Critical Review:
Is phonological awareness training an effective literacy intervention for children with Down syndrome?

Rachael Millard
M.Cl.Sc. (SLP) Candidate
University of Western Ontario: School of Communication Sciences and Disorders

This critical review examines the literature measuring the effectiveness of phonological awareness interventions for children with Down syndrome. Four studies are reviewed with the following study designs: multiple baseline across behaviours, multiple case studies, and two studies with mixed between and within groups designs. Overall, research to date shows a small improvement in phonological awareness following a targeted intervention with very little generalization. The evidence is suggestive regarding the effectiveness of phonological awareness interventions as part of a broader intervention plan.

Introduction

The cognitive profile of children with Down syndrome has been shown to be quite variable. Often these children display stronger receptive language skills than expressive language or grammatical skills, stronger visual than verbal skills, and for some, reading can be a relative strength (Snowling, Nash, & Henderson, 2008). However, there is considerable variation within reading sub-abilities. Generally, children with Down syndrome show relative strength in word identification and relative weakness in nonword reading/decoding (Cupples & Iacono, 2000) and in reading comprehension (Boudreau, 2002).

It has been well established within the literature that phonological awareness strongly predicts reading ability in typically developing children (Blachman, 2000). Phonological awareness is a particularly important skill for decoding (i.e., the ability to read novel or new words). Specifically, phonological awareness is the ability to detect, manipulate or analyze the sound structure in spoken language, unrelated to meaning. This includes the ability to segment phonemes, syllables and words (Blachman, 2000). Research has demonstrated that children with speech and language delays can benefit from a phonological awareness intervention (Bernhardt & Major, 2005). However, there has been some controversy as to whether this relationship holds true in children with Down syndrome.

A study by Cossu, Rossini and Marshall (1993), found that children with Down syndrome were able to acquire reading ability in the absence of phonological awareness. Similarly, Roch and Jarrold (2008) conducted a study to examine whether children with Down syndrome used a phonological or more visual route (e.g., sight words) in learning to read. Children with Down syndrome demonstrated impaired nonword reading and they concluded that the visual route may have some advantage to reading for these children. This idea that the visual route may be more dominant has been duplicated in other studies (e.g., Fletcher & Buckley, 2002). Although this can be an effective strategy to reading, it limits the reader from being able to decode novel words.

In opposition to Cossu et al. (1993), other studies have found impaired but measurable amounts of phonological awareness in children with Down syndrome (Fletcher & Buckley, 2002; Snowling, et al., 2008). Furthermore, some research has shown that despite being impaired, phonological awareness can still predict reading ability in children with Down syndrome (Gombert, 2002; Snowling, Hulme & Mercer, 2002). Finally, Joseph and Seery (2004) conducted a review of the literature on studies involving the use of phonetic analysis strategies in children with Down syndrome and other cognitive delays. They concluded that these children have the capacity to benefit from phonetic analysis instruction.

The development of literacy is an important goal for all children including those with Down syndrome. The current controversy within the literature can make choosing an effective, evidence-based intervention plan difficult for clinicians or other professionals working with these children.

Objectives

The primary objective of this paper is to critically analyze the literature evaluating the effectiveness of phonological awareness interventions in order to improve literacy in children with Down syndrome. A secondary objective is to form clinical recommendations based on an amalgamation of the available research.

Methods

Search Strategy

The relevant articles were obtained through a computerized search of CINAHL and PsychInfo using the search terms (Down syndrome) AND (phonological awareness) OR (literacy) OR (reading) AND (intervention). Hand searches of the references from relevant articles were conducted to identify other relevant articles.

Selection Criteria

Only studies employing an intervention involving phonological awareness in children with Down syndrome were included. No other exclusion criteria were used.

Data Collection

The search identified four studies that met the above criteria. The study designs included: a) multiple case studies approach, b) multiple baseline across behaviours, and c) mixed between and within groups design.

Results

Cupples and Iacono (2002) conducted an intervention study comparing the benefits of an analytic approach versus a whole word approach to reading. The analytic approach involved explicit training in phonological awareness. The participants included seven children with Down syndrome between the ages of 8 and 11-years. The authors used an experimental case study design. The children were randomized into two groups, three children receiving a whole-word intervention and four receiving an analytic approach to reading intervention. The intervention lasted a total of 6-weeks, with pre- and post-testing occurring in weeks one and eight. The measures included standardized and experimental tests.

