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Phonological Awareness Intervention with Children with Childhood Apraxia of Speech:

A Case Study

by

Rachel M. Barnes

A thesis

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Rachel M. Barnes find a satisfactory and recommend that is be accepted.

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RE: Regarding study numberIRB-FY2017-88: Phonological Awareness Intervention with Children with Childhood Apraxia of Speech

Dear Ms. Barnes:

This message is your official notification that your project/survey IRB-FY2017-88: Phonological Awareness Intervention with Children with Childhood Apraxia of Speech does not meet the definition of research under the Code of Federal Regulations Title 45 Part 46.102(d); therefore is not subject to review by the Institutional Review Board. You are free to proceed with your study.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Table of Contents

List of Figures

List of Tables

Chapter 1: Review of Literature

Introduction

Many day to day activities rely on communication and literacy skills. Verbal and written communicative activities such as speaking, reading, and writing are pervasive throughout life for a typical adult, and perhaps even taken for granted. Despite this, processes involved in speech, reading, and writing are quite complex. These abilities were learned during childhood and have become ingrained within us. Nonetheless, some individuals struggle to be understood during a conversation, or painstakingly sound out each letter of a word that they are attempting to read.

The ability to read and write is an essential skill that one must have in this society to succeed. Our education system is based around reading, writing, and arithmetic, and when a student graduates from the school system, these processes are expected to be well developed in order to obtain employment. Often times, individuals who face speech, language, and/or literacy impairments struggle to obtain well-paying jobs, and they feel isolated due to their difficulties in being understood. Speech-language pathologists, teachers, and other professionals can provide therapies and other interventions to assist those who struggle in all areas of language. The earlier professionals are able to provide appropriate intervention, the better the prognosis of success for individuals with language and literacy impairments. This requires identifying and treating children at risk for future communication and literacy problems.

This review of the literature discusses the definition and characteristics of children who have been diagnosed with Childhood Apraxia of Speech (CAS), a motor planning disorder affecting speech production, as well as development of literacy in

children. This study hopes to answer the question: What is the relation between CAS and childhood literacy?

Childhood Apraxia of Speech

Childhood Apraxia of Speech (CAS) is a diagnosis that stirs up much controversy within the practice of the speech-language pathologist. The arguments range from what to call it, how to diagnosis it, and whether or not if CAS actually exists. Throughout the years, this condition has been known as *developmental apraxia of speech* and *developmental verbal dyspraxia*. The American Speech-Language-Hearing Association (ASHA) prefers the term Childhood Apraxia of Speech, as it covers all aspects of the condition, both congenital and acquired. The term *developmental* suggests that a child might mature out of the disorder, after he or she has passed the developmental period, whereas children with CAS typically do not grow out of the condition (ASHA, 2007). Because this is the preferred term of the field, Childhood Apraxia of Speech, or CAS will be used throughout this paper.

Another area of controversy is how the clinician diagnoses CAS. There is no specific site of lesion identified with the brain, nor a typical list of signs and symptoms that accompany each case, making it difficult to definitively diagnosis, and then treat, such a condition. In order to guide clinicians who might come across children who present with difficulties that possibly arise from a diagnosis of CAS, ASHA has defined CAS as "a neurological childhood speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits" (ASHA, 2007). Simply put, the child knows what he or she wants to say, but there is a disruption in the motor plan for execution that is preventing

the message from being correctly conveyed. In addition, there are no deficits related to muscular function that contribute to the condition. Three features have been identified by ASHA to broadly characterize speech in CAS, although these features have not yet been validated by the research: inconsistent errors on consonants and vowels, troubles with transactions between sounds and syllables, and inappropriate prosody during lexical and phrasal stressing. Co-occurring characteristics of children who present with apraxia of speech often include delayed language development, expressive language problems, literacy learning problems, and problems with social language/pragmatics (ASHA, 2007).

Nijland, Terband, and Maassen (2015) expanded upon the three broad characteristics of CAS. They show that the inconsistent errors demonstrated by children with CAS are not the typically immature errors often seen with an articulation disorder. Vowel errors are mostly distortions and reductions, and there are more omission errors than substitution errors in consonant production. Often times, these errors consist of productions that cannot be accurately transcribed, even through narrow transcription.

Nijland et al. (2015) discuss the second feature of CAS, which is the difficulties with transitions between sounds and syllables, noting that coarticulation in the speech of children with CAS has been found to be more segmental or hyperarticulated than that of typically-developing children. This characteristic might explain why children with CAS also feature inappropriate prosody, the third distinguishing feature. These behaviors consist of groping and searching, which will affect the appropriate prosody of smooth speech (Nijland, Terband, & Maassen, 2015).

Research conducted by Marquardt, Sussman, Snow, and Jacks (2002) examined the possibility that the breakdown in children with CAS comes from the inability to

perceive the syllable, which leaves them needing an alternate means of positioning and structuring words and sentences. The syllable is recognized as a fundamental building block in phonological theory (Blevins, 1994). Young children are more adept at recognizing syllable structure or syllable segmentation rather than individual phonemes (Liberman, Shankweiler, Fischer, & Carter, 1974). Without the foundation of syllable knowledge, children with CAS may have no way to develop correct phonological structures in speech and language.

Speech typically develops in interaction with other psycholinguistic and cognitive functions. For example speech-motor skills can be related to verbal short-term memory. It has been shown that the efficiency of speech coding influences verbal short term memory and that short-term auditory memory is a prerequisite for speech (Bishop, 1997). Kent (2004) indicates that "cognition exerts strong influence on motor control, such that speech is best viewed as a cognitive-motor accomplishment" (p. 3). It is possible that this planning and programming difficulty arises from cognitive and sensory components such as memory, gross and fine motor coordination, and even sensory processing.

Literacy

Of particular interest to the present study is the prevalence of literacy learning problems among the population of children with CAS. A study performed by Lewis, Freebairn, Hansen, Iyengar, and Taylor (2004) demonstrated that children diagnosed with CAS have more severe written language (defined as reading and spelling) deficits than children with other speech-sound disorders. As these children enter elementary school, education becomes more and more literacy based, and these children are at risk of falling even further behind their peers.

Literacy refers to the ability to read and write. Appropriate literacy skills are crucial to success in school, gaining employment, and functioning within society. ASHA (2001) has deemed literacy development in children and adolescents as a critical area in the scope of practice of speech-language pathologists. Often, children who struggle to develop appropriate language and speech skills will also have difficulty with abilities needed to read, spell, and develop other higher-level problem solving and metacognitive skills (Gillon & Moriarty, 2007; Storch & Whitehurst, 2002). Speech-language therapists are in a unique position to guide the child through all forms of language learning: verbal and written, expressive and receptive.

Literacy and the development of literacy learning is, in and of itself, a much researched topic, with many of its own controversies. A discussion of ways literacy is developed during childhood is appropriate to gain insight into understanding how the typical child acquires literacy skills. Highlighted are two interrelated models of literacy acquisition that are widely accepted by the reading theorist community, and will assist in understanding the struggles that children with CAS face in appropriate literacy development.

Development of literacy.

The first model of literacy acquisition is a two-component model of reading set forth by Gough and Tunmer (1986) that is based on the idea that reading acquisition is both a cognitive and a linguistic learning process. In the first component, the reader develops lexicons (vocabularies) and knowledge of grammar rules (syntax) for comprehension. In the second component, the reader develops the ability to transfer information from the phonemic level into written units (phoneme to grapheme

correspondence), and vice versa. Put another way, the process of reading is dependent on both oral language skills and code-related skills working together (Zaretsky, Velleman, & Curro, 2010).

The second model of literacy acquisition was developed by Coltheart (2006). This model suggests that there are two different code-related skills that are needed to develop accurate decoding abilities. He labels them simply Route A and Route B. Route A is referred to as the lexical route, focusing on the correct reading of familiar words (such as regular and irregular sight words). It needs to be noted that non-words cannot be read using this route. In Route A, the reader is able to read the words because he or she recognizes the whole word, not the sum of its parts. Route B is known as the phonological route, where the reader is able to read non-words and unfamiliar regular words using his or her phonological awareness abilities. The reader breaks down the word, using what he or she knows about onsets, rhymes, syllables, etc., then builds it back up to create a new word. Both routes are essential in the process of learning how to read.

Thus, the Gough and Tunmer (1986) and Coltheart (2006) models are quite similar. Gough and Tunmer's model requires not only a lexicon of all words and all rules of syntax to help with comprehension (which can be interpreted as Coltheart's route A), it also requires a separate phoneme to grapheme knowledge to assist in code-breaking (which can be understood as Coltheart's route B). Each model requires an automatic knowledge of skills already mastered, and a way to decipher words that are unknown.

