Evaluating the long-term effectiveness of Integrated Phonological Awareness approaches on literacy skills in children with Speech Sound Disorders: A Critical Review

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Abstract

This study presents a critical review of research examining the long-term effectiveness of Integrated Phonological Awareness (IPA) approaches on literacy skills in children with Speech Sound Disorders (SSD). The critical review involves an evaluation of eight articles exploring the utility of IPA approaches in the areas of articulation, language and literacy. Children with Childhood Apraxia of Speech (CAS) were included in this review as a sub-population of children with SSD. Overall, the results of this review suggest that IPA intervention approaches have positive and accelerated long-term effects on literacy skills in children SSD, but remain to be inconclusive for children with CAS.

Introduction

For the purpose of this review Speech Sound Disorder (SSD) is defined as an atypical articulation delay in the absence of diagnosed sensory, neurological, physical, or intellectual disabilities. Despite the prevailing feature of SSD being articulation difficulties, children with SSD are also at risk for literacy deficits (Raitano, Pennington, Tunick, Boada & Shriberg, 2004; Carroll & Snowling, 2004). Even after the resolution of speech sound errors, children with SSD may exhibit delayed reading development and/or spelling weakness that follows them into their school years (Gillon, 2002; Lewis, Freebairn & Taylor, 2000).

Childhood Apraxia of Speech (CAS), although categorized as a motor speech disorder, is also characterized by a delay in speech sound production. This hallmark feature of CAS contributes to the fact that these children also demonstrate persistent literacy deficits (Lewis et al, 2004; Moriarity & Gillon, 2006; Gillon & Moriarity, 2007). Research further demonstrates that children with CAS, like those with SSD, continue to experience literacy deficits even after their articulation problems have been remediated (Lewis et al, 2004). Unfortunately, the large majority of current treatment approaches for both SSD and CAS focus solely on articulation while failing

to address skills related to literacy. For these reasons, CAS will also be examined in this review as a sub-population related to general SSD.

One type of intervention approach that does incorporate articulation and literacy skills is the Integrated Phonological Awareness (IPA) approach. IPA approaches simultaneously target speech production, phonological awareness, and literacy (writing and spelling). Research on IPA approaches have demonstrated immediate post-intervention improvements regarding speech, phonological awareness and literacy skills in children with moderate-to-severe speech sound disorders, as well as children with CAS (Gillon 2000; Major & Bernhardt, 1998; McNeill, Gillon & Dodd, 2009a; Moriarty & Gillon, 2006). However, few studies have investigated the long-term effects of IPA interventions for these groups of children. The long-term effectiveness of the IPA approach is important to examine due to research indicating that children with SSD and CAS have persistent literacy deficits throughout development. Examining the long-term effectiveness of the IPA approach will help determine if these

populations are able to maintain and/or improve phonological awareness and literacy gains achieved during intervention.
The objective of this paper is to review and evaluate existing literature exploring IPA intervention and its long-term effects on literacy skills in children with Speech Sound Disorder and Childhood Apraxia of Speech.

Methods

Search Strategy
Online databases (PSYCHINFO, PubMed, Proquest Nursing & Allied Health) were searched using the following terms: ((integrated phonological awareness OR phonological awareness OR metaphonology OR phoneme awareness) AND (literacy) AND (speech impairment OR speech sound disorder OR articulation disorder OR childhood apraxia of speech)).

Selection Criteria
To ensure that articles were appropriate for this review, four criteria were put in place. First, studies had to address integrated phonological awareness approaches such as those that simultaneously target speech sound production and phonological awareness. Second, study outcomes had to include at least one measure of early literacy skills (defined as phonological awareness, reading and/or spelling). Third, participants had to be diagnosed with speech sound disorders/speech impairments not related to comorbid conditions such as hearing loss or intellectual disability. Participants diagnosed with Childhood Apraxia of Speech were also included in a sub-section of this review. Fourth, long-term results were defined as those greater than 3-months post-intervention.

