

LITERACY

Reading interventions for children with Down syndrome

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Though many individuals with Down syndrome are now able to achieve useful levels of literacy skills, it is still not clear how best to support the development of reading skills with this group. Research with typically developing children has identified successful methods of teaching reading, and recent work has begun to evaluate these methods for individuals with Down syndrome. The aim of this paper is to review this work, and to highlight areas in need of further research.

Many children with Down syndrome are now educated in mainstream classrooms and have access to the same levels of literacy teaching as typically-developing children. As a consequence many individuals with Down syndrome are now able to achieve useful levels of literacy skills. A recent overview of the literature suggests that children with Down syndrome aged between 7-14 years typically attain reading ages of between 5 years, 5 months and 10 years^[1]. There is, however, wide variability in the level of reading skills that children with Down syndrome can achieve, with some children able to develop reading skills that are in line with, or in advance of, their chronological age (e.g. REFS 2,3). Explaining this variability is not straightforward, as a wide range of factors impact on reading progress^[1]; nonetheless, effective literacy instruction is imperative to enable all children to reach their full potential and many believe that more can be done to promote reading development in children with Down syndrome (e.g. REF 4). Given the potential benefits of reading for the development of speech, language and memory skills of children with Down syndrome (see REF 1) there is a clear need to explore potential methods of supporting reading with this group of children. Research with typically developing children has identified effective methods of supporting reading development, and this work has informed the development of reading intervention research with children with Down syndrome. The aim of this paper is to review some of this work, and to highlight areas that are in need of

further research.

Learning to read is a complex and challenging task which requires explicit teaching and considerable practise to acquire. To appreciate what is involved in learning to read, and therefore what needs to be taught, it is useful to simplify the process. A useful framework for this is provided by the Simple View of Reading^[5]. In this framework, which underlies the National Strategy Primary Curriculum, effective reading (reading with meaning) involves two interacting, but separate, components: word recognition and language comprehension. To become effective readers, children need to develop the skills involved in both word recognition and language comprehension; both are necessary for reading, but neither is sufficient on its own. Thus, reading cannot occur unless the child can recognise the printed word. However, the child must not only identify the words, but must also understand the text, for reading to be effective. Research supports the independence of word recognition and linguistic comprehension components (e.g. REFS 6-9), and clear evidence of the dissociation between the two abilities is seen in populations with dyslexia (who have good comprehension but impaired word reading) and 'poor comprehenders' (a group who have significant difficulties understanding text despite good word reading skills). The Simple View of Reading suggests that, to become effective readers, children need to be taught both components: how to identify the words on the page, and how to understand the texts that they read. This

update will first consider interventions which target the processes involved in the development of word recognition skills, before considering work which has a more specific focus on comprehension.

Much of the reading research has focused on the word recognition component. Work with typically-developing children has identified phonological awareness and letter knowledge to be essential for the development of alphabetic reading. Phonological awareness is the ability to reflect on the sound structure of speech and is assessed by tasks which require children to separate words into syllables, identify and produce rhymes, match words that begin with the same sound, and to manipulate individual sounds (or 'phonemes') in words, for example, by blending, segmenting and deleting them. This skill is a strong predictor of reading in typically-developing children (e.g. REFS 10,11,12), and a large body of research evidence points to the efficacy of phonics teaching in supporting the reading development of typically-developing children who have reading difficulties. An early study^[11] compared four groups of 7-year-old poor readers: a control group and three experimental groups who received training in reading, phonology, or reading and phonology combined. The results showed that following the intervention, the group who received training in both reading and phonology made the most progress. Thus, the teaching of phonology is most effective when it is combined with reading instruction, and when the links between sounds and letters are made clear. The

success of this approach (reading with phonology) in helping struggling readers has since been supported by a large body of research evidence (e.g. REFS 13-17). In line with this accumulating knowledge base a recent review of the teaching of early reading^[18] recommends an integral role for the teaching of phonics within the national literacy framework.

Though early research with children with Down syndrome suggested no relationship between phonological awareness and reading ability for this group^[19] later studies showed that phonological skills were not absent in this group, though they are delayed relative to typically-developing groups and to word reading skills (e.g. REFS 20-23). A comparison of 12 individuals with Down syndrome (aged 10-26 years) with 14 typically-developing children aged 6-7-years, who were matched for word reading skills, demonstrated measurable levels of phonological awareness skills (initial sound detection, phoneme deletion and rhyme detection) for the group with Down syndrome, though they scored significantly lower on these measures than the typically-developing group^[22]. Nonetheless, phonological awareness skills are correlated with reading for individuals with Down syndrome (e.g. REFS 22,24). Thus, though research has yet to clarify whether phonological awareness skills are an essential precursor to reading for children with Down syndrome, or whether they develop as a consequence of reading^[22], the evidence does suggest that phonological awareness skills play a role in the reading development of this group of children.

