Critical Review:

Evaluating the Effectiveness of an Integrated Phonological Awareness Intervention Model for Childhood Apraxia of Speech

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This critical review evaluates the effectiveness of an integrated phonological awareness (IPA) intervention model in simultaneously improving speech production, phonological awareness and literacy skills in children with childhood apraxia of speech (CAS). Overall, the research suggests that the use of an IPA approach is both appropriate and effective in improving the phonological awareness deficits, speech sound production, and literacy skills of children with CAS.

Introduction

What is Childhood Apraxia of Speech (CAS)?

Children with CAS demonstrate difficulties with the accuracy and consistency of speech sound production in the absence of neuromuscular deficits (American Speech–Language–Hearing Association [ASHA], 2007; Dale & Hayden, 2013). CAS is considered to be a multi-level impairment, as it contains both motor (phonetic production and sequencing of sounds, syllables and words) and linguistic deficits (phonological representation and awareness of phonemes) (Gillon & Moriarty, 2007; Moriarty & Gillon, 2006). The motor deficits associated with CAS include inconsistent speech errors on vowels and consonants, sound sequencing difficulties, articulatory groping, and inappropriate prosody (ASHA, 2007). Linguistic deficits include expressive and receptive language impairment, phonological awareness deficits, and reading and spelling difficulties (Lewis, Freebairn, Hansen, Iyengar et al., 2004).

Delays in speech production associated with CAS are typically correlated with an expressive language delay that may evolve into a more global language processing delay. This puts children with CAS at risk for language and academic problems (i.e., spelling, reading, and writing) (Lewis et al., 2004).

Preliminary findings indicate that children with CAS are more likely than children with similar surface disorders to experience written language difficulties (Lewis, et al., 2004). McNeill, Gillon, and Dodd (2009c) compared phonological awareness, word decoding, and letter knowledge ability between children with CAS, children with inconsistent speech disorder (ISD) and children with typical speech-language development (TD). The researchers found that the CAS group exhibited inferior phonological awareness skills and had more participants performing below the average range on letter knowledge and word decoding measures than the comparison groups.

The diverse nature of CAS symptoms creates a challenge for clinicians to provide efficient and effective intervention. The majority of interventions for CAS focus on remediating speech deficits (Dale & Hayden, 2013). The development of written language must also be fostered in intervention as phonological awareness deficits at phoneme, rhyme and syllable level appear to underlie the written deficits of children with CAS.

One longitudinal study focusing on language impairment and written language abilities among children with CAS, children with isolated speech disorders (S), and children with combined speech and language impairment (SL) found that children with CAS were more likely to experience receptive and expressive language deficits in addition to their speech difficulties than the two comparison groups (Lewis et al., 2004). This study provides valuable information regarding the severity of language impairment in children with CAS.

This multi-level impairment limits the ability of traditional approaches to improve these children's linguistic deficits or reduce their risk for later language and academic problems (Gillon & Moriarty, 2007).

One intervention that may be a promising method of simultaneously targeting speech and language deficits is an integrated phonological awareness (IPA) intervention model. This approach incorporates targeted speech practice into phonological awareness activities and uses letters and phonological cues to prompt speech production (McNeill et al., 2009b).

What is an IPA intervention model?

IPA is an intervention model designed to simultaneously target speech, phonological awareness, reading, and spelling deficits in children with CAS (McNeill et al., 2009b, c). This approach is consistent with theoretical descriptions of CAS that emphasize disordered phonological representation systems, and unstable motor programming for speech production (McNeill et al., 2009b). The IPA intervention model provides children with a more stable motor program for speech production by focusing on improving underlying phonological representations of targeted speech words (McNeill et al., 2009b). This approach simultaneously improves speech and phonological awareness.

Objectives

The primary objective of this paper is to critically evaluate the existing literature on the effectiveness of an IPA intervention model at improving phonological awareness, literacy skills, and speech production in children with CAS. The secondary objective is to propose recommendations for future practice and research on integrated intervention programs for children with CAS.

