

Is emergent literacy advanced through speech intervention that incorporates structured early/pre-literacy training for preschool children with isolated phonological disorders?

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This critical review examines the need for incorporating structured early/pre-literacy training into speech intervention for preschool children with isolated phonological disorders. A literature search yielded the following study designs: 5 between groups studies, 2 case-control studies, and 1 study incorporating 18 single subjects. Results are inconsistent, but suggestive for inclusion of early/pre-literacy deficit screening for children with speech sound disorders characterized by consistent, non-developmental speech errors.

Introduction

The current research linking history of speech sound disorders with later difficulties acquiring literacy is ambiguous. It is widely accepted that children with speech and language difficulties are at increased risk of problems acquiring literacy, but whether this can be attributed to speech or language abilities, or possibly an interaction of the two, is yet to be determined.

Learning to read depends on phonological skills. Liberman, et al., (1989) argues that what makes learning to read more difficult than learning to speak is that it requires explicit awareness of things previously learned at an automatic, implicit level, e.g. the structure of sounds in speech and the phonological structure of syllables. It is therefore conceivable that children who have difficulties at this automatic stage will have difficulties later with metaphonology/phonological awareness. Stanovich, et al., (1988) states that children that experience difficulty learning speech sounds go on to have poorly defined phonological representations/awareness and this can lead directly to literacy deficits (Core Phonological Deficit Hypothesis). A systematic review by McOrmack et al. found an association between speech impairment and deficits in phonological awareness/processing and reading. Furthermore, these skills may continue to be affected into adulthood (McOrmack, McLeod, McAllistar, & Harrison, 2009).

Since children with isolated, conceptual (non-motoric) speech difficulties make up a large portion of the speech-language pathology clientele (Broomfield & Dodd, 2004; Joffe & Pring, 2008; McLeod & Baker, 2004) and reading difficulties are a prevalent concern in schools, the pursuit to either verify or dismiss this link is worthwhile. In the meantime, Speech-language pathologists, having early access to these children, as well as, the appropriate skills have means by which to provide preventative care. Also, phonological awareness interventions have been shown to have lasting, positive effects in children with and without speech sound disorders (Gillon, 2000, 2002). Therefore incorporation

of early/pre-literacy training into therapy for at-risk children is a valuable pursuit.

Objectives

The primary objective of this review is to critically evaluate existing literature addressing the need for and impact of speech intervention that incorporates structured literacy training in preschool children with isolated phonological disorders. A secondary objective is to provide relevant evidence-based recommendations for clinical practice.

Methods

Search Strategy

Computerized databases, including CRKN Wiley Online Library 2011, EBSCOhost Academic Search Complete, Highwire Press Journals and ProQuest Education Complete New Platform were searched using the following search strategy:

((Early literacy training) OR (Early literacy intervention) OR (Phonological awareness training) OR (Phonological awareness intervention)) AND ((Speech disorders) OR (Speech sound disorders) OR (Speech impairment))

Selection Criteria

Studies selected for inclusion in this critical review were required to address the link between isolated phonological impairments and early literacy skills and/or the effects of early literacy intervention for children with isolated phonological disorders. Articles were excluded if the experimental population included only those children with comorbid language difficulties.

Data Collection

The literature search resulted in 7 articles congruent with the above-mentioned criteria (one of which reported two studies): 5 between groups studies, 2 case-control studies, and 1 study incorporating 18 single subjects.

Results

Between groups study #1. In this level 2a evidence study, Carroll and Snowling (2001) examined whether 17 children with a family history of dyslexia differ from 17 typically developing children and 17 children with speech difficulties on tasks of phonological processing, phonological learning, phonological awareness, and literacy. Participants were aged 3;11 to 6;6. The study employed within subjects ANOVAs followed by paired t-tests.

Phonological processing was assessed through mispronunciation detection, expressive phonology, and non-word repetition tasks. Controls had higher composite scores than the family history group, which had higher composite scores than the speech impaired group for these tasks. Assessment of phonological learning revealed that control children performed better than children with speech impairment and children with a family history of dyslexia, however, children with speech impairment and those with a family history of dyslexia did not differ from each other on these tasks. Phonological awareness was assessed through syllable, rhyme and initial phoneme matching tasks. Control children outperformed children with speech impairment and children with a family history of dyslexia; however the latter two did not differ from each other. Early literacy was assessed through letter knowledge and single word reading tasks. The children with speech impairment performed significantly lower than the family risk group, which did not differ from controls on these measures. These results support the notion that children with speech impairment are at risk of reading difficulties.