This evidence has led a number of researchers to investigate the efficacy of phonological awareness training for supporting reading development in children with Down syndrome. In a small-scale intervention study^[25], three children with Down syndrome (aged 6 years, 11 months; 8 years, 4 months; and 8 years, 10 months) received training in phonological awareness delivered in eight one-hour sessions over four weeks. Improvements in targeted phonological awareness skills (alliteration detection, initial phoneme isolation) were observed following the intervention, as were gains in spelling, though it should be noted that it is difficult to evaluate the size of the gains as no statistics are reported. These skills did not, however, general-

ise to untrained phonological awareness tasks (i.e. segmentation), suggesting that specific skills need to be taught explicitly. This study also assessed the effects of the training on speech production: though some improvements were recorded, these were minimal and were not apparent in all participants. It must be noted that this intervention was over a very short period and did not explicitly target speech production; effects of phonological awareness on speech production may be seen from longer training studies that include a specific speech element. There is some support for this argument from research with children with speech impairment, which found improvements in speech production following 20 hours of phonological awareness training^[26].

A larger study^[27] evaluated a phonological intervention programme based on Jolly Phonics^[28]; a programme which is widely used in UK schools to teach letter-sounds) and the reading with phonology programme developed by Peter Hatcher and colleagues^[11]. The intervention incorporated training in phoneme awareness and letter knowledge, and was adapted to include a component which worked on speech production, though the impact of training on this skill is not reported. Learning support assistants were trained to deliver the intervention to individual children in daily 40-minute sessions. In this study, 15 children with Down syndrome (aged 8-14 years) were split into two groups: Group 1 received the intervention over eight weeks whilst Group 2 acted as a waiting control group; both groups then received the intervention for the following eight weeks. Group 1 showed larger gains in phoneme awareness, letter-knowledge, word and non-word reading than the waiting control group, who began to make progress once they started the intervention; effect sizes were large to moderate (Cohen's $d = 1.27$ for letter knowledge to 0.40 for non-word reading). Gains were maintained five months after the intervention had ended. In sum, the intervention was effective in accelerating development: Children made more progress in reading during the intervention than they did during the year before the intervention started. Furthermore, this study suggests that learning support assistants can be trained to deliver effective intervention which is tailored to the

needs of individual children.

Other work^[29] suggests that parents can also deliver effective phonics-based training. In this study, parents of 7 young children (aged 4-years) were trained to deliver an intervention which combined phonological awareness and letter-knowledge training, delivered through parent-child shared reading activities in four 10-minute sessions each week, for six weeks. When reading books with their children, parents were encouraged to bring the child's attention to targeted letters and corresponding sounds within words by stating the letter name ('this is the letter S'), describing the sound it makes ('it makes the ssss sound') and bringing the child's attention to the letter visually and orally ('sss is the first sound in the word Spot'). Statistically significant gains in letter knowledge, print concepts and initial phoneme identity were reported following the intervention.

Cologon, Cupples and Wyver^[30] compared two training programmes: a phonological awareness programme, and a silent reading or comprehension programme. Fifteen children with Down syndrome, aged 2-10-years were allocated to one of the two training programmes which were delivered over 10-weeks. The phonological awareness training emphasised oral reading, using word reading and blending tasks. The comprehension or silent reading tasks included selecting pictures to match action words and sentences. There was also some overlap between the programmes, as both included sentence completion and oral reading components. In addition, taking advantage of the visual strengths of children with Down syndrome^[1], both programmes made use of visual aids, such as pictures and plastic letters, to promote learning. Both programmes led to significant gains on measures of phonological awareness, letter-sound knowledge and word and passage comprehension. This research suggests that children with Down syndrome may make considerable improvements in phonological awareness and letter-sound knowledge following periods of instruction, even when teaching does not explicitly target those skills. However, other work which has compared phonological awareness intervention with other types of training (i.e. narrative training) in children with Down syndrome report greater gains following explicit teaching

of phonological awareness (e.g., Cleave, Kay-Raining Bird, Bourassa, Armstrong & MacIsaac, 2006, cited in^[31]).

