Video Self-Modeling for Bilingual Children

with Identified or Suspected Childhood Apraxia of Speech

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THESIS
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This thesis is dedicated to my mother, Minerva Sanchez, my husband Alexis Olivares, and my children, Ariana, Madilyn and Olivia Olivares without whom it would never have been accomplished. Thank you mother for your unconditional love, never ending words of encouragement and for instilling within me since my childhood that all dreams were possible, if only I believed. I love you more than you know. Thank you to my soulmate, Alexis, for being by my side, for your enduring patience, and your unequivocal love throughout this journey. I will forever love you. Thank you to my beautiful children Ariana, Madilyn and Olivia, who everyday made me smile, laugh, and kept me focused. It is because of you that I sought to be a better me. I will forever love you to infinity and beyond. To you my village, know that the world is a better place because you are in it.

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LIST OF ABBREVIATIONS

CAS	Childhood Apraxia of Speech
IEP	Individual Education Program
ASHA	American Speech-Language Hearing Association
CV	Consonant Vowel
CVC	Consonant Vowel Consonant
CVCV	Consonant Vowel Consonant Vowel
ACT	Adapted Cueing Technique
PROMPT	Prompts for Restructuring Oral Muscular Phonetic Targets
MRI	Magnetic Resonance Neuroimaging
TKP	Tactile Kinesthetic Proprioceptive cues
VOT	Voice Onset Time
EPG	Electropalatography
IPC	Initial Phoneme Cue
PPC	Percentage of Phonemes Correct
PCC	Percentage of Consonants Correct
PVC	Percentage of Vowels Correct
MLU	Mean Length of Utterance
RAN	Rapid Automatic Naming
RAS	Rapid Alternating Stimulus
MIT	Melodic Intonation Therapy
TCM	Touch Cue Method
PMLU	Phonological Mean Length of Utterance
NDP	Nuffield Dyspraxia Program
PICAC	Porch Index of Communicative Ability in Children
GFTA	Goldman Fristoe Test of Articulation
KLPA	Khan Lewis Phonological Analysis
DEAP	Diagnostic Evaluation of Articulation and Phonology Inconsistency Test
RCT	Randomized Control Trial
NDP3	Nuffield Dyspraxia Programme-3rd Edition
ReST	Rapid Syllable Transition
VSM	Video Self-Modeling
VM	Video Modeling
VMO	Video Model with Other
SLP	Speech-Language Pathologist
ELL	English Language Learner
IDEA	Individuals with Disabilities Education Act
ERIC	Education Resource Information Center
sCAS	Suspected Childhood Apraxia of Speech
PML	Principles of Motor Learning
CELF	Clinical Evaluation of Language Fundamentals
PND	Percentage of Non-Overlapping Data
POD	Percentage of Overlapping Data

Summary

The cultural and linguistic diversity of our nation continues to grow and the skills needed by speech-language pathologists to address the needs of their existing caseload continue to be vast. According to the ASHA (2016) Schools Survey, only 8% of speech-language pathologists (n=1689) reported feeling very qualified to address cultural and linguistic influences on service delivery outcomes. While the population of bilingual children with speech and language disorders continues to increase (ASHA, 2016), speech sound disorder interventions for English language learners, continue to be scarce across the literature.

Although the prevalence of childhood apraxia of speech (CAS) specifically is unknown, speech sound disorders in general, are noted to be common developmental conditions affecting 2%-25% of children 5 to 7 years of age (Sices et al., 2007; ASHA, 2007). Moreover, it has been documented that CAS, a speech sound disorder, has increased substantially during the past decade due to birth to three legislative changes driving diagnosis based on possible erroneous behaviors, and increased information on the disorder (ASHA, 2007).

The purpose of this study was to evaluate how a sensory cueing intervention model using a video self-modeling technique effected the speech production of developing bilingual children with identified or suspected childhood apraxia of speech. The effects of a sensory cueing intervention using a video self-model on the speech production tasks of developing bilingual (English/Spanish) children with suspected apraxia of speech was explored. A single case A-B-A-B withdrawal research design with repeated introduction and withdrawal of an intervention was used to evaluate causality of intervention across speech behaviors. This study utilized a video self-model with three, 3-5 year old developing bilingual children with identified or suspected

apraxia of speech, across 26 sessions over a period of 8 weeks with a one week post intervention follow-up/maintenance phase. Within-condition analysis and between condition analysis were conducted to determine effect and change in condition on dependent variable (speech).

The findings of this study showed that the video self-modeling sensory cueing intervention which contained a cross-linguistic approach to target selections and conducted in the Spanish language had an improving trend effect on the speech outcomes of preschool aged developing bilingual children identified with or suspected of CAS. Implications for practice, research and limitations are discussed.

I. INTRODUCTION

Our schools as a nation continue to be comprised of racially, ethnically and linguistically diverse students; this trend is only predicted to continue (Ford, 2012; Waitoller, 2014). According to the U.S. Census (2013) demographics, the United States currently includes 50.4 million Hispanics and is comprised of over 60 million individuals who speak a language other than English. The U.S. Department Office of English Language Learners (2015) reported the top five languages in one or more states during the 2011-2012 school year included Spanish, Chinese, Vietnamese, Arabic, and Hmong with Spanish representing the largest percentage of speakers. Additional special needs factors including the child's language needs and mode of communication should be considered for both assessment and direct instruction per the Individuals with Disabilities Education Act (2004). Over 30 years ago, the "Clinical Management of Communicatively Handicapped Minority Populations" position statement by ASHA (1985), called for assessment and intervention of speech and language disorders should be conducted in the client's primary language. "Limited English proficient" children, as defined by ASHA (1985), include individuals who are proficient in their native language but not in English. Noting that a true communication disorder is marked by limited communication competence in both languages, ASHA asserted that these individuals should be assessed in both languages to determine language dominance and that the language of intervention would be determined by the results of the assessment. As non-English languages continue to comprise an increasing percentage of students in public schools, legal and ethical considerations need to be assumed.

Various factors and considerations for treating bilingual children with speech sound disorders, such as childhood apraxia of speech, need to be taken into account in order to effectively meet their communication needs. Childhood apraxia of speech (CAS), as defined by

the American Speech-Language Hearing Association is a “neurological pediatric speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits. The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound productions and prosody” (ASHA, 2007). Although limited agreement has been documented in the literature specific to the diagnostic criteria for CAS, consensus across researchers concluded the following to be diagnosis markers: 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” (ASHA, 2007). However, factors such as age, severity of involvement, and task complexity can change or vary across individuals which contributes to difficulties in differential diagnosis between children with CAS and other speech sound disorders (ASHA, 2007; Lewis et al., 2004).

Speech sound disorders (e.g., articulation, phonology) are noted to be common developmental conditions affecting 2%-25% of children 5 to 7 years of age with the prevalence of 75% of the condition resolving among these children by the age of 6 (ASHA, 2007; Sices et al., 2007). Preschool aged children often are identified with speech sounds disorders (Sices et al., 2007). Although the prevalence of childhood apraxia of speech is uncertain, it has been documented that CAS has reportedly increased substantially during the past decade due to birth to three legislative changes driving diagnosis based on possible erroneous behaviors, and increased information on the disorder (ASHA, 2007). However, progression of intervention for children with speech sound disorders may in fact also influence the prevalence rate and

subsequently return a diagnosis of CAS or be reclassified as a phonological disorder during the course of remediation (Iuzzini-Seigel et al., 2017; Sices et al., 2007).

