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**The Struggle of Differential Diagnosis for Childhood Apraxia of Speech: A Qualitative  
Case Study**

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### **Abstract**

This study addresses the controversial diagnosis of childhood apraxia of speech (CAS) and the struggle many clinicians face with differential diagnosis through a retrospective qualitative case study following a participant who received the diagnosis of CAS. Research questions targeted the characteristics the participant presented with, whether they were consistent or not, as well as if they were unique to CAS or evidence of a phonological disorder, and the treatment approaches that were implemented throughout the participant's history of receiving speech-language services and the effectiveness of those approaches. These research questions were answered through the records and documents obtained from the participant's therapeutic journey. The participant presents with characteristics that could evidence CAS, however, presentation of some characteristics of CAS are not necessarily indicative of the diagnosis. This case study highlights the discrepancy between diagnoses and goals given to the same individual in a short time span with a variety of targets. As evidenced through this study, there continues to be a need for a diagnostic standard for CAS easily accessible to practicing speech-language pathologists.

*Keywords:* childhood apraxia of speech, differential diagnosis, case study, retrospective, qualitative

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## Chapter 1: Introduction

Childhood apraxia of speech (CAS) is a neurological disorder that affects the motor planning part of speech production (American Speech-Language-Hearing Association, ASHA, 2007). This disorder can have a known cause; however, the majority of cases appear to be idiopathic (Murray et al., 2015). There has been controversy regarding the diagnosis of CAS among speech-language pathologists. Some professionals in the field do not believe CAS to be a true separate disorder, but rather a severe phonological disorder. Other professionals believe in its existence, however there is no agreed upon set of unique characteristics that justify a diagnosis of CAS.

According to ASHA's most recent position on the subject (2007), childhood apraxia of speech has a few well established characteristics: inconsistent errors, distorted vowels, and inappropriate prosody; however, the presence of one or all of these characteristics does not justify a CAS diagnosis without further evaluation. All these controversies regarding CAS likely stem from the idiopathic etiology and lack of a concrete standard test that can be used to determine whether or not a child should receive a diagnosis of CAS. Due to the lack of standard unique characteristics of CAS and diagnostic tools, the true incidence of CAS is unknown as it may be over or under diagnosed.

The issues surrounding CAS, distinguishing characteristics, true incidence, and lack of a standardized test or diagnostic criteria continue to hinder the accurate development of such an assessment and there is currently no agreed upon standard diagnostic criteria or test. According to ASHA (2007), the two main research goals pertaining to CAS is to create valid assessments to reliably diagnose CAS and to discover or create treatments appropriate for CAS. Hall (1992) addressed the controversy of the existence of CAS, mentioning issues surrounding CAS, such as

the lack of a unique characteristic. Although this article was written over two decades ago, some of the issues highlighted are still relevant today. Shriberg et al. (2017a) reported on the continuing difficulties to appropriately diagnose CAS as children that meet the criteria of CAS may also meet the criteria for speech delay and vice versa. Most of the population of children misdiagnosed with CAS have severe speech delay (Shriberg et al., 2017b).

Researchers in the field have continued to investigate the unique characteristics of CAS and treatment approaches, however, there remains a lack of validated diagnostic criteria for the disorder. Therefore, all of the results of previous research are contingent on the fact that the research participants said to have CAS did in fact have CAS. Until a standard assessment can be reliable and valid, all research using inclusion/exclusion criteria to justify diagnosis of CAS in their participants are limited to the possibility that participants may have been misdiagnosed (Shriberg et al., 2003a).

This research aims to analyze characteristics in a participant who has previously been diagnosed with CAS to aid speech-language pathologists in the pursuit to accurately diagnose CAS. The purpose of this study is to aid speech-language pathologists in the pursuit to accurately diagnose childhood apraxia of speech through scrutinizing the characteristics both present and missing in a participant who received a diagnosis of CAS prior to this study.



## **Chapter 2: Literature Review**

### **Apraxia of Speech**

Apraxia of speech (AOS), also known as verbal apraxia or dyspraxia, arises from difficulty in planning and/or programming the movements for speech production. Apraxia of speech is not the result of muscle weakness or paralysis, but may occur with dysarthria, aphasia, limb and/or oral apraxia, gait, and/or swallowing apraxia (ASHA, n.d.). Apraxia of speech that is present from the child's birth is referred to as childhood apraxia of speech (CAS). CAS may have neurological, neurobehavioral, or idiopathic etiologies (ASHA, 2007). Idiopathic CAS appears to be the most prevalent (Murray et al., 2015).

Apraxia of speech that occurs later in life as an adult diagnosis, potentially following a stroke or brain injury is referred to as acquired apraxia of speech (AAS). Acquired apraxia of speech may present in an overall slower rate of speech, distorted phonemes, potentially increased difficulty with increased phonemic load and complexity, voicing errors, sound and syllable repetitions, and groping (ASHA, n.d.).

### **The Changing Characteristics of CAS**

CAS, formerly known as developmental verbal dyspraxia or developmental apraxia of speech (DAS), is still a new topic in speech-language pathology. Previously, professionals questioned the true existence of a disorder separate from a severe phonological disorder (Hall et al., 2007). Research as recent as 2003 brought to light the continued debate. According to Forrest (2003), "the existence of DAS as a distinct disorder continues to be debated, with some reports suggesting that the disorder is subsumed under the general category of phonological disorder, whereas other classification schemes regard DAS as a separate disorder with a motor-based etiology" (p. 376). Since its discovery, CAS was described through characteristics of speech and

has gone by a variety of names (Strand, 2001). Previously recognized as developmental apraxia of speech or developmental verbal dyspraxia to differentiate the disorder from and highlight the similarities of characteristics to acquired apraxia of speech, the disorder has been renamed to better reflect its characteristics. The most current appropriate clinically accepted term for the disorder is childhood apraxia of speech which more accurately describes the nature of the disorder and changes the word “developmental,” as children with CAS are not able to just grow out of it (ASHA, 2007; Lewis et al., 2004; Gretz & Bauer, 2004).

CAS continues to be an enigma. It was not until seventeen years ago in 2003 that ASHA created an Ad Hoc Committee on CAS (Gretz & Bauer., 2003). Increased research and empirical support for evaluation and treatment methods related to CAS remains a necessity; however, there are significant barriers researchers face and these challenges have been present for some time now. In 1992, Hall composed a list of the difficulties handicapping the research involving CAS that is still relevant today; small participant group sizes, heterogeneous subject groups, the provided characteristics of participants with CAS are not effective in differentiating the disorder and diagnosis is not dependent on the presence of any specific characteristics, and the characteristics seem to change with age and maturity.

Differential diagnosis of CAS from other childhood speech sound production disorders is becoming a priority. CAS is acknowledged by ASHA as an independent and different diagnosis from phonological and articulation disorders that has been added to ASHA’s Practice Portal within the last few years (“Practice portal adds childhood apraxia of speech”, 2015). Although CAS is now recognized as a supported diagnosis, speech-language pathologists and researchers have yet to determine a standard diagnostic marker or even consistent characteristics that can diagnose CAS (Ozanne, 1995; Lewis et al., 2004; Stackhouse, 1992; Shriberg et al., 1997a).

According to Ozanne (1995), diagnosing CAS can be a long process that “may remain a hypothesis which is continually being tested rather than conclusively proven” (p. 95).

Inappropriate stress could potentially be used to differentiate CAS from other speech disorders and was proposed that it could be indicative of a subtype of CAS (Shriberg et al., 1997b). Three generally agreed upon characteristics that are most notable for CAS are: “(a) inconsistent errors on consonants and vowels in repeated productions of syllables or words, (b) lengthened and disrupted coarticulatory transitions between sounds and syllables, and (c) inappropriate prosody, especially in the realization of lexical or phrasal stress,” however children do not have to present with these characteristics to be diagnosed with CAS, and the presence of these characteristics do not warrant a diagnosis of CAS (ASHA, 2007, p. 10).

### **Incidence and Prevalence**

It is estimated that one or two out of every 1,000 children will have CAS at 0.1%-0.2% and males tend to outnumber females in research (Shriberg et al., 1997a; Stackhouse, 1992). With the population of the United States of America being above 331,000,000 individuals, the potential prevalence of CAS based upon Shriberg et al.’s (1997a) estimation could be as many as 662,000 individuals with CAS. Ultimately, however, the true incidence and prevalence of CAS is unknown. Recent to its 2001 publication, training programs did not stress differential diagnosis (Strand, 2001). Being as differential diagnosis was not critical in diagnosing CAS prior to 2001, this poses an even greater risk of misdiagnosis for everyone diagnosed with CAS before and around that time. Differential diagnosis is beneficial in finding the most accurate diagnosis, however, until a diagnostic tool or assessment that can reliably diagnose CAS can be confirmed and standardized, the true incidence and prevalence will remain unknown.

### **Current Diagnostic Assessments**

Presently, there are a few assessments used to aid speech-language pathologists in the diagnosis of CAS. These tests include: the Dynamic Evaluation of Motor Speech Skills (DEMSS), the Orofacial Praxis Test, the Madison Speech Assessment Protocol (MSAP), the Verbal Motor Production Assessment for Children (VMPAC), and the Kaufman Speech Praxis Test (KSPT). Gubiani et al. (2015) conducted a review of these assessments.

The DEMSS has been reported to have 89% test-retest reliability, 89% intrajudge reliability, and 91% interjudge reliability, and is sensitive in the North American population (Strand et al., 2013; Gubiani et al., 2015). This test uses imitation to assess articulation at the word and vowel level as well as prosody and consistency at the utterance level. This test is intended to assess children between the ages of 3 to 6 years 7 months and requires the child to attempt the target and then repeat the same target with cues as needed. The DEMSS consists of 9 subtests to assess consonant-vowel words, vowel-consonant words, duplicate syllable words, consonant-vowel-consonant words, disyllabic words, multisyllabic words, and longer length productions (Strand et al., 2013; Gubiani et al., 2015). As of its 2015 publication, Gubiani et al. reported that the DEMSS is not fully available.

The Orofacial Praxis Test assesses volitional movements and the ability to sequence movements of the orofacial muscles and can be used to diagnose CAS as well as other motor coordination disorders (Gubiani et al., 2015). Although normative data is given, reliability and validity were not provided for the Orofacial Praxis Test (Gubiani et al., 2015).

The MSAP is approximately an hour-long protocol that uses multiple tasks and tests to diagnose CAS as well as speech sound disorders. This protocol uses the Goldman Fristoe Test of Articulation and the Kaufman Brief Intelligence Test among other tasks (Gubiani et al., 2015).

Another assessment is the Verbal Motor Production Assessment for Children (VMPAC) and is targeted at children between the ages of 3 and 12, assessing general motor control, speech and non-speech orofacial motor control, sequencing, connected speech and language, and speech characteristics (Gubiani et al., 2015).