Methods

Search Strategy

The following computerized databases were searched: CINAHL, PubMed, PsychInfo and the University of Western Ontario's library search engine.
The following search terms were used:
"childhood apraxia of speech" OR "CAS" OR "developmental apraxia of speech" OR "DAS" AND "integrated phonological awareness program". Reference lists of the articles selected were also searched for further relevant articles.

Selection Criteria

Studies selected for inclusion in this review were required to examine the phonological or literacy deficits of children with CAS and the effectiveness of an IPA approach in treating children with CAS. Studies examining the effectiveness of an IPA program for children and/or adults with speech impairments alone or spoken language impairments were excluded as they did not meet the criteria of CAS.

Data Collection

Results of the literature search yielded the following study types: two multiple single-subject designs with repeated measures, and one multiple single-subject baseline analysis.

Results

McNeill, Gillon, and Dodd (2009b) evaluated the effectiveness of an IPA intervention model for 12 children with CAS with no history of sensory, cognitive or neurological deficits using a multiple single subject design and an AB (baseline-intervention) format for each treatment goal and speech probe. The children were aged 4-7 years (3 females). Participants completed two 6-week blocks of intervention (24 sessions in total) targeting speech errors, phonological awareness, letter-sound knowledge, word decoding, and spelling. Appropriate assessment measures were administered to each child to establish a baseline phase and to evaluate intervention effects. Appropriate statistical analysis including a two standard deviation (2SD) band method, and paired *t*-tests revealed significant improvements for the majority of the participants (67%-83%) on trained and untrained speech probes, phonological awareness, and literacy measures (except real-word decoding), with transfer to spontaneous speech contexts.

Due to the small number of children aged 6 years and older, it was difficult for the researchers to detect statistically significant results on the reading tasks (real-word decoding).

The effects of intervention on each child's speech, reading, and spelling ability were appropriately monitored using assessment measures commonly employed in similar research. Multiple measures were taken for each child throughout the study (every second intervention session and three times post intervention). Additionally, in order to ensure treatment fidelity, the content and materials used in intervention were standardized and administered by trained Speech-Language Pathologists (SLPs). Inter-rater reliability on the non-word reading and spelling measures ranged from 88-100% agreement, demonstrating high treatment adherence. Both trained and untrained speech probes were used to measure improvements in speech error patterns ensuring a transfer of knowledge rather than a teaching to the test. Finally, intervention was provided over an extended period of time which allowed the researchers to determine if these participants were able to maintain their improvements post-intervention.

Results from this study offer compelling evidence that an integrated approach improves phonological awareness, letter knowledge, and the development of reading and spelling in children with CAS.

Moriarty and Gillon (2006) investigated the effectiveness of an IPA intervention model for three children with CAS aged 7;3, 6;3 and 6;10 (two males, one female). They used a multiple single-subject design with repeated measures (pre- and post-intervention) to determine the effects of intervention. Each participant acted as their own controls. Participants completed three sessions per week for three weeks targeting speech error patterns, phonological awareness, and word decoding. Appropriate statistical analysis including the celeration line and the 2SD band method revealed significant improvements in all trained speech production and phoneme awareness skills, as well as transfer of grapheme to phoneme knowledge to non-word reading tasks. The phoneme awareness skills acquired also led to an improved performance on untrained items. Two of the three children improved performance to near-ceiling levels post-intervention.

It should be noted that one of the participants' non-verbal cognition may have inhibited his ability to progress as quickly as the other two participants.

These results should be interpreted with caution as it is unknown if the children maintained or improved skills post- intervention due to the lack of long term follow-up of the participants' speech production and phonological awareness skills. This is concerning because children with CAS are renowned for the persistent nature of their impairments even with extended periods of intervention (McNeill et al., 2009b). The varied linguistic profiles of each child did not permit for comparisons across participants. A lack of repeated measures throughout the study made it difficult to assess the effects of intervention.