The Struggle with Learning to Read

Why does the child with CAS also struggle with the process of learning to read? What causes the child with CAS to struggle with learning how to write and spell? Gillon and Moriarty (2007) have proposed that there are four factors that increase the risk of delayed literacy development for children with CAS. These four factors are: (a) the nature of the speech disorder, (b) the presence of phonological awareness difficulties, (c) genetic risk factors, and (d) the negative impact of early reading difficulties on later written language development.

The first factor that Gillon and Moriarty (2007) name is the nature of the speech disorder, CAS. The previously discussed definition of CAS indicates that the child struggles with consistency in motor planning. This deficit may not directly affect a child's ability to read and write, but the motoric deficits prevalent in CAS provide obstacles for the child's language and literacy development (Gillon & Moriarty 2007). Furthermore, a study by Stackhouse and Wells (1997) more thoroughly explains this flow-on effect and proposes that because of the inconsistent and inaccurate speech that children with CAS possess, they are not receiving adequate correct input to their developing literacy systems, so their skills in auditory processing and vocabulary knowledge are lacking. Additional information presented by Ozanne (2005) classifies CAS as a multi-deficit disorder, with three levels. The first level is phonological plan impairment, the second level is phonetic program assembly impairment, and the third is motor-program execution impairment. This multi-deficit model of CAS predicts that children with CAS are indeed at risk for literacy difficulties because CAS is not simply a motor planning problem, but there are also existing deficits at the phonological and

cognitive levels of the child that precede the motor planning deficit itself (Gillon & Moriarty 2007). Given what we know about the skills needed in developing literacy skills, children with CAS are at a disadvantage, seeing as phonological awareness skills are crucial in developing Route B code-related skills.

The second of Gillon and Moriarty's risk factors for literacy development in children with CAS is that there are phonological awareness deficits in the child with CAS. Several researchers (Gillon & Moriarty, 2007; Marion, Sussman, & Marquardt, 1993; Stackhouse & Snowling, 1992;) suggested that children with CAS have phonological awareness deficits at the syllable, rhyme, and phoneme level in both receptive and expressive language tasks. Marquardt, Sussman, Snow, and Jacks (2002) proposed that because of the imprecise access to phonological representations in the spoken word and the consequent lack of correct rehearsal and repetition these children are able to experience, children with CAS have difficulty recognizing the phonological representations in the written word. This phonological representation deficit then affects the child's phonological awareness development (Gillon & Moriarty, 2007).

The third risk factor of literacy learning in children with childhood apraxia of speech is genetic. Gillon and Moriarty (2007) discussed a study that examined the family history of children who had CAS. In this study 86% of children with CAS had at least one family member who had speech, language, and/or a reading disorder. They proposed that the families of children with CAS have more affected genes for these disorders, which could also support a similar pattern in the breakdown of phonological processing. It is possible that this genetic factor leads to a high prevalence of children with CAS who share their home with a caregiver or sibling who also experience speech, language, and/or

literacy difficulties, making it less likely that the child with CAS receive appropriate early childhood intervention and access to materials that encourage language learning and print awareness concepts.

The fourth risk factor that Gillon and Moriarty (2007) suggest is that the negative effects from early literacy efforts limit the practice and exposure those children have for later language learning. When children have negative experiences and fail at early reading tasks, they will assume that reading is too difficult, and not be excited or willing to try again and to increase their experiences in the task. This limits the amount of practice they will receive in learning how to read as well as exposure to new vocabulary and other syntactic structures. This creates a destructive spiral of continued lack of crucial development of good phonological awareness skills, word decoding, and reading comprehension. Early success is crucial to support the learner and encourage additional practice of these skills.

Phonological Awareness: The Link between CAS and Literacy Development

Looking back through the research leads one to question whether phonological awareness is the connection between CAS and early literacy development. Phonological Awareness (PA) refers to the awareness one has for the sound system of a language and its various units (Gillon, 2004; Stackhouse, Wells, Phil, Pascoe, & Rees, 2002). Gillon (2004) notes that "phonological awareness is the ability to consciously reflect on and manipulate the subunits of spoken language such as syllables, rhymes, and phonemes" (p. 72). A hierarchy of skills proposed by Stackhouse, Wells, Phil, Pascoe, and Rees (2002) is acquired when developing PA. First, the child must be able to identify that language is divided into words, syllables, rhymes, and onsets. He or she then develops awareness of

individual phonemes (each individual unit of sound) and begins to identify them. The child then progresses to skills requiring phoneme segmentation, blending, counting, and finally manipulation. He or she works from a general awareness (knowing that sounds exists) to a systematic and methodical deconstruction of the sound system (e.g. if the child takes away the first sound of /kct/ and replaces it with the sound /b/, it results in a new word, /bct/). It is important to note that PA is the recognition of *sounds* within a language system, not the letters or the alphabet of that language system. PA is about identifying the sound and its relationship to other sounds around it. It is well known in education settings that development of phonological awareness skills is critical to learning how to read (Storch & Whitehurst, 2002).

Relationship between CAS and Phonological Awareness

From the review it is apparent that: 1. children with CAS struggle with literacy and learning (Lewis, Freebairn, Hansen, Iyengar, & Taylor, 2004); 2. children with CAS have a PA deficit (Gillon & Moriarty, 2007); and 3. PA is key to developing early literacy skills (Stackhouse, Well, Phil, Pascoe, & Rees, 2002). But why do children with CAS have a PA deficit? Isn't CAS a motor planning disorder? Gillon and Moriarty (2007) suggest that "a phonological representation deficit may disrupt phonological awareness development in children with CAS as phonological awareness tasks are dependent on access to a segmental representation of lexical items in long term memory." They go on to explain that "the phonological representation deficit theory of CAS thus places the core of the disorder in representational systems and predicts phonological reading and spelling difficulties in those affected" (p. 51). *Phonological representation* is an abstract concept that describes how speech sound information is stored in long term

memory. This theory suggests that children with CAS lack the ability to appropriately store phonological representation information, thus limiting their access to quality representations that direct accurate motor programming. This phonological representation deficit suggests that PA, reading, and spelling difficulties can also be predicted for this population (McNeill, Gillon, & Dodd 2009). To further support these findings, Gillon and Moriarty (2007) have discovered that therapy techniques that give additional phonological information to the child are much more successful than drill based imitation strategies for improving speech production in children with CAS.

Gillon and Moriarty (2007) collected spelling attempts from children with CAS to highlight the difficulty children with CAS have in using phonological awareness information when spelling. While none of the children sampled had specific phonological awareness intervention, they all had been receiving speech and language therapy, and had received at least 2 years of formal reading and spelling education. All three children sampled showed partial awareness of the relationship between phonemes and graphemes. For example, they all demonstrated consistent awareness of the initial sound and the initial letter (teeth always started with a "t," fish started with an "f"). However, attempts at spelling other words (e.g. kangaroo became "actcwot," and shark became "atit") showed very limited ability to analyze words at the phoneme level.

Phonological Awareness Intervention: Two Case Studies

Once one has decided to connect CAS, literacy learning, and PA, a decision must be made about appropriate intervention with these students. Evidence has shown that by focusing treatment on the underlying link of PA, children with CAS not only improve the early literacy skills of reading and spelling, but also improve their productions of speech

sounds (McNeill, Gillon, & Dodd 2009; Moriarty & Gillon, 2006). Moriarty and Gillon (2006) suggest that the current therapy approaches addressing intelligibility for children with CAS have been limited by addressing three separate factors. These factors are "1. Overemphasis on motoric-based imitation techniques, 2. Neglect of phonological awareness and literacy deficits, and 3. Failure to produce rapid changes in children's speech skills" (Moriarty & Gillon, 2006 p. 717). Moriarty and Gillon suggest using PA training to emphasize correct production to create rapid changes in the child's production ability and literacy skills. A variety of approaches and therapies have been developed and researched, but all these programs follow the same theory, more or less, of using the child's individual and specific misarticulations as the springboard for introducing PA therapy.

Hesketh (2009) has developed an intensive PA training as an evidence based practice approach to treatment that incorporates PA-type activities in support of the child's specific speech errors and difficulties. The clinician uses a variety of stimuli, activities, and games that target various sounds, phonological processes, syllable structures, and contrasts. The point is not to target PA skills as a whole, but rather focus on targeting the child's individual speech sound struggles. Goals are made to target the child's articulation rather than the PA deficits. However, by using the PA games, children are able to recognize when a sound error is made and attempt to correct this. By starting at the lowest level of the PA hierarchy (syllable segmentation), and moving up (sound manipulation), and guiding the child through a tacit representation of the phoneme (auditory and articulatory) to a more explicit representation (orthographic) the clinician can tailor therapies to the individual child. Within a session, the child might listen to,

think about, or produce phonemes and manipulate them according to his or her needs and goals. Examples of activities would include requiring the child to judge the presence or absence of a phoneme, identify phonemes in different word positions, and match words that have the same initial or final phonemes (e.g. Does "cat" have the same ending sound as "dot" or "dog?") (Bowen, 2015).