The Kaufman Speech Praxis Test (KSPT) relies on the child's ability to imitate to assess their speech (Gubiani et al., 2015). This test has four sections: oral movements, simple movements such as isolated vowels and consonants and syllables, consonants and complex targets, and spontaneous speech. This assessment is targeted toward children between the ages of 2 to 5 years 11 months to aid in diagnosis (Gubiani et al., 2015; Newmeyer et al., 2007). This assessment utilizes imitation to assess the child's productions (Kaufman, 2016). This assessment also differentiates when a child presents with a consistent error pattern as errors in isolation are not marked in error throughout the subsequent sections if the error is consistent (Kaufman, 2016).

### **The Need for a Diagnostic Standard**

Nineteen years ago, Strand (2001), asked a question that is still at the forefront of the CAS debate today; "what behaviors are validly and reliably indicative of developmental apraxia of speech?" (p. 301). Due to the controversy of the existence of CAS and defining characteristics, research pertaining to CAS has had to establish inclusion and exclusion criteria with which to best determine participants who would be eligible and productive in the research studies pertaining to CAS.

### ***Characteristics used to Diagnose CAS***

Diagnostic checklists have been created to diagnose CAS. Yoss and Darley (1974) compiled a list of ten characteristics, five speech characteristics and five non speech

characteristics that would aid in diagnosing CAS: slow diadochokinetic rates and incorrect syllable sequence, increased difficulties with polysyllabic words, multiple error features in repeated speech tasks, distortions, one-place feature errors, additions, and omissions during spontaneous speech, inappropriate prosody, difficulty with nonspeech oral movements, soft neurological signs, sequenced movements need to be demonstrated more, decreased auditory perception, and potential specific learning disability. Another list used by Davis et al. (1998) to diagnose individuals with potential CAS includes eight speech characteristics and three non-speech characteristics. This list consists of: a limited phonetic inventory, omission errors, vowel errors, inconsistent errors of the same target, inappropriate rate, pitch, and/or loudness, more errors as utterance lengthens, groping, unwillingness or inability to imitate words and phrases, use of simple syllable shapes through simple words or reductions, difficulty with non-speech oral movements, reduced expressive language, reduced rates when performing diadochokinetic tasks (Davis et al., 1998).

Despite lists of characteristics used to diagnose CAS existing throughout the research on the subject, Forrest (2003) conducted a survey at an Indiana Speech-Language-Hearing Association continuing education workshop pertaining to the assessment and treatment of CAS and the findings demonstrated that practicing speech-language pathologists in attendance were unable to establish distinguishing characteristics of CAS (Forrest, 2003). Speech-language pathologists in attendance were asked to write down three characteristics they would use to diagnose CAS. Of the 75 participants, 67 wrote three characteristics and 8 wrote only two characteristics. There were 50 different characteristics the participants listed to describe CAS. Among these 50, there were potential differences in the meaning or presentation of the characteristic and even some were contradictory. The most agreed-upon characteristic of CAS

was “inconsistent productions” which was still written down by less than half of the participants (Forrest, 2003, p. 378).

### ***Current Research Surrounding CAS***

A standard used to diagnose CAS must be agreed upon to solidify and confirm that participants included in research do in fact have CAS. Despite the field still lacking a consistent set of characteristics to reliably diagnose CAS, research continues to better understand and illuminate the nature of the disorder using diagnostic checklists (Watts, 2009; Yoss and Darley, 1974; Davis et al., 1998). Shriberg et al. (2012) reported a list of characteristics Strand determined to be effective in diagnosing children with CAS. This list has been used to supplement or guide eligibility criteria in other research studies such as the one conducted by Gomez et al. (2018).

Iuzzini-Seigel et al. (2017) conducted a research study for which they had to establish criteria to diagnose their participants with CAS. This research was done to compare children with CAS, a speech delay, or language impairment. Iuzzini-Seigel et al. (2017) found that both of their groups who were diagnosed with CAS, through the use of the researchers’ agreed upon eligibility checklist, (CAS alone and CAS with a comorbid language impairment) displayed inconsistencies in their speech.

Another study conducted by Zuk et al. (2018) assessed speech perception in participants with CAS, CAS and language impairment, language impairment, speech delay, and typical controls. Due to the lack of a diagnostic marker for CAS, the authors had to establish criteria by which to diagnose eligible participants with CAS. All participants completed a hearing screening, exhibited normal cognition according to the Reynolds Intellectual Assessment Scales, presented with no signs of dysarthria, completed the *Goldman-Fristoe Test of Articulation-*

*Second Edition* GFTA-2 and the CELF-4 or CELF-4 Screening Test. To be placed in one of the CAS groups, participants must have presented with a minimum of five out of eleven characteristics during the GFTA-2. Based on correct diagnosis of the participants, this study found that CAS alone does not affect a child's speech perception, however, children with CAS and a language impairment may experience deficits in speech perception.

Nijland et al. (2015) conducted a study to assess the cognitive functions of individuals with CAS. In order to assess the cognitive functions of individuals with CAS, this study also had to define CAS in order to find eligible participants through the use of common characteristics of individuals with CAS. This study found that children with CAS might also present with delays in cognitive functions.

These studies aimed to discover and research different characteristics or effects of CAS: comparing CAS to speech delay and to language impairment, the effect of CAS on speech perception, and the effect of CAS on cognitive functions. Despite these studies providing results and conclusions for future research and treatments, the results are entirely contingent on a correct and consistent diagnosis of CAS. Ultimately, these research articles shared similar standards or characteristics that participants had to present with in order to be included or excluded from the group diagnosed with CAS yet differed in how many characteristics must be present to justify a diagnosis of CAS. According to some, a minimum of 4 out of 10 characteristics across three tasks may be sufficient for participants to be diagnosed with CAS; some participants were required to present with a minimum of 5 out of 11 characteristics, and others required a minimum of 8 out of 11 characteristics be present before diagnosing the participant with CAS (Murray et al., 2015; Murray et al., 2012; Zuk et al., 2018; Martikainen and Korpilahti, 2011). Even those that used the same or similar checklists may have interpreted each characteristic



differently potentially leading to different results and conclusions. The results of these studies and research pertaining to CAS is crucial to the field and furthering the knowledge base of CAS, however, in order to truly illustrate the nature of the disorder and the effects of certain treatments or treatment schedules on CAS, it must first be clearly and universally understood as to what constitutes a true diagnosis of CAS. As a diagnostic standard for CAS does not exist presently, all research pertaining to the disorder is uncertain (Strand, 2001). “The lack of validated inclusionary criteria for childhood apraxia of speech continues to be the primary constraint on the development of a coherent descriptive-explanatory account of this proposed disorder. As suggested in the companion paper (Shriberg et al., 2003), all findings in the experimental literature have to be considered tentative due to the lack of a gold standard for CAS and to the large differences in the inclusionary criteria used by investigator groups” (Shriberg et al., 2003a, p. 576). To establish reliability in the diagnosis of CAS, available diagnostic tools need to be assessed and potentially new ones created in order to aid in successful and consistent diagnosis of CAS across all practicing speech-language pathologists.

### **Current Diagnostic Research**

Fortunately, recent research is promising in the report of a reliable diagnostic marker. Shriberg et al. (2017) published a series of research articles examining a potential diagnostic marker that could reliably diagnose CAS. This diagnostic marker, termed the Pause Marker (PM), may allow speech-language pathologists to confidently and accurately give the diagnosis of CAS and reliably differentiate CAS from other phonological disorders.

Shriberg et al. (2017a) developed a pause marker to diagnose CAS through the analysis of pauses throughout a child’s speech. Children with suspected CAS tended to exhibit “inappropriate pauses” between words. Taken from a speech sample with a minimum of 40

between-words opportunities for pauses, Shriberg et al. (2017b) examined the pauses and their appropriateness to determine the PM. In order to be determined a “pause” for this research, Shriberg et al. (2017c) required a break between words of a minimum of 150 milliseconds. To be determined “inappropriate,” the pause must be classified as abrupt, alone, change, or a grope. In determining a child’s pause marker score, researchers calculated the percentage of inappropriate pauses throughout a 24-utterance speech sample. According to this study, a pause marker score higher than 5% was used as an indicator of CAS, meaning that children with percentages of 95 or greater were negative for CAS. Shriberg et al. (2017a, p. S1106) accounted for children scoring 94% to 95.9%, classifying these scores as “marginal PM scores.” Children who scored within this marginal range were then assessed using Supplemental Pause Marker Signs (SPMS) to determine if they were PM- or PM+. The SPMS analyzes articulatory rate, sentential stress, and transcoding errors. If a child received a PM score within the marginal range, they must present with two out of the three aforementioned attributes; a slow articulatory rate, inappropriate sentential stress, and transcoding errors, in order to test positive for the pause marker (PM+). If a child had a marginal PM score but did not present with two out of the three attributes, they were classified as having tested negative for the pause marker (PM-) and therefore would not justify a diagnosis of CAS (Shriberg et al., 2017d).

This PM provides hopeful data supporting the reliability of using the PM to diagnose CAS. This series of articles support the specificity and the sensitivity of the PM comparing its results of individuals with suspected CAS based on the Mayo Clinic System (MCS), children with speech disorders, to aid in distinguishing between a speech disorder and CAS, and adults with AAS, as the symptoms of CAS and AAS are “substantially similar” (Shriberg et al., 2017b, p. S1121). The second article in the research series by Shriberg et al. (2017b) reported the

sensitivity and specificity percentages for the PM in diagnosing children with CAS using participants who have suspected CAS based on the MCS, children with severe speech disorders and adults with AAS. To test the specificity of the PM, the authors compared the results of the PM to the MCS for children who were suspected to be positive for CAS. Agreement of the MCS and PM in diagnosing positive or negative CAS was the most reliable. Although there were a few disagreements, the overall sensitivity of the PM in diagnosing CAS was 86.8%.

According to Shriberg et al. (2017d, p. S1165), based on the findings in the previous articles (Shriberg et al., 2017b, 2017c) and the current one, the PM is accurate, reliable, coherent, discrete, parsimonious, and generalizable and therefore fulfills six out of seven criteria to be considered a valued diagnostic marker as detailed in (Shriberg et al., 2017a). The PM is an exciting potential diagnostic marker for CAS; however, the PM should be considered “near conclusive” as opposed to “conclusive” when differentiating CAS from speech delay (Shriberg et al., 2017d, p. S1165). The PM needs to be confirmed as an effective diagnostic tool with more populations such as individuals with varying types and degrees of “dysarthria, stuttering, cluttering, and velopharyngeal incompetence” across the developmental stages (Shriberg et al., 2017d, p. S1165).