Data Collection
This literature search generated five articles related to the long-term effectiveness of IPA approaches on literacy skills in children with SSD including: one case study and four case-control studies. It also generated three multiple single subject designs related to the long-term effectiveness of IPA approaches on literacy skills in children with CAS.

Results

Case-control Studies
Case-control studies are an effective design to study changing populations where follow-up is difficult. It is also useful to examine long-term intervention effects; however, it can be subject to selection and observation bias. Case-control studies are often not representative of the greater population; thus, conclusions cannot always be generalized.

Gillon (2002) examined the long-term performances of 20 children (aged 5;6-7;6 years) with SSD, who received 20 hours of individual IPA intervention. Performance was compared to two socioeconomic and aged-matched control groups made up of 20 children with SSD who received articulatory intervention, and 20 children with typical language development. Standardized methods of evaluation were used to assess participants' phoneme awareness, word decoding, reading, and speech production at 11-months post intervention. Spelling success was measured in accordance with researcher developed methods. These methods were carefully designed to include a variety of phoneme-grapheme connections to ensure generalizability, and sufficient scoring examples were provided for future replication. Acceptable scoring reliability for spelling data was also reported.

Appropriate statistical analysis revealed that children who received IPA intervention performed significantly better on measures of phoneme awareness, word decoding, and speech production than children who received an articulatory intervention. Children who received the IPA intervention did not demonstrate significant differences in phonological awareness when compared to their typically developing peers. Children with IPA also demonstrated sustained growth in

word-decoding and word-recognition skills. Additionally, 10 out of 12 children who received the IPA intervention were reading at or above their age-expected level at follow-up.

Participants with SSD in this study were taken as a convenience sample from Gillon (2000); however, post-hoc analysis revealed no significant differences in measures between the two SSD groups prior to intervention. Participants also varied in their length of participation in the formal education system (6-12 months) and were not matched on this factor. Another limitation of this study involves the unmatched follow-up periods for the two groups of children with SSD (11-months) when compared to the group of typically developing children (seven months).

Despite these weaknesses, the study presents compelling evidence to suggest that IPA intervention contributes to significant and sustained growth in literacy skills for children with SSD.

Kirk and Gillon (2007) explored the longitudinal effects of preschool IPA intervention on reading and morphological awareness in eight children (aged 7;6-9;5 years) with SSD. A control group of nine children with SSD who received articulatory intervention and a typically developing group of 24 children were also used in this study. For the purpose of this review, only results regarding reading skills will be discussed.

Appropriate statistical analyses revealed that children with a history of SSD who received IPA performed significantly better on gold-standard measures of non-word decoding than both the SSD control group and the group of typically developing children. No significant group effects were found for word recognition; however, further analyses revealed a large effect size for this measure. Researchers discovered a large standard deviation in word recognition scores for children who received IPA intervention. For this reason, they inspected individual data and found that six out of eight children demonstrated skills 1-4 years above age-expectation, while the remaining two children performed more than a year below age-expectation.

The participant inclusion criteria employed by the researchers was adequate for the design. The researchers also relied on parent report to determine if children in the typical development group had a history of speech and/or language impairment. It should be noted that this is not the most reliable source of diagnostic information.

Overall, the assessment procedure was appropriate and sufficiently detailed for future replication. This study presents highly suggestive evidence that IPA intervention provides accelerated and longitudinal literacy benefits for the majority, but not all, children with SSD.

Gillon (2005) examined the long-term effects of IPA intervention on phonological awareness development in 10 children with Speech Sound Disorder (aged 3;00-3;11 years at the commencement of the study). Participants were assessed with credible measures of phonological awareness, reading and spelling three-years post-intervention. Performance on these measures was compared to a group of 19 typically developing children as well as a third convenience sample consisting of 19 children with SSD who did not receive IPA.

Appropriate statistical analyses revealed that at the three-year follow-up, children who received IPA performed significantly better on scores obtained for word recognition, non-word reading and spelling when compared to children in the SSD control group. Many children in the IPA group (8 out of 10) were also reading at or above their age-expected level. Results additionally revealed that children who participated in IPA had no significant group differences when compared

to typically developing children on these measures.