The evidence outlined above suggests that reading instruction, and more specifically, training phonological awareness in the context of learning letter-sound knowledge, is effective for supporting the development of reading in groups of typically-developing children, and in children with Down syndrome. Thus, many children show strong and lasting gains on reading measures following phonological awareness intervention even where interventions are of short duration. It is important to note, however, that a minority of children who receive phonological awareness intervention fail to respond; many studies of typically-developing children and of children with Down syndrome report wide variation in response to phonological awareness intervention, with some children failing to make any progress, or even showing in a decline in reading (e.g. REFS 15,27,29,32). Goetz et al.^[27] report no progress for 2 of the 15 children with Down syndrome who participated in their intervention, whilst a further 4 children showed small declines in reading age over the course of the intervention period. Similarly, van Bysterveldt et al.^[29] report significant variability within the group of children with Down syndrome, both in terms of initial level of skill, and in progress made over the course of the intervention, with some children making very little or no progress.

Research with typically-developing children has begun to explore why some children fail to respond to phonological awareness intervention. This research suggests that these children have a similar profile of more severe deficits in phonological awareness and letter-sound knowledge and relatively poor vocabulary skills^[15,32]. It has been argued that oral language, particularly vocabulary knowledge, supports the development of phonological awareness^[33] as increasing vocabulary knowledge forces a restructuring of the mental lexicon at a sub-lexical phonological level. In this way, developing vocabulary knowledge is likely to have a facilitative effect on developing phonological awareness. This would predict that intervention which targets oral language skills alongside phonological awareness skills would be particularly effective for supporting reading

development for this group of children. Evidence with typically-developing children appears to support this prediction. A recent study^[34] evaluated a programme of intervention which combined training in reading and phoneme awareness^[15] with a programme of rich vocabulary instruction^[35] with 12 8-year-old children who had previously failed to respond to a period of reading intervention. This programme included work on book-reading, vocabulary instruction and narrative skills, combined with phoneme awareness, letter-knowledge and sight-word reading. Teaching assistants were trained to deliver the intervention to individual children in two daily 15-minute sessions over a period of nine weeks. The findings showed that, for this group, a combined reading and vocabulary training programme was more effective than a programme which solely targeted reading. Significant progress was made in word reading, letter-sound knowledge, phoneme segmentation and expressive grammar over the course of the intervention (effect sizes ranging from Cohen's $d = 0.44$ to 1.23), with children showing gains in reading that were three times greater than gains made before and subsequent to the intervention.

Research with typically-developing children therefore suggests that children who have low levels of vocabulary may be less able to benefit from phonics training and that intervention which combines robust vocabulary teaching with reading instruction could be more effective for this group than traditional reading intervention programmes. Potentially, children with Down syndrome may also be more likely to benefit from a combined approach. Language impairments are common in children with Down syndrome (see e.g. REF 4) and evidence suggests that oral language skills play a significant role in the development of reading for this group^[3]. This suggests that instruction which combines highly-structured phonics training with oral language skills training might be highly beneficial to the reading and language skills of children with Down syndrome.

The work reviewed above has focused on developing reading skills through the word recognition component, mainly by targeting phonological awareness skills and letter knowledge. It is clear though

that the most recent developments in reading intervention work, which include oral language training as a component to reading intervention, take a more holistic view of reading that incorporates processes involved in supporting language comprehension, i.e. vocabulary. By including vocabulary and narrative skills in the teaching programme, this training has the potential to impact directly on the development of comprehension, though this needs to be evaluated in future studies. Returning to the *Simple View of Reading*^[5] discussed earlier, this framework identifies language comprehension as the second essential component involved in reading. In contrast to research on word reading and phonological awareness, there is considerably less research on comprehension and we know much less about how best to support the development of this skill. This paper will first provide a brief summary of the processes involved in comprehension and review what we know about the comprehension skills of children with Down syndrome, before considering methods by which comprehension may be supported.

Reading comprehension clearly relies to some extent on word recognition: children cannot begin to understand text unless they can first accurately identify the printed word. Indeed, poor reading skills are the cause of some children's difficulties with reading comprehension. However, recognising the word is no guarantee of comprehension; many more processes beyond those involved in word recognition are required to make sense of text. In line with this, research has identified a group of children who have particular difficulties with comprehension, despite demonstrating good decoding skills. These children are referred to in the literature as 'poor comprehenders', and they are typically identified as having reading comprehension skills that are at least one year below age-appropriate reading accuracy skills. The discrepancy between reading accuracy and comprehension means that they understand text at a level significantly below that which could be expected from their reading accuracy, signalling a problem with comprehension that is not caused by reading accuracy difficulties. Research suggests that approximately 10% of children of primary-school age fit the profile of poor comprehenders^[8].