The presence of a speech sound disorder, such as childhood apraxia of speech, has been evidenced to impact a child's academic and social outcomes (Lewis et al., 2004; Verdon et al., 2015). Difficulties with a child's ability to produce speech sounds early can lead to phonological awareness difficulties that can pose challenges in literacy development skills such as spelling, reading and writing and the development of appropriate social skills with peers and adults (McNeill et al., 2009; McNeill et al., 2010; Zaretsky et al., 2010; Skebo et al., 2013; Thatcher et al., 2008). Current literature posits persistent speech sound disorders of an individual with CAS can create potential current and future consequences of oral language use, reading, writing and social skills as the child transitions from primary education to post-secondary education and vocational settings in adulthood (ASHA, 2007; Skebo et al., 2013; Verdon et al., 2015). The speech-motor programming difficulties of a child with CAS places him at greater risk than most children classified with the diagnosis of other speech sound disorders for literacy difficulties in spelling and writing, due to its correlation with phoneme-grapheme correspondence; and phonological tasks such as segmenting, and/or blending due to the child's ability to correctly pronounce words (Lewis et al., 2004). The interactions between oral language and speech sound productions are often manifested in erroneous morphological skills (e.g., word endings), and grammar use (e.g., articles) which directly impacts mean length of utterance (ASHA, 2007; Murray et al., 2018).

Bilingual Speech Sound System

As with monolingual children with speech sound disorders, the goal of a bilingual child with a speech sound disorder is to increase the accuracy and precision of the sound targets to

improve overall speech intelligibility (ASHA, 2007; Gildersleeve-Neumann, & Goldstein, 2015; Goldstein, & Gildersleeve-Neumann, 2015; Kohnert, 2007). When the speech sound system of a bilingual child is impaired, this can in turn impact the speech production of both the home language (e.g., Spanish) and the speech production of the second language (i.e. English); although the manifestation of the errors may be distributed across the languages given the language phonotactic constraints (Gildersleeve-Neumann, 2005; Goldstein et al., 2015; Kohnert, 2007).

Shared Sound System

It has been questioned if bilingual children have a single or a separate phonological system yet literature documents specific speech features for the English and Spanish languages as (Ray, 2002; Paradis, 2016). According to Goldstein (1995) and Zampini (1994), the consonant sounds of /b, p, t, g, k, m, n, l, tʃ, s, j, w/ occur in both the English and Spanish language. In Fabiano-Smith and Goldstein (2010) documents shared sounds between the languages but also note sounds that are specific to each language. See Table 1 for summary of speech sound shared between English and Spanish. See Table 2 for summary of unshared speech sounds for each language.

Table 1

Shared Speech Sounds Between English and Spanish

Sound Classes	Shared Sounds
Plosives	/p, b, t, d, k, g/
Nasals	/m, n/
Fricatives	/f, s, ð /
Affricate	/tʃ/
Lateral Liquids	/l/
Glides	/w, j/

Note. Adapted from Fabiano-Smith, L., & Goldstein, B., (2010). Phonological acquisition in bilingual Spanish-English speaking children. *Journal of Speech, Language, and Hearing Research,* 53, 160-178. https://doi.org/10.1044/1092-4388(2009/07-0064)

[a]Modifcations of sounds may be warranted due to variations in Spanish dialects.

Table 2

Unshared Speech Sounds Between English and Spanish

Sound Classes	Unshared English	Unshared Spanish
Nasals	/ŋ/	/ɲ/
Fricatives	/v, ʒ, z, ʃ,θ, h/	
Spirants		[ß], [ɣ]
Affricate	/dʒ/	
Nonlateral liquids	/ɹ/	
Flap/Tap		/ɾ/
Trill		/r/

Note. Adapted from Fabiano-Smith, L., & Goldstein, B., (2010). Phonological acquisition in bilingual Spanish-English speaking children. *Journal of Speech, Language, and Hearing Research,* 53, 160-178. https://doi.org/10.1044/1092-4388(2009/07-0064)

[a]Modifcations of sounds may be warranted due to variations in Spanish dialects.

The stages at which each sound is developed and in what order these sounds are developed has been documented for both the English and Spanish languages (Bedore, 1999; Goldstein, 1999). See Table 3 for English and Spanish sounds.

Table 3

Stages for English and Spanish Sounds

Stage	Sounds
English[a]	
Early	/m, b, j, n, w, d, p, h/
Middle	/t, ŋ, k, g, f, v, tʃ, dʒ /
Late	/ʃ, ð, s, z, θ, l, r, ʒ/
Spanish[b]	
Early	/ŋ, t, m, n, k, x/
Middle	/s, f, p, tʃ/ [ß, ɣ]
Late	/l, ð, ɾ, r/

Note. Adapted from Shriberg, L.D. & Kwiatkowski, J. (1994). Developmental phonological disorders I: A clinical profile. *Journal of Speech and Hearing Research*, 37, 1100-1126. https://doi.org/10.1044/jshr.3705.1100. Adapted from Fabiano-Smith L., & Goldstein, B. (2010a). Early-, middle-, and late-developing sounds in monolingual and bilingual children: An exploratory investigation. *American Journal of Speech-Language Pathology, 19, 66-77.* https://doi.org/10.1044/1058-0360(2009/08-0036)

[a]English data on speech sound development. [b]Spanish data on speech sound development.

Early, Middle, and Late Sounds.

Given the continuous nature of speech sound development, it is important to recognize sounds which are typically acquired first by children and those noted to be more complex and acquired later in a child's development (Fabiano-Smith, & Goldstein, 2010). The study conducted by Fabiano and Goldstein (2010) sought to measure the construct of complexity and development of speech sound categories for bilingual English-Spanish speaking children through marking early, middle and late developing categories. Variations were noted, yet it was concluded that bilingual English-Spanish speaking children do indeed acquire sounds in a simple to complex fashion but the level of accuracy and mastery by age is unclear (Fabiano-Smith, & Goldstein, 2010). Although findings for delineating the construct of complexity and development comparative to the work of Shriberg and Kwiatkowski (1994) who classified sounds by early, middle and late developing sounds for monolingual English speaking children by age and level of accuracy, the same classification of sounds for bilingual children has not been solidified. However, it can be concluded that nasals, stops, and glides are earlier in development with later developing sounds being fricatives, affricates and liquids in English whereas in Spanish similar categories have been identified with again earlier developing sound categories including nasals, stops and glides, and later developing sounds including fricative, affricates, and tap and trill /r/ in Spanish. Liquids in Spanish appear to have mixed results with production occurring in both early and late sequences of acquisition (Cataño et al., 2009; Fabiano-Smith, & Goldstein, 2010). See Table 2 for early, middle and late sounds for both English and Spanish.

Syllable Considerations.

An additional speech consideration to mark across language relative to CAS beyond the production of speech sounds includes the motoric movement from sound to syllables in the production of words to phrases and sentence levels (Marquart, Sussman, Snow, & Jacks 2002).

The distinction between the languages should also be documented for both differences and similarities between and across languages for the purpose of intervention and assessment. These syllable shape variations are documented in simple to complex levels in Table 4.

Table 4

English and Spanish Syllable Shapes

Language	Feature
English[a]	CV, VC, CVC, CVCV, CCVC, CVCC, CCV, CCCVC
Spanish[b]	C, CV, VC, CVC, CCVC

Note. Adapted from Marquart, T.P;. Sussman, H.M., Snow, T., & Jacks, A. (2002). The integrity of the syllable in developmental apraxia of speech. *Journal of Communication Disorders*, 35, 31-49. https://doi.org/10.1016/s0021-9924(01)00068-5

Adapted from Goldstein, B. & Cintrón, P. (2001). An investigation of phonological skills in Puerto Rican Spanish-speaking 2-year-olds. *Clinical Linguistics & Phonetics,* 15(5), 343-361. https://doi.org/10.1080/02699200010017814

[a]English data for syllable shapes. [b]Spanish data for syllable shapes.