Despite the participants' severe speech impairments, and relatively short treatment period, improvements were noted on phonological awareness skills to many untrained tasks. Point-by-point analysis showed 90% and 92% inter-rater agreement for baseline and post intervention repeated measures, respectively. This study employed an appropriate and commonly used method for CAS diagnosis (Ozanne's method) to decrease problems arising from non-standard inclusionary criteria.

Overall, results from this study provide compelling evidence that speech production and phoneme awareness skills in children with CAS can be improved within an IPA intervention model.

McNeil, Gillon, and Dodd (2009a) evaluated the long term effectiveness of an IPA intervention model for identical twin boys with CAS, using a multiple baseline analysis. The two boys were assessed on four occasions at the ages of 4;5, 4;9, 5;3, and 5;9 (pre-intervention, post-intervention, six months and one year following completion of the intervention program). Appropriate assessment measures were used to establish a baseline and determine the effects of intervention. The results of the study showed that improvements were noted in consonant and vowel production within single words as well as consistency in speech production throughout the study. Improvements were made on phoneme awareness, phonological representation, and reading and spelling measures, as both participants performed near ceiling levels.

The results of this study should be interpreted with caution as it lacked any statistical analysis. The researchers completed a visual inspection of the data to measure improvements. It is uncertain whether improvements in speech, phonological awareness, and literacy skills were statistically significant.

This study revealed the long term positive effects of an IPA intervention model for children with CAS. A follow-up period of 1 year allows for an appropriate evaluation of the long term effects of an IPA model, and provides clinicians the ability to understand the evolving shape of the disorder over time. Additionally, the use of identical twins in a study allows for a better understanding of the etiology of the disorder and the role of genetics.

Overall, this study suggests that an IPA intervention may be effective in treating CAS; however, its effectiveness cannot be concluded due to the omission of statistical analyses. Therefore, this study offers a suggestive level of evidence with high clinical importance.

Discussion

The studies reviewed in this paper found that an IPA intervention model has a positive impact on the development of speech, language, and literacy skills in children with CAS.

The McNeill et al., (2009b), and Moriarty and Gillon (2006) studies targeted speech production by focusing on speech error patterns rather than employing drill exercises. This approach may be more likely to create a widespread change in a child's phonological system as it corrects patterns of errors rather than specific words or phrases. Additionally, these intervention models employed a visual–verbal learning style that facilitated the development of letter–sound knowledge by using letters to prompt speech production and phoneme awareness. The visual-verbal learning is strongly correlated to reading ability and is better at achieving

this skill than verbal-verbal or visual-visual learning approaches (McNeill et al., 2009b). Furthermore, the Moriarty and Gillon (2006) study targeted sound structures in words through the use of explicit phoneme awareness. As a result, children with CAS were able to develop strong and specific underlying phonological representations of the phonemes, which in turn provided them with the ability to manipulate language (i.e., rhyme, identify phonemes) and develop a foundation for literacy (i.e., reading and spelling).

All three studies demonstrated the efficiency of an IPA model at simultaneously targeting speech production, phonological awareness, letter knowledge, and reading and spelling skills in children with CAS.

It is important to note that the following limitations should be considered when summarizing the results of these studies:
(1) Single subject designs were employed in all three of the studies. Although this was an appropriate design method for a rare population such as CAS, single subject designs often lack external validity, making it difficult to generalize results.
(2) Two of the three studies reviewed had a small sample size of three or less. Although this is an on-going issue when conducting research with rare populations, it is still a limitation to the evidence.
(3) All participants included had been diagnosed with CAS. Currently there is a lack of consensus regarding diagnostic criteria and there is no designated protocol for diagnosis of this disorder. Despite the varying diagnostic criteria and definition of the impairment, based on the information provided, it appears as though all the authors had selected participants with a diagnosis of CAS to the best standard available. Although one of the studies included a participant with an underlying cognitive impairment, improvements post-intervention were still noted.

Regardless of these inherent differences among participants, each study demonstrated positive results for all participants with CAS as well as compelling evidence for the clinical importance of an IPA intervention model.