Strengths of Carroll and Snowling's study include matching of all three groups on the basis of age, educational experience, and vocabulary scores, reliable and valid methods and appropriate statistical analyses. Weaknesses include a small sample size and that the authors do not characterize the speech impaired group as having conceptual or motoric speech difficulties. Also, children were studied at a very early stage in literacy development, where sizeable variation is to be expected. Overall, these results are judged to be suggestive to compelling.

Between groups study #2. In this level 2a evidence study Kirk and Gillon (2007) compared the morphological awareness and reading ability of children aged 7;6 to 9;5 with speech impairment who previously received two different courses of intervention during preschool; one focused on speech production and phonological awareness (Group 1, n=8) and the other only on speech production (Group 2, n=9). They

compared these children's abilities to those of typically developing peers (Group 3, n=24). Morphological awareness tasks included: spelling of derived words and verbal generation of base words. Reading performance tasks included: non-word decoding and word recognition.

Morphological awareness tasks: Absolute spelling accuracy and awareness of morphological spelling rules were analyzed with a one-way ANOVA followed by appropriate post-hoc pairwise comparisons with either the Tukey HSD procedure or Dunnett's T3 procedure. Performance on verbal generation of base words was compared through a MANOVA. Groups 1 and 3 both performed significantly better than group 2 and did not differ significantly from each other for absolute spelling accuracy and awareness of morphological spelling rules. There were no group differences on base word detection. *Reading tasks:* Performance on reading tasks was analyzed using one-way ANOVAs followed by appropriate post-hoc pairwise comparisons with either the Tukey HSD procedure or Dunnett's T3 procedure. Group 1 outperformed both groups 2 and 3 who did not differ significantly from each other for non-word decoding. Groups 1 and 2 did not differ significantly; groups 1 and 3 did not differ significantly, and group 3 outperformed group 2 on word recognition.

After receiving supplemented therapy, children with speech sound disorders performed at the same level as controls on early literacy tasks; whereas those children who received only traditional therapy, performed significantly lower. These results suggest that supplementing phonological therapy with early literacy training may help children with speech sound disorders 'catch up' to typically developing peers in early literacy.

Strengths of the Kirk and Gillon study include reliable and valid methods, as well as, appropriate statistical analysis. Also, children in the study lacked sensory, physical or intellectual contributors to their speech impairment, making them more likely to exhibit conceptual speech sound disorders. Sample sizes were small and therefore it is difficult to generalize these findings. Overall these results are judged to be suggestive to compelling.

Between Groups Study #3. In this level 2a evidence study Apel and Lawrence (2011) investigated whether 44 children, ages 6;2 to 8;9, with speech sound disorders differ in their performance on measures of morphological awareness in comparison to 44 children with typical speech. They also sought to understand what level of independent significant variance in word-level reading and spelling can be accounted for by morphological awareness skills beyond known

contributors to literacy e.g. phonological awareness, letter knowledge, receptive vocabulary, and nonverbal cognition.

T-tests were used to compare the two groups' performance on various tasks of reading, spelling, phonological awareness, morphological awareness, nonverbal cognition, articulation, and receptive vocabulary. Appropriate post-hoc analyses were conducted where necessary. Children with speech sound disorders scored significantly lower on all measures except letter knowledge and nonverbal cognitive skills; this includes all morphological awareness tasks. However, both groups performed within normal limits on norm-referenced tests of word-level reading, letter knowledge, phonemic awareness, receptive vocabulary, and nonverbal cognition. Morphological awareness failed to explain any unique variance in reading but explained 4% unique variance in spelling in children with speech sound disorders. However, for typically developing children, morphological awareness explained 13% and 18% unique variance for reading and spelling, respectively. Results indicate that although, children with speech impairment score significantly lower than typically developing peers on tasks of morphological awareness, they are not considered impaired in this area since their scores tend to be within normal limits. Also, morphological awareness does not seem to be a useful predictor of literacy abilities in these children at this point in their development.