Intervention duration and content were described with ample detail making accurate replication possible. Participant inclusion criteria for this study were also well-defined, as was the individual participants' educational situations with regards to their exposure to early literacy promotion. Participants in the experimental and SSD control group were adequately matched by age, severity of speech impairment, socio-economic status (SES), and type of preschool facility. The study's small sample size restricted some of its analyses and the ability to generalize its results.

Overall, this study presents compelling evidence to support the facilitation of IPA intervention and its ability to provide long-term advancements in literacy skills for children with SSD.

Hesketh, Adams, Nightingale & Hall (2000) compared the effectiveness of an IPA intervention and articulation training on speech production and phonological awareness outcomes for 61 children with SSD (aged 3;6 to 5;0 years). SSD participants were allocated to IPA or articulation training in a semi-random fashion which was not discussed in further detail. Maturational effects were controlled for with the inclusion of an additional control group of 59 typically developing children in the same age range. The IPA intervention was described in a clear and thorough manner so that it can be replicated in future research. Participant measures of speech production and phonological awareness were taken at three time points: pre-intervention, post-intervention and three-months post-intervention. No standardized assessment measure was available for phonological processing at the commencement of this study, however, researchers took steps to ensure reliability and validity of the measure used.

Appropriate statistical analyses revealed that both groups of children with SSD improved their phonological skills during the intervention period and no significant differences were found between the two groups at the three-month follow-up. Results also revealed an absence of statistical significant difference between children who received IPA and typically developing children on measures of phonological awareness at follow-up.

The researchers suggest that the lack of effect for intervention type may have been partly due to the small group size used in the study, however, compared to other similar studies, the sample size of 61 children with SSD seems large considering the sub-population. Criteria for participant inclusion was a weakness in this study, as some participants did not receive appropriate screening for language impairment and therefore, may have demonstrated a language impairment in addition to a speech impairment. Since children with co-current speech and language impairments are not homogenous with children with sole speech sound disorder, this lack of participant exclusion may have skewed results.

Overall, this study presents a suggestive level of evidence for the long-term effectiveness of an IPA approach in promoting literacy skills in children with SSD, as no significant differences were found between IPA groups and typically developing children.

<u>Case Studies</u>

Case studies are descriptive research methods. Due to their qualitative nature, they are often able to provide great participant detail.

Major and Bernhardt (2005) examined the speech, language and literacy skills of 12 children with SSD (aged 3;3-4;1 years) 3-years post IPA intervention. The intervention methods used in this study are clearly described in a way that is easily understood and allows for future replication. For the purpose of this review only the results

concerning measures of metaphonology, reading recognition and comprehension, and spelling will be discussed.

Participants' pre-intervention and post-intervention profiles were described in great detail. The authors also explored individual performance features for participants who stood out in the sample which allowed for a more thorough qualitative analysis of individual data. A control group was not employed, but standardized measures of the assessment constructs served as norm references. Appropriate constructs were used to assess measures, including metaphonology which, at the time of the study, had no commercially available test sufficient for the authors' range of tasks. Instead, the author created a battery which was described in sufficient detail and seemed appropriate to measure the constructs/activities they hoped to assess in the study.

It should be noted no statistical analyses followed the authors' descriptive presentation of the following outcome data: 10 out of 12 children demonstrated average or above average scores on reading recognition and comprehension, 7 out of 12 children demonstrated average or above average spelling performance.

Overall, this study provides somewhat suggestive evidence that an IPA intervention can promote normal acquisition of literacy skills in at least some children with a history of SSD, however, the results of this study should be interpreted with caution as it lacks statistical analysis.

Multiple Single-Subject Designs

Single-subject designs are a useful research method to examine cause and effect relationships as well as long lasting effects in small subject populations, however, interpretation of these results should be made cautiously due to small sample sizes. Individual differences in participants, and possible selection bias can also impact the generalization of results.