The McNemar χ^2 Test for Significance of Changes was used to compare pre- and post-test data. In total, four children (two from each group) showed significant improvement on trained items. Conversely, on the generalization items, no children from the whole-word approach improved while two children from the analytic approach significantly improved on reading the generalization words. The authors concluded that children with Down syndrome can be taught to read using a whole-word or analytic approach, but may generalize better with an analytic or phonological awareness based instruction.

Generalization of treatment in the analytic group was seen mainly in words from the same rime family as trained words. For the two children who demonstrated generalization, 85.7% and 71.4% of words read were from the same rime family respectively. Furthermore, performance on the two standardized tests of word and nonword reading did not improve as a result of the intervention. This suggests that the improvements may have been limited to words similar to those in the training set. A strength of this study was the inclusion of the intervention program allowing for future replication. This study is limited by its small sample size, making the conclusions suggestive but not compelling.

Similar to the previous study, Kennedy and Flynn (2002) conducted an intervention study to measure the effectiveness of a phonological intervention for children with Down syndrome. The authors employed a multiple baseline across behaviours design. The intervention included three children, between the ages of seven and eight years of age. The intervention involved eight, one-hour sessions over a four week period. The intervention targeted alliteration detection, initial-phoneme isolation, spelling and recognition of rhyme words. Experimental probes were used to collect pre- and post-performance data. To validate the scoring, inter-rater reliability was determined for 33% of the probe results. The inter-rater agreement was 95% and 100%. In order to demonstrate improvement stemming from the intervention, the authors measured control and target behaviours.

The authors report that all three participants made significant gains in phoneme level awareness related to the intervention, compared to the control behaviours which remained stable or equally variable from pre- to post-test. However, participants did not generalize these gains to a novel phoneme segmentation task. All three participants also made significant gains in spelling. This effect was likely related to the phonological tasks which involved explicitly linking letters to their sounds. Finally, none of the participants made significant gains in their speech as measured by percent consonants correct.

Similar to Iacono and Cupples (2002), a strength of this paper was the inclusion of the intervention materials allowing for future study replication or use in clinical interventions. Unfortunately, conclusions based on this study are very limited as the statistical analyses used were not reported, the sample size very small and no control group was included. The results from this study are suggestive and with corroborating results could be important for future clinical practice.

To build on these earlier studies, van Bysterveldt, Gillon and Moran (2006) conducted an intervention study to determine the effectiveness of a phonological awareness intervention on 4-year-old children with Down

syndrome. They employed a mixed between and within groups design. The participants included a group of seven children with Down syndrome recruited from a group of nine children attending a transition to school program. A control group of age-matched typically developing children were randomly selected from a total of 17 children living in the same urban area as the experimental group. The authors administered standardized assessments pre-intervention and experimental assessments pre- and post-intervention to measure the speech and language skills of the children. To control for the variation seen in children with Down syndrome's expressive language production, the experimental tasks did not require verbal responses.

Prior to the intervention beginning, parents were trained in print referencing techniques involving explicit reference to letter name, letter sound and first sound in a word. They were also trained on suitable book selection and were each given one of the *Where's Spot* books. To ensure accurate administration of the intervention, parents were videotaped on three occasions. The author and an independent researcher noted that six of the seven parents accurately used all three techniques consistently.

Using *t* tests to compare group scores pre- and post-test, it was found that the groups differed significantly on three of the four phonological awareness measures. Conversely, the control group made a significant change on only one phonological awareness measure. A series of paired *t*-tests were used to examine individual differences pre- and post-test revealing statistically significant differences on three out of the four measures. This method of data analysis is somewhat weak as it does not account for the multiple *t*-test comparisons completed; an ANOVA may have been more appropriate. There was considerable variability in performance for the experimental group that was demonstrated by plotting the data using the standard deviation band method.

The evidence suggests that with appropriate training parents can be an effective mode of intervention delivery for phonological awareness. This study was limited by the small sample size, ceiling effects achieved by children in the control group as early as the pre-intervention assessment, and lack of environmental control due to a parent-led, home-based intervention. Overall, this study was well designed, although the analysis could have been more appropriate, the conclusions from this study are strongly suggestive.

The final study included in this review, conducted by Goetz, Hulme, Brigstocke, Carroll, Nasir and Snowling (2008), focused on a short-term reading intervention for children with Down syndrome. A mixed between and within groups design was used for this study. Fourteen children with Down syndrome were recruited from a large sample providing they had emerging reading skills. The eight girls and six boys were divided into two groups. Group 1 began the intervention in January and group 2 started the intervention the following May. The intervention was administered by trained learning support assistants who worked with group 1 for 16 weeks and group 2 for 8 weeks. The program taught children phoneme segmentation and blending while learning letter-sounds and working with words in books. The children were assessed pre-intervention, mid-, post-intervention and during a 5-month follow-up. The assessment measures included both standardized and experimental measures.