Two case studies have provided strong evidence supporting the hypothesis that PA intervention is an effective practice for treating both speech sound errors and literacy development difficulties. Gillon and Moriarty (2007) point out that currently there is little empirical research concerning specific PA therapy techniques treating the condition of CAS since most of the research for CAS emphasizes drill based motor learning and planning. It is noted that the sample sizes of these studies are rather small, and thus limit generalization to the larger population, but current research is promising.

The first of the studies was conducted by Moriarty and Gillon (2007), and consisted of three children who presented with CAS. Each child received 7 hours of intense PA intervention therapy over the course of three weeks. All three participants improved their PA skills during the course of the intervention, while two were able to generalize these new PA abilities to an untrained, non-word reading task. Two out of the three participants were also able to significantly improve their targeted speech skills. One child involved in the study increased speech production measures with Percent Phonemes Correct (PPC) from 56% at baseline to 100% post-intervention. Moriarty and Gillon noted that the rapid positive response was "particularly remarkable" due to the previous slow progress these children had made in prior therapy sessions.

The second study, done by McNeil, Gillon, and Todd (2009), expanded on the previous study. McNeil et al.(2009) examined twelve children between the ages of four and seven years old who participated in two 6 week therapy blocks, separated by a six week break in intervention, totaling 24 individual 45 minute therapy sessions over 18 weeks. Each session included tasks in letter-sound knowledge, phoneme identity, segmentation, and blending. Results indicated that nine of the twelve children showed marked improvement in target speech sound production, and that they transferred these new skills into connected speech. All children that participated in the study improved PA skills, letter knowledge, decoding, and spelling ability.

Thus, both case studies resulted in improved PA: Moriarty and Gillon (2007) found that focusing on PA improved PA and speech, while McNeil et al (2009) found that focusing on PA resulted in improved PA and literacy.

Conclusions

This review has discussed in detail the condition of Childhood Apraxia of Speech, literacy and childhood literacy development, phonological awareness, and the connections between these three topics, as well as an analysis of evidence based practices that are used in treatment of CAS and PA and their outcomes. The research presented indicates that a child who is diagnosed with CAS may be at risk for literacy development delays, and that intervention in phonological awareness tasks may not only assist in treating those literacy delays, but also support typical and appropriate speech production. The purpose of the current study is to examine whether intensive phonological awareness training decreases articulation errors and increase literacy learning in children with CAS. The research hypothesis is that there will be an increase in correctly pronounced sounds,

as well as an increase in ability to read by children with CAS as a result of treatment using phonological awareness therapy.

Chapter 2: Methodology

The aim of this study was to determine whether intensive phonological awareness training can improve both the articulation errors and the deficits in literacy learning in school-aged children with Childhood Apraxia of Speech.

Research Design

A single-subject design was the framework for this study. After assessment to determine eligibility, the participant received phonological awareness therapy in 25 minute sessions, three days a week, over a three-week period, totaling nine assessment/treatment sessions. Treatment effectiveness was determined by obtaining and comparing baseline and generalization data of targeted articulation sounds, pre- and post-assessment measures of the Decoding subtest of the Phonological Awareness Profile (PAP) and an age-appropriate reading passage at the beginning and the end of the testing period. All testing, baseline and generalization data, and the entirety of each therapy session was audio recorded.

Participants

Eligibility requirements for participation was as follows. He or she must be between five and nine years of age and enrolled in elementary school (kindergarten through grade three). They must also exhibit hearing abilities within normal limits when screened bilaterally at 500, 1000, 2000, and 4000 Hz at 20 dB HL using routine audiometric procedures. The participant also must have been given a diagnosis of Childhood Apraxia of Speech by an ASHA certified speech-language pathologist. The participant's parents. teacher, or speech-language therapist needs to have expressed a

concern about the child's literacy development. The participant must also have no co-morbid diagnosis of Autism Spectrum Disorder, cognitive deficits, dysarthria, cerebral palsy, ataxia, or oral muscular weakness.

Instruments

An audiometer was used to screen the participant's hearing. Screening was done bilaterally at 500, 1000, 2000, and 4000 Hz at 20 dB HL using routine audiometric procedures.

The *Goldman-Fristoe Test of Articulation* (GFTA-2) (Goldman & Fristoe, 2000) is a systematic means of assessing an individual's articulation of the consonant sounds of Standard American English. It provides a wide range of information by sampling both spontaneous and imitative sound productions, including single words and conversational speech. It uses 34 picture plates and 53 target words to elicit the articulation of 61 consonant sounds in the initial, medial, and/or final position and 16 consonant clusters (blends) in the initial position. The examinee is required to name the pictures or to reply to questions about them. The examiner does not model the single word response. The GFTA-2 norms have a wide age range and because of this, it can be used for gathering longitudinal research data and comparative research studies can be designed. The test should take 5-15 minutes to administer. The GFTA-2 examines all appropriate consonants, is easy to administer, provides method for recording responses that facilitates comparative evaluations under various test conditions, appropriate for range of ages, from multicultural and varied socioeconomic backgrounds. The GFTA-2 has a represented sample size of 2350 examinees (equal genders) aged 2-0 through 21-11 at 300 sites worldwide, and has high test-retest reliability and interrater reliability studies

(Goldman & Fristoe, 2000). The GFTA-2 was used in this study to assess the research participant's sound production errors to target sound productions that will be worked on during the therapy period.

The *Phonological Awareness Profile* (PAP) (Linguisystems, 2016) is a standardized assessment used to assess student's phonological processing and phoneme/grapheme correspondence. Often, it is used as a pre- and post- measure to track improvement in individual student's phonological awareness abilities, and can be used to plan intervention programs. The authors of the test allow administering the entire test or use of only the necessary subtests. The test should be administered by a trained professional who has understanding in analyzing phonological structures of speech, such as a speech-language pathologist. Individual test items are scored with a + for a correct response and a 0 for an incorrect response, then, the number correct is calculated to a percentage, with 80% correct or greater is considered mastery of that particular skill. If a student falls below mastery level of a task, the student needs instruction in that area. This is a well-respected, criterion-referenced instrument (Linguisystems, 2016). The PAP was used in this study to assess the phonological awareness abilities in the research participant and to determine a starting point in the therapy period.

Procedures

Baseline and intervention probes.

After the participant had been accepted, the GFTA-2 was administered to determine to speech sound errors the child exhibits. This information provided a baseline

of abilities to compare with the end results, and also provided a starting place to determine therapeutic needs.

The PAP was also be administered. This assessment indicates areas of strength and weakness in phonological awareness tasks (e.g. rhyming, segmentation, isolation, deletion, substitution, and blending). This assessment also provided a baseline of abilities to compare with the end results and provide a starting place to determine therapeutic needs.

After the GFTA-2 and the PAP was completed and scored, and the child's needs for therapy were determined, the researcher administered a probe of the targeted articulation sounds and a short reading passage to use as baseline and generalization data to determine the effectiveness of the therapy (see Appendix A). The articulation probe had nine words on it, and accuracy was determined by accuracy of sound production, and was calculated as percentage of targeted sounds correct. The participant was also be asked to read as much of the passage as possible in one minute and then a score was determined by how many whole words the participant was able to correctly read in that minute. These probes were not used during the course of the treatment session.

Treatment.

Treatment consisted of nine total sessions, conducted over a period of three weeks. Therapy was for 25 minutes per day, three days a week. Therapy was conducted by the researcher, in a well-lit, quiet room, free from distractions. An ASHA certified speech-language pathologist was present during all testing and treatment sessions. Therapy was designed around the participant's individual needs. The phonological

awareness needs and articulation errors of the participant were matched whenever possible. As an example, if the participant had showed errors with initial /p/ on the GFTA-2, therapy targets would include words that begin with /p/. Also, if the participant showed difficulty in segmenting sounds on the PAP, therapy targets would use the initial /p/ phoneme to teach the phonological awareness skill of segmenting. Using the given example, the words "pet," "pig," "pie," and "park" might be used to teach the skill of segmenting to the participant. Each session included the following types of PA tasks: identifying phonemes in isolation, identifying initial and final phonemes in words, phoneme segmentation and phoneme blending, phoneme manipulation, and rhyming. The participant was required to articulate target words in a variety of activities. A variety of games and activities were used to motivate the participant, and cueing levels began at a direct model with maximum support and decrease towards independence as comprehension was demonstrated (see Appendix B). Standard treatment protocols were used and observed.

