness and letter naming-decoding fluency. *Journal of School Psychology, 46*, 281-314.
- Al Otaiba, S., & Fuchs, D. (2006). Who are the young children for whom best practices in reading are ineffective: An experimental and longitudinal study. *Journal of Learning Disabilities, 39*, 414-431.
- Bell, N. (1986). *Visualizing and verbalizing for language comprehension and thinking*. Paso Robles, CA: Academy of Reading Publications.
- Bishop, D.V.M. (2008). Letters to the editor: Criteria for evaluating behavioural interventions for neurodevelopmental disorders. *Journal of Paediatrics and Child Health, 44*, 520-530.
- Bishop, D.V.M., & Snowling, M.J. (2004). Developmental dyslexia and Specific Language Impairment: Same or different? *Psychological Bulletin, 130*, 858-886.
- Bowey, J. (2005). Predicting individual differences in learning to read. In M.J. Snowling, & C. Hulme (Eds.), *The science of reading* (pp. 155-172). Oxford: Blackwell Publishing.
- Bowyer-Crane, C., Snowling, M.J., Duff, F.J., Fieldsend, E., Carroll, J.M., Miles, J., Götz, K., & Hulme, C. (2008). Improving early language and literacy skills: Differential effects of an oral language versus a phonology with reading intervention. *Journal of Child Psychology and Psychiatry, 49*, 422-432.
- Brooks, G. (2007). *What works for pupils with literacy difficulties? The effectiveness of intervention schemes*. London: DCSF Publications. Available from <http://www.standards.dcsf.gov.uk/phonics/downloads/gregbrooks.pdf>
- Burgess, S.R., & Lonigan, C.J. (1998). Bi-directional relations of phonological sensitivity and pre-reading abilities: Evidence from a preschool sample. *Journal of Experimental Child Psychology, 70*, 117-141.
- Bus, A.G., & Van IJzendoorn, M.H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology, 91*, 403-414.
- Byrne, B. (1998). *The foundation of literacy: The child's acquisition of the alphabetic principle*. Hove, UK: Psychology Press.
- Byrne, B., & Fielding-Barnsley, R. (1991). Evaluation of a program to teach phonemic awareness to young children. *Journal of Educational Psychology, 83*, 451-455.
- Cain, K. (2006). Individual differences in children's memory and reading comprehension: An investigation of semantic and inhibitory deficits. *Memory, 14*, 553-569.
- Cain, K., & Oakhill, J.V. (1996). The nature of the relationship between comprehension skill and the ability to tell a story. *British Journal of Developmental Psychology, 14*, 187-201.
- Cain, K., & Oakhill, J.V. (1999). Inference making and its relation to comprehension failure. *Reading and Writing, 11*, 489-503.
- Cain, K., & Oakhill, J. (2006). Profiles of children with specific reading comprehension difficulties. *British Journal of Educational Psychology, 76*, 683-696.
- Cain, K., Oakhill, J., & Bryant, P.E. (2004a). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96*, 31-42.
- Cain, K., Oakhill, J., & Lemmon, K. (2004b). Individual differences in the inference of word meanings from context: The influence of reading comprehension, vocabulary knowledge, and memory capacity. *Journal of Educational Psychology, 96*, 671-681.
- Cain, K., & Towse, A.S. (2008). To get hold of the wrong end of the stick: Reasons for poor idiom understanding in children with reading comprehension difficulties. *Journal of Speech, Language, and Hearing Research, 51*, 1538-1549.
- Camilli, G., Vargas, S., & Yurecko, M. (2003). Teaching children to read: The fragile link between science and federal education policy. *Education Policy Analysis Archives, 11*. Retrieved July 9, 2009, from <http://epaa.asu.edu/epaa/v11n15/>
- Carroll, J.M., Bowyer-Crane, C., Duff, F.J., Hulme, C., & Snowling, M.J. (in press). *Developing language and literacy: Effective intervention in the early years*. Oxford: Wiley-Blackwell.
- Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition, 91*, 77-111.