Although this new research from Shriberg et al. (2017) holds promising advancements in the realm of speech-language pathology and childhood apraxia of speech, the current concern of a reliable and standard diagnostic tool that is effective and efficient for all speech-language pathologists to utilize still remains until these advancements can be made easily available to all practicing speech-language pathologists.

## **Treatment of CAS**

A systematic review regarding the effectiveness of treatments for individuals with CAS was unable to be completed due to the lack of research using randomized control trials (Watts, 2009). Based upon the results from treatment, phonological disorders and CAS are separate disorders and should be treated accordingly. Following treatment, participants with phonological disorders demonstrated growth in their phonetic inventory that participants with CAS lacked (Iuzzini & Forrest, 2010).

Relatively common factors among motor-based interventions that could be used for individuals with CAS such as Dynamic Temporal and Tactile Cueing (DTTC), Rapid Syllable Transition (ReST), Nuffield Dyspraxia Programme (NDP3), and Physically Restructuring Oral Muscular Phonetic Targets (PROMPT), are “high amount of practice, a relatively small set of treatment targets, a homework component, provision of knowledge of results and knowledge of performance feedback, and use of alternative feedback modalities” (Maas et al., 2014 p. 203).

### ***Treatment Frequency and Duration***

Children diagnosed with CAS show greater improvements when seen for treatment sessions twice a week compared to only once a week (Namasivayam et al., 2015). Treatment should be frequent, at least twice a week, and provide the child the opportunities for a minimum of approximately 60 trials per session (Murray et al., 2014; Maas et al., 2014). According to the small sample size studied, the majority of the participants benefited greater through the use of blocked practice over random practice (Maas & Farinella, 2012). Children with CAS may require continuing treatment (Murray et al., 2014).

### *Treatment Strategies*

Children diagnosed with idiopathic CAS should be more accurately and appropriately treated than through the use of Nonspeech Oral Motor Exercises (McCauley & Strand, 2008). A single case study supports the use of Melodic Intonation Therapy (MIT) and the Touch-Cue Method (TCM) in combination for children with CAS (Martikainen & Korpilahti, 2011). In this study, the participant attended six weeks of eighteen 30-minute-long sessions using MIT. The participant increased their percentage of vowels correct during this treatment period but decreased in percentage of consonants correct. Following the six-week period of MIT therapy, the participant did not receive any treatment for an additional six weeks. During this period without treatment, the participant experienced gains for both percentage of vowels correct, and percentage of consonants correct and increased their phonological mean length of utterance. After the six-week treatment free period ended, treatment resumed for six weeks with the same duration and intensity using the Touch-Cue Method. This period showed improvement for percentage of vowels correct as well as percentage of consonants correct and the participant's phonological mean length of utterance. After treatment ended, the participant continued to make progress during the twelve-week period, supporting that the combination of MIT and TCM treatment strategies was effective for the participant with CAS (Martikainen & Korpilahti, 2011).

A systematic review of research conducted evaluating the effectiveness of treatment concluded that the motor-based treatments of DTTC and ReST and the linguistic treatment of Integrated Phonological Awareness Intervention are effective and supported treatments for this population. More specifically, according to the research studied, Integrated Phonological Awareness Intervention is most beneficial for children between the ages of 4 and 7 years diagnosed with mild to severe CAS, ReST for children between the ages of 7 and 10 years

diagnosed with mild to moderate CAS, and DTTC for children diagnosed with severe CAS (Murray et al., 2014).

### **Chapter 3: Methods**

#### **Participant**

The participant was a five-year one-month old male who had previously received a diagnosis of CAS from a speech-language pathologist in an outpatient private clinic setting. His speech was characterized as highly unintelligible. Additionally, the participant was referred to and evaluated by a neurologist secondary to concerns with speech and development. The diagnosis of CAS was confirmed by the neurologist with no additional diagnoses or deficits identified. The participant attended preschool four days a week and received speech and language services through the public preschool where a speech-language pathologist provided services in the preschool classroom. Outside of the school setting, he received individual services at a private outpatient clinic for speech once a week and at a university clinic once a week for 45 minutes.

#### **Research Design**

This study used a retrospective qualitative single case study research design. Only one participant who had been diagnosed with the disorder in question was studied for this research. This research design was chosen to provide the maximal amount of information regarding a child who had received a diagnosis of CAS and to determine the accuracy of that diagnosis as evidenced by the characteristics and progress that this individual presented with. Individualized results from this study can provide additional information and insights into the diagnostic challenges speech-language pathologists face with assessment and treatment of CAS. This research also aimed to illuminate the similarities and differences between CAS and other speech disorders, such as a severe phonological disorder.

**Research Questions**

The purpose of this study was to aid practicing speech-language pathologists in making a confident diagnosis through analyzing critical characteristics both present and missing in a child previously diagnosed with CAS. Specifically, the researcher aimed to investigate the following research questions:

***RQ1: What characteristics does the participant consistently present with?***

The characteristics that are present consistently will help determine the participant's current and accurate diagnosis without sway of a preconceived or prior diagnosis.

***RQ2: What characteristics does the participant present with inconsistently? Under what circumstances are they present?***

Does the participant present with any characteristics that are inconsistent? This question will help establish if the participant presents with inconsistent characteristics, as well as what they are, and which circumstances they tend to present in. The presence of inconsistent characteristics or lack thereof may potentially aid in determining the best diagnosis for this participant.

***RQ3: What characteristics that the participant presents with are consistent with phonological disorders?***

Specifically listing the characteristics that are consistent with phonological disorders can enable the researchers to make informed decisions when determining the best diagnosis for the participant.



***RQ4: What characteristics that the participant presents with are specific or unique to childhood apraxia of speech?***

Due to the participant's previous diagnosis of childhood apraxia of speech, it may be difficult to evaluate and treat the participant objectively. By noting the presence or lack of characteristics that are unique to CAS, the researchers can provide a complete assessment and true representation of the participant.

***RQ5: What treatment approaches have been used or are currently being used? Are they effective?***

By evaluating the treatments that have been and/or are currently being used for this participant, it can be used to validate or invalidate specific diagnoses. If the participant truly has CAS, would they exhibit a beneficial response to a phonological intervention and vice versa? If the participant has a phonological disorder, would they have notable progress with a treatment approach based on childhood apraxia of speech?

## **Procedures**

### ***Informed consent***

The participant's guardian was informed of the study and asked to provide consent to the study using a written script that had been approved by the IRB to detail the study. The informed consent form as well as records release forms were given to the guardian to be signed. The participant's guardian provided informed consent for the participant to participate in the study. Data collection began upon receiving the signed documentation of informed consent and records release forms.

### *Case history and records*

After approval from the IRB to begin the research study and receiving informed consent from the participant's parent, data collection began. An interview was conducted over the phone with the participant's parent to ask relevant questions about the participant. The parent was given a case history form as well as permission forms to request documentations and records from facilities the participant attended to fill out. Upon receiving consent to release records from the participant's guardian, the written request to obtain documents on the participant was then faxed or given to the appropriate medical facilities and service providers. Records requested included past hearing screening and hearing assessment results, speech and language evaluation reports, progress reports, treatment notes, medical records from the otolaryngologist and neurological records. All electronic data collected for this research to be stored on an encrypted flash drive and all physical data collected will be stored in a locked filing cabinet in a locked room until one year following the participant's eighteenth birthday, at which point it will be properly shredded or erased. The participant's history as well as assessments and past data were assessed retrospectively to analyze characteristics of speech sound production skills.

### *Data Analysis*

The participant's records were analyzed for behavioral, linguistic, and speech characteristics, specifically to address the targeted research questions. Characteristics included, phonetic inventory, consistency in speech, intelligibility, use of metalinguistic cues, present phonological processes, productive changes in speech independently and with a model or cueing. The participant's behavioral characteristics and general notes about temperament and participation in services were analyzed in conjunction with speech and language characteristics.

All records were reported chronologically throughout the results section and then scrutinized to address each research question throughout the discussion section.

## Chapter 4: Results

### Case History

A case history form was completed by the participant's mother in the fall of 2020. Answering concerns about her child's speech, language, and/or hearing, the participant's mother wrote that the participant did not speak "until he was 3 years old, he would only make noises and gestures." Once he began speaking, she wrote that "you couldn't understand his words, he would only say parts of words." The participant's mother checked boxes stating that her child's speech was "easy for family to understand, but unfamiliar people have trouble" and "family has trouble understanding." When the participant was not talking, the participant's mother wrote that he expressed his wants and needs "through hand gestures and acting out." The participant's mother stated that "he completely understands what is being said to him." The participant had not been hospitalized in the past two years and was not currently being treated for a chronic condition. The participant started having ear infections at 6 months, then had tubes placed in his ears at 18-24 months. His tonsils and adenoids were taken out at 4 years old, and he had a second set of tubes placed in March 2020. The participant's first set of tubes caused a lot of issues: "he had copious amounts of drainage from both ears on and off for 3 years." He "was on multiple antibiotics and has had frequent audiology exams." His hearing was normal, and he had received services in a local outpatient hospital setting, two private practices, and a university clinic. The participant weighed 8lbs 6oz at birth. The participant's mother reported a SUA (single umbilical artery) in utero. An ultrasound of kidneys at birth was normal with no complications. The participant said his first word at 9 months old, took his first steps at 10 months old, and played patty-cake or peek-a-boo as a baby. The participant lived at home with his mother and two sisters, one age 7 and one age 2 where the primary language spoken is English. The participant's

mother reported no family history of speech or hearing problems. The participant's mother stated, "Currently [the participant] struggles most with speaking in sentences. It is very frustrating for him."

### **General Medical History**

The participant was seen by local medical outpatient facilities on various occasions. The first documentation of one of these visits on November 1<sup>st</sup>, 2016. The participant experienced pain in the right ear, runny nose, chest congestion, and wheezing. His pharynx was noted to be swollen, and his tonsils were symmetrical, abnormal in color, and were mildly swollen. His tympanic membranes were an abnormal color and were both cloudy with mild air-fluid level and he had discharge present. He was seen on multiple occasions and was diagnosed with streptococcus pharyngitis multiple times. Throughout his numerous visits to an outpatient facility, he was also diagnosed with otitis media in his right ear on more than one occasion, with bilateral otitis media, vomiting, and bilateral otorrhea. From his visit on August 2<sup>nd</sup>, 2018 to a local medical outpatient clinic, he was referred to a pediatric audiologist for speech delay and possible hearing deficit.