Data Collection.

Data was collected at every treatment session. Every initial attempt at a targeted sound production and PA task was recorded as data. Data was also collected for each phoneme/phonological process that was being treated, as well as every phonological awareness skill thatswas being taught (identifying phonemes in isolation, identifying initial and final phonemes in words, phoneme segmentation and phoneme blending, and phoneme manipulation).

Post-treatment measures.

After the three-week intervention period, the baseline probes created prior to the intervention period were readministered to assess growth in the targeted areas. These baselines included an assessment of targeted articulation and phonological processing errors and a grade level reading passage. Each baseline/generalization test was administered identically as they were during the pre-treatment testing period. Baseline and post-treatment scores were compared to examine how the provided PA treatment facilitated sound production accuracy and a timed reading task.

Chapter 3: Results

The present case study was undertaken to investigate the effects of phonological awareness training during therapy sessions with children who have Childhood Apraxia of Speech as a way to address both the articulation errors and literacy concerns children with CAS experience. The research hypothesis was that there will be an increase in correctly pronounced sounds (the non-target behavior), as well as an increase in ability to read (the treated behavior) by children with CAS as a result of treatment using phonological awareness therapy. Results will be presented by means of baseline and generalization data, the Decoding subtest of The Phonological Awareness Profile, and an age-appropriate, one-minute timed reading sample.

Case Study Subject

The subject for this case study is a 7 year old male who is enrolled in the first grade in a local elementary school. His private speech-language pathologist recommended him as a participant for this case study. His speech-language pathologist had diagnosed him previously as having CAS. Both his speech-language pathologist and his mother have previously expressed concerns with age-appropriate literacy skills. A pure-tone audiometric hearing screening was completed 6 weeks earlier by the researcher, and there were no concerns noted at that time. Consent forms (Appendix C and D) were obtained from both the subject and his mother, before pre-treatment assessment began.

Pre-Treatment Assessment.

The pre-treatment assessment battery consisted of the Goldman Fristoe Test of Articulation-2 (GFTA-2), the Rhyming, Segmentation, Isolation, and Decoding subtests of the Phonological Awareness Profile (PAP), a grade level one-minute timed reading (Appendix E), and baseline data. All pre-treatment assessment was conducted in a private office that was quiet, well-lit, and familiar to the participant and was audio recorded. Results are as follows:

The GFTA-2 was used to obtain information of the different speech sounds that the participant could not produce correctly, so the researcher could individualize therapy. Results of the GFTA-2 indicated a standard score of 40, which scored him below the 1 percentile. The following table (Table 1) breaks down which speech sounds and blends the participant could not accurately produce in initial, medial, and final positions.

Table 1- Missed phonemes on the GFTA-2

Initial	Medial	Final
b, g, j, sh, l, r, voiced and voiceless th, bl, br, dr, fl, fr, gl, gr, kl, kr, kw, pl, sl, st, tr	p, g, nj, t, sh, l, voiced and voiceless th, v, z	n, d, nj, sh, r, dz, voiced th, z

Next, the PAP was conducted. Only the Rhyming, Segmentation, Isolation, and Decoding subtests were completed, so no standard scores were obtained. The Rhyming, Segmentation, and Isolation subtests were conducted to assist in choosing a starting point for phonological awareness training during future therapy sessions, and the Decoding subtest was used to maintain an initial baseline to measure how successful treatment was in regards to literacy. Table 2 indicates results in each subtest.

Table 2- Subtest scores on the PAP

Rhyming	Discrimination: 5/5 100% accuracy Production: 1/5 20% accuracy
Segmentation	Sentences: 4/5 80% accuracy Compound Words: 5/5 100% accuracy Syllables: 2/5 40% accuracy Phonemes: 6/10 60% accuracy
Isolation	Initial: 4/5 40% accuracy Final: 0/5 0% accuracy Medial: 3/5 60% accuracy
Decoding	VC words: 2/5 40% accuracy CVC words: 0/5 0% accuracy Consonant Blends: 0/5 0% accuracy CVCe words: 4/5 80% accuracy Vowel Digraphs: 3/5 60% accuracy Diphthongs: 3/5 60% accuracy R-Controlled Vowels: 3/5 60% accuracy Consonant Digraphs: 3/5 60% accuracy

Next, a one-minute timed reading sample was collected that was at a first grade reading level (Appendix D). During this initial attempt at the reading passage, the participant read 5 words per minute.

The final assessment conducted was baseline data. During discussion between the researcher and the participant's speech-language pathologist, it was determined that the targeted phoneme during this research study would be initial /l/. The researcher created a list of nine words with initial /l/ sounds and found pictures from the Webber Articulation Photo Cards for /l/ sounds (Super Duper Publications, 2017) that corresponded with each picture. The researcher showed each picture to the participant and he said the word to the best of his ability. The researcher also created a list of five words with final /l/ sounds to see if the /l/ sound would generalize to the final position during the course of treatment.

Tables 3 and 4 demonstrates the results of the initial generalization probes for the initial and final /l/ phoneme.

Table 3- Baseline data for initial /l/ phoneme.

Lemon	-
Lock	-
Lion	-
Light	-
Lunch	-
Leaves	-
Letters	-
lobster	-
Ladybug	-

Initial generalization probe indicates 0/10, or 0% accuracy with producing initial /l/ sounds in words.

Table 4- Baseline data for final /l/ phoneme.

Doll	+
Apple	-
Pinwheel	+
Whale	+
Seal	+

Initial generalization probe indicates 4/5, or 80% accuracy with producing final /l/ sounds in words.

Treatment.

Treatment sessions were conducted in the same private therapy office in which pre-assessment was conducted. All treatment was conducted in a well-lit, quiet room with an ASHA certified speech-language pathologist present, and was audio recorded.

Therapy was conducted three times a week for three weeks for 25 minutes each session, totaling nine sessions and 225 minutes of therapy. The first and last sessions were assessment sessions, so therapy was only done seven times, for a total of 175 minutes. Originally, therapy was planned for a total of four weeks, but due to the participant's Spring Break and family travel plans, therapy needed to be cut a week short. Each lesson treatment plan (Appendix E) and data collection sheet (Appendix F) is included in the appendix.

Session 1.

In the first session, initial sound discrimination and phoneme segmentation, was focused on as phonological awareness targets, and initial /l/ was the articulation target. The activity for sound discrimination included showing the participant a worksheet with pictures on it and having him say the name of each picture and identify whether the word began with an /l/ sound or not. The participant achieved 94% accuracy on this activity, with a direct model. The activity for phoneme segmentation results were 100% accuracy with a direct model. In this activity, the researcher used three blocks to indicate the separate sounds of a word with three phonemes. For example, "leg" was one of the targeted words. The researcher pointed to the first block and indicated that it was /l/, the second block indicated /e/, and the third block indicated /g/, then modeled that all three sounds together produced the word "leg." The participant repeated each section after the researcher. Every time a word with initial /l/ was said by the participant, the researcher indicated if he said it the correct way, and corrected the sound if it was not accurately produced. The data indicated that initial /l/ accuracy for this first session was 22% with a direct model.

Session 2.

The second session targeted phoneme segmentation and rhyming production. Initial /l/ was the articulation target. Phoneme segmentation practice was conducted in the same manner as the previous session and indicated 47% accuracy with a direct model. The activity for rhyming production consisted of the researcher saying a word and having the participant come up with a rhyming word that started with the /l/ sound. The participant during this activity achieved a 47% with a direct model. Data for initial /l/ indicated 50% accuracy with a direct model.

Session 3.

The third session targeted phoneme segmentation and rhyming production again, with initial /l/ as the articulation target. Both phoneme segmentation and rhyming therapy activities were similar to the previous session. In phoneme segmentation, the participant achieved a 50% with direct model. In rhyming the participant achieved a 36% with direct model. Data for initial /l/ indicated 53% accuracy with direct modeling.

Session 4.

Due to the low achievement during the previous session, the researcher decided to focus on rhyming identification and production during the fourth session. Data collection for rhyming indicated the participant achieved 57% accuracy with direct modeling. Data collection for initial /l/ indicated 50% accuracy with direct model.

Session 5.

Rhyming discrimination activities were continued into the fifth session. A white board was utilized during this session as another way of showing the participant that placing /l/ in front of other letters can make new rhyming words. For example, the researcher would write the word "rug" on the white board, and have the participant erase the /r/ sound, and add a /l/ sound. The researcher would then ask the participant what new word was made and if it rhymed with the first word. During this activity, the participant achieved a 56% with indirect modeling. Initial /l/ sound production accuracy was 57% accuracy with direct modeling. A note was made to attempt an indirect model for the next session.

Session 6.