McNeill, Gillon and Dodd (2009a) examined the effectiveness of an IPA approach at improving speech production, letter knowledge and phonological awareness skills in 12 children with CAS (aged 4;0-7;0 years) three-months post-intervention. Stringent participant criteria, which included strict requirements for CAS identification, were well-documented. Appropriate standardized subtest measures for speech production, phonological awareness, letter-sound knowledge, and word decoding were administered to each participant to establish baseline. An informal, but appropriate, spelling measure was also used. Baseline was established for each of the measures mentioned above and data continued to be collected at every second intervention session, as well as three times post-intervention.

Appropriate statistical analyses revealed significant improvements for the majority of participants on measures of phonological awareness, letter-sound knowledge and spelling. Real word-decoding was the only measure of literacy that did not result in significant improvements; however, only a small number of participants were over six years of age post-intervention which made it difficult to detect statistical significant differences on word-decoding tasks.

The IPA intervention used in this study was well-defined and included details regarding the structure of intervention sessions and methods of cueing. The authors also ensured treatment fidelity at 96.6% adherence. Inter-rater reliability was also high for all measures. Trained and untrained probes were assessed for each measure of literacy, which allows for greater generalizability of skills.

Despite the small sample size, results from this study offer compelling evidence that an IPA intervention improves phonological awareness skills and promotes the

development of reading and spelling in some children with CAS.

McNeill, Gillon and Dodd (2009b) evaluated the long-term effectiveness of an IPA intervention for identical twin boys with CAS. The participants were assessed on four occasions; pre-intervention (age 4;5 years), post-intervention (age 4;9 years), six-month follow-up (age 5;3 years) and one-year follow-up (age 5;9 years). Detailed case history for both boys, including shared and non-shared environmental features, was provided. Appropriate assessment measures for speech production, phoneme awareness, phonological representation, reading, and spelling were used to establish baseline and further determine effects of intervention. Inter-rater reliability for these measures ranged from 80-97%. The method of analyses used to compare results in this study were not well described, and thus, results are qualitative in description. A visual inspection of the data revealed improvements in speech production, phoneme awareness, phonological representation, reading, and spelling measures at all assessment points. At the one-year follow-up both participants performed within or above their age expected range for measures of phonological awareness, decoding and reading comprehension. Since statistical analysis was not performed, it is uncertain if the participants' improvements were statistically significant at any time point during the study.

Overall, this study provides somewhat suggestive evidence that an IPA approach is an effective method of intervention to provide long-term literacy benefits in children with CAS; however, its effectiveness cannot be concluded due to the absence of statistical analyses and the limited sample size.

McNeill, Gillon and Dodd (2010) evaluated the phonological awareness, letter knowledge, decoding, and spelling development in 12 children with confirmed diagnoses of CAS (aged 4-7 years) following an IPA intervention. A group of 12 children with typical language development was also followed during the 6-month follow-up period in order to compare changes. No significant differences were found in age, vocabulary, and SES between the experimental and control groups. This follow-up study used the same outcome measures as its predecessor, McNeill, Gillon and Dodd (2009a), which consisted of gold standard measures. Use of each standardized measure was explained in sufficient detail to allow for future replication. Although the intervention method was not described in detail in the current study, it did refer to the original study where that information can be found. It also mentioned its high treatment fidelity of 96.6% adherence.

In regard to data analysis, the researchers completed an appropriate statistical analysis. Results revealed that improvements made in PA, decoding and spelling immediately post-intervention were maintained six-months post-intervention. Results also demonstrated that no further growth was found in any of the above measures.

Despite weaknesses in this study, such as the small sample size and lack of a CAS control group, this study provides compelling evidence that an IPA intervention can result in the long-term sustainment of literacy skills in children with CAS.

Discussion

Overall, the studies in this review indicate that IPA intervention is an effective method to elicit and sustain literacy skills in both children with SSD and CAS. Findings further indicate that IPA intervention is an effective method to promote accelerated long-term literacy growth in children with SSD, but not those with CAS.