### **Initial Evaluation in Outpatient Setting**

The participant was seen for a language evaluation at a local hospital on October 17<sup>th</sup>, 2017 at the age of 2. This was his first formal evaluation in the area of speech and language completed by a speech-language pathologist. The participant was assessed using the *Rossetti Infant- Toddler Language Scale* (RITLS) with results obtained from clinical observations and parent/caregiver interview. The participant scored 24-27 months in play, 9-12 months with some 12-15 months in language comprehension, and 9-12 months with some 12-15 months in language expression. An oral motor assessment was not completed due to the participant's lack

of cooperation. The results of the evaluation demonstrated the presence of a language disorder with moderate to severe delays in expressive and receptive language. It was recommended that the participant receive speech-language services 1-2 times weekly. The short-term goals from this evaluation were to identify body parts, make animal sounds, imitate words spontaneously, and to participate in speech-routine games, and the long-term goal was to understand/express basic wants/needs in a supervised environment.

*Table 4.1 RITLS Results October 2017*

	<b>Play</b>	<b>Language Comprehension</b>	<b>Language Expression</b>
<b>Age Equivalents</b>	24-27 months	9-12 months; 12-15 months	9-12 months; 12-15 months

### **Outpatient Services for Language Disorder**

The participant received therapy provided by a speech-language pathologist, addressing language concerns at the local hospital following the evaluation and diagnosis of a mixed expressive-receptive language disorder. He received services once a week from October to the end of April when the participant was seen twice a week for the majority of the remainder of the therapy sessions. Throughout the therapy sessions at this facility, the participant engaged in behaviors such as kicking, screaming, throwing objects, and trying to run out of the room. Due to the participant's behavior, some of the sessions ended early and it was suggested that the therapy sessions be shortened to 30 minutes to minimize behaviors and increase participation. The SLP began using a child-led approach during some sessions and noted during a session that when a child-led approach was used, the participant was "more responsive" however he continued to have behavioral issues.

The participant was noted to be unintelligible, deleted final consonants, and was missing the early developing sounds /b/, /p/, and /m/, however, he was noted to have appropriate prosody. The SLP anticipated articulation errors and reported during a session that he presented with unintelligible jargon-like utterances during play but did not evaluate speech as the participant was “not appropriate for standardized testing... due to behavioral/attention concerns.” These therapy sessions began to target speech through verbal cues and gestural cues to target the sounds /b/, /p/, and /m/, and tactile cues to bring awareness to final consonants. The participant was reported to demonstrate his ability to follow directions when he was motivated, and his mother noted improvements in his communication. The long-term goal was for the participant to exhibit understanding or expression of “basic wants/needs in a supervised environment.” Goals included producing animal sounds, identifying body parts, imitation of words, participating in speech-routine games, using a communication board to communicate wants and needs, using a symbol or label to choose desired toy or activity, answer yes/no questions, appropriately turn-take, and identifying objects by category. The participant received services at this facility until June 17th, 2018 when he was discharged due to the speech-language pathologist leaving their position at the hospital. It should be noted that a few months before being discharged from this setting, the participant had undergone an evaluation from a preschool for language and was to begin with services in that setting following the appropriate ARC meetings.

### **Autism Evaluation**

The participant was referred by his mother due to concerns with expressive speech, tantrums, and food selectivity and was evaluated on March 21<sup>st</sup>, 2018 while he was still receiving services in the hospital outpatient setting. The participant was assessed using the Bayley Scales of Infant and Toddler Development - 3rd Edition, a clinical interview, and the Vineland Adaptive

Behavior Scales - 3rd Edition. According to the report, the participant was open and approachable at the beginning of the evaluation, however refused to cooperate and cried when desired items were taken away. Due to the participant's behavior during the evaluation, the test results and their interpretations were to be considered with extreme caution as much of the evaluation could not be completed. The participant was given diagnoses of language disorder and speech sound disorder. The participant's parents were recommended to consider pursuing a comprehensive speech and oral motor assessment to guide intervention supports, continue to promote new foods through incidental exposure during meals and snack, and continually make new foods available that vary in type and texture. The participant was recommended to receive targeted, intensive therapy by a qualified provider to address deficits in speech and language. It was also recommended that the participant's nutritional requirements should continue to be met exclusively through oral intake with varied types and textures that meet his dietary requirements for calories and nutrition and intervention progress should be monitored monthly if not more frequent.

### **Audiological Evaluation**

The participant was referred to an audiologist for evaluation by a local outpatient medical clinic on August 2<sup>nd</sup>, 2018. At this time, the participant had been evaluated for language at a preschool approximately 4-5 months prior to this referral appointment and was receiving language services there. The referral appointment was made, and the participant was seen by an audiologist on September 25<sup>th</sup>, 2018 secondary to concerns of speech delay and possible hearing loss. The participant was reported to have middle ear infections and has bilateral pressure equalizer (PE) tubes in his patient history. This evaluation consisted of otoscopy, tympanometry, distortion product otoacoustic emissions (DPOAE), and conditioned play audiometry (CPA). The



participant was reported to have clear external auditory canals bilaterally and the PE tubes were visualized to be in place. Tympanometry was consistent with PE tubes as results detailed an enlarged ear canal volume bilaterally. DPOAE were reported to be in the normal or near normal outer hair cell function. CPA using headphones suggested hearing was within normal limits (WNL) for both ears. The speech reception threshold was obtained at 15dB for the right ear, but was unable to be obtained for the left ear due to patient fatigue. The audiologist reported normal function and sensitivity bilaterally based on the evaluation results and the audiologist stated hearing loss is not considered a source of speech delay at this time.

### **Private Practice Evaluation and Therapy Services**

The participant was seen at a private speech therapy clinic. The initial examination was completed on November 9<sup>th</sup>, 2018. At the time of this evaluation and throughout the services received from this setting, the participant was receiving services from a preschool for language. The primary concern from the participant's mother and grandmother was reported to be expressive language with no concerns regarding cognition, behavior, or receptive language. The participant's mother stated that he used less than 20 words and that they were not "complete" or "always understood." The participant was assessed using the Kaufman Speech Praxis Test (KSPT).

The Kaufman Speech Praxis Test was completed at a table during one session with the use of toys and items for reinforcement. He achieved a raw score of 2 for part one oral movements with a standard score of 2 (disordered) and 51 (normal), percentile rank of 51% (disordered) and "below the charts" percentile rank (normal), and an age equivalent of <2.0. His raw score for simple movements in part two was 32 with a standard score "below the charts" (normal) and 30 (disordered), percentile ranks "below the charts" (normal) and <3%

(disordered), and an age equivalent <2.0. Part four regarding spontaneous length had a raw score of 1 with a standard score of 48 (normal) and 85 (disordered), a percentile rank of 5% (normal) and 18% (disordered), and an age equivalent of <2.0. According to the KSPT, the participant was rated 1/10 on the rating scale/diagnosis. It was noted that during the evaluation, the SLP “elicited items from the checklist of CAS key characteristics.” During the evaluation, the participant presented with 7/10 key characteristics of CAS and 4/5 other characteristics.

*Table 4.2 KSPT Results November 2018*

	<b>Oral Movements Raw Score</b>	<b>Simple Movements Raw Score</b>	<b>Spontaneous Length</b>	<b>Rating Scale/Diagnosis</b>
<b>Raw Score</b>	2	32	1	1/10
<b>Standard Score (Disordered; Normal)</b>	2; 51	30; “below the charts”	85; 48	N/A
<b>Percentile Rank (Disordered; Normal)</b>	51%; “below the charts”	<3%; “below the charts”	18%; 5%	N/A
<b>Age Equivalent</b>	<2.0 years	<2.0 years	<2.0 years	N/A

The participant was recommended to receive services twice a week for twenty weeks and goals were established for future treatment sessions. The goals were established to target the participant’s ability to use appropriate CV combinations to name/request items through completing oral motor tasks and producing VC and CV targets. Due to the lack of records from this facility, it is unknown if therapy sessions began directly following this evaluation at the recommended frequency as well as the participant’s progress and behaviors during each session.

The discharge summary was completed on February 25<sup>th</sup>, 2019 when the participant was 3 years 10 months old on the 14th visit to this private clinic. Through his grandmother’s report,

he “has not made progress with expressive language in structured therapy sessions,” but he “attempts to communicate more frequently to meet wants/needs” as well as attempted to use sign language and gestures. It was recommended by the SLP that the participant be discharged from speech therapy and visit a behavioral specialist “to address his participation and increase his focus for skilled therapy sessions.” It was also recommended that he receive therapy through “multiple faucets” to achieve an intensive treatment schedule of 3-5 days a week.

Participation was “variable” during treatment sessions, refusing “to participate and cooperate.” Multiple behavior strategies were reported to be unsuccessful. The SLP attempted to use techniques for apraxia during structured play, however, the participant would repeat “no” “until his wanted objects are obtained, or the SLP reduces demands.” During this discharge, the SLP reported that the participant’s mother and grandmother were understanding that the participant “needs intensive speech therapy, apraxia-based therapy training, an AAC device or training with PECS/ASL, behavioral therapy, and a therapy location closer to home.” It was also recommended that the participant receive services there at the private clinic one time a week if the other concerns are addressed. The participant’s caregivers were provided with practice at home via worksheets as well as education regarding apraxia cueing techniques to improve his apraxia. His mother was also educated on “what to address with the school SLP and the behavioral therapist.” The participant demonstrated his ability to exchange picture cards for toys during structured play and it was noted that he would occasionally produce CV targets. The participant did not meet any goals addressed at this facility before being discharged. He achieved 40% accuracy completing oral motor tasks with modeling, tactile cues, and sensory stimulation, 35% accuracy producing VC targets in 3-5 consecutive repetitions with a model, hand cues, and tools, 70% accuracy producing CV targets in 3-5 consecutive repetitions with a model, hand

cues, and tools, and 50% accuracy using picture exchange cards to communicate wants in structured play with 5 cards over 25 trials with a verbal cue, and 25% accuracy on the long-term goal to appropriately use CV combinations to name/request items in communication exchanges.

The reason stated for discharge was “no progress.”

### **Neurological Evaluation**

The participant was referred by his pediatrician for a neurological evaluation on April 11<sup>th</sup>, 2019 due to concerns of CAS. At the time of this evaluation, the participant had been discharged from the private clinic that diagnosed him with CAS but was currently still receiving services for language through the preschool. According to the participant’s history of present illness, the participant received a diagnosis of CAS from a SLP in a private clinic but the SLP at his school “does not feel he has speech apraxia.” His mother reported that his speech resembles that of someone with a hearing impairment; however, he has passed audiological evaluations.

During this evaluation, the participant was “pleasant, cooperative, and appeared to be in no acute distress.” From the head, eyes, ears, nose, and throat (HEENT) examination, the participant presented with a clear oropharynx with moist mucous membranes. Based on the general examination, the participant had no cause for further evaluation. During the neurological examination, the participant was noted to be alert and “followed all commands appropriately.” His speech was minimal; it was reported to be primarily single syllables and hypernasal. His pupils presented to be normal and facial muscles appeared symmetrical. The participant’s tongue was midline and his palate was observed to rise symmetrically. The muscles appeared to be functioning normally and symmetrically with typical bulk and tone. There were no abnormalities reported. His gait was appropriate for his age and he was able to coordinate the movement of placing his finger on his nose.