During the sixth session, the researcher used rhyming discrimination and phoneme segmentation activities during therapy. For rhyming discrimination, the researcher asked the participant if two words rhymed or not. Results for this activity were 7% accuracy with no model. A bead slide was used for phoneme segmentation and the participant achieved 77% accuracy with an indirect model during this activity. Three different measures for initial /l/ were taken during this session. First, accuracy for initial /l/ at the word level with an indirect model was 67%. Accuracy for initial /l/ at word level with no model was 45%. Another measure taken was for /l/ phoneme isolation, resulting in was 57% accuracy with direct model assistance.

Session 7.

The seventh session was the last therapy session the participant was available. Phoneme segmentation and rhyming were once again the focus of the phonological awareness training. Using a bead slide during phoneme segmentation, the participant achieved an 80% with an indirect model. Activities for rhyming discrimination resulted in 80% accuracy with a direct model. The same three measures of initial /l/ accuracy were conducted during this session as well. Initial /l/ at word level with an indirect model was measured at 64% accuracy. Accuracy for initial /l/ at word level with no model was measured at 70% accuracy. Accuracy for /l/ in isolation with a direct model was measured at 50% accuracy.

The two phonological awareness activities that were the focus of these therapy sessions were rhyming and phoneme segmentation. Figures 1 and 2 show the progression of the participant in accuracy and modeling. Figure 1 shows the progress in rhyming, while Figure 2 shows progress made in phoneme segmentation.

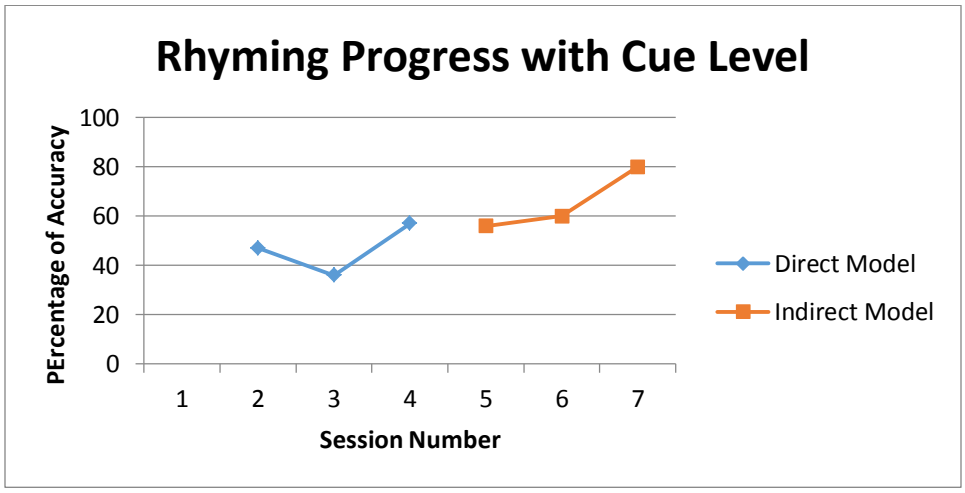

Figure 1. Rhyming Progress with Cue Level

Figure 1 reveals that rhyming was not targeted until the second treatment session, with a direct model used for cuing. By the fourth session, some progress was made with the direct model and the cuing level was advanced to an indirect model, where progress stayed the same. By the seventh and final session, marked improvement was shown with an indirect model.

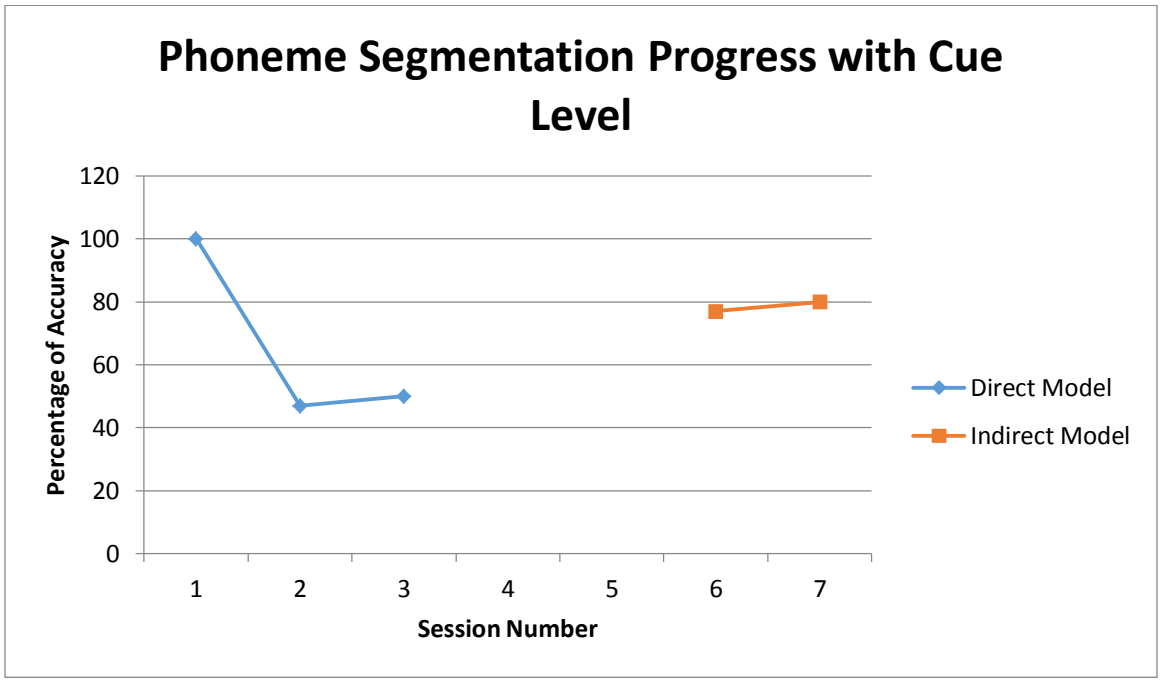

Figure 2. Phoneme Segmentation Progress with Cue Level

As seen in Figure 2, in the first session, phoneme segmentation was the target of therapy and the participant achieved a 100% on the activity. During the next session, a similar phoneme segmentation activity was used as a warm up exercise and it was noted that accuracy dropped significantly. The researcher decided to continue working on this activity. By the end of the seventh therapy session, the participant was being cued with an indirect model with 80% accuracy.

The articulation target that was the focus for the entire research period was initial /l/. Figure 3 shows the progress of the participant with initial /l/ in words.

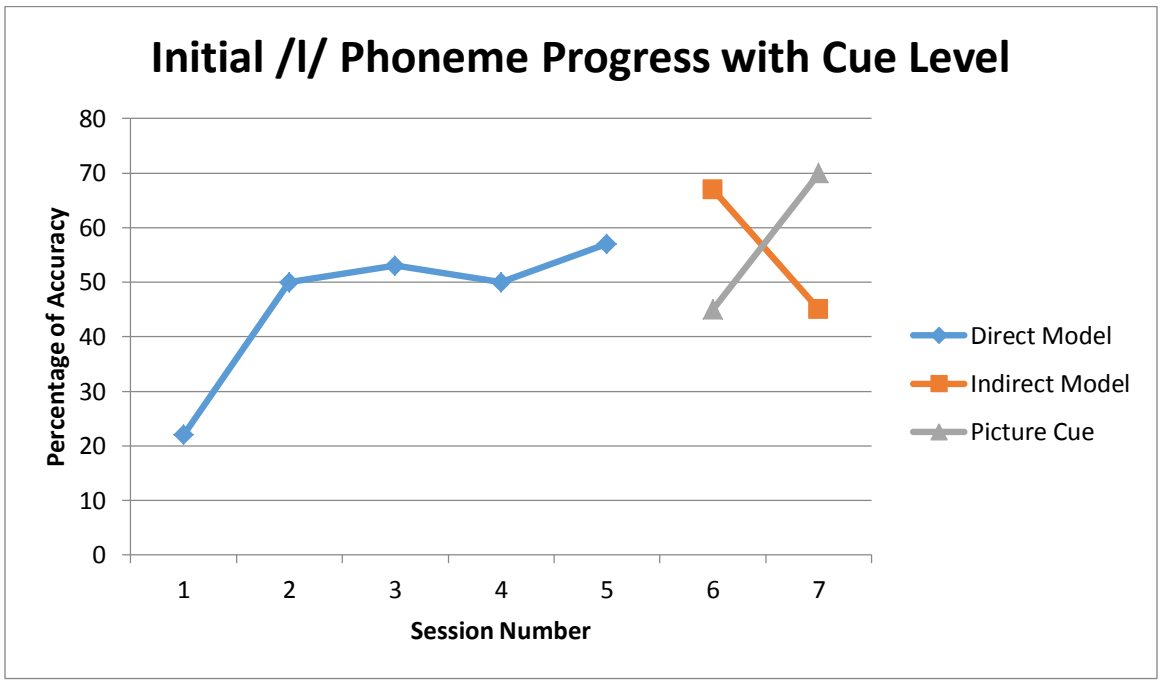

Figure 3. Initial /l/ Phoneme Progress with Cue Level

As pre-treatment assessment and results from the first therapy session show, initial /l/ was a difficult target for the participant to correctly produce. He typically glided the initial /l/ sound into a /w/ sound, making words like "ladder," sound like "wadder." The cue of a direct model was used to begin the therapy period, and the participant made steady progress throughout the treatment period, moving to an indirect cue level during the sixth and seventh session. During the sixth session, the researcher introduced a picture cue with no verbal cue, and the participant did moderately well with that activity the first time, and increased accuracy to 70% the second time.