- Catts, H.W., Fey, M.E., Zhang, X., & Tomblin, J.B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3*, 331-361.
- Clarke, P., Snowling, M.J., Truelove, E., & Hulme, C. (2010). Ameliorating children's reading comprehension difficulties: A randomised controlled trial. *Psychological Science, 21*, 1106-1116.
- Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*, 155-159.
- Compton, D.L., Fuchs, D., Fuchs, L.S., & Bryant, J.D. (2006). Selecting at-risk readers in first grade for early intervention: A two-year longitudinal study of decision rules and procedures. *Journal of Educational Psychology, 98*, 394-409.
- Cragg, L., & Nation, K. (2006). Exploring written narrative in children with poor reading comprehension. *Educational Psychology, 26*, 55-72.
- Department for Children, Schools and Families (DCSF). (2008). *The assessment for learning strategy*. London: DCSF Publications.
- Department for Children, Schools and Families (DCSF). (2009). *Identifying and teaching young children with dyslexia and literacy difficulties*. London: DCSF Publications.
- Duff, F.J., Fieldsend, E., Bowyer-Crane, C., Hulme, C., Smith, G., Gibbs, S., & Snowling, M. (2008). Reading with vocabulary intervention: Evaluation of an instruction for children with poor response to reading intervention. *Journal of Reading Research, 31*, 319-336.
- Ehri, L., Nunes, S.R., Willows, D.M., Schuster, B.V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children to learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly, 36*, 250-287.
- Ehrlich, M.F., Remond, M., & Tardieu, H. (1999). Processing of anaphoric devices in young skilled and less skilled comprehenders: Differences in metacognitive monitoring. *Reading and Writing, 11*, 29-63.
- Elleman, A.M., Lindo, E.J., Morphy, P., & Compton, D.L. (2009). The impact of vocabulary instruction on passage-level comprehension of school-age children:

- A meta-analysis. *Journal of Research on Educational Effectiveness*, 2, 1–44.
- Fuchs, L.S., & Fuchs, D. (2002). Curriculum-based measurement: Describing competence, enhancing outcomes, evaluating treatment effects, and identifying treatment nonresponders. *Peabody Journal of Education*, 77, 64–84.
- Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read*. London: Erlbaum.
- Gough, P.B., & Tunmer, W.E. (1986). Decoding, reading and reading disability. *Remedial and Special Education*, 7, 6–10.
- Hatcher, P.J., Hulme, C., & Ellis, A.W. (1994). Ameliorating early reading failure by integrating the teaching of reading and phonological skills: The phonological linkage hypothesis. *Child Development*, 65, 41–57.
- Hatcher, P.J., Hulme, C., Miles, J.N.V., Carroll, J.M., Hatcher, J., Gibbs, S., Smith, G., Bowyer-Crane, C., & Snowling, M.J. (2006). Efficacy of small-group reading intervention for beginning readers with reading delay: A randomised control trial. *Journal of Child Psychology and Psychiatry*, 47, 820–827.
- Hulme, C., Hatcher, P.J., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology*, 82, 2–28.
- Hulme, C., Snowling, M.J., Caravolas, M., & Carroll, J. (2005). Phonological skills are (probably) one cause of success in learning to read: A comment on Castles and Coltheart. *Scientific Studies of Reading*, 9, 351–365.
- Johnson-Glenberg, M.C. (2000). Training reading comprehension in adequate decoders/poor comprehenders: Verbal vs. visual strategies. *Journal of Educational Psychology*, 92, 772–782.
- Johnson-Glenberg, M.C. (2005). Web-based training of metacognitive strategies for text comprehension: Focus on poor comprehenders. *Reading and Writing*, 18, 755–786.
- Lyon, R., Shaywitz, S.E., & Shaywitz, B.A. (2003). A definition of dyslexia. *Annals of Dyslexia*, 53, 1–14.
- McGee, A., & Johnson, H. (2003). The effect of inference training on skilled and less skilled comprehenders. *Educational Psychology*, 23, 49–59.