The authors used Mann-Whitney *U* and Cohen's *d* to determine whether the taught group made more gains then the waiting group. These measures were chosen due to the small sample sizes and the variation in initial reading ability. They found that group 1 significantly improved on approximately half of the literacy measures compared to group 2, although the nonsignificant measures had moderate to large effect sizes and may have been significant given a larger sample size (d =.80, d =.40, respectively). When group 2's performance was measured from mid- to post-intervention using a Wilcoxon Matched-Pairs Signed Ranks test, none of the literacy measures were significantly different. This may again be attributable to high variability in participant skill as well as the small sample sizes. However, both groups 1 and 2 maintained the gains made post-intervention when measured again at the 5-month follow-up. This study included two direct measures of phoneme awareness, final phoneme matching and alliteration. Performance for the final phoneme task was at floor, however, there was a trend for the taught group to make more progress on the alliteration measure following 8 weeks of intervention compared to the waiting group. The large effect size (d =1.11) suggests that given a larger sample size the change may have reached significance.

Overall, the taught group made significant progress on some measures of literacy, as well as tended towards improvement on phonological awareness (i.e., an alliteration task). A positive feature of this study was their ability to essentially replicate their findings. When the waiting group of children received the same treatment, they also demonstrated lasting gains at the five-month follow-up. This study was well designed and made use of appropriate statistics for the group comparisons. The results from this study are suggestive for future clinical practice.

Discussion

A number of correlation studies have demonstrated low levels of phonological awareness in children with Down syndrome (e.g., Cupples & Iacono, 2000, Fletcher & Buckley, 2002). Some researchers have suggested that children with Down syndrome use a more visual route to reading. Unfortunately, simply using a sight word approach to reading does not allow children to sound-out and read novel words. This has led to the need to investigate the effectiveness of phonological awareness interventions for children with Down syndrome.

All four studies reviewed in this paper targeted aspects of phonological awareness in their intervention programs. Unfortunately, the tasks measuring phonological awareness, as well those used to improve it, varied between the studies reviewed. This variation makes direct comparison of the studies difficult. However, all four studies did find some significant improvement following the intervention. Together, these results suggest that children with Down syndrome can benefit from a phonological awareness intervention.

The strength of conclusions based on the results of these studies is restricted due to a number of methodological limitations. First the small sample sizes found in all four studies reduced the statistical power of the analyses as well as limited the generalizability of the results. Furthermore, children in three of the four studies (Cupples & Iacono, 2002; Goetz, et al., 2008; Kennedy & Flynn, 2002) were involved in previous research projects while the participants in the final study (van Bysterveldt, et al., 2006) were selected from a specialized transition to school program. Therefore, all the children in the various studies had likely already received some training in phonological awareness, and may have made more gains because of this previous training. Consequently, it cannot currently be concluded that children with no previous exposure to phonological awareness training, or perhaps only simply exposure to intervention methods, will show the same benefits in the same amount of time as the children in the reviewed studies.

Another limitation in methodology involves some of the study designs. Currently, there is some controversy over the best method of comparison in studies involving children from special populations (Snowling et al., 2008). The studies reviewed involved age-matched typically developing children, a delayed treatment group of children with Down syndrome, as well as no comparison groups at all. This wide variety in comparison methodology can be viewed as both an advantage and disadvantage. On the positive side, no matter with whom the children were compared, they all showed some significant improvement. On the other hand, the variation in comparison groups or lack of comparison groups prevents the grouping of studies together in order to form stronger conclusions.

Conclusion and Recommendations

Overall, the results from the studies are individually suggestive and taken together fairly compelling. The small but significant improvement in phonological awareness makes a strong case for this ability to be included in a literacy intervention for children with Down syndrome.

It would be useful for future research to attempt a longer intervention period. This would enable researchers to determine the optimal amount of intervention time as well as to apply more direct measures of reading to determine exactly what skills may be affected by a phonological awareness intervention. At this time, the current research demonstrated that children with Down syndrome could improve their phonological awareness on a limited set of activities but with very little generalization. However, it was not clearly demonstrated that this is a beneficial skill for them to build. For example, a longitudinal study involving a trained group and an untrained group of children with Down syndrome could compare actual changes in reading ability due to the intervention. To this end a paper is currently being prepared by Goetz and colleagues following the completion of their longitudinal research study.