Post-treatment assessment.

The post-treatment measures were completed on the ninth and final session. These measures were replicated to parallel the initial pre-treatment assessments. Assessments were conducted in the same quiet, well-lit, private office in which pre-assessment and therapy was conducted. The post-assessments were audio recorded, and supervised by an ASHA-certified speech-language pathologist. The post-treatment assessment battery consisted of the Decoding subtest of the PAP, the same grade level one-minute timed reading, and baseline/generalization data of initial and final /l/ sounds in words. Results of the post-assessment and comparisons between the pre- and post-assessments are as follows:

First the Decoding subtest of the PAP was completed.

Table 5-Pre- and Post- Assessment Comparison

	Pre-Assessment	Post-Assessment
VC Words	2/5: 40% accuracy	2/5: 40% accuracy
CVC Words	0/5: 0% accuracy	1/5: 20% accuracy
Consonant Blends	0/5: 0% accuracy	0/5: 0% accuracy
CVCe Words	4/5: 80% accuracy	0/5: 0% accuracy
Vowel Digraphs	3/5: 60% accuracy	0/5: 0% accuracy
Diphthongs	3/5: 60% accuracy	4/5: 80% accuracy
R-Controlled Vowels	3/5: 60% accuracy	4/5: 80% accuracy
Consonant Digraphs	3/5: 60% accuracy	4/5: 80% accuracy

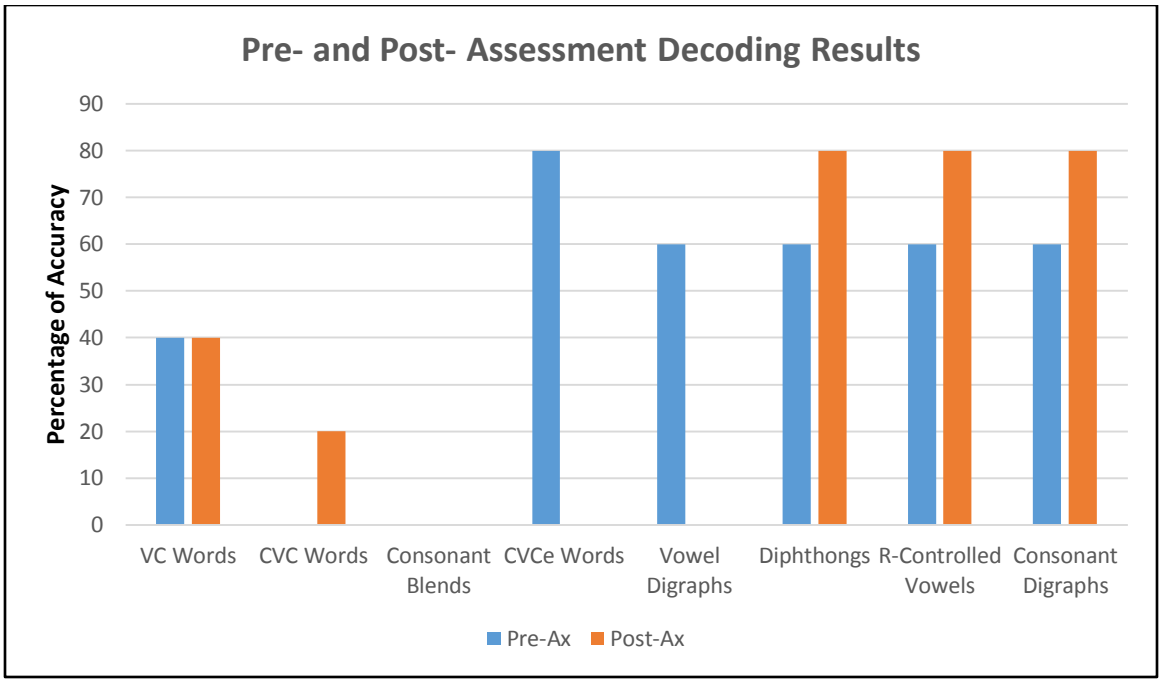

Figure 4. Pre- and Post- Assessment Decoding Results

As can be seen in Table 5 and Figure 4, improvements were seen in 50% of the eight subcategories in the area of decoding. Decoding CVC words improved from 0% accuracy to 20% accuracy, decoding diphthongs improved from 60% accuracy to 80% accuracy, decoding r-controlled vowels improved from 60% accuracy to 80% accuracy, and decoding consonant digraphs improved from 60% accuracy to 80% accuracy. In the remaining four subcategories, two areas remained the same (VC words and consonant blends) and in two of the areas, accuracy was shown to decrease (CVCe words, vowel digraphs).

Next, the one-minute timed reading passage was completed. During the initial read, the participant read 5 words per minute. During the post-assessment read, the participant read 18 words per minute. Figure 5 shows this improvement.

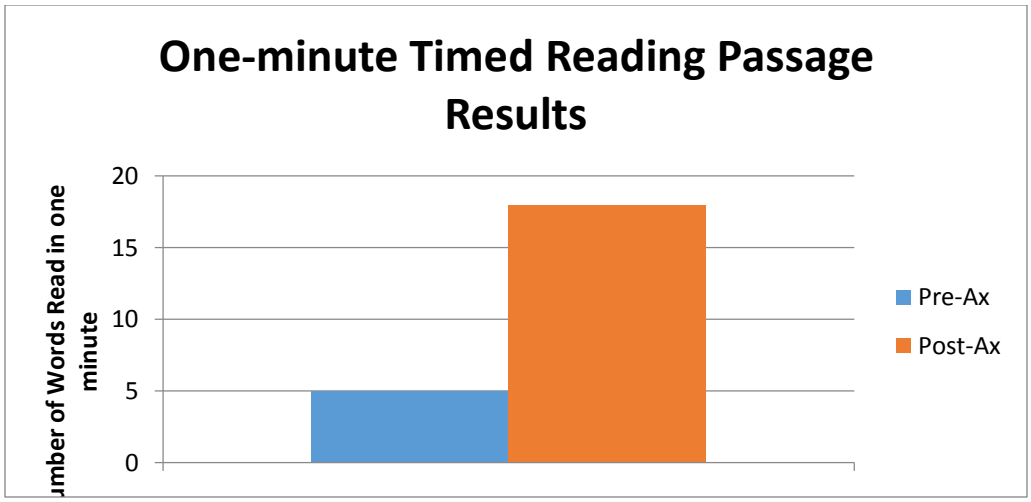

Figure 5. Improvement of one-minute timed reading passage

The final post assessment measure conducted was baseline/generalization data of initial and final /l/ sounds. The researcher conducted this generalization data assessment in the same way she conducted the baseline data assessment. The same nine pictures were presented in the same order as they were during the pre-assessment, and none of the words were used during the previous treatment sessions (see Table 6 and Figure 6).

Table 6-Pre- and Post-Assessment Results of Initial /l/

	Baseline/Pre-Assessment	Generalization/Post-Assessment
Lemon	-	+
Lock	-	+
Lion	-	+
Light	-	+
Lunch	-	+
Leaves	-	+
Letter	-	-
Lobster	-	+
Ladybug	-	+

The baseline probe indicated that the participant accurately produced 0% of initial /l/ words. The participant's accuracy improved significantly over the course of treatment to an accuracy level of 89%, suggesting that the treatment period was successful in increasing initial /l/ sound production accuracy.