Dynamic Systems Theory

The complexities of a bilingual child's speech sound system are multifaceted and include assumptions which may be better explained by the Dynamic Systems Theory which accounts for variability across children and child development. According to Thelen (2005), the dynamic

systems theory and the complexity of change occurs at many levels and at different time scales. Variability in development is noted as continuous with systems interacting and changing immediately and over periods of time. The principles of dynamic systems theory encompass complexity, variety of time patterns, and varying degrees of stability and flexibility. Fundamentally, this theory portrays the potential intervention of a bilingual child as bilingual phonological skills may occur under a variable environment, language history, language use, language proficiency levels, and phonemic and phonetic factors (Gildersleeve-Neumann, 2005; Pieretti & Roseberry-McKibbin, 2016; Thelen, 2003).

Intervention Approaches

An emerging body of intervention models for treating speech productions of children identified or suspected of childhood apraxia of speech exists and is classified by its approach. These approaches are rhythmic, motor programming, linguistic, combination and sensory cueing. Although many of these approaches and techniques have been noted to be advantageous in treating the speech production skills of children with childhood apraxia of speech across levels of severity and communication needs of the child, no specific intervention has been ruled as a discrete standard for treating children identified with this speech sound disorder (ASHA, 2007). Positive outcomes for the intervention model category of sensory cueing, which involves the use of the child's senses and gestures to cue targeted speech sound(s) and used in conjunction with a motor programming approach, has been noted to be effective in increasing speech productions of children across various studies (Dale & Hayden, 2013; Klick, 1985; Martin et al., 2016; Rosenbek et al., 1974; Vashdi, 2014; Yu et al., 2014). However, the body of literature for treating bilingual children with identified or suspected childhood apraxia of speech using these various intervention approaches is scarce (Gildersleeve-Neumann, 2005).

Although studies with bilingual participants are limited, some studies were discovered in the literature which explored various interventions with bilingual children or children of other languages with CAS or suspected CAS. For example, a study conducted by Gildersleeve-Neuman and Goldstein (2015), found that treating speech sound disorders in both English and Spanish resulted in positive changes for the speech accuracy of the bilingual child for treated and non-treated error patterns; this in turn, contributed to the assumptions of interaction of languages as speculated by the Dynamic Systems Theory. A sensory cueing study by Vashdi (2014), conducted with a primarily Hebrew speaking child, investigated the use of an initial phoneme cue (IPC) technique on speech outcomes. The IPC, or word formation technique involved prompting the first syllable of the word using auditory information to cue the participant to the next phoneme in a word while the visual cue provides the participant with information on how to pronounce the phoneme, demonstrated positive outcomes for the production of Hebrew word shapes. A third study by Singh and Trivedi (2016) explored the effectiveness of the Nuffield Dyspraxia Program (NDP) with melodic intonation therapy, and a multisensory approach with an 8-year-old CAS Hindi speaker. Treatment included imitation tasks, visual and tactile cueing, repetition of stimuli, immediate feedback, in addition to fading of cues and supports. Auditory discrimination, perception tasks, and adapted MIT steps were followed along with multisensory input simultaneously. Results of the eclectic treatment revealed improved motor speech tasks such as word repetition rate, alternating motion rate, vowel prolongation, and non-word repetition accuracy as well as prosodic characteristics (e.g., stress).

Video Self-Modeling as an Intervention

Multiple interventions to address the needs of preschool aged children with speech sound disorders have been documented in the literature (Wren et al., 2018). The technique of modeling

has been noted to be a traditional trajectory for intervening in verbal speech sound intervention for children in order to impact articulatory movement. Traditional articulatory intervention has consisted of using adult models during production practice or imitation and drill practice by rectifying errored manner and placement (Kamhi, 2006; Wren et al., 2018). Various auditory or visual cues have also been used to engage the child participant in observing self-productions with frequent errored postures and models (Kamhi, 2006; Wren et al., 2018). An intervention approach not yet explored with CAS or suspected CAS includes video self-modeling (VSM) or video modeling (VM). Two categories of video based modeling have emerged in the literature 1) video modeling with other as model (VMO) and, 2) video self-modeling (VSM). Video modeling is "a technique that involves demonstration of desired behaviors through video representation of the behavior" (Bellini & Akullian, 2007, p. 266). The individual watches the video and then imitates the model of the peer, adult, sibling, etc. in the demonstration (Bellini et al., 2007). Video self-modeling is described as "a specific application of video modeling that allows the individual to imitate targeted behaviors by observing himself successfully perform a behavior" (Bellini & Akullian, 2007, p. 266).

The idea of video modeling (VM) or self-modeling (VSM) was derived from the concept first introduced by Albert Bandura in 1977 who theorized on modeling, or observational learning. Bandura (1977) believed children who attended to a model were in fact able to imitate that model or behavior if motivated by the model. According to Ortiz et al. (2012) the concept of video modeling provides individuals with a model of the desired behavior or skill of interest and see correct execution in order to mirror that behavior. It is theorized that when the self becomes the model, the student has a visual of himself or herself executing the behavior correctly, which may then in turn increase the student's self-efficacy (Bandura,1977; Dowrick, 2012;). The use of

video self- modeling has been explored with various complex disorders and has been noted as a technique which has produced positive results across a variety of behaviors, disability types, and ages (Buggey & Ogle, 2012; Mason et al., 2013). Video self-modeling has been noted to create positive behavior change across physical, social, educational, and diagnostic variations (e.g., reading disabilities, autism spectrum disorders, selective mutism, developmental delays) (Bellini et al., 2007; Buggey & Ogle, 2012; Edwards & Lambros, 2018; Hepting, & Goldstein, 1996; Kehle et al., 2011).

Video self-modeling (VSM) has been documented to be an evidence based intervention that is not only effective in promoting behavior change, but also engaging through its use of technology (Bellini & Akullian, 2007; Edwards et al., 2018; Hong et al., 2017; Mason et al., 2016). Adaptations to traditional intervention trajectories which include a medium such as digital technology can in fact create an environment that may be suitable for preschool aged children. Adaptations within the known traditional interventions may be necessary in order to provide a playful and fun dialogue as original adult protocols can be characterized as monotonous in nature or lack interest for children (LaGasse, 2012).

Purpose of the Proposed Study

This proposed study will directly assess the impact of a sensory-cueing intervention with a video self-model technique on the Spanish speech outcomes for developing bilingual children identified with or suspected of childhood apraxia of speech. The importance of an intervention study for LEP children with speech sound disorders is significant for progressing clinical practice, effecting remediation and overall child educational advancement (Guiberson, 2009). Research is warranted to assess the effect of video self-modeling as a sensory cueing intervention

technique on the speech production gains of bilingual children with a moderate severity level of childhood apraxia of speech.

The purpose of this study was to evaluate how a sensory cueing intervention model using a video self-modeling technique effected the speech production of developing bilingual children with identified or suspected childhood apraxia of speech. The research question of this study was:

1. What are the effects of a sensory cueing method with a video self-modeling component on the speech production tasks of developing bilingual (English/Spanish) children with suspected apraxia of speech?