Furthermore, larger sample sizes would be helpful in future research studies in order to increase the statistical power of the findings. The inclusion of different comparison groups within the same study would also be beneficial. This would enable researchers to make stronger conclusions with greater confidence about generalizability.

Finally, future research would benefit from examining more closely how children with Down syndrome learn to read and if the different processes can build from one another. For example, Cupples and Iacono (2002) suggest that research examine the learning of regular versus irregular words. Due to the strength of the visual route to reading, Goetz et al. (2008) recommend determining whether it is better to introduce phonics immediately or whether it is better to wait until children have a larger sight vocabulary.

In conclusion, there is a great need for further research into this area in particular and into reading development in children with Down syndrome in general. At this

stage in the research the results are suggestive but need greater development.

Clinical Implications

Although individually the results are only suggestive there are a number of important clinical implications from these studies. First, it is clear that including phonological awareness training in an intervention will certainly do no harm and will likely be at least minimally beneficial. It would be best to include simple activities that do not require a large amount of auditory information to be remembered as research has demonstrated that this is an area in which children with Down syndrome struggle (Cupples & Iacono, 2000). Results from Kennedy and Flynn (2002) suggest that using activities that explicitly link letters to their sounds may have the secondary benefit of improving spelling ability.

Currently, the evidence also suggests that phonological awareness should be included only as one component of a literacy intervention for children with Down syndrome. The intervention should also target sight word vocabulary development. Finally, the research reviewed in this paper demonstrated that a variety of intervention delivery modes are effective. Specifically, a parent led intervention as well as one led by learning support assistants were employed in the studies reviewed. This suggests that with the appropriate program a variety of delivery methods can be effectively utilized.

References

Bernhardt, B., & Major, E. (2005). Speech, language and literacy skills 3 years later: A follow-up study of early phonological and metaphonological intervention. *International Journal of Language & Communication Disorders, 40*(1), 1-27.

Blachman, B. (2000). Phonological awareness. In M. Kamil, P. Mosenthal, P Pearson. & R. Barr. (Eds.). Handbook of reading research (Vol. 3, pp.483-502). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Boudreau, D. (2002). Literacy skills in children and adolescents with Down syndrome. *Reading and Writing: An Interdisciplinary Journal, 15*, 497-525.

Cossu, G., Rossini, F. & Marshall, J. C. (1993). When reading is acquired but phonemic awareness is not: A study of literacy in Down's syndrome. *Cognition, 46*, 129-138.

Cupples, L. & Iacono, T. (2002). The efficacy of 'whole word' versus 'analytic' reading instruction for children with Down syndrome. *Reading and Writing, 15*, 549-574.

Cupples, L. & Iacono, T. (2000). Phonological awareness and oral reading skills in children with Down syndrome. *Journal of Speech, Language and Hearing Research, 43*, 595-608.

Fletcher, H. & Buckley, S. (2002). Phonological awareness in children with Down syndrome. *Reading and Writing Quarterly: Overcoming Learning Difficulties, 11*, 311-334.

Goetz, K., Hulme, C., Brigstocke, S., Carroll, J., Nasir, L. & Snowling, M. (2008). Training reading and phoneme awareness skills in children with Down syndrome. *Reading and Writing, 21*, 395-412.

Gombert, J-E. (2002). Children with Down syndrome use phonological knowledge in reading. *Reading and Writing, 15*, 455-469.

Joseph, L. M. & Seery, M. E. (2004). A review of the literature on the use of phonetic analysis with students with mental retardation. *Remedial and Special Education, 25*, 88-94.

Kennedy, E. & Flynn, M. (2002). Training phonological awareness skills in children with Down syndrome. Research in Developmental Disabilities, 24, 44-57.

Snowling, M. J., Hulme, C. & Mercer, R. C. (2002). A deficit in rime awareness in children with Down syndrome. *Reading and Writing, 15*, 471-495.

Snowling, M. J., Nash, H. & Henderson, L. (2008). The development of literacy skills in children with Down syndrome: Implications for intervention. *Down Syndrome Research and Practice, 12*, 62-67.

van Bysterveldt, A., Gillon, G. & Moran, C. (2006). Enhancing phonological awareness and letter knowledge in preschool children with Down syndrome. *International Journal of Disability, Development and Education, 53*, 301-329.