Strengths include good measures of inter-rater reliability for all tests administered (ranging from 96%-100%), fair sample sizes, sound methodology and appropriate statistical manipulations. Weaknesses include the use of production morphological awareness tasks only, resulting in difficulty parsing out whether speech sound difficulties were the cause of poorer performance, since all of the children with speech sound disorders presented with persisting problems at the time of testing. Speech sound difficulties were not well defined in this study, leaving the reader uninformed as to whether difficulties were motoric, physical, or conceptual. Overall, results are judged to be suggestive.

Between groups study #4. The first experiment presented in this paper by Holm, Farrier, and Dodd (2008) is a level 2a evidence study that examined the phonological awareness abilities of children with speech disorders classified into subgroups according to the nature of their surface error patterns. Fourteen children with a mean age of 5;6 presented with delayed phonological development, 17 children with a mean age of 5;4 presented with consistently used non-developmental errors, and 15 children with a mean age

of 5;4 presented with inconsistent speech errors. Comparisons were made to 15 typically developing children with a mean age of 5;3.

Groups were first compared for their articulation, e.g. inconsistency, Percent Consonants Correct (PCC), Percent Vowels Correct (PVC), language and oro-motor abilities. Data for these tasks was analyzed using a one-way ANOVA, followed by Bonferroni multiple comparisons. All groups differed significantly from each other for inconsistency of errors and PCC with the control group performing better than the delayed group, which performed better than the consistent group, which performed better than the inconsistent group. There were no significant differences between the control group, the delayed group, and the consistent error group on PVC, but all performed significantly better than the inconsistent error group. The delayed group performed less well than all other groups, who did not differ from each other on measures of receptive language. There were no significant differences between groups in oro-motor abilities. Phonological awareness was assessed using syllable segmentation, rhyme awareness, and alliteration awareness subtests from the Preschool and Primary Inventory of Phonological Awareness (PIPA). Data were evaluated through a repeated measures ANOVA and post-hoc Bonferroni corrections.

The control group performed significantly better than the other groups on all tasks of phonological awareness. Notable is that the consistent errors group was the only group whose mean scores fell below the normal range. The authors conclude that children who consistently make non-developmental errors are more likely to have poor phonological awareness due to (or perhaps resulting in) less accurate phonological representations.

Strengths of the Holm, Farrier, and Dodd study include sound methodology and appropriate statistical manipulations. Limitations of this study include a small sample size and that all participants were male. Also, although the authors had the interesting thought of separating children based on surface speech errors, severity of disorder remains a confounder in this study. The results of this study are judged to be suggestive to compelling.

Between Groups Study #5. In this level 2a evidence study Hesketh, Adams, Nightingale, and Hall (2000) compared the speech output and phonological awareness skills of 61 children, ages 3;6 to 5;0, with developmental phonological disorders who received differing therapies, an articulation based approach (ART) and a metaphonologically based approach (MET) pre- and post-therapy. Fifty-nine typically developing children of the same age range formed a

control group. They also sought to compare the outcomes of the two approaches to initial phonological awareness status and to identify factors that best predicted the amount of speech change made by the children over the course of therapy.

Children with phonological disorders were assigned in a “semi-random fashion” to the two therapy groups in order to achieve even numbers and comparable severity in each group. Pre-therapy all children received an assessment of their speech and phonological awareness abilities (A1); these abilities were reassessed post-therapy for the speech disordered children and 12 weeks from the first assessment for control children (A2). Three months post therapy the speech abilities of children with phonological disorders were retested (A3). At A1, control children attained significantly higher scores on phonological awareness than did children with phonological disorders. ART, MET, and control groups were compared for amount of change in phonological awareness skills between A1 and A2; no significant difference was shown among the three groups. However when the ART and MET groups were collapsed, it was revealed that the children receiving therapy made more change than did controls and this difference was significant. Also, at A2 differences in phonological awareness skills between the control and treatment groups were no longer significant. There were no significant differences in PCC scores between the MET and ART groups at A1. Changes in PCC between A1 and A2 were significant between the ART/control and MET/control groups, but there were no significant differences in PCC change between the MET and ART groups. Difference in changes in individual probe measures between the MET and ART groups was significant, with the ART group making more change. There were no significant differences in measures between A2 and A3 between the ART and MET groups. To compare the outcomes of the two approaches to initial phonological awareness status children were grouped based on type of therapy received and initial phonological awareness status into four subgroups: Good MET, good ART, poor MET, and poor ART. There was no significant difference among the four subgroups for change in individual probe measure. Significant differences were shown between the Good MET/control and Good ART/control groups, with mean change in phonological awareness skill being significantly better for children with initially good skills. To identify factors that best predicted the amount of speech change over the course of therapy, PCC change was included in a correlation matrix along with initial metaphonological ability, metaphonological change, initial speech severity, age, initial language ability, and initial cognitive ability. The majority of correlations were markedly low; factors showed weak