Children with SSD who received IPA intervention outperformed SSD control groups on measures of literacy in the large majority studies evaluated (Gillon, 2002; Gillon, 2005; Kirk and Gillon, 2007; Major & Bernhardt,

2005). The single study that did not demonstrate superior performance by an IPA group (Major & Bernhardt, 2005) had several methodological weaknesses, including poor participant criteria, and a short follow-up period of only three-months, which may have been too short for participants to demonstrate an advancement in skills.

All studies that employed a typically developing control group (Gillon, 2002; Kirk & Gillon, 2007; Gillon, 2005; Hesketh et al, 2000) revealed that groups of children with SSD, who participated in IPA approaches, demonstrated equivalent literacy skills to their typically developing peers at follow-up. The null effects found in these studies are positive because they suggest a lack of perpetual literacy deficits in children with SSD following an IPA intervention. A lack of difference in SSD and typically developing peers further suggests that IPA approaches are successful at promoting long-term literacy skill development at a consistent rate to age equivalent peers.

It is important to note that four of the five studies reviewed involved case-control methods (Gillon, 2002; Gillon, 2005; Kirk & Gillon, 2007; Hesketh et al, 2000). As previously discussed, case-control studies can have issues with generalization. The small sample sizes employed in Gillon (2002), Gillon (2005) and Kirk and Gillon (2007) limit the ability to generalize findings to wider populations of children with SSD. Several studies also demonstrated a lack of matched control criteria (Kirk & Gillon, 2007; Hesketh et al, 2000). For example, in Kirk and Gillon (2007), the intervention and SSD control groups were only matched on severity of speech impairment, unlike other similar studies which employed more rigorous matching criteria to include things like age and socioeconomic status. Gillon's (2005) study did appropriately match across participant groups, however, the large majority of participants in the study (83%) were middle or high SES, which could also limit the generalizability of its results to low SES populations who are usually at higher risk for literacy delays (Bowey, 1995). In combination, these factors limit the overall generalizability of the studies mentioned above. Therefore, despite the highly suggestive and compelling evidence provided by these case-control studies, conclusions cannot be confidently drawn beyond the participants described in each study.

Furthermore, measures of literacy skills differed between studies, making them difficult to compare to one another. The duration and schedule of each IPA approach also differed across studies; thus, it is unclear whether the alterations in the implementation of IPA intervention influenced long-term effectiveness.

As previously mentioned, studies addressing the long-term effects of IPA approaches in children with CAS did not result in the same conclusion as those with SSD. Long-term effects of IPA approaches in children with CAS involved the sustainment of literacy skills acquired during the intervention period, rather than accelerated growth.

All three of the studies regarding CAS were single subject designs. As previously mentioned, single subject designs often lack external validity and therefore generalizability. However, it is an appropriate method to evaluate rare populations like CAS. Small sample sizes also plagued all three studies: two had a sample size of 12, where one had a sample size of two. This is common issue in research with rare populations; however, it remains to be a limitation to evidence.

Despite the inherent differences among participants in these co-current single subject designs, each study demonstrated positive results for many children with CAS. They also demonstrated compelling evidence for the clinical importance of IPA

approaches in promoting literacy skill development. The lack of evidence to support accelerated growth in literacy skills in this population suggests that children with CAS may require more intensive intervention in order to continue to develop skills at an age-appropriate rate.

It should also be noted that this field of research is dominated by a single author (Gillon, G.) who appears in six of the eight studies used in this review. Several of the studies were also co-current and involved the same participants, which furthers the previously mentioned complications with generalization.