The neurologist found no developmental delays outside of the already diagnosed speech delay. It was reported that the participant's speech was "most consistent" with CAS, however, he was not actively engaging in therapy services. The neurologist discussed options such as a communication board and a text-to-talk app for a device and American Sign Language (ASL). It was recommended that the participant continue with speech therapy and attend behavioral therapy. It was also noted that the neurologist might trial medication for the participant based on his hyperactivity and behaviors. The neurological exam was "non-focal" and did not warrant imaging.

### **Private Practice Evaluation**

Not all treatment records from this facility were provided to the researcher. A speech/language evaluation was completed July 9<sup>th</sup>, 2019 when the participant was 4 years 3 months old at a local private practice concurrent to them continuing services at a preschool for language. This evaluation was completed using parent interview, informed clinical opinion, informal play assessment, and the *Goldman-Fristoe Test of Articulation-Third Edition* GFTA-3. The participant's mother reported that he had previously been diagnosed with CAS. At the time of this evaluation, the participant was attending preschool and was receiving services there under his IEP. During behavior observations, the participant was "happy and engaged" and "self-motivated to play." The participant required redirections to help attend to tasks during the formal assessment; however, he was attentive during joint attention activities with his mother and the SLP. The participant followed multi-step directions with 100% accuracy and his mother reported that these behaviors were typical of the participant. An informal oral mechanism exam was completed during this evaluation. The GFTA-3 was administered but was not fully completed due to the participant's difficulty attending. The full test was to be finished in the first sessions.

Through the GFTA-3, it was determined that the participant presented with the phonological disorders of “final consonant deletion, initial consonant deletion, and cluster reduction. Vowel distortions were also noted during the assessment.” The participant’s speech was reported to be 30% intelligible and had appropriate intonation. Expressive and receptive language was noted to not be an area of concern at the time of the evaluation but were to be assessed if concerns arose in treatment. This evaluation concluded that the participant had a severe speech delay. Therapy was recommended two times a week for thirty minutes. Goals were to correctly imitate syllables from a consistent list, correctly imitate words from a consistent list, label items with consistent productions, and for the participant’s parents to engage in a home education plan.

### **Private Practice Therapy Services**

Not all the documents were received regarding the beginning of therapy sessions. The first therapy session notes obtained were from January 13th, 2020. Throughout the available notes for the sessions, it was reported that the participant had exhibited disruptive behaviors and that structured activities were completed in the kitchen area to reduce distractions. The participant “requires maximum prompting to participate in structured imitation tasks.” The participant was noted to be improving in his speech skills. The participant was approximately 20% intelligible in conversation and was improving in his imitations of CV and CVCV words from a word list. As the therapy progressed, it was reported that his speech had become approximately 30% intelligible in conversation and was better understood with context. The participant was producing a variety of age-appropriate phonemes but exhibited difficulty with /k/ and /g/. Goals targeted were for the participant to plan and sequence simple syllable structures including CV, VC, and CVC syllable shapes following direct models, appropriately produce /k/ and /g/ in isolation and syllables, appropriately plan and sequence words from a consistent list of

high-frequency words, participate in OMP, and for his parents to incorporate a home education program. It was noted that he was improving in his productions of /k/ in isolation and was starting to produce it at the syllabic level when given maximal prompting, but /g/ “continues to be an area for improvement.” The participant was reported to still present with a severe speech delay, but his “family is actively participating in [a] home education plan and are open to all therapeutic suggestions.”

### **Preschool Evaluation**

The participant was seen for an evaluation through a local preschool on January 30th, 2018 and April 17th, 2018. At the time of this initial evaluation for the preschool, the participant had not yet received the diagnosis of CAS or speech disorder from the private clinics or been evaluated by the audiologist; however, they were still receiving services through the outpatient hospital and had already been evaluated for autism. According to the communication written report, the participant was found to have speech sound production and use, fluency, and voice all within normal limits and passed a hearing screening. His oral structure and function was not assessed. The participant’s mother’s main concerns were his ability to communicate as well as control emotions. This evaluation included behavior observations, parent interview, and a standardized assessment. The participant was assessed using the *Rossetti Infant Toddler Language Scale* on January 30th, 2018 at the local hospital.

*Table 4.3 RITLS Results January 2018*

	<b>Play</b>	<b>Language Comprehension</b>	<b>Language Expression</b>
<b>Age Equivalents</b>	N/A	12-15 months; 18-21 months	9-12 months; 12-15 months

It was reported that the participant improved in his linguistic ability, both expressive and receptive. Despite improvement, the participant was below expected for his age, with greater difficulty in expressive language. The participant was noted to rely heavily on gestures and vocalizations to express wants and needs. The participant's mother reported that the participant may have attempted to imitate new words but lacked intelligibility. A behavior observation was completed in the preschool classroom. The participant had difficulty separating from his mother. The participant was observed to use gestures to communicate but made vocalizations and word approximations. The participant used imaginary play for toys such as pots and bugs flying around the room. The participant used eye contact with both peers and graduate clinicians and laughed and smiled appropriately. During play, the participant was noted to produce unvoiced linguoblabial trills (raspberries). The participant's mother wrote, "[his] only issue seems to be communication. He plays and interacts well with peers, just isn't able to communicate with them."

This evaluation concluded that the participant presented with a moderate language delay and was recommended to receive services through the school district. An ARC was held on April 10<sup>th</sup>, 2018 to discuss intervention data and referral. The participant was not yet enrolled in school. He had passed a hearing screening on September 19<sup>th</sup>, 2017. The ARC received consent to evaluate the participant in the areas of communication. Another ARC was held May 7<sup>th</sup>, 2018. The participant was 3 years 1 month old. According to his communication status, the participant presented with appropriate voice and fluency but with expressive and receptive language skills below same age peers. The participant was to receive services four times a month for 20 minutes each session by the speech-language pathologist in the classroom.



**Preschool Therapy Services**

The participant began therapy services at the preschool with goals to improve his language skills through pointing or choosing targeted items and/or actions, imitations, increasing his total lexicon to include fifty words, and requesting or responding to a communication partner. The participant's progress report for the fall of 2018 stated that he presented with deficits in expressive and receptive language, spoke unintelligibly, and relied heavily on gestures to communicate. It was also noted that the participant "did not always respond to greetings, participate in classroom activities, or engage in play with peers." The participant received therapy two times a week for one hour each session. Therapy was completed in the classroom with a naturalistic approach. The participant "mastered" his goal to request or respond to a communication partner and was "progressing" in his other goals. Throughout the semester, the participant began using signs and verbalizations. At the beginning of the semester, "he did not appropriately request or respond consistently."

During the following semester, it was reported that the participant had had his tonsils removed and was absent at the beginning of the semester. The participant also experienced a ruptured eardrum. Therapy "changed to a more naturalistic approach, with less structured activities" during the semester. During this period, the participant received therapy twice a week for 30 minutes total. Therapy used a visual schedule at the beginning of the session; however, the participant did not positively respond to the visual schedule. The participant met his goal to imitate simple movements, actions, or vocalizations and was progressing in his other two goals. The participant used three two-word utterances throughout the semester.

### Preschool Speech Evaluation

A speech evaluation was completed September 3rd, 2019 when the participant was 4 years 5 months old. After the initial language evaluation but prior to this speech evaluation at the preschool, the participant was diagnosed with CAS from a private clinic and discharged from services at that setting, diagnosed with a speech disorder from the other private clinic, and been evaluated by both the audiologist and neurologist. During this evaluation, the participant was found to present with normal fluency and voice and passed a hearing screening in 2018. His structure and function were found to be within normal limits. His mother wrote, “[participant] has improved tremendously with his speech in the last 20 months. He still frequently leaves out certain vowels and/or consonants out of words. He is learning to speak in sentences that can be understood by others.” At this time, the participant was receiving therapy services for speech at a local private clinic. According to his mother, the participant did very well in school and enjoyed going. She wrote at the end of the report, “[the participant] is so eager to learn and is so excited about being able to communicate much more effectively in the last 2-3 months. He is extremely intelligent but has been setback by his inability to speak and express his emotions.”

The participant was 4 years 4 months when the GFTA-3 was administered. He had a raw score of 113, standard score of 40, a percentile rank of less than .1, and a test-age equivalent of younger than 2 years old. He presented with phonological processes including final consonant deletion, cluster reduction, glottal replacement, and initial consonant deletion.

*Table 4.4 GFTA-3 Results September 2019*

<b>Raw Score</b>	<b>Standard Score</b>	<b>Percentile Rank</b>	<b>Test-Age Equivalent</b>
113	40	<.1	<2 years old

Regarding expressive language, the participant relied on word approximations, pointing, and physical touch to communicate. He could be understood with context; however, it was recommended that he receive services to address his speech errors and enable him to communicate more effectively with teachers and peers. An ARC was held on October 17th, 2019 to address the results of the speech evaluation and amend his IEP. His language goals were to follow simple one-step directions, correctly name objects and/or actions, increase utterance length to 2-3 words, and answer “wh” questions. His speech goals were to correctly produce final consonants, accurately produce nasals /n/ and /m/, and accurately produce stops /p/, /t/, /d/, /b/ at isolation, word, and phrase levels in all positions.

### **Preschool Therapy Services**

In a progress report following the Fall 2019 semester, it was reported that the participant exhibited unwillingness to engage in structured clinician-led activities by “grunting, clenching his hands, and turning away from the clinician, sometimes placing his head in his hands.” He was more actively engaged in child-led play. The participant did not consistently respond positively to a visual schedule, timer, or stickers used as a reward. To increase participation, therapy became more child led. The participant met two out of four language goals: following simple one-step directions and answering “wh” questions verbally or by pointing. This progress report noted that the data for the goal to follow one-step directions may not have been truly representative of his abilities due to his lack of motivation and focus as he demonstrated the ability to follow one-step directions when engaged and participating. He was also noted to do well answering “wh” questions during play and when he was engaged. His other two language goals, correctly naming objects and actions and increasing his utterance length to 2-3 words, were listed as “progressing.”

The participant's speech goals had been added to the IEP on October 17<sup>th</sup>, 2019. Due to the re-evaluation and amendment to the IEP not culminating until the middle of October, the participant's speech goals were all three marked as "emerging." To help the participant toward his goal to correctly produce final consonants, the clinician used metalinguistic cues "closed up sound" and would close their hand to increase awareness of final consonants. The participant achieved 0% accuracy toward this goal of correctly producing final consonants, however, he was noted to imitate the hand gesture when he repeated the clinician's vocalizations, although his vocalizations were still without the final consonant. The other speech goals targeting the nasals /n/ and /m/ and the stops /p/, /b/, /t/, and /d/ were not "fully targeted in therapy as therapy has focused on building his word structure to include final consonants." The participant had done well in targeting his goals; however, he continued to have difficulty naming actions, "speaking in 2-3 word utterances spontaneously, and using final consonants on the end of words as well as the correct phonemes throughout his speech." Behavioral issues as well as lack of motivation were reported to potentially have had a negative impact on his progress toward his goals and may have hidden his true expressive and receptive language and speech abilities. It was recommended that the participant continue to receive therapy services in the following spring 2020 semester.