Reading comprehension is a multidimensional skill that involves a number of processes at several different levels, any of which may impair comprehension; components identified as important for comprehension include language skills (grammar, semantics and pragmatics), working memory, background knowledge, and processes including inferential processing, and comprehension monitoring^[36]. Given that many children with Down syndrome experience difficulties with at least two of these components, namely language^[37] and memory^[38], it may be expected that this group would demonstrate difficulties with comprehension. Few studies of reading skill in individuals with Down syndrome report comprehension data; consequently the evidence base is limited. However, the evidence that is available suggests that reading comprehension is typically below reading accuracy for this group (e.g. REFS 2,24,39-43). In a preliminary report^[39] 10 individuals with Down syndrome (aged 11-19 years) were compared with 10 typically developing children (aged 8-10 years) who were matched for single-word reading. Though the groups did not differ in reading ability, the group with Down syndrome scored significantly more poorly on a test of reading comprehension. Reading comprehension scores in this group were found to be on average 18 months below reading accuracy. Similarly, the case study of an 'exceptional' reader with Down syndrome^[2] showed that K.S. achieved scores on a reading comprehension test that were significantly below the level which would be expected from her reading accuracy ability; specifically comprehension was 13 months below reading accuracy. Thus, many children with Down syndrome comprehend text at a level which is poorer than could be expected given their reading accuracy skills. Discrepancies between accuracy and comprehension are comparable to that recorded for poor comprehenders, suggesting a similar profile^[2].

As noted above, many children with Down syndrome have weaknesses with language and memory, both of which are likely to constrain their ability to understand text. Indeed, the reading comprehension difficulties of children with Down syndrome are associated with difficulties with language comprehension and wider language skills including verbal cogni-

tive ability, receptive vocabulary and receptive semantic knowledge^[2,39]. This would suggest that interventions which target vocabulary knowledge or memory skills may also support the development of comprehension. Though research has explored ways of supporting these skills in children with Down syndrome (see e.g. REFS 4,44) there is little research evidence concerning the impact of this on comprehension; clearly, this is an area in need of further research. There is insufficient space here to discuss research which has developed and evaluated language and memory interventions with children with Down syndrome; this will be addressed in future research updates.

There is some suggestion that children with Down syndrome have particular difficulties with inferential comprehension^[2,39]. Inferencing is the process whereby readers fill in the gaps left by explicit text information, and the ability to do this is significantly related to comprehension^[45-47]. Work with typically-developing children suggests that less-skilled comprehenders experience impaired inference making relative to skilled comprehenders^[46-47]. Nash et al.^[39] suggest that children with Down syndrome also experience particular difficulties with inference generation: though both typically-developing children and children with Down syndrome scored lower on questions that required an inference than on questions that required a literal understanding of the text, the difference between the scores on the two question types was greater for the group with Down syndrome. Groen et al.^[2] also argue that children with Down syndrome may find inferential comprehension particularly difficult. In their study, K.S. scored more highly on a test of comprehension which was argued to test mainly literal understanding, than on a comprehension test which also included inferential questions. Research with typically-developing children suggests intervention which targets inferencing skills can be effective for supporting comprehension^[48-49]. For example, McGee and Johnson^[49] found that 3 weeks of inference training led to comprehension gains of 20-months in 6- to 10-year-old less-skilled comprehenders. Training in this skill may also then be effective for children with Down syndrome. However, further work which clarifies the nature of comprehension dif-

ficulties in children with Down syndrome is needed before exploring this kind of intervention.

Work with typically-developing children suggests that teaching comprehension strategies is also effective for supporting comprehension. Strategies that have been identified as particularly important for successful comprehension include prediction, questioning, clarifying and summarising^[50]. Readers can be taught to use comprehension strategies with the result that understanding and memory of the text is improved^[51]. Palincsar and Brown^[52] developed an instructional programme to teach comprehension strategies called "Reciprocal Teaching". This method makes use of modelling and scaffolding techniques to teach appropriate use of strategies and children learn to apply strategies during group activities which encourage discussion and dialogue between participants. This programme of instruction has been shown to lead to significant increases in comprehension for different populations of students^[52-55]. Recent work with adults with mild intellectual disability^[56] suggests that direct teaching of strategies to individual children is as effective as the traditional reciprocal teaching format (working with groups) for supporting comprehension.