- McMaster, K.L., Fuchs, D., Fuchs, L.S., & Compton, D.L. (2005). Responding to nonresponders: An experimental field trial of identification and intervention methods. *Exceptional Children*, 71, 445–463.
- Moher, D., Schulz, K.F., & Altman, D.G. (2001). The CONSORT statement: Revised recommendations for improving the quality of reports of parallel-group randomised trials. *The Lancet*, 357, 1191–1194.
- Muter, V., Hulme, C., Snowling, M.J., & Stevenson, J. (2004). Phonemes, rimes and language skills as foundations of early reading development: Evidence from a longitudinal study. *Developmental Psychology*, 40, 665–681.
- Nation, K., Adams, J.W., Bowyer-Crane, C.A., & Snowling, M.J. (1999). Working memory deficits in poor comprehenders reflect underlying language impairments. *Journal of Experimental Child Psychology*, 73, 139–158.
- Nation, K., Clarke, P., Marshall, C.M., & Durand, M. (2004). Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairment? *Journal of Speech, Language, and Hearing Research*, 47, 199–211.
- Nation, K., Clarke, P., & Snowling, M.J. (2002). General cognitive ability in children with reading comprehension difficulties. *British Journal of Educational Psychology*, 72, 549–560.
- Nation, K., & Snowling, M.J. (2000). Factors influencing syntactic awareness skills in normal readers and poor comprehenders. *Applied Psycholinguistics*, 21, 229–241.
- National Reading Panel (NRP). (2000). *Report of the National Reading Panel: Reports of the Subgroups*. Washington, DC: National Institute of Child Health and Human Development Clearing House.
- Neale, M.D. (1966). *The Neale Analysis of Reading Ability*. London: Macmillan.
- Neale, M.D. (1989). *The Neale Analysis of Reading Ability – Revised British Edition*. Windsor: NFER-Nelson.
- Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology*, 54, 31–39.
- Oakhill, J., Hart, J., & Samols, D. (2005). Levels of comprehension monitoring and working memory in good and poor comprehenders. *Reading and Writing*, 18, 657–686.
- Oakhill, J.V., & Patel, S. (1991). Can imagery training help children who have comprehension problems? *Journal of Research in Reading*, 14, 106–115.
- Palincsar, A.S., & Brown, A.L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction*, 1, 117–175.
- Perfetti, C.A., Beck, I., Bell, L., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first-grade children. *Merrill-Palmer Quarterly*, 33, 283–319.
- Phillips, B.M., Clancy-Menchetti, J., & Lonigan, C.J. (2008). Successful phonological awareness instruction with preschool children. *Topics in Early Childhood Special Education*, 28, 3–17.
- Scarborough, H.S. (1990). Very early language deficits in dyslexic children. *Child Development*, 61, 1728–1743.
- Schneider, W., Kuespert, P., Roth, E., Vise, M., & Marx, H. (1997). Short- and long-term effects of training phonological awareness in kindergarten: Evidence from two German studies. *Journal of Experimental Child Psychology*, 66, 311–340.
- Share, D.L. (2008). On the Anglocentricities of current reading research and practice: The perils of overreliance on an 'outlier' orthography. *Psychological Bulletin*, 134, 584–615.
- Snowling, M.J. (2000). *Dyslexia*. Oxford: Blackwell.
- Snowling, M.J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A follow-up in early adolescence. *Journal of Child Psychology and Psychiatry*, 48, 609–618.
- Stanovich, K. (1986). Matthew-effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, 21, 360–406.
- Stanovich, K.E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological-core variable-difference model. *Journal of Experimental Child Psychology*, 38, 175–190.
- Stothard, S.E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing*, 4, 245–256.
- Stuebing, K.K., Barth, A., Cirino, P.T., Francis, D.J., & Fletcher, J.M. (2008). A response to the recent reanalyses of the national reading panel report: Effects of systematic phonics instruction are practically significant. *Journal of Educational Psychology*, 100, 123–134.

- Torgerson, C., & Torgerson, D. (2003). The design and conduct of randomised controlled trials in education: Lessons from health care. *Oxford Review of Education*, 29, 67–80.