An ARC was held on April 21st, 2020. During this meeting, it was established that the participant would continue to receive services in the preschool classroom, and in kindergarten, he would receive services for speech and language in the resource room. The participant presented with normal voice and fluency and had progressed in the semester. The participant had engaged in independent play as well as parallel play with a peer and more frequently played with peers through the semester. It was reported that if peers asked him a question, he would imitate words but was often misunderstood. The participant would respond with one to two-word

unintelligible utterances and would become frustrated by stopping responding or walking away if he was not understood. The participant's lexicon was expanding, and he was progressing in his ability to correctly name objects and actions with direct modeling and visual cues. It was noted that the participant "consistently demonstrates the ability to correctly [follow] directions and answer simple questions." His speech was also improving, using final consonants with 33% accuracy, nasals /m/ and /n/ with 28% accuracy, and stops with 47% accuracy. Despite his progress, it was reported that "he continues to have a severe phonological impairment and limited phonetic inventory that strongly impact his ability to communicate." It was recommended that the participant should target a sound class such as fricatives that he had not demonstrated production or awareness of to produce a broader change in intelligibility. The goals were amended for the participant to use 3-4 word utterances, correctly produce final consonants at the word and sentence level, demonstrate awareness of fricatives /f/, /s/, /sh/, and correctly produce fricatives /f/, /s/, /sh/ at the isolation and word level.

Throughout the next semester, therapy was naturalistic and play based. The participant met his goal to correctly name objects and actions. The report stated that while he might have known the object, his speech could be unintelligible but could sometimes be understood by the initial sound of his utterance. He was progressing in his goal to speak in 2-3 word utterances. The data for this goal was taken indirectly and reported that the participant used primarily 1-2 word utterances but following a prompt to use longer utterances and through the semester, it was assessed that he spoke in an average of 2-3 word utterances in approximately 50% of opportunities. It was noted that his MLU might have still been lower than that of same age peers potentially due to his attempt to keep his utterances more intelligible. The participant was progressing with all of his speech goals. His goal to target final consonant production shifted to

target awareness of final consonants. The participant used the hand gesture of closing the hand and increased his accuracy from 0% to 33% accuracy of awareness. Regarding his goal to produce /n/ and /m/, it was stated that “in some instances, he would use correctly say /n/ or /m/ inconsistently.” It was noted that he achieved higher accuracy when the target sound was in the initial position of the word. Focusing on his goal to correctly produce stops, he also exhibited more success in isolation and in the initial word position. He was reported to consistently use /b/ and /d/ and increased his overall accuracy of using stops to 47%. In the summary, the participant was said to have progressed in his goals and was “often willing to participate in therapy... but at times requires redirection to follow directions or respond.” It was recommended that he continue to receive therapy in the following fall semester of 2020.

### **University Clinic Evaluation**

During the first few sessions at a local university clinic, the participant was evaluated using the Kaufman Speech Praxis Test in November of 2019 when the participant was four years and 7 months old and still receiving services for speech and language at the preschool and for speech at a private clinic. This assessment was completed over the course of multiple sessions and allowed the participant to engage in play. The participant had a raw score of 11 for part one assessing oral movement, a raw score of 31 on part two, and did not fully complete part three. During this evaluation, it was noted that the participant exhibited a few slight vowel distortions, voicing errors (/b/ for /p/, /d/ for /t/), consonant replacements (/m/ for /b/, /d/ for /k/), some inconsistencies in productions (/pe/ then /be/, /t/ and /d/ for /k/), fronting (/t/ and /d/ for /k/ and /g/), glottal replacements, gliding, and final consonant deletions.

*Table 4.5 KSPT Results November 2019*

	<b>Oral Movements Raw Score</b>	<b>Simple Movements Raw Score</b>	<b>Rating Scale/Diagnosis</b>
<b>Raw Score</b>	11	31	N/A
<b>Standard Score (Disordered; Normal)</b>	109; 106	-; -	N/A
<b>Percentile Rank (Disordered; Normal)</b>	40%; 24%	-; -	N/A
<b>Age Equivalent</b>	3.0-3.6	<2.0	N/A

### **University Clinic Therapy Services**

The participant began receiving services from the local university clinic in the fall of 2019 for 45-minute sessions once a week and has continued to receive services from the university clinic. The treatment plan for the 2020 spring semester stated that the participant presented with final consonant deletion as well as with other phonological processes and that his speech was often unintelligible but could be understood based on word approximations with context. “In isolation with maximum prompting and cues for stimulability he is able to correctly produce /m/, /t/, /p/, /b/, /h/, /d/, /n/, /w/, “sh”, /s/” but his phonetic inventory was still limited. Therapy was targeted to bringing awareness to final consonants and eventually production of final consonants. Therapy was naturalistic and child-led and used the communicative approach to target awareness of final consonants through the use of metalinguistic cues such as saying “closed up sound,” using a hand gesture of closing the fingers to the thumb, clapping, or a tactile cue of touching the participant’s arm or leg. The participant was able to choose from a variety of activities using a visual choice board.

Throughout his services at the university clinic, the participant exhibited generally unintelligible speech without context, appropriate prosody, and consistent productions. There was an instance noted of inconsistency in his production of /s/: “When saying ‘sand’, initially, [he] produced a distorted /s/. Later in the session, when he said ‘monkey sand’, the /s/ was produced as the /s/ in ‘measure’.” Throughout the therapy notes, it was reported that the participant also presented with additional phonological processes such as fronting, glottal replacement, gliding, cluster reduction, stopping, and weak syllable deletion. In these more child-led sessions, the participant engaged and participated throughout sessions, however, might still have required redirection. The participant began imitating and using the hand gesture that was used to target awareness of final consonants, but his vocal imitations still lacked the final consonant. As the participant’s awareness of final consonants continued to progress, he began to use the hand gesture of closing the hand more independently and eventually began producing the final consonants numerous times throughout a session.

### **Pediatric Otolaryngologist**

The participant was seen for an evaluation by an otolaryngologist on January 27<sup>th</sup>, 2020. At this evaluation, the participant was receiving services from the preschool for speech and language, and speech from a private clinic and the university clinic. According to the participant’s history reported by his mother, he was referred by a local outpatient medical facility with concerns from continuous ear drainage, MRSA, and frequent apnea. It was also reported by his mother that he previously had a tonsillectomy and adenoidectomy. The discussion from this evaluation stated that the participant presented with developmental delay, speech apraxia, and chronic otorrhea with prolonged unextruded tubes. It was reported that the otolaryngologist would schedule to have the tubes removed, possibly conduct an adenoidectomy, and would plan



to culture the participant's ear and follow up after surgery. The otolaryngologist also discussed the "possibility of ongoing drainage, perforation, infection" as well as the possible need for a bilateral myringotomy with tubes (BMT) surgery.

## Chapter 5: Discussion

Unfortunately, the researcher was unable to obtain the documentation and records beyond the initial evaluation and the discharge records from the facility that diagnosed the participant with CAS. In this section, the diagnosis of CAS given to the participant will be closer analyzed through specifically addressing the research questions listed in the methods.

### **RQ1: What characteristics does the participant consistently present with?**

The participant was recorded to experience frequent ear infections; however, his hearing was found to be within functional limits and has not been noted to be a cause for further concern. The participant was noted to have a high amount of energy and a strong will throughout the records from the facilities. He was noted to exhibit disruptive behaviors during more structured activities and appeared to do better with more child-led activities. He is social but does not initiate social interactions with peers.

There is no known familial history of speech and/or language disorders. The participant's speech was cause for concern from the local hospital, both private practices attended, as well as the preschool and university clinic. His speech was noted to be highly unintelligible; only about 20%-30% intelligible per treatment notes from one of the private clinics, however his prosody was noted from multiple facilities to be appropriate. The participant presented with phonological processes such as fronting, gliding, cluster reduction, glottal replacement, and final consonant deletion that indicate a pattern in some of his speech errors. Final consonant deletion was noted from the therapy sessions at the local hospital. Despite occasional vowel distortions, the participant exhibited normal prosody according to the local hospital therapy notes as well as the records from the university clinic.

**RQ2: What characteristics does the participant present with inconsistently? Under what circumstances are they present?**

According to the private clinic that diagnosed him with CAS, the participant presented with 7/10 characteristics and 4/5 other characteristics for CAS. It is unknown what those characteristics are, but no other facility appeared to report such a high number of characteristics that would be characteristic of CAS. The participant was noted to produce inconsistent productions during the KSPT at the university clinic, however, was reported to be consistent in his productions throughout therapy services. From the KSPT evaluation at the university clinic, it was also noted that the participant presented with voicing errors and inconsistent consonant substitutions (/t/ for /k/ in some instances and /d/ for /k/ in others).

The participant was originally given a diagnosis of a language impairment that was supported in later evaluations from the preschool, however, language was stated to not be a concern from one of the private practices he attended. It was also noted during his evaluation at the private clinic that diagnosed him with CAS as well as during the evaluation at the university clinic that he sometimes presented with vowel distortions. The participant's volitional oral movement abilities have also been inconsistent as he demonstrated his ability to complete simple oral movements only twice out of eleven trials, but later when given the same assessment was able to complete all eleven oral motor tasks. This inconsistency might be explained through the difference in testing environments as further discussed under research question four.

Based on the nature of the records and documents received and addressed throughout this document, there is not sufficient data to report on specific characteristics that were inconsistently present and scrutinize under what particular circumstances those characteristics were present beyond what was prior mentioned.

**RQ3: What characteristics that the participant presents with are consistent with phonological disorders?**

The participant was noted to have phonological processes during his speech evaluation from the preschool as well as while at the university clinic. As with phonological disorders, the participant demonstrated patterns in his errors consistent with final consonant deletion, stopping, cluster reduction, glottal replacement, and initial consonant deletion. He was also noted to have consistency in his vocalizations, even if the vocalization was not without errors. According to the local hospital and university clinic, the participant's prosody was within normal limits. Oral motor movements according to the university clinic's evaluation using the KSPT was within normal limits as he scored a raw score of 11 out of 11 on the simple oral movement subtest.