relationships with PCC change. Only change in metaphonological ability and initial speech severity were significantly correlated to PCC change.

These results are congruent with the idea that children with phonological disorders show poorer metaphonological skills than typically developing children. Also, therapy that incorporated metaphonological instruction was beneficial for increasing the metaphonological abilities of children with speech sound disorders in meeting the level of ability of typically developing children. However, this study did not show that therapy incorporating metaphonological instruction was any more beneficial to phonological awareness or speech gains than traditional articulation therapy.

Strengths of this study include sound methodology and appropriate statistical evaluations. Children with phonological disorder included in the study did not have any structural or motor speech difficulties or hearing difficulties that may have contributed to their speech disorders. Weaknesses include small sample sizes for a study with small anticipated effect size.

Results are judged to be suggestive to compelling

Case Control Study #1. In the second, level 2b, experiment presented in their paper, Holm, Farrier, and Dodd (2008) investigated the literacy skills of 9 children ages 7;5 to 8;2, with a history of speech disorder characterized by inconsistent speech errors. Nine typically developing children, ages 7;6 to 8;2 made up a control group. They examined phonological awareness, reading accuracy, and spelling; data from all three sets of tasks were analyzed using MANOVA.

No significant differences were found between groups on phonological awareness skills or reading. The only significant findings were that children with a history of inconsistent speech errors had poorer spelling than children in the control group on tasks of spelling accuracy and on an assessment of phonetically plausible spellings.

These results support the notion that it is conceptual speech difficulties that are associated with difficulties in phonological awareness, and therefore early literacy, not other forms of speech sound disorders, such as difficulties in motor planning. However, these results are suggestive at best since no comparisons were made to children with conceptual speech sound disorders.

Strengths of this study include sound methodology and appropriate statistical analyses. Weaknesses include a small sample size.

Case Control Study #2. In this level 2b evidence study, Nathan, Stackhouse, Goulandris, and Snowling (2004) compared the phonological awareness and literacy skills of children who had previously been diagnosed with isolated speech difficulties (n=28) to those of children with speech and language difficulties (n=19). Secondly, they questioned whether children whose speech difficulties persisted until age 6, show poor concurrent phonological awareness and literacy development. Lastly, they sought to understand the relationship between language abilities, speech processing abilities (input and output phonology), phonological awareness, and literacy skills. Forty-seven typically developing children made up a control group.

Children were assessed in various domains at ages 4;6 (T1), 5;8 (T2), and 6;9 (T3). Principle component analysis was used to reduce the data, which resulted in 8 factors of interest; input phonology, output phonology, rhyme awareness, phoneme awareness (phonological tasks), receptive language, expressive language, reading, and spelling (language and literacy tasks). MANOVAs were used to analyze the data gathered. The speech-language group performed significantly less well on phoneme awareness at T3; this was the only significant finding among all phonological awareness tasks at all testing times. At T1 the speech only group performed significantly less well than controls and significantly better than the speech-language group on tasks of output phonology. Whereas at T2 and T3 the speech-language group performed significantly less well than the other two groups, who did not differ from each other for this task. Significant differences were found for input phonology at T2, where the speech-language group performed less well than both the other groups, who were not different from each other. At T1, receptive language abilities of the speech-language and speech only group did not differ significantly from each other, although the speech-language groups performed significantly poorer than controls. At T2 and T3 the speech-language group performed significantly worse than the other two groups, who did not differ significantly from each other for these tasks. Expressive language performance showed the same pattern as receptive language for both T1 and T2, however no significant effect of group was found at T3. The trend was for the speech-language group to perform worse on reading and spelling than the speech-only group, however this was not statistically significant. The authors found that there were strong correlations between language, literacy, and phonological awareness variables and that these relationships were stronger among controls and for expressive language than for receptive language.