The impact of comprehension strategy instruction for enhancing reading comprehension has been evaluated for 6 young adults with Down syndrome (aged 18-25-years)^[58]. The intervention was delivered over 15 weeks in weekly sessions of 15-30 minutes duration. Participants attended in pairs for the first 12 weeks at which point training was tailored to individual student's needs. This study focused on three key strategies: accessing prior knowledge and past experiences, prediction and retelling. Findings are reported for a single case study: a young man with Down syndrome named Lewis, aged 19 years and 6 months. Following the intervention, Lewis demonstrated increased use of the trained strategies: he was more able to access relevant prior knowledge and past experiences and to use this to understand the text, was better able to predict the context of text and discuss the text following reading, and better able to recall details and retell a text. These types of strategic processing facilitate comprehension by enabling the reader to actively

process the text and to develop a more detailed and coherent representation of the text that is supported by personal experience and background knowledge. Increases in strategy use were coupled with significant increases in reading ability: at the end of the intervention period, Lewis's comprehension had increased by 12 months, and accuracy by 10 months. Thus, teaching comprehension strategies may be an effective method of supporting comprehension for individuals with Down syndrome, though clearly further work is needed to support this.

A different type of strategy training that has been investigated is the use of mental imagery techniques. Imagery may facilitate comprehension by providing an alternative (visual) way of representing information: visual mental images can help to organise information for retrieval and support integration of ideas, which would complement and may reduce the verbal processing load. Research suggests that mental imagery training is as effective as verbally-based reciprocal teaching methods for improving the reading, language and memory skills of typically-developing groups with poor comprehension^[58]. Oakhill and Patel^[59] carried out a training study with 9-10-year-old typically-developing children who were identified as good and poor comprehenders, by teaching them to picture stories in their minds which they were then to use to answer comprehension questions. The training led to increased comprehension, having a greater effect for poor comprehenders than for the more skilled group, who presumably are already using this strategy to aid comprehension. A recent study^[60] evaluated visual imagery training as a method of supporting comprehension

in children with specific language impairment (SLI). In this study, nine children with SLI aged 9 years, 6 months participated in five 30-minute training sessions each week for three weeks. Using picture cues, children were encouraged to visualise sentences; as children progressed in the intervention they gradually shifted from visualising segmented sentences, through to individual sentences, before graduating to 5-sentence stories. The use of picture cues was gradually reduced over time so that children were required to create their own mental images by the end of the intervention. The intervention was delivered to children in small groups, in which they were encouraged to share and discuss their mental imagery. Significant gains in comprehension were reported following the intervention (effect size = 0.608).

Research has yet to evaluate mental imagery training as a method of supporting comprehension in children with Down syndrome; however, evidence that this group benefit from visual learning^[1] suggests that visual imagery training may play to their strengths. Furthermore, there is evidence that this group benefit from mental image strategies to improve recall^[61]. In this study, 52 individuals with Down syndrome (aged 7-57 years) were asked to listen to stories and recall words and ideas. Recall was best when the stories were presented along with pictures representing the main points of the story. Recall was also significantly better when participants were given a short training period in 'the formation of mental images in order to learn a story' than when they only listened to the stories. This suggests that this type of strategy is suitable for individuals with Down syndrome and may support learning. However further

research is needed to evaluate whether mental imagery training can be used to support comprehension specifically in children with Down syndrome, rather than simply recall.

In summary, reading intervention work with typically-developing children has identified methods of supporting reading development by targeting the processes involved in word recognition and in comprehension. This evidence has started to inform research with children with Down syndrome, and there is clear evidence that some of these methods are effective for supporting the reading skills of this group. It must be noted that there are difficulties interpreting many of these training studies as they often fail to include an untreated control group with which to compare the intervention group, and are often small scale or report data from single case studies. There is clearly a need for further research to evaluate those methods which appear promising for supporting reading in children with Down syndrome, using well-designed and controlled research methods. In addition, despite recent advances in knowledge, there remain significant areas in which our understanding is lacking, and this is particularly true of comprehension. More research is needed to explore the comprehension skills of children with Down syndrome, and to evaluate methods of instruction which may support the development of this skill. Clearly, there is still a long way to go.

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