The baseline/generalization data of final /l/ words is as follows (see Table 7 and Figure 6):

Table 7- Pre- and Post- Assessment Results of Final /l/

	Baseline/Pre-Assessment	Generalization/Post-Assessment
Doll	+	-
Apple	-	+
Pinwheel	+	+
Whale	+	+
Seal	+	+

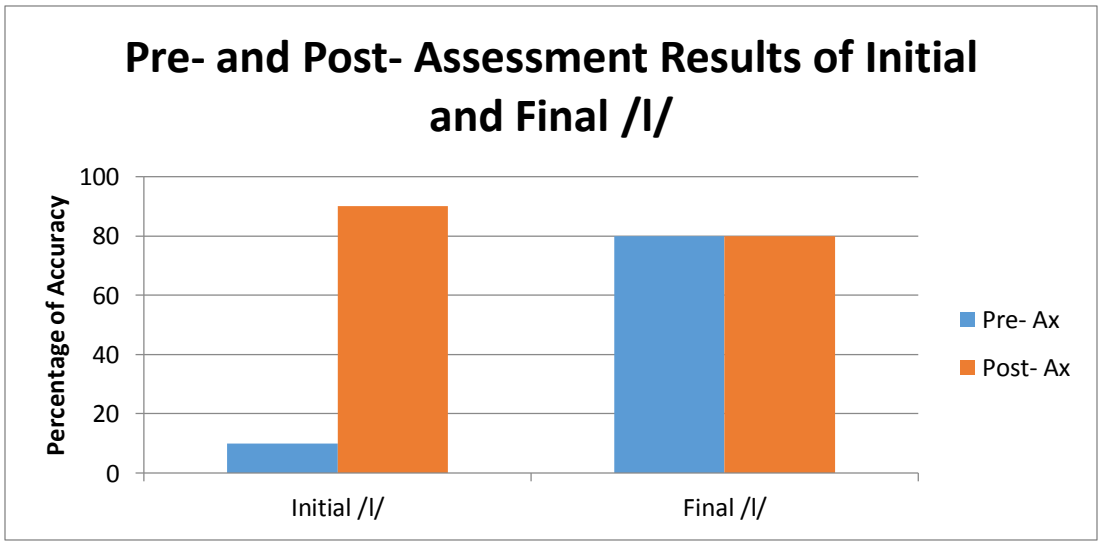

Figure 6. Comparison of Pre- and Post- Assessment Results of Initial /l/ and Final /l/

Accuracy for final /l/ in words remained the same at 80% based on the probe. This does not show any evidence that the treatment provided generalized to the final position.

The research hypothesis proposed was that there will be an increase in correctly pronounced sounds, as well as an increase in ability to read by children with CAS as a result of treatment using phonological awareness therapy. Post-assessment results suggest that phonological awareness therapy, in conjunction with classical articulation therapy. This hypothesis was confirmed by the recent study, in which treatment directed at phonological awareness therapy in conjunction with articulation therapy can be a useful tool to help children with CAS improve speech sound disorders as well address literacy concerns.

Chapter 4: Discussion

The current study sought to determine if intensive phonological awareness training during phonological intervention therapy sessions helped children with CAS decrease speech sounds errors as well as increase decoding ability and literacy fluency. Specifically, the research hypothesis was that there would be an increase in (a) in correctly pronounced sounds, as well as (b) an increase in ability to read by children with CAS as a result of treatment using phonological awareness therapy. The findings of this case study indicate that there is evidence that phonological awareness training is an efficient way to address the speech sound issues and literacy concerns experienced by children with CAS. Post-assessment measures showed marked improvement in the initial /l/ sound that was targeted throughout the treatment period. Also noted was improvement in non-word decoding ability and in reading fluency.

The researcher noted many times throughout the course of the treatment that progress seemed to be very inconsistent. Progress would be made and then the participant would decline in accuracy the next session. As found by Nijland, Terband, and Maassen (2015), inconsistency of accuracy is a hallmark of CAS, and this study showcased the same behaviors as noted in previous research. That having been said, the gains seen from this treatment protocol provide support for the use of PA training for children with CAS.

Sound Production Accuracy

The present study found marked improvement in production of the /l/ phoneme as a result of the intervention provided, even after the relatively short three week treatment

period. These results echo those of prior research. Moriarty and Gillon (2006) conducted PA therapy with three school-aged children with CAS, with intervention aimed to "develop phoneme awareness, increase knowledge of phoneme grapheme relationships, and improve speech" (p.728). Post-intervention findings showed that two out of three participants improved their speech production accuracy over the course of their treatment, similar to the findings of the present study. The authors determined that, by focusing on the awareness of the sound structure of speech, the phonological representations of those sounds were better stored in the child's memory, which supports earlier research indicating that phonological representations are important for speech development (Marquardt, Sussman, Snow, & Jacks, 2002; Gillon & Moriarty, 2007).

Another longitudinal case study done by McNeill, Gillon, and Dodd (2009) assessed the progress of school-aged twin boys with CAS who received PA training over a period of one year, finding similar results. The researchers' first hypothesis was that the twins' single-word speech accuracy would improve and speech inconsistency would decrease over the course of the study. The researchers targeted speech error patterns that the twins had and focused on those patterns during PA therapy. McNeill, Gillon, and Dodd found that the data collected over the course of the year-long study supported their hypothesis that PA training improved their speech accuracy and consistency. The current study indicated similar results, but with a much shorter intervention period.

The hypothesis of the present study was that PA training would improve articulation errors. The researcher tested this by focusing PA training exercises upon words that began with the /l/ sound, so that the participant would receive extra repetition of both hearing a correct /l/ sound (presented by the researcher) and using a correct /l/

sound. This supports the research and suggests that PA training can improve articulation errors made by children with CAS.

Decoding

Improvements in decoding also showed remarkable improvement over the course of the seven therapy sessions. In the Decoding subtest of the PAP, the participant improved his ability to decode non-words in half of the trials, a finding supported by the work of Moriarty and Gillon (2006). The third hypothesis of the Moriarty and Gillon study was that an integrated PA intervention would enable participants to improve decoding performance, which was confirmed for non-word reading tasks for two of the three children receiving PA therapy with improved performance. Their research, combined with the current research study, gives further evidence that there are strong positive treatment effects from PA interventions, suggesting that these interventions can help children with CAS in their reading development (Ehri, et al. 2001). The present study also supports previous evidence that PA is important in developing Route B skills to acquire non-word reading ability (Coltheart, 2006).

Although the decoding skills in the present study did not improve to the same degree as articulation and fluency, the improvements were obvious and supported by prior research. The current study's data supports the previous research. From the data, it appears that PA training is an effective way to teach crucial decoding abilities to assist children with CAS in developing literacy skills.

Fluency

A significant finding of this study is the improvement of reading fluency over the course of the treatment period. The participant entered the treatment period able to read 5 words per minute orally. After seven, 25 minute treatment sessions, the participant raised his fluency ability to 18 words per minute. It is worth note at this point that the single most consistent component of CAS is reduction in verbal fluency arising from articulatory groping and false-starts in production. This is a large increase in fluency ability over a very short period of time. The researcher observed the participant using PA techniques such as phoneme segmentation during the reading of the passage, indicating that the PA intervention and its application by the participant was solely responsible for this remarkable increase. To the researcher's knowledge there are no other studies that have utilized fluency measures with PA, and clearly none finding the impact discovered in the present study. This measure offers a new way to look at the effectiveness of PA with CAS, and data from this study suggests that PA therapy positively impacts reading fluency in children with CAS. The present research brings a unique contribution to the literature on this subject.

Overall, the findings of the current study agree with the findings of a similar study conducted by McNeill, Gillon, and Dodd (2009), suggesting that "it is possible to simultaneously target speech production, phonological awareness, . . . reading . . . skills in children with CAS (p. 191)." They note that these results are important because prior research has demonstrated that speech production difficulties in children with CAS tend to minimize over time, yet literacy deficits tend to persist (Lewis, Freebairn, Hansen, Iyengar, & Taylor, 2004). By being able to use PA therapy to treat all aspects of

difficulties that children with CAS have, SLP's can maximize therapy outcomes and be more efficient therapists.

Limitations

The results of the current study are limited by the narrow nature of a single-subject case study, making it difficult to extrapolate the findings to a larger population. The findings are also limited by the confinement of articulation, decoding, and fluency to only a structured therapy setting, with no evidence of generalization to another environment. Also, articulation and decoding was limited to single word production, and no measures were taken to show how the participant was able to generalize to phrases, sentences, or conversation.

Another limitation was that the time frame for the study had to be cut short due to the participant's family vacation, so the researcher was unable to complete the length of time proposed for the study. While twelve sessions were proposed, only seven therapy sessions, plus one day each for pre- and post- assessment were completed.

One aspect that the researcher found to be difficult was the limiting nature of using only PA activities. It is the opinion of the researcher that PA intervention can and should be used as part of a larger toolbox of therapy ideas, so as not to limit the potential of the client.