According to the neurological examination, the participant was not found to have any neurological concerns that warranted imaging. The neurologist knew the controversy in the diagnosis of CAS as it was noted in the report that he had been given the diagnosis but that the SLP at his school felt that he did not have CAS. Despite knowing this, and reporting that the participant spoke minimal words during the evaluation, the neurologist stated that he agreed with the diagnosis of CAS as he felt that the participant's speech was like that of someone's with CAS. The neurologist had no evidence from his examination to support the diagnosis of CAS or severe phonological disorder. Based on the report, the participant spoke very few words during the evaluation, giving the neurologist an equally small speech sample to base his support of the controversial diagnosis on. In stating that the participant's speech was most characteristic of CAS, the neurologist did not provide specific characteristics he noted during the evaluation and it is unknown what the neurologist heard or did not hear that gave him reason to validate the diagnosis of CAS.

**RQ4: What characteristics that the participant presents with are specific or unique to childhood apraxia of speech?**

According to the parent interview with the participant's mother, she would describe his speech as, "hard to understand a lot of the times, very inconsistent." When asked if the participant's word repetitions are the same or vary and if there were any words that were consistently the same or consistently different, she responded, "a lot of times it changes, but sometimes it's the same." She provided examples of words that are consistent; "McDonald's is always 'nonalds'," "mama," "nana," "papa" and all the names of familiar people are consistent. According to the limited available documentation from the private clinic that diagnosed him with CAS, the participant presented with 7 out of 10 key characteristics of CAS and 4 out of 5 "other" characteristics, however, it is unknown based on the available reports exactly what those characteristics were that the participant presented with to justify the diagnosis of CAS.

When he was later evaluated using the KSPT at the university clinic, he achieved a raw score of 11 out of 11 on the oral movements tasks compared to his initial evaluation with the KSPT in which he reportedly achieved a raw score of 2 on the same subtest. The KSPT is a standardized assessment to aid a clinician in the decision to make the diagnosis of CAS. The test itself includes standard scores for both "normal" and "disordered," however, ultimately the results are up for interpretation by the clinician. In this assessment, if an error is made at the isolation level and then consistently throughout the assessment, it is only counted as incorrect for the initial error; following the error pattern would be uncharacteristic of CAS and would lean more toward a phonological process. The difference in the environments during these assessments should be evaluated to potentially explain the gap in scores.

During the initial assessment using the KSPT at the private clinic, the evaluation was completed in one session at a table with the use of toys or items for motivation and reinforcement. Conversely, when the KSPT was administered at the university clinic, it was done in a naturalistic setting in which the participant was able to engage in activities of his choice. This assessment took multiple sessions to complete. The participant, as seen throughout the therapy sessions discussed in the results section, engaged and participated better during more naturalistic and child-led activities. The KSPT administered by the university clinic exhibited patterns of fronting, voicing errors, final consonant deletion, glottal replacement. Despite the patterns and phonological processes found in this assessment, it should also be noted that there were also instances of variance in the participant's responses, vowel distortion, and using different phonemes as a substitute for the same phoneme (/t/ and /d/ for /k/, as well as /d/ for /t/). Inappropriate prosody can also be used to characterize CAS; however, the participant was recorded to have appropriate prosody from various facilities through which he received services. The participant was diagnosed with language disorders which can also co-occur with CAS; however, this is not a unique characteristic of CAS as language disorders can occur independently or with other speech disorders.

**RQ5: What treatment approaches have been used or are currently being used? Are they effective?**

Before diving into the treatment approaches taken by these different facilities, we need to first address the diagnoses given in each setting that will undoubtedly have had an impact on the approaches taken as well as the goals each speech-language pathologist determined appropriate for the participant. The first speech and language evaluation the participant underwent was at a local hospital in October 2017. From this assessment and evaluation, the participant was

diagnosed with a mixed language disorder. Based on the evaluation results, the participant had goals targeting expressive and receptive language. Therapy, based on the treatment notes, included structured activities for the participant.

The following spring in 2018, the participant was evaluated through a local preschool. This evaluation utilized the standardized test results from the local hospital and came to the same conclusion that the participant presented with a language disorder. Goals were created for therapy to target expressive and receptive language. Therapy was initially more structured and clinician directed but gave way to being more child-led in order to increase participation.

In the fall of 2018, he was evaluated at a private practice. This initial evaluation report stated that the participant's mother and family's main concern was his expressive language. Despite their main concern being his language skills, he was evaluated using the KSPT and was given the diagnosis of CAS. Goals from this facility reflected this most recent diagnosis and included goals for oral motor movements and practicing high frequency words. Therapy notes were not included for the individual treatment sessions at this facility.

He was later evaluated at another private practice in the summer of 2019 who diagnosed him with a speech disorder and stated that language was not a concern at the time of evaluation. Goals from this evaluation targeted his speech production skills and reflected agreement in the prior diagnosis of CAS through imitations of syllables and words, labeling items with consistent productions, and a home education plan for his parents. More recent goals from this setting continued to target his speech skills through planning and sequencing CV, VC, and CVC syllable shapes following direct models, appropriate productions of /k/ and /g/ in isolation and syllables, appropriately planning and sequencing high frequency words, and a home education plan for his parents. This setting also utilized oral motor protocol (OMP) to improve his oral motor

movements for speech production despite these goals lacking substantial evidence for treatment of developmental speech sound disorders (Ruscello, 2008; Lass & Pannbacker 2008).

In the fall of 2019, the preschool he attended completed a speech evaluation. Through this evaluation, it was determined that the participant also presented with a speech disorder. In addition to his language goals already targeted in this setting, speech goals were addressed following this evaluation. The approach in therapy remained generally naturalistic and child-led to increase engagement and encourage sustained participation.

During the same fall of 2019, the participant was evaluated at the university clinic and results concluded that the participant presented with a severe phonological disorder. A phonological approach to intervention was utilized and goals were created to target the phonological process of final consonant deletion. There was a strong emphasis on metalinguistic awareness in therapy with the use of metalinguistic verbal and gestural cues to bring awareness to final consonants first and focusing on production at the word level.

The wide variety of goals targeted as well as the variety of approaches used in therapy for this single participant during a short time should be noted. It is interesting that the same individual could have such drastically different targets and approaches. There was such discrepancy that the researcher found it beneficial to specifically list the goals across settings for comparison and can be found in Table 5.1 and Table 5.2. Some of the facilities targeted language, some speech, some included oral motor movements in their goals, and some targeted both speech and language. Of all the settings that the participant received services in, the participant had goals targeting language at two: the local hospital and the preschool. He had goals targeting speech at four different facilities: two private clinics, the preschool, and the



university clinic. He also had goals regarding oral motor protocol and oral motor tasks in two of the settings: the two private clinics.

### *A Closer Examination of Goals*

**Language Goals.** Speech and language goals were appropriate for this participant based on his diagnoses of mixed expressive and receptive language disorder as well as speech disorder. However, not all goals addressed across settings were appropriate to most effectively target the participant's needs. Language goals should target expressive and receptive language that will improve the participant's abilities to use language to express his wants, needs, and thoughts. The goal for the participant to make animal sounds was not appropriate as the targeted skill of making animal sounds does not convey any information; for example if the participant is feeling thirst, hunger, pain, or has other needs or wants. Although the hospital and the preschool were targeting language through their goals, there is a huge variety in what the short-term goals entail. The participant had goals to imitate, increase his lexicon, increase his utterance length, correctly name objects and actions, identify body parts, follow one-step commands, requesting/responding to communication partners, participate in speech-routine games, use a communication board, choose wants, answer yes/no questions, answer "wh" questions, appropriately take turns, and to identify objects by category. All of these goals were from throughout the participant's therapy services including those that were met, indicating the participant was ready to move on to higher level goals. Refer to Table 5.1 for all the language goals targeted with the participant.

**Speech Goals.** As mentioned, speech goals were appropriate for this participant based on the results from the speech evaluations. However, there are discrepancies in what speech goals were most appropriate for this participant. He had speech goals to target velars /g/ and /k/ from one private clinic, goals to target final consonants, /n/, /m/, /t/, /b/, /d/, /p/, and then /f/, /s/, /sh/

from the preschool, and awareness and production of final consonants from the university clinic. The goals from different settings and even in the same setting were not consistent for the same participant who would have exhibited the same characteristics and phonological processes. It should be noted that to the knowledge of the researcher based on the available treatment records, the participant did not meet any of the speech goals deemed appropriate for them until they met their goal to demonstrate awareness of final consonants through making a productive change five times a session across three consecutive sessions. Refer to Table 5.2 for the speech goals targeted with the participant throughout the facilities.

**Oral Motor Goals.** There were two facilities that included oral motor tasks as part of their treatment plan for the participant. Both of them were private clinics; one stated that the participant should complete OMP “to support oral motor planning and sequencing abilities for improved speech intelligibility” and the other stated that the participant was to complete oral motor tasks. These goals only appeared in the participant’s treatment plans following his diagnosis of CAS.

Regardless if the participant does in fact have idiopathic CAS, oral motor tasks and exercises may not be the most effective and efficient therapy goals. As briefly addressed in the literature review, these goals would not have been appropriate for the participant even with the assumption that the diagnosis of CAS was accurate. According to McCauley and Strand (2008), speech-language pathologists should not consider the use of non-speech oral motor exercises in their treatment approach for children with CAS, but rather they suggested longer stays in the initial articulatory position, slowing the rate of speech, and maximizing trials. Even if the participant truly exhibited difficulties with volitional oral movements as noted through the first evaluation using the KSPT and presented with nonverbal oral apraxia, non-speech oral motor

exercises are not likely to aid the individual in carrying over to speech production (McCauley & Strand, 2008).