Strengths of this study include appropriate statistical manipulations and study design. Also, participants were excluded if speech difficulties were due to a physical cause. Weaknesses include the fact that study participants were receiving speech-language therapy over the course of the study; no details of interventions type are reported, although the authors acknowledge that some participants may have received phonological awareness training as part of their intervention. Following the children for a longer period of time may have helped precipitate the gap in literacy differences, at a time when children begin to acquire literacy skills more rapidly. These results are judged to be suggestive at best.

Single Subjects Design #1. In this level 1 evidence paper presented by Major and Bernhardt (1997) 18 Speech-Language Pathologists (SLP) conducted single subject studies; with one SLP having two subjects. The studies aimed to explore the relationship between phonological and metaphonological skills in 19 children, ages 3;0 to 4;11, with phonological disorders. They also studied outcomes in metaphonological development following phonological intervention and after phonological plus metaphonological intervention.

The children's phonological awareness and speech skills were measured at T1-before intervention, at T2- after phonological intervention, and at T3- after phonological plus metaphonological intervention. PVC and metaphonology had the highest correlation among variables at T1; although metaphonology also showed a relationship with PCC, consonant matching, word shape matching and other variables. A multiple regression analysis showed that PVC was the only variable to contribute significantly to performance on metaphonological tasks. All changes to phonology measures between T1 and T2 and between T2 and T3 were significant. Also, significant differences were found between metaphonological task performance between T1 and T2 and between T2 and T3.

The authors found much individual variation in children's responses to the two therapy types, leading to the conclusion that some children improve their metaphonological skills with only limited training, while others require more explicit training. These results are judged to be equivocal since the authors used unconventional modes of data analyses and the rationale for groupings of data was unclear. Also, having all children go through both courses of intervention severely confounds the data presented since no true comparisons were made between the two intervention types.

Strengths of this study include inclusion criteria, which excluded children with impairments in hearing, oral-motor structure or function, and language comprehension. Weaknesses are that children's speech difficulties were not classified as delayed versus disordered and the authors used a small sample size.

Discussion

There is great variation in the literature regarding whether or not children with speech sound disorders are at increased risk for difficulties in literacy acquisition. It is likely that this reflects the wide variation in speech sound disorder type, as well as, severity. As Holm, Farrier, and Dodd (2008) suggest, speech sound disorders can be subdivided into types based on error patterns; 1) delayed (persisting developmental errors) 2) inconsistent errors 3) consistent non-developmental errors. If impaired internal phonological representations are truly the precursor for difficulties in acquiring literacy, as per Stanovich, *et al.*, then it may be that only one of these subtypes is relevant, i.e. consistent, non-developmental errors. Only one of the reviewed studies subdivided the children into these categories and their findings were consistent with the above hypothesis (Holm, *et al.*, 2008). However, Holm, *et al.*, suggests that poor phonological representations may also be the result of poor phonological output.

The second major contributor to discrepancy in results is that all studies measured early/pre-literacy skills and later literacy achievement differently. This reflects the need for greater knowledge in the field about what measures are most relevant to literacy achievement at different stages of child development.

Some studies included in this review (Carroll *et al.*, 2001, Apel *et al.*, 2011) did not indicate whether participants were clear of motoric or physical impairments that may have contributed to their described speech difficulties. This is a major confounder since speech difficulties due to physical or motoric deficits are not hypothesized to include impaired phonological representations, and therefore would not be hypothesized to contribute to difficulties in literacy achievement.

Severity of speech impairments were not addressed in any of the studies, although it makes sense that children with more severe or pervasive disorders, affecting many sounds, would have greater deficits in internal phonological representations and likely, greater difficulty acquiring literacy.

Clinical Implications

It appears, from the literature, that it is still too early to say whether it is necessary to incorporate a form of early/pre-literacy training into speech intervention for all children with isolated phonological disorders. However, there are reasons to believe that it may be beneficial to screen for early/pre-literacy difficulties in children with speech sound disorders characterized by consistent, non-developmental errors, or severe forms of other speech disorders so that these difficulties can be remediated. In this case, Speech-language pathologists are the most qualified professional to decide whether children meet these screening criteria.

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