Future Research

Future research in this area has exciting potential. I would be interesting to further examine use of reading fluency in CAS and PA. The present study found remarkable changes in this measure, and it could indicate a useful avenue of future

research in PA and CAS. Also, future research should separate out articulation and phonology to see the differential effects that PA has on these separate areas. An area that was neglected in the current study was the importance on phoneme-grapheme correspondence on PA and reading acquisition. Zaretsky, Veleman, and Curro (2010) notes that this skill allows the child to "transfer the abstract awareness of smaller linguistic units (syllables, onsets, rimes, phonemes) onto more concrete, visual representations (graphemes) (p. 66)." Further research could continue with seeing how PA intervention affects spelling ability in children with CAS.

Finally, increasing the duration of treatment could have a marked effect. While a "dose effect" for PA on CAS fluency has not been demonstrated, further research that involves longer and a more intense treatment period could elucidate the effects of PA on phonology in CAS.

Chapter 5: Conclusions

This case study examined the effects of intensive phonological awareness training on a school-aged child with CAS in producing correct speech sounds and addressing literacy concerns. While this has previously been tested and had shown some efficacy as a treatment option for children with CAS, the current case study sought to gain further information on the helpfulness of phonological awareness intervention. The hypothesis was that there would be an increase in correctly pronounced sounds, as well as an increase in ability to read by children with CAS as a result of treatment using phonological awareness therapy. The study showed remarkable improvement in the production of initial /l/ phoneme, as well as reading fluency, as the result of treatment. Data also indicated an increase in decoding ability after the course of treatment.

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Appendix A

Hypothetical Assessment Results and Baseline Tests

Participant was assessed using the GFTA-2 and the PAP. Results of the GFTA-2 included errors in initial /p/ and /t/. Results of the PAP included errors in rhyming production, segmentation in syllable, and in isolating the initial phonemes within words. The following baseline measures would be created to assess articulation progress:

Initial /p/	Initial /t/
1. pig	1. tire
2. pet	2. toy
3. pony	3. talk
4. pie	4. top
5. park	5. time

A grade level reading passage would also be selected. These three baseline measures

would then be used at the completion of the intervention period to gauge improvement in these areas and assess if PA intervention can improve both sound production errors and literacy in children with CAS.

Appendix B

Hypothetical Lesson Plan and Data Tracking

PA Task	Activity	Data Tracking
Identifying phonemes in isolation	Say a variety of phonemes to the child. Have the child make a tally mark on a white board whenever they hear the targeted sound.	Use the child's data to compare to your data. Did he/she hear all the sounds correctly? What was the cueing level needed?
Identifying initial and final phonemes in words	Use a worksheet with several pictures on it. Have the child say each word and identify if they hear the targeted phoneme in the initial or final position.	Did the child identify each picture with the correct targeted phoneme? What was the cueing level needed?
Phoneme segmentation and phoneme blending	Use a bead slide to separate the individual sounds of words, and the blend them back together.	Start cueing at direct model. When the child is able to imitate your model with correct production of targeted phoneme, the child gets a +. Adjust cueing accordingly.
Phoneme manipulation	Using magnetic letters, give the child a word and have them manipulate the letters according to your directions, and have them say the new words.	Starting cueing at direct model. When the child is able to imitate your model with correct production of targeted phoneme, the child gets a +. Adjust cueing accordingly.

Appendix C

Parent Consent Form

Consent Form

Dear Parent or Guardian:

We are asking your permission for your child to participate in a research study conducted by Rachel Barnes, a graduate student at Idaho State University, as a partial requirement to obtain a Speech-Language Pathology Master's degree. The purpose of this study is to explore the effects of Phonological Awareness therapy in Children with Childhood Apraxia of Speech. The research will be conducted during the first half your child's speech therapy sessions for four weeks and will consist of standard clinical treatment protocols involving a variety of stimuli, activities, and games that reflect on and manipulate different sounds and syllables in the English language. It is our hope that data from this research will contribute to a better understanding of how we can more efficiently treat children with Childhood Apraxia of Speech in therapy.

Your child's identity and any data collected throughout the research study will be anonymous. Your child's name will not be appearing anywhere in the data or discussion and complete anonymity will be guaranteed.

Your consent and your child's participation are completely voluntary and your child may withdraw at any time. There is no reward for participating or consequence for not participating.

For further information regarding this research please contact Rachel Barnes at 208-520-7043, email: barnrac4@isu.edu or Dr. Tony Seikel at seikel@isu.edu.

If you have any questions about your rights or child's right as a research participant, you may contact the Idaho State University Institutional Review Board at (208) 282-2179.

Thank you in advance for your cooperation and support.

If you agree to allow your child to participate, please sign below. After signing your name, return this sheet to your child's speech therapist.

Parent's Signature: _____

Child's Name: _____ (Please Print)

Date: _____

Appendix D

Child Assent Form

Assent Form

Dear Student:

We are asking you to help us with a research study involving different therapy methods with children with Childhood Apraxia of Speech. The purpose of this study is to discover new methods of conducting therapy with children with Childhood Apraxia of Speech.

Participating is voluntary, which means you do not have to take part if you don't want to. Nothing will happen to you if you decide not to participate.

If you agree to participate you will be given Phonological Awareness intervention during the first half of your therapy session. Therapy will consist of games and activities that focus on sounds in which you struggle.

Please read the following and sign below if you agree to participate.

I understand that:

- if I don't want to participate that's ok and I won't get into trouble
- anytime that I want to stop participating that's ok
- all personal information will be kept private

Signature: _____

Name: _____ (Please Print)

Date: _____

Thank you in advance for your cooperation and support.

For further information regarding this research please contact Rachel Barnes at (208) 520-7043, email: barnrac4@isu.edu or Dr. Tony Seikel at seikel@isu.edu.

If you have any questions about your rights as a research participant you may contact the Idaho State University Institutional Review Board at (208) 282-2179.

Appendix E

First Grade Fluency Passage

Working Dogs

Dogs make great pets. They can be very friendly. And they are fun to play with. But did you know that dogs can have jobs, too? Many dogs work to help people in important ways.

Some dogs are trained to help blind people get around. They are called seeing-eye dogs. Other dogs are trained to assist deaf people. They can alert their owner to sounds like fire alarms and doorbells.

Most dogs have a good sense of smell. That is why police use them to find people who are lost or hurt. Dogs are also used for herding animals. They know just how to make the sheep and cows move along. Dogs like to plat. But they are hard workers too!

(122)

Appendix F

Lesson Plans

Session: 1

PA Task	Activity	Materials
Initial Sound Discrimination	Show pictures; have participant name them and say if they begin with /l/ sound or not	/l/ sounds picture worksheet
Phoneme Segmentation	Use blocks to separate out individual sounds in words	3-5 blocks; initial /l/ words list

Session: 2

PA Task	Activity	Materials
Rhyming	Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound	Rhyming words list
Phoneme Segmentation	Use blocks to separate out individual sounds in words	3-5 blocks; initial /l/ words list

Session: 3

PA Task	Activity	Materials
Rhyming	Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound	Rhyming words list
Phoneme Segmentation	Use blocks to separate out individual sounds in words	3-5 blocks; initial /l/ words list

Session: 4

PA Task	Activity	Materials
Rhyming	Say two words and ask participant if those words rhyme. Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound; use white board to show how the initial phoneme changes	Rhyming words list Rhyming words list; white board; dry erase marker

Session: 5

PA Task	Activity	Materials
Rhyming	Say two words and ask participant if those words rhyme. Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound; use white board to show how the initial phoneme changes	Rhyming words list Rhyming words list; white board; dry erase marker

Session: 6

PA Task	Activity	Materials
Rhyming	Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound;	Webber Phonological Awareness Fun Park game; bead slide; white board; dry erase marker
Phoneme Segmentation	Use a bead slide to separate out individual sounds in words	

Session: 7

PA Task	Activity	Materials
Rhyming	Say a word, and have participant say a word that rhymes with that word, but starting with /l/ sound;	Rhyming words list; white board; dry erase marker
Phoneme Segmentation	Use a bead slide to separate out individual sounds in words	Bead slide; initial /l/ words list

Appendix G

Initial /l/ Words List

lamp
laugh
leak
list
long
land
listen
look
love
lamb
leg
lips
log
lazy
lake
lucky
late
ladder
lettuce
lawn mower

Appendix H

Rhyming Words List

dog

rug

ham

rub

man

ten

hop

win

here

am

car

see

box

house

boat

train

rake

Appendix I

Data Collection Sheets

Date/Session #:_____

Goal/Cue Level	Data/Accuracy Level
Initial /l/ Cue:	

Date/Session #:_____

Goal/Cue Level	Data/Accuracy Level
Initial /l/ Cue:	

Date/Session #:_____

Goal/Cue Level	Data/Accuracy Level
Initial /l/ Cue:	