Table 5.1 Language Goals Across Facilities

Local Hospital:		School District:	
Patient will identify 3 body parts upon verbal command in 3/4 opportunities by 2/17/18 (date changed to 8/27/18 on 2/27/18)	Patient will express his immediate basic wants/needs by utilizing communication board presented in 3/4 opportunities by 4/19/18	Long-term During classroom activities, [participant] will increase his use of age appropriate language skills as demonstrated by meeting a minimum of 3/4 objectives as measured weekly through direct frequency counts, direct anecdotal records, and indirect teacher interview.	Short-term During therapeutic activities, [participant] will request or respond to a communication partner using verbal speech, pictures, or sign in 5/5 opportunities, measured weekly by direct and indirect methods
Patient will imitate 10 words spontaneously per caregiver/SLP report by 12/17/17 (date changed to 4/30/18 on 1/30/18)	Patient will choose desired object/activity by providing ST with symbol/label in 50% of opportunities by 4/19/18	Short-term During therapeutic activities, [participant] will increase his receptive language skills as measured by pointing to/choosing targeted items and actions with 70% accuracy, as measured weekly by direct and indirect methods	Long-term During therapeutic activities, [participant] will increase his use of age-appropriate language skills as demonstrated by meeting a minimum of 3 out of 4 objectives as measured bi-monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.
Patient will produce 3 animal sounds in 3/4 opportunities by 12/17/17. (date changed to 4/30/18 on 1/30/18)	Patient will answer yes/no questions regarding preferences with gestures/verbalizations/pictures in 3/4 opportunities by 4/30/18	Short-term During therapeutic activities, [participant] will imitate simple movements, actions or vocalizations during therapeutic activities with a minimum of 3 times during a session, as measured weekly by direct and indirect methods	Short-term During therapeutic activities, [participant] will follow simple one-step directions at 80% accuracy with minimal cues in 3 out of 3 consecutive sessions, as measured bi-monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.
Patient will participate in speech-routine games in 3/4 opportunities by 12/17/17 (date changed to 4/30/18 on 1/30/18)	Patient will maintain appropriate turn taking activities (rolling ball, making noises, stacking blocks) with ST given verbal cues in 3/4 opportunities by 6/13/18	Short-term During therapeutic activities, [participant] will increase his lexicon through the use of multiple modalities (words, gestures or pictures) to include 50 words, as measured weekly by direct and indirect methods	Long-term During therapeutic activities, [participant] will increase his use of age-appropriate language skills by meeting 1/1 benchmarks measured monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.
Patient will attempt imitations of single word labels after ST models in 3/4 opportunities by 9/13/18.	Patient will identify objects by category given verbal cues in 3/4 opportunities by 8/22/18	Short-term During therapeutic activities, [participant] will correctly name objects/actions at 80% accuracy with no more than 1 cue in 3 out of 3 consecutive sessions, as measured bi-monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.	Short-term During therapeutic activities, [participant] will use 3-4 word utterances (intelligible or unintelligible) in 80% of opportunities in 3 out of 3 consecutive sessions, as measured monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.
		Short-term During therapeutic activities, [participant] will increase his utterance length to 2-3 words in 80% of opportunities in 3 out of 3 consecutive sessions, as measured bi-monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.	Short-term During therapeutic activities, [participant] will answer “wh” questions (including, but not limited to: what, who, where) either verbally or by pointing at 80% accuracy with no more than 1 verbal/visual cue in 3 out of 3 consecutive sessions as measured bi-monthly through direct frequency counts, direct anecdotal records, and indirect teacher interview.

Table 5.2 Speech Goals Across Facilities

Private Clinic 1	Private Clinic 2	School District	University Clinic
<p>Long-term [Participant] will use appropriate CV combinations to name/request items in communication exchanges.</p>	<p>[Participant] will plan and sequence simple syllable structures including CV, VC, and CVC syllable shapes, using sounds in his repertoire following direct imitation no more than one visual and/or verbal cue with 80% accuracy during a 30-minute session in 3/3 consecutive sessions.</p>	<p>Long-term During therapeutic activities, [participant] will demonstrate increased correct production of speech sounds by targeting final consonant deletion, nasals (m, n), and stops (p, b, t, d), at 80% accuracy in all positions of words, at the isolation, word, and phrase level, with MIN cues across 3/3 consecutive sessions as measured monthly by frequency counts, anecdotal data, and indirect teacher interview.</p>	<p>Long-term [Participant] will demonstrate more age-appropriate speech through the use of final consonants.</p>
<p>Short-term [Participant] will complete oral motor tasks given a model, tactile cueing, and sensory stimulation with 90% accuracy.</p>	<p>[Participant] will appropriately produce velars /k, g/ in isolation and syllables with 80% accuracy during a 30-minute session in 3/3 consecutive sessions.</p>	<p>Short-term During therapeutic activities, [participant] will demonstrate correct production of final consonants with 80% accuracy and minimal verbal/visual cues across 3/3 consecutive sessions as measured monthly by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	<p>Short-term During therapeutic activities, [participant] will demonstrate awareness of final consonants by making a productive change or using the metalinguistic cue independently, up to 5 times in a session over 3/3 consecutive sessions as measured by direct frequency counts.</p>
<p>Short-term [Participant] will complete oral motor tasks given a verbal/visual cues, tactile cueing, and sensory stimulation with 90% accuracy.</p>	<p>[Participant] will appropriately plan and sequence words from a consistent list of high-frequency words with 80% accuracy during a 30-minute session in 3/3 consecutive sessions.</p>	<p>Short-term During therapeutic activities, [participant] will accurately produce nasal sounds /n/, /m/ at the isolation level, word level, and phrase level in all positions of the words with 80% accuracy and minimal verbal/visual cues across 3/3 consecutive sessions as measured monthly by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	<p>Short-term During therapeutic activities, [participant] will produce final consonants at the word level with 50% accuracy when given a direct model and prompt over 3/3 consecutive sessions as measured by direct frequency counts.</p>
<p>Short-term [Participant] will complete oral motor tasks given a verbal/visual cues with 90% accuracy.</p>	<p>[Participant] will participate in an OMP to support oral motor planning and sequencing abilities for improved speech intelligibility.</p>	<p>Short-term During therapeutic activities, [participant] will accurately produce the stops (p, b, t, d) in all positions of words, at the isolation level, word level, and phrase level with 80% accuracy and minimal verbal/visual cues across 3/3 consecutive sessions as measured weekly by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	<p>Long-term [Participant] will increase his use of age appropriate speech sound production skills to improve communication success with adults and peers across settings as demonstrated by making progress toward and meeting his short term objectives each semester.</p>
<p>Short-term [Participant] will produce VC targets in 3-5 consecutive repetitions given a model, hand-cues, and tools with 90% accuracy.</p>	<p>[Participant's] parents will participate in a home education program as outlined by the speech language pathologist.</p>	<p>Long-term During therapeutic activities, [participant] will demonstrate increased correct production of age appropriate speech sounds by meeting 3 out of 3 objectives, across 3/3 consecutive sessions as measured monthly by frequency counts, anecdotal data, and indirect teacher interview.</p>	

Table 5.3 Speech Goals Across Facilities Cont.

Private Clinic 1	Private Clinic 2	School District	University Clinic
<p>Short-term [Participant] will produce CV targets in 3-5 consecutive repetitions given a model, hand-cues, and tools with 90% accuracy.</p>		<p>Short-term During therapeutic activities, [participant] will correctly use final consonants at the word and sentence level with 80% accuracy and minimal verbal/visual cues across three consecutive sessions as measured monthly by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	
<p>Short-term [Participant] will produce VC targets in 3-5 consecutive repetitions given hand-cues and verbal cues with 90% accuracy.</p>		<p>Short-term During therapeutic activities, [participant] will show awareness of fricatives /f/, /s/, and /sh/ by using the metalinguistic term, gestural cue, or an attempt at productive change 5 times during a session across three consecutive sessions as measured by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	
<p>Short-term [Participant] will produce CV targets in 3-5 consecutive repetitions given hand-cues, and verbal cues with 90% accuracy.</p>		<p>Short-term During therapeutic activities, [participant] will correctly produce fricatives /f/, /s/, and /sh/ with 50% accuracy at the isolation and word level with verbal/visual cues across three consecutive sessions as measured monthly by direct frequency counts, anecdotal data, and indirect teacher interview.</p>	
<p>Long-term [Participant] will use appropriate CV combinations to name/request items in communication exchanges.</p>			
<p>Short-term [Participant] will use picture exchange cards to communicate wants in structured play given five cards over 25 trials with a verbal cue.</p>			

The participant has received speech and language therapy from multiple facilities. The treatment notes detailed behavioral issues noted at the local hospital during structured activities that impeded the participant's ability to improve his speech and language. It was also noted at one of the private clinics that the participant's mother had gone into sessions with him in order to reduce behaviors. Based on the notes from the school district and the university clinic, the participant excelled in a more child-led play-based therapy in which he was able to be active in choosing the activities and release energy during play. At the university clinic, the therapy sessions utilized a visual choice board to aid in improving the participant's behavior by providing him with options and allowing him to make a choice for his desired activity.

Although the participant was not formally diagnosed with a speech disorder while receiving services from the local hospital due to his behaviors and attention to complete standardized testing, the speech-language pathologist there began targeting speech during the session through the use of verbal cues, gestural cues, and tactile cues. The university clinic used the communicative approach to target the phonological process of final consonant deletion. Looking at past treatment notes and based on the characteristics and behaviors noted of this participant, as well as his age, therapy should be more naturalistic and child-led in nature in order to increase the participant's involvement during sessions and therefore success and generalization of the skills in the session and in broader contexts. This communicative approach has been most successful in improving his speech skills while minimizing adverse behaviors. Based on treatment notes, the participant actively enjoyed therapy sessions and engaging with the clinicians. The participant went from producing very few final consonants to producing over fifty during the final session. Progress or lack thereof throughout therapy could be utilized as evidence for the diagnosis as well as the therapy approach (Lewis et al., 2004).

## **Conclusion**

According to all the records and documents addressed throughout this study, the participant does not and cannot fit neatly into a diagnostic box for CAS. He presented with a mixed expressive-receptive language delay which is not uncommon for children diagnosed with CAS, but this alone is not enough to warrant the diagnosis in question. He scored poorly regarding the volitional oral movements when given the KSPT under structured setting yet scored perfectly on that same subtest when given the same test in a more child-led environment.

He has presented with instances of vowel distortions which would be characteristic of CAS; however, he has demonstrated his ability to produce vowels correctly. He does not present with groping and has been noted to present with phonological disorders following patterns such as fronting, gliding, cluster reduction, glottal replacement, and final consonant deletion. He has been noted to have had some inconsistencies in his productions, however, it has also been reported that he presented with consistent productions. He has demonstrated significant progress when the therapeutic approach was phonologically based as seen in his progress during his therapy at the university clinic.

Based on the questions analyzed and the records given, the participant does not show substantial evidence in support of the diagnosis of CAS. This diagnosis could potentially have been given as a result of the participant's high energy levels, unwillingness to cooperate during structured clinician-directed activities, and his severe phonological disorders. Regardless of his behaviors during structured activities, his presentation as reported lacks ample evidence to justify a diagnosis of CAS without knowing all of the characteristics that were noted to be present during the crucial evaluation resulting in the diagnosis. This diagnosis is controversial and speech-language pathologists should be diligent in the characteristics of the individual before



conclusively giving a diagnosis. As CAS remains without solid standard diagnostic criteria, this diagnosis can only be given by an experienced speech-language pathologist using characteristics indicative of CAS based on the knowledge available through the current research and their experience in the field.

### **Future Research Needs**

Research should address finding a diagnostic standard for CAS, potential links between behavior and CAS, what factors or characteristics should be considered when a diagnosis is unclear and what goals should be targeted as well as in what order, and what therapy approaches are most effective for individuals with behavioral issues. Speech-language pathologists working with pediatric clients should be knowledgeable of the research regarding CAS presently and as the research continues to grow in the future to potentially answer the crucial question: what characteristics are truly indicative of and unique to CAS that can warrant a diagnosis?

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