Conclusion

This comprehensive literature review provides support and compelling evidence for the appropriateness, effectiveness, and added value that an IPA model may offer to children with CAS. Each of the studies demonstrated positive effects in treating multiple levels of the disorder. In addition, the two studies by Moriarty & Gillon (2006), and McNeil et al., (2009b) provided compelling evidence for the effectiveness of an IPA model at improving both linguistic (phonological awareness, literacy skills) and motor (speech sound production and articulation) abilities in children with CAS.

Recommendations

For future research, the following factors need to be addressed:

i) A follow-up on participants in the Moriarty and Gillon (2006), and McNeill, Gillon and Dodd (2009b) studies
ii) More longitudinal studies that evaluate the long term effectiveness of this approach on speech, language, and literacy
iii) More studies that use multiple baseline measures to measure effectiveness of the intervention
iv) Comparing IPA intervention to traditional therapy for children with CAS in order to evaluate the added value phonological awareness and literacy training provides to these children

Clinical Implications

Currently there is no designated treatment that is known to be most effective for CAS. Various interventions are being employed by Speech-Language Pathologists, however further research is needed in order to determine an effective course of therapy for treating children with CAS. This critical review has examined the current literature concerning the effectiveness of employing an IPA approach with this population and has revealed that there is compelling evidence for the validity and clinical importance of such an intervention design. This approach improves speech sound production in children with CAS and targets phonological awareness and literacy skills including word decoding, spelling, and reading. Overall, it appears that an integrated model is an ideal approach for Speech-Language Pathologists to consider when working with children with CAS as it simultaneously targets multiple levels of the impairment.

References

American Speech-Language-Hearing Association. (2007). *Childhood apraxia of speech* [Technical Report]. Available from www.asha.org/policy.

Dale, P.S., & Hayden, D. A. (2013). Treating Speech Subsystems in Childhood Apraxia of Speech with Tactual Input: The PROMPT Approach. *American Journal of Speech-Language*

Pathology, 22 (4), 644-661. DOI: 10.1044/1058-0360(2013/12-0055)

Gillon, G. T., & Moriarty B.C. (2007). Childhood Apraxia of Speech: Children at Risk for Persistent Reading and Spelling Disorder. *Seminars in Speech and Language*, 28(1), 48-57. DOI 10.1055/s-2007-967929. ISSN 0734-0478.

Kaufman, N. R. (2014). Childhood Apraxia of Speech. The Kaufman Children's Center for Speech, Language, Sensory-Motor, and Social Connections. Inc. Available from http://www.kidspeech.com/index.php.

Lewis, B. A., Freebairn L. A., Hansen, A. J., Iyengar, S. K ., & Taylor, H. G. (2004). School-Age Follow-Up of Children with Childhood Apraxia of Speech. *Language, Speech, and Hearing Services in Schools*, 35(2), 122-40. DOI: 0161–1461/04/3502–0122

McNeill, B. C., Gillon, G. T., & Dodd, B. (2009a). 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 Language & Communication Disorders,* 11(6), 482-495. DOI: 10.3109/17549500902842583

McNeill, B. C., Gillon, G. T., & Dodd, B. (2009b). Effectiveness of an Integrated Phonological Awareness Approach for Children with Childhood Apraxia of Speech (CAS). *Child Language Teaching and Therapy,* 25(3), 341–366. DOI: 10.1177/0265659009339823

McNeill, B. C., Gillon, G. T., & Dodd, B. (2009c). Phonological Awareness and Early Reading Development in Childhood Apraxia of Speech (CAS). *International Journal of Language & Communication Disorders,* 44(2), 175-92. DOI: 10.1080/13682820801997353

Moriarty B.C., & Gillion, G. T. (2006). Phonological Awareness Intervention for Children with Childhood Apraxia of Speech. *International Journal of Language & Communication Disorders,* 41 (6), 713-743. DOI: 10.1080/1368282060062396