- Torgerson, C., & Torgerson, D. (2008). *Designing and running randomised trials in health and the social sciences*. London: Palgrave Macmillan.
- Torgerson, C.J., Brooks, G., & Hall, G. (2006). *A systematic review of the research literature on the use of systematic phonics in the teaching of reading and spelling*. Department for Education and Skills. London: DfES Research Report 711. Available from http://www.dcsf.gov.uk/research/data/uploadfiles/RR711_.pdf
- Torgesen, J.K. (2000). Individual differences in response to early interventions in reading: The lingering problem of treatment resisters. *Learning Disabilities Research and Practice*, 15, 55–64.
- Torgesen, J.K. (2002). The prevention of reading difficulties. *Journal of School Psychology*, 40, 7–26.
- Torgesen, J.K. (2005). Recent discoveries on remedial interventions for children with dyslexia. In M.J. Snowling, & C. Hulme (Eds.), *The science of reading* (pp. 521–537). Oxford: Blackwell Publishing.
- Torgesen, J.K., Alexander, A.W., Wagner, R.K., Rashotte, C.A., Voeller, K., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long-term outcomes from two instructional approaches. *Journal of Learning Disabilities*, 34, 33–58. 78.
- Torgesen, J.K., Wagner, R.K., Rashotte, C.A., Lindamood, P., Rose, E., Conway, T., & Garvan, C. (1999). Preventing reading failure in young children with phonological processing disabilities: Group and individual differences to instruction. *Journal of Educational Psychology*, 91, 579–593.
- Troia, G.A. (1999). Phonological awareness intervention research: A critical review of the experimental methodology. *Reading Research Quarterly*, 34, 28–52.
- Vadasy, P.F., & Sanders, E.A. (2009). Supplemental fluency intervention and determinants of reading outcomes. *Scientific Studies of Reading*, 13, 383–425.
- Vellutino, F.V., Fletcher, J.M., Snowling, M.J., & Scanlon, D.M. (2004). Specific reading disability (dyslexia): What we have learned in the past four decades. *Journal of Child Psychology and Psychiatry*, 45, 2–40.
- Vellutino, F.R., & Scanlon, D.M. (2002). The interactive strategies approach to reading intervention. *Contemporary Educational Psychology*, 27, 573–635.
- Vellutino, F.R., Scanlon, D.M., Sipay, E.R., Small, S.G., Pratt, A., Chen, R., & Denckla, M.B. (1996). Cognitive profiles of difficult-to-remediate and readily remediated poor readers: Early intervention as a vehicle for distinguishing between cognitive and experiential deficits as basic causes of specific reading disability. *Journal of Educational Psychology*, 88, 601–638.
- Vellutino, F.R., Scanlon, D.M., & Spearing, D. (1995). Semantic and phonological coding in poor and normal readers. *Journal of Experimental Child Psychology*, 59, 76–123.
- Wagner, R.K., & Torgesen, J.K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, 101, 192–212.
- Wagner, R.K., Torgesen, J.K., Rashotte, C.A., Hecht, S.A., Barker, T.A., Burgess, S., Donahue, J., & Garon, T. (1997). Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study. *Developmental Psychology*, 33, 468–479.
- What Works Clearing House. (2007). *WWC topic report: Beginning reading*. Available from http://ies.ed.gov/ncee/wwc/pdf/BR_TR_08_13_07.pdf
- Wolf, M., Barzillai, M., Gottwald, S., Miller, L., Spencer, L., Norton, E., Lovett, M., & Morris, R. (2009). The RAVE-O intervention: Connecting neuroscience to the classroom. *Mind Brain and Education*, 2, 84–93.
- Yuill, N.M., & Oakhill, J.V. (1988). Effects of inference awareness training on poor reading comprehension. *Applied Cognitive Psychology*, 2, 33–45.
- Yuill, N., Oakhill, J., & Parkin, A. (1989). Working memory, comprehension ability and the resolution of text anomaly. *British Journal of Psychology*, 80, 351–361.

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