II. Literature Review

Childhood apraxia of speech as defined by the American Speech-Language-Hearing Association (ASHA), is a "neurological childhood speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits". "It is the position of ASHA that apraxia of speech exists as a distinct diagnostic type of childhood speech sound disorder that warrants research and clinical services" (ASHA, 2007, p.1). Evidence-based intervention models become critical in the service delivery for improving speech skills of children with childhood apraxia of speech (CAS) as it is the responsibility of the certified speech-language pathologist to not only make the primary diagnosis of CAS, but also to design and implement the treatment programs needed for improvement and for monitoring progress (ASHA, 2007, p.3).

According to the ASHA, the incidence and prevalence of CAS is difficult to estimate due to a number of factors such as "the lack of clear diagnostic guidelines for differential diagnosis" (2007). As a result of challenges and continued debates in the literature specific to differential diagnosis characteristics for motor speech disorders, such as childhood apraxia of speech, ASHA has identified those characteristics and features which have gained the most consensus across the existing body of research. Three segmental and suprasegmental features that have consistently gained consensus in the body of literature for the diagnosis of childhood apraxia of speech include: a) "inconsistent errors on consonants and vowels in repeated productions of syllables or words b) lengthened and disrupted co-articulatory transitions between sounds and syllables; and c) inappropriate prosody, especially in the realization of lexical or phrasal stress" (Strand et al., 2013).

CAS is found in approximately 3.4%-4.3% of the children referred for speech disorders; a higher prevalence rate of CAS has been reported with certain medical conditions such as

epilepsy, galactosemia, autism spectrum disorders, Fragile X syndrome, and Rett syndrome, (ASHA, 2007). According to the ASHA Schools Survey 2016, 63.4 percent of speech-language pathologists regularly served students with childhood apraxia of speech and 88.7 percent of speech language pathologists (SLP) provided services to students with speech sound disorders. Although there is an ongoing debate specific to assessment practices for diagnosing CAS, given the reported numbers of children within ASHA certified speech-language pathologists' caseloads as documented in the ASHA Schools Survey, it is imperative to identify appropriate intervention practices for serving the needs of these children.

According to the ASHA Schools 2014 Survey Report: SLP Caseload Characteristics Trends 1995-2014, the median number of English language learner students (ELLs) on SLP caseloads averaging 48 students varied from 3-4 ELLs in the western regions with a higher number of 7-10 ELLs in the northeastern, midwestern, and southern regions of the country. Of the SLPs that were surveyed in the ASHA Schools Survey (2016), only 8% of SLPs (n=1689) reported feeling very qualified to address cultural and linguistic influences on service delivery outcomes.

U.S. Census (2013) demographic data reveal that the United States currently represents 50.4 million Hispanic, 38.9 million African American, 14. 6 million Asian, 2.9 million American Indian or Alaska Native. According to the United States Census (2013), over 60 million individuals reported to speak a language other than English. According to the U.S. Department of Education Office of English Language Acquisition (2015), the top five languages reported in one or more states during the 2011-2012 school year included Spanish, Chinese, Vietnamese, Arabic, and Hmong.

According to the Individuals with Disabilities Education Act (IDEA) (2004), states must have policies and procedures designed to prevent inappropriate over identification and disproportionate representation by race and ethnicity of children with disabilities. Continued disparities and challenges exist in appropriately identifying culturally and linguistically diverse students in special education as a result of limited sound assessment measures, qualified personnel, and intervention/academic instructional methods (Sullivan, 2011). Moreover, language discrepancies can pose a challenge to referral of, assessment of, and provision of services to minority children who speak various languages (Miller & Katsiyannis, 2014). Under IDEA (2004), additional special needs factors including the child's language needs and mode of communication should be considered for both assessment and direct instruction. Failure to address the needs of students with limited English proficiency often leads to disproportionate representation in special education programs (Ford, 2012; Miller & Katsiyannis, 2014; Sullivan, 2011).

Motor speech intervention for children of various languages and ethnicities is not well supported by research (ASHA, 2007). While the population of bilingual children with speech and language disorders continues to increase (ASHA, 2016), speech sound disorder interventions for English language learners, continues to be scarce across the literature.

The purpose of this systematic literature review was to analyze and present the research on the current intervention models used to treat monolingual and/or bilingual children with motor speech disorders between the ages of 3 and 10 years of age.

The guiding questions for the review were:

1. What intervention models exist for monolingual and bilingual children between the ages of 3-10 with motor speech disorders, specifically CAS?

2. What intervention models are noted to be effective when working with monolingual and/or bilingual children between the ages of 3-10 with motor speech disorders specifically CAS?
3. What research methods were used to determine the effects of motor speech interventions for bilingual or monolingual children between the ages of 3-10 diagnosed with or suspected of CAS?

Method

Selection of studies for this literature review followed a multiple step process. First, an electronic search of articles containing descriptors related to CAS and intervention models was conducted. This was followed by a hand search in specific journals and cross referencing of existing literature reviews. All articles that met initial criteria were coded and the inclusion criteria was applied. For this literature review, individuals with motor speech disorders, childhood apraxia of speech, dyspraxia, developmental apraxia, and developmental dyspraxia of speech were included. Definitions of terms can be found in Table 5.

Table 5

Disability Definitions

Term	Definition
Motor speech disorder	speech disorder resulting from deficits in the central or peripheral nervous system that involves the sensorimotor planning and programming of speech movement, as well as those processes that execute, control, and regulate movement (Strand, 2013)
Childhood apraxia of speech	a neurological childhood speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits (ASHA, 2007).
Developmental apraxia of speech	term also used to label motor speech disorder; term "developmental" may be interpreted and/or suggestive as an impairment that will eventually resolve (Moriarty, Gillon, & Moran, 2005)
Residual speech sound disorders	a subtype of speech sound disorder in which sounds remain in error beyond the typical age of acquisition (Preston, McCabe, Rivera-Campos, Whittle, Landry, & Maas, 2014)
Speech sound disorder	umbrella term referring to any combination of difficulty with perception, motor production, and/or the phonological representation of speech sounds and speech segments (ASHA, 2007)
Developmental verbal dyspraxia	term indicates that there is a linguistic aspect to the disorder (Moriarty, Gillon, & Moran, 2005)
Developmental articulatory apraxia	term "articulatory" highlights the motoric symptoms of the motor speech impairment (Moriarty, Gillon, & Moran, 2005)

Search Procedures

Electronic searches were conducted using seven databases: Ebscohost, Education Resources Information Center (ERIC), Proquest, PsychINFO, Linguistics and Language

Behavior Abstracts, Web of Science, and Web of Knowledge. Search terms included categories of words separated by 'OR": "second language acquisition", "English language learner", "Spanish", "ELL", "bilingual", "English-Spanish speakers", "Spanish-English", "multilingual*"; "integral stimulation", "CAS", "childhood apraxia of speech", "speech sound disorders", "apraxia of speech", "developmental apraxia", "apraxia", "dyspraxia", "motor speech disorder"; "intervention", "treatment", "therapy"; "child*". These terms were submitted in various combinations for each search across databases (e.g., "motor speech intervention" AND "child" AND "intervention" OR "treatment" NOT "aphasia"). Hand searches through the American Speech-Language-Hearing Association (ASHA) peer reviewed journals and ASHA's Evidence Maps were also conducted. Existing literature reviews found were hand searched to cross-check articles obtained and possible articles missed. A meeting with the university librarian was held to ascertain and realize additional Boolean search terms, Boolean operators, and database search engines yielded two additional articles. Upon exhausting Boolean searches that included "second language acquisition", "English language learner", "Spanish", etc., the search was expanded to include the other search terms. This search produced 3429 articles. These 3429 articles were then narrowed down electronically by inputting years and specific terms. Each article was then assessed for inclusion based on the set criteria of motor speech intervention for children with CAS and specifically intervention methodologies for children of various languages and ethnicities.

Inclusion Criteria and Exclusion Criteria

Articles were included in this literature review, if they a) were published in a peer-reviewed journal as early as 1974 to 2018 b) included participants between the ages of 3 and 10 years of age, c) met disability definition for motor speech disability or specifically CAS d)

identified language (e.g., English, Spanish, Hebrew) use of participant e) implemented independent variable (e.g. intervention) with a child with diagnosed or suspected apraxia of speech, and f) contained dependent variables that addressed increasing motor planning skills.

Studies were excluded from this review if: a) participant was not suspected of or diagnosed with CAS, b) all of the participants were above the age of 10 or under the age of 3, c) intervention included alternative/augmentative communication use or a technology emphasis free of intervention phases, d) targeted a suprasegmental feature (e.g. stress, pitch, loudness), e) there was no independent variable, that is, did not test an intervention, f) published in a peer reviewed journal earlier than 1974, or g) treatment approach did not focus directly on improving speech production or speech intelligibility. Applying the above criteria yielded 42 articles. See Appendix H, Abbreviated Summary of All Articles Reviewed.

Interrater Reliability

In order to ensure accuracy in the selection of inclusion criteria for the 42 articles, 20 articles were selected to be independently examined by two colleagues including 9 that had been included and 11 that had required above average scrutiny to determine exclusion. Each of the two colleagues applied the criteria independently. Agreement as to whether the study should be included or excluded was obtained for 19 of the 20 articles (95%). After group discussion, the one article disputed (the same one by both) subsequently was agreed upon, resolved and reached group consensus.

Analysis

A total of 42 studies were identified from 1974 to 2018 that focused on intervention models for children with suspected apraxia of speech (sCAS) with only one study that focused on intervention for bilingual children (e.g., Spanish-English), one study on the Hindi language

and one study on the Hebrew language. The studies were published in 19 different journals (see Table 6).

Table 6

Peer Reviewed Journal

Journal	Tally of Studies
American Journal of Speech-Language Pathology	7
Asia Pacific Journal of Speech, Language, and Hearing	1
Asia Pacific Journal of Research	1
Brain Topography	1
Child Language Teaching and Therapy	4
Clinical Linguistics & Phonetics	4
Developmental Neurorehabilitation	1
International Journal Child Health Human Development	1
International Journal of Language & Communication Disorders	3
International Journal of Speech-Language Pathology	3
Journal of Communication Disorders	2
Journal of Medical Speech-Language Pathology	2
Journal of Music Therapy	1
Journal of Speech, Language, and Hearing Research	4
Language, Speech, and Hearing Services in Schools	2
Logopedics Phoniatrics Vocology	1
Music Therapy Perspectives	1
Pediatrics	2
The Arts in Psychotherapy	1

Coding Procedures

The primary categories documented for each study were participant Demographics and Methodological Components. Within each primary category, several subcodes were recorded for each study.

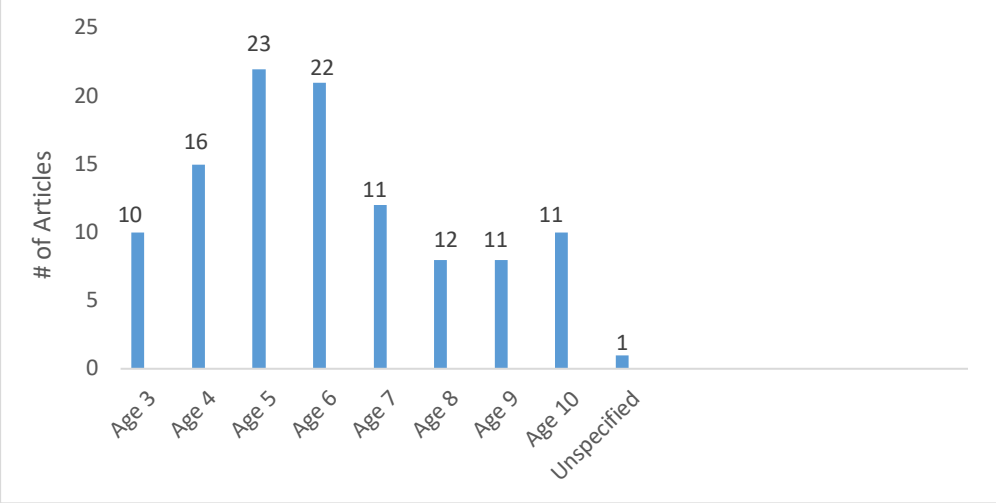
Demographics

The following categories were identified and coded: (a) age and gender, b) language spoken, c) motor speech disability, d) severity level of CAS, and e) and history of therapy.

Age and gender of participants. The studies reviewed included a combined total of 225 participants with a motor speech disability such as suspected childhood apraxia of speech (sCAS) or having met the definition for CAS. Given the participants included in the studies, the age prevalence and gender of participants was tallied. If a study had multiple participants of the same age, the participant age was only tallied one time, while a study that included more than one age group was tallied under the various age groups. Among the 42 included studies, 7% included the age of 3, 13% included 4 years of age, 18% included 5 years of age; 17% included 6 years of age, 8% were 7 years of age, 9% were 8 years of age, and 8% were 9 and 10 years of age. The study conducted by Krauss and Galloway (1982) did not specify age of children participants but was included because it was one of the first studies to explore a rhythmic intervention approach (see Figure 1).

Figure 1

Number of Articles that Included Participants 3 to 10 Years of Age



Note. Total is greater than 42 because more than one age was included in most studies.

Of the total number participants (n=225) tallied across the studies, 61% were male and 24% were female and 15% were unspecified.

Language spoken. Of the 42 studies, 39 engaged CAS participants who were English only speakers. One study engaged a CAS participant who was a Hebrew speaker, and another study engaged a child participant with CAS and a participant who was identified as having a speech sound disorder but not specifically with CAS, both of whom were bilingual English/Spanish speakers. The third study included a participant who was a Hindi speaker; English language use of this speaker was unknown.

Motor speech disability. Among the participants in the 42 studies, 31 were diagnosed/labeled with various disorders that included CAS, six Developmental Apraxia of Speech, two Dyspraxia, one Idiopathic Apraxia of Speech, one Developmental Verbal Dyspraxia, and one as having a 'speech sound disorder' (see Table 7).

Table 7

Terms Used in Studies

Terms	Number of Studies Found
Childhood Apraxia of Speech (CAS)	31
Developmental Apraxia of Speech (DAS)	6
Dyspraxia (DYS)	2
Idiopathic Apraxia of Speech	1
Speech sound disorder	1
Developmental Verbal Dyspraxia (DVD)	1

Speech sound disorders, as defined in ASHA's Clinical Topics *Speech sound disorders-articulation and phonology* (2007), is an "umbrella term referring to any combination of difficulty with perception, motor production, and/or the phonological representation of speech

sounds and speech segments". This category or definition was accepted if the study explicitly identified the participant(s) with characteristics or "red flags" specific in diagnosing CAS such as clinical presence of variable or inconsistent productions for the same phoneme, variable or inconsistent productions for phoneme combinations or phrases, and vowel distortions (e.g., Yu et al., 2014). Use of this criteria yielded the one article.

Severity level of CAS. Participant level of severity was tallied across the 42 articles. Table lists the number of studies per each reported level of severity.

Table 8

Reported CAS Severity Level Across Studies

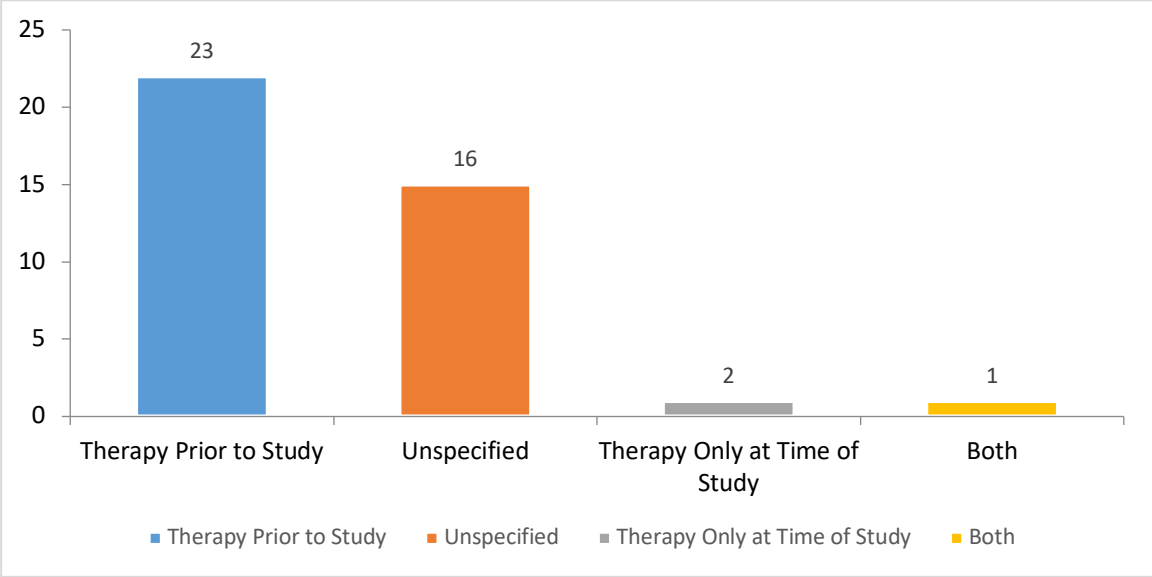
Severity Level	Number of Studies	Reference
Unspecified	27	Beathard & Krout (2008); Dale & Hayden (2013); Edeal & Gildersleeve-Neumann (2011); Gomez et al. (2018); Grigos & Kolenda (2010); Hitchcock et al. (2017); Klick (1985); Krauss & Galloway (1982); LaGasse (2012); Lundeborg & McAllister (2007); Martikainen & Korpilahti (2011); Martin et al. (2016); McCabe et al. (2014); McNeill et al (2009a); McNeill et al. (2009b); Murray et al. (2015); Powell (1996); Preston et al. (2013); Preston et al. (2016); Rosenbek et al. (1974); Singh & Trivedi (2016); Thomas et al. (2014); Thomas et al. (2016); Tierney et al. (2016); Vashdi

		(2014); Watson & Leahy (1995); Zaretsky et al. (2010)
Mild to moderate	2	Ballard et al. (2010); Preston et al. (2017)
Moderate to severe	2	Gildersleeve-Neumann & Goldstein (2015); Yu et al. (2014)
Moderate to profound	1	Namasivayam et al. (2015)
Severe	6	Iuzzini & Forrest (2010); Kadis et al. (2014); McNeill et al. (2010); Moriarty & Gillon (2006); Strand et al. (2000); Strand et al. (2006)
Varied	1	Case & Grigos (2016)
Moderate, moderate-severe, severe	2	Maas et al. (2012); Skelton & Hagopian (2014)
Moderate-severe, severe	1	Maas & Farinella (2012)

History of therapy. In review of the participants' history of therapy across the 42 articles, 23 articles documented the participants to have received therapy prior to the study; two articles stated no history of therapy prior to the study; 16 articles did not specify a history of therapy; and one article documented a combination of both, participants who had and did not have a history of therapy (see Figure 2).

Figure 2

Participant History of Therapy Across All Articles



Methodological Components

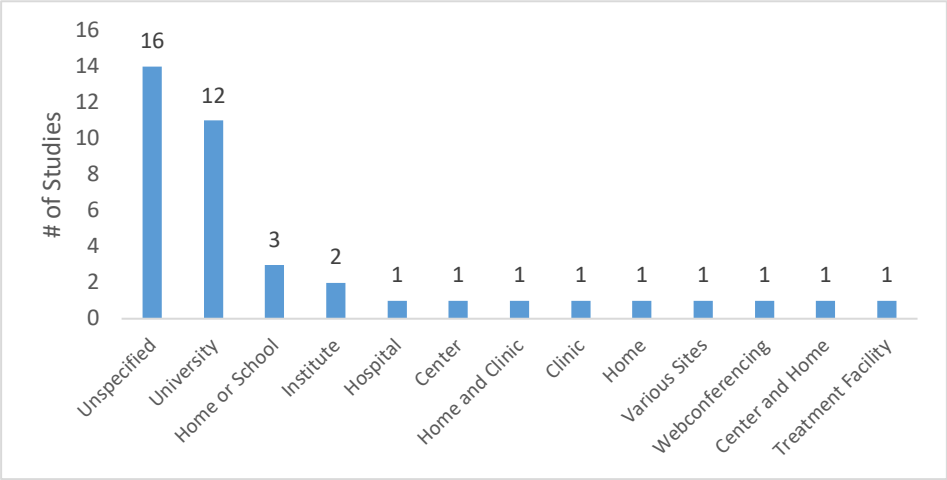
In addition to participant demographics, studies were coded for methodological components. These methodological features included the following: a) research design, b) settings, c) reliability and treatment fidelity, d) intervention intensity, e) independent variable or speech intervention, f) dependent variables or speech production and intelligibility level, g) parental involvement or home programs and h) inclusion of a maintenance phase.

Research design. Many of the studies used single-case research designs (Gast & Ledford, 2010). Multiple baseline designs were used in 33% of studies (n=14), combination research designs were used in 12% of studies (n=5), withdrawal and reversal designs were used in 33% of studies (n=14) and alternating treatments (n=1). Descriptive case studies accounted for 12 of studies (n=5), summative research design pre-post was used in two studies, and randomized control trial was used in one of the studies (Spieth, Kubasch, Penzlin, Illigens, Barlinn & Siepmann, 2016).

Settings. Settings as identified per the study included the following or combinations of them: university clinics, institutes, centers, hospitals, facilities, homes, and schools. Others specified "various sites", web conferencing, or were unspecified. Interventions conducted in unspecified settings were the greatest in occurrence with 16 or 38% of studies identified, followed by university settings with 12 or 28% (see Figure 3).

Figure 3

Setting Where Studies Were Conducted



Reliability and/or treatment fidelity. Not all 42 articles reported reliability and/or treatment fidelity. Of the 42 studies, 21 studies or 50% did not report inter-rater reliability, intra-reliability and/or treatment fidelity. The remaining 21 studies documented inter-rater reliability, intra-reliability and/or treatment fidelity at rates from 75% to 100% with a mode of 85-86%.

Intervention intensity. All of the studies had various intervention intensity for duration (length of sessions), frequency or number of sessions and time period (e.g., number of days or weeks), for the intervention study completed. Frequency of intervention varied in number of sessions ranging from one to ten sessions (n=x) to 30-40 sessions (n=14) and greater than 40 sessions (n=1), 4 times (n=1), daily (n=1), 2-4 days (n=1), weekly (n=8), 1-2 times a week (n=3),

2-3 times a week (n=11), and 4 times a week (n=1). Of the 4 articles reviewed, 12 articles did not specify the frequency of intervention. Duration of intervention across studies was also mixed with most studies being reported at 1 hour or less (n=26) with the exception of 18 hours (n=1) being documented in one study as a cumulative figure of intervention duration time; 12 studies had unspecified duration. Time period of intervention was diversely reported by number of days (n=1), weeks (n=23), months (n=7) and years (n=8). The intervention time period of 3-6 weeks was noted as being the highest in occurrence (n=9) with an incidence of 28%. Six studies did not specify time period of intervention (see Table 9).

Table 9

Duration, Frequency, and Time Period of Intervention Across Studies

Intensity	Number of Studies
Frequency	
1-10 sessions	2
11-20 sessions	8
20-30 sessions	3
30-40 sessions	1
40+ sessions	1
4 times	1
Daily	1
2-4 days	1
weekly	7
1-2 times a week	3
2-3 times a week	11
4 times a week	1
Unspecified	12
Duration	
15-20 minutes	1
30 minutes	3
40 minutes	3
45 minutes	7
50 minutes	2
55 minutes	3

	60 minutes	9
	7 hours	1
	18 hours	1
	Unspecified	15
Time		
	3 days	1
	3-6 weeks	11
	8 weeks	5
	9-11 weeks	5
	16 weeks	2
	12 weeks	1
	3 months	3
	4 months	1
	18 weeks	1
	7 months	1
	8 months	1
	9 months	1
	1 year	1
	14 months	1
	18 months	2
	2 years	2
	3 years	1
	Unspecified	6

Note. Numbers do not total 42 due to various research designs (i.e. withdrawals, controls) across studies.

Independent variable or speech intervention. The interventions, or independent variable, included in each article were summarized according to the following speech production categories: a) motor-programming, b) sensory cueing, c) linguistic, d) combination, e) technology and f) rhythmic approaches. Definitions of each intervention category and the number of studies that included this intervention can be found in Table 6. Fifteen studies focused on motor programming intervention approaches followed by 6 linguistic studies, 13 sensory-cueing, 5 combination intervention approaches, and 3 rhythmic intervention approaches. See Table 10 for a summary of the study interventions reviewed.

Table 10

Intervention Category Definitions and Number of Studies

Approach	Definition
Motor-Programming (15)	approach that utilizes motor-learning principles, including the need for many repetitions of speech movements to help the child acquire speech skills
Sensory Cueing (13)	involves the use of child's senses (e.g. vision, touch) as well as gestures to cue some aspect of the targeted speech sound.
Linguistic (6)	focus on CAS as a language disorder; approach focus on teaching child how to make speech sounds and the rules for when speech sounds and sound sequences are used in a language
Combination (5)	use both motor-programming and linguistic approaches
Rhythmic (3)	(prosodic) approach that uses patterns (melody, rhythm, and stress) to improve functional speech production

Motor-programming category. This intervention category was represented by the largest number of articles. These studies primarily implemented the principles of motor learning for increasing speech production and accuracy at the phoneme, syllable, word, phrase and utterance levels. Some studies focused on these speech production levels in conjunction with other behaviors and factors. Strand and Debertine (2000), one of the earlier studies to evaluate the efficacy of incorporating motor learning principles in treatment approaches for children with CAS, explored an integral stimulation approach within the framework of the motor learning tenets of a five-year-old girl described as a severely impaired child with CAS. Results of this study showed a greater degree of change for target utterances than control probes after treatment, and improvement was maintained for each utterance. The study by Ballard et al. (2010), explored

the feature of dysprosody in CAS intervention. In Ballard et al. (2010), the principles of motor learning were applied to investigate lexical stress differneces in 3 participants as it is anticipated that lexical stress impairments may occur from a deficit in rapid and fluent control of temporal and spatial parameters of articulator movement required to produce the variations in duration, vocal intensity (loudness), and fundamental frequency (pitch) across syllables. The treatment targeted rapid and fluent productions of lexical stress contrasts in multisyllabic strings structured in accordance with the principles of motor learning (high intensity practice, training multiple and varied skills in parallel with random ordering of stimuli, and initiating training at high levels of task or stimulus complexity). For example, strong-weak syllables (e.g., BAtigu) and weak-strong syllables (baTIgu) in three syllable strings were contrasted. Results of the study revealed positive effects for duration contrasts across syllables in treated three-syllable strings which also was noted to generalize to less complex three-syllable strings. Control of vocal intensity (loudness) and fundamental frequency (pitch) also improved for all participants. Edeal and Gildersleeve-Neumann (2011), explored the variable of frequency of production, in the context of integral stimulation in which the principles of motor learning are incorporated, to determine if more practice of speech targets lead to increase in session performance and generalization to untrained words. Two boys diagnosed with CAS participated in treatment according to the principles of motor learning through blocked and random practice, distributed practice, variability of practice, feedback and rate modifications. Targets were selected specific to their sound inventory, within a hierarchal framework, and practiced in initial and final word positions in differing words, phrases and sentences. One child was treated three times a week for 11 weeks and the other child was treated two times a week for 5 weeks. Production practice frequency and treatment intensity were found to have significantly better outcomes for speech sound productions at the word and

phrase levels within in-session treatment for both participants. A post treatment language sample taken 2 weeks after the intervention showed a greater percentage of consonants correct for targets in short sentences (3-5 words) for one participant while the post treatment results of the second participant's utterances were not as diverse in word shapes or length of utterance (1, 2, and a few 3 word utterances) as percentage of consonants correct did not decrease. In general, both participants made gains however, the participant who was assigned the higher production frequency treatment (over the 11 weeks) had greater in-session performance and greater generalization to untrained probes.

In the study conducted by Thomas et al. (2014), the effectiveness of Rapid Syllable Transition Training (ReST) with a dose-frequency of twice a week for six weeks was investigated. ReST, which is an intervention strategy that requires a high frequency of sessions (4 sessions a week for 3 weeks), was examined to determine the efficacy of dose-frequency. Given that a high frequency of intervention is often recommended for CAS children, this study sought to a) explore the effectiveness of segmental and prosodic treated and untreated pseudo-words and real words, and b) maintenance of gains if a lower-dose frequency treatment (2 times a week) was used with children with CAS. Findings revealed treatment (twice a week) had similar effects to high dose-frequency treatment. ReST treatment resulted in significant speech skill acquisition for real words across all participants and two of the four children demonstrated generalization to untreated pseudo words. ReST intervention was also noted to have a significant effect on stress of bisyllabic pseudo words containing orthographic cues; stress pattern changes were also noted in connected speech. The variable of severity level of impairment for the children in this study may have played a role in the outcomes for low-dose frequency, meaning

that an intervention with low-dose frequency or intensity may be better suited for children with less severe delays.

In Murray et al. (2015), a randomized control trial study compared the Rapid Syllable Transitions (ReST) intervention and the Nuffield Dyspraxia Programme-3rd Ed. (NDP3) effects for 26 children (two groups of 13) between the ages of 4 and 12 years with idiopathic CAS. Treated items from pre-treatment to 1 week posttreatment an increase in performance was noted; however, the NDP3 group made greater gains in accuracy than the ReST group. Maintenance of treatment was greater for the ReST group between 1 week and 1 month posttreatment. The ReST group showed a small increase in accuracy in treated words whereas the NDP3 group showed a moderate decrease in accuracy. Performance on the untreated real word stimuli only showed moderate gains at pretreatment to 1 week posttreatment and small gains from 1 week posttreatment to both 1 month and 4 month posttreatment for both NDP3 and ReST (Murray et al., 2015). The ReST group showed a large increase in accuracy of untreated pseudowords whereas the NDP3 group showed a small increase in accuracy. Both treatments evidence and support clinical use however, ReST suggests greater gains.

McCabe et al. (2014), looked at the efficacy of the ReST intervention used in combination with two syllabic pseudo word stimuli containing orthographic cues related with strong-weak (SW) or weak-strong (WS) patterns of lexical stress (or prosody). During treatment, the participants demonstrated change in prosody and segmental accuracy for both strong and and weak patterns of lexial stress yet no one reached the 80% criterion (McCabe et al., 2014). Treatment retention and generalization effects were noted as mixed across participants. Maintenance and generalization of prosody use continues to be demonstrated as an area of challenge for children with CAS. In Thomas, McCabe, Ballard and Lincoln (2016), the efficacy

of ReST treatment for children with CAS via video conferencing was examined. All five children showed significant improvement in imitated pseudo-words and generalized to untreated pseudo words and real words. Two of the participants generalized to untreated words and pseudo words in in carrier phrases. These two participants were characterized as having more mild speech difficulties, thus, per the literature on ReST treatment, appears to parallel results of other studies with participants who share similar profiles.

Namasivayam et al. (2015) systematically assessed the effects of speech and functional outcomes in a group of children with CAS undergoing individual motor speech intervention subsequent to the treatment intensity of 1x a week (lower intensity) or 2x a week (higher intensity). Results indicated the group who underwent a higher intensity of motor speech intervention had greater results than the lower intensity group for articulation and functional communication.

A study conducted by Maas et al. (2012) examined the role of high and low frequency feedback on speech motor learning in four children with CAS. Feedback frequency in the context of dynamic temporal and tactile cueing or DTTC and the incorporation of integral stimulation was used as the treatment while systematically varying one of these approaches. Results obtained noted to have mixed results with showing an advantage for low-frequency feedback for 2 participants, 1 child participant had a small benefit for high-frequency feedback, and 1 child showed no change in either condition. Generalization of results for treated and untreated words were noted as limited; consistent with previous literature.

In Strand and Debertine (2006), a treatment efficacy study using the dynamic and temporal tactile cueing (DTTC), an integral stimulation based treatment, was used with four severely impaired children with CAS. Three of four participants showed change for all targeted

functional utterances. The fourth participant's inability to show measureable change was attributed to the lack of motivation and desire to participate in tasks. Although high levels of treatment sessions were provided, direct correlation was not tracked.

The study conducted by Skelton and Hagopian (2014), explored concurrent treatment with randomized variable practice to determine its effectiveness as an intervention for CAS. All participants demonstrated increased correct productions. Generalization probes, administered after every fifth session, showed increases in correct productions. For participants 2 and 3 increases were similar for both single word and three-word phrase tasks, whereas participant 1 showed increase in only single words and subsequently, a decrease in correct productions by the final generalization probe. This approach proved to be effective for this small sample size.

Maas and Farinella (2012) compared the effects of random vs blocked practice in the treatment of CAS. A two phase alternating treatments design with multiple baselines across behaviors and a withdrawal/maintenance component was used in this study. Four children, with either mild-moderate, moderate-severe, or severe speech and language delays and CAS, participated in this study. Two of the three participants showed improvements whereas the fourth participant showed no improvement. Results of the study showed mixed results for the given intervention practice with two demonstrating greater gains for blocked practice and one participant demonstrating greater gains for random practice. Evidence of participant severity and additional speech and language difficulties (dysarthria) may have played a role in fully determining efficacy of practice schedule; however, study suggests blocked practice to be more beneficial than random practice.

In a study conducted by Case and Grigos (2016), the articulatory control and speech production accuracy during a novel word-learning task that integrated motor learning principles

with typically developing children and children with CAS were examined. It was concluded that articulatory control and movement for lip and jaw movement did not change over time; jaw movement was noted to be longer in CAS participants; short and long-term changes in consonant accuracy and consistency were all noted in the novel-word learning task. This study is consistent with previous literature findings showing improved speech patterns when the principles of motor learning were incorporated into treatment.

A study conducted by Gildersleeve-Neumann and Goldstein (2015) examined the cross-linguistic generalization of speech skills as well as the effect of bilingual intervention on two children's bilingual speech systems. Although it is stated that it is likely the two speech sound systems in bilingual children are interlinked, per the dynamic systems theory, the degree of generalization had not been explored (Gildersleeve-Neumann & Goldstein, 2015). The two five-year-old participants were a) diagnosed with speech sound disorders within their perspective educational settings, with one participant diagnosis of CAS b) born to parents from Mexico and spoke little to no English c) limited English language use. A cross-linguistic intervention was conducted with the two-sequential bilingual (English/Spanish) participants for 2-3 sessions across a period of 8 weeks in both languages (in Spanish for at least 2 of every 3 days). Target selection (existence of error in both language, error rate, developmental appropriateness considerations), drill play, intense production frequency, and controlled treatment duration and frequency were conducted to measure gains across the English and Spanish languages. Treatment involved articulatory placement training, as well as cuing and feedback to ensure accurate production in isolation or single syllables. After the child produced the sound or syllable shape correctly, the target was practiced in functional words and phrases. A variety of words and phrases of varying lengths were used. When errors occurred, the utterance was reduced in

complexity and upon securing accuracy in production, the phonetic complexity was then increased. Consonant and vowel accuracy and utterance-level complexity gains were noted after treatment. Speech was noted to improve in both languages; treated patterns generalized to non-treated speech patterns across languages. Treating the stronger language (Spanish), had positive effects on the overall speech sound system of the two male participants.

The latest study included in this category was a pilot study by Gomez et al. (2018) conducted to determine the feasibility of the Kaufman Speech to Language Protocol for treating children with CAS. Two participants were engaged in prepractice, a practice phase which incorporated distributed practice, and immediate feedback of words and phrases selected. Results were mixed for the participants as C1V1C2V2 words (e.g., potty), simple polysyllabic words (e.g., animal), and C1V1C2V2 + CVC (e.g., muddy boot) demonstrated growth but it was not maintained or generalized at post treatment. Results for selected phrase production was not met.

Sensory cueing category. Thirteen studies within the category of sensory cueing, or use of senses and gesture to cue speech, had positive outcomes across various aspects of speech communication. In the case study by Klick (1985), an Adapted Cueing Technique (ACT) was implemented to improve the participant's functional carrier phrase and single word use along with oral-motor control for verbal imitation after 3 months of treatment. This ACT, or use of hand motions held by the clinician's face as visual representations of patterns of articulatory movement and manner of production of words or phrases to be repeated by the participant, is based on the manual alphabet for the deaf but, in contrast to the static characteristic of the manual alphabet, ACT includes a guided motion to represent the coarticulatory aspect of speech sound production. Throughout the treatment words and their complexity along with phrases were modified along with the cueing presentation (e.g., fading, repeating, accentuating) based on the

participants response. After 3 months of ACT treatment, an increase carrier phrase used and single words produced by the participant were noted as well as a greater oral-motor control for verbal imitation was observed. Within 6 months of beginning treatment, the participant was reported to produce novel utterances and, per parental report, an increased speech intelligibility level. The studies completed by Kadis et al. (2014), Dale and Hayden (2013), and Grigos and Kolenda (2010), involved the implementation of the Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) approach for tracking speech changes among the participants. The PROMPT