Future research considerations:
To improve the level of evidence provided by the existing literature, the following is recommended:

- Employ larger and more representative sample sizes.
- Employ more rigorous matched control criteria.
- Establish a uniform measure of literacy skills.
- Use a consistent time period to define long-term effects.
- Additional replication research from groups not involving Gillon, G.
- Investigate outcome differences based on varying IPA intervention schedules (ie. treatment length, number of sessions, intensity)

Clinical Implications

These results have strong implications for the treatment of children with SSD and CAS with regards to mitigating their risk for later literacy problems. The findings strongly suggest that intervention for SSD should involve articulation remediation in addition to explicit instruction in phonological awareness to promote sustained and accelerated growth in literacy skills. In children with CAS, longer and more intensive phonological awareness instruction may be necessary to promote long-term age-appropriate literacy development.

Overall, an Integrated Phonological Awareness model of intervention, appears to be an ideal approach for Speech-Language Pathologists working with children with SSD and/or CAS, since it can promote long-term maintenance and/or gains in literacy skills while simultaneously treating delays in speech production. As SLP caseloads continue to grow, an approach that simultaneously targets two areas of intervention, is an effective and efficient practice.

References

Carroll, J. M., & Snowling, M. J. (2004). Language and phonological skills in children at high risk of reading difficulties. *Journal of Child Psychology and Psychiatry, 45*(3), 631-640.

Gillon, G. (2000). The efficacy of phonological awareness intervention for children with spoken language impairment. *Language, Speech, and Hearing Services in Schools, 31*, 126-141.

Gillon, G. (2002). Follow-up study investigating the benefits of phonological awareness intervention for children with spoken language impairment. *International Journal of Language and Communication Disorders, 37*, 381-400.

Gillon, G. (2005). Facilitating phoneme awareness development in 3-and-4-year-old children with speech impairment. *Language, Speech, and Hearing Services in Schools, 36*, 308-324.

Gillon, G., & Moriarty, B. (2007). Childhood apraxia of speech: Children at risk for persistent reading and spelling disorder. *Semin Speech Lang, 171*, 048-057.

Hesketh, A., Adams, C., Nightingale, C., & Hall, R. (2000). Phonological awareness therapy and articulatory training approaches for children with phonological disorders: A comparative outcome study. *International Journal of Language and Communication Disorders, 35*, 337-354.

Kirk, C. and Gillon, T. (2007). Longitudinal Effects of Phonological Awareness Intervention on Morphological Awareness in Children with Speech Impairment. *Language, Speech, and Hearing Services in Schools, 38*, 342-352.

Lewis, B., Freebairn, H., Taylor, G. (2000). Follow-up of children with early expressive phonology disorders. *Journal of Learning Disabilities, 33*(5), 433-444.

Lewis, B., Freebairn, H., Hansen, S, Taylor, G. (2004). School-age follow-up of children with childhood apraxia of speech. *Language, Speech, and Hearing Services in Schools, 35*, 122-140.

Major, E., & Bernhardt, B. (1998). Metaphonological skills of children with phonological disorders before and after phonological and metaphonological intervention. *International Journal of Language and Communication Disorders, 33*, 413–444.

McNeill, B. C., Gillon, G. T., & Dodd, B. (2009a). Effectiveness of an integrated phonological awareness approach for children with childhood apraxia of speech (CAS). *Child Language Teaching and Therapy, 25*(3), 341-366.

McNeill, B. C., Gillon, G. T., & Dodd, B. (2009b). A longitudinal case study of the effects of an integrated phonological awareness program for identical twin boys with childhood apraxia of speech (CAS). *International Journal of Speech-Language Pathology, 11*(6), 482-495.

McNeill, B. C., Gillon, G. T., & Dodd, B. (2010). The longer term effects of an integrated phonological awareness intervention for children with childhood apraxia of speech. *Asia Pacific Journal of Speech, Language, and Hearing*, *13*(3), 145-161.

Moriarty, B., & Gillon, G. (2006). Phonological awareness intervention for children with childhood apraxia of speech. International *Journal of Language & Communication Disorders, 41*(6), 713-734.

Raitano, N., Pennington, B., Tunick, R., Boada, R., & Shriberg, L. (2004). Pre-literacy skills of aubgroups of children with speech sound disorders. *Journal of Child Psychology and Psychiatry, 45*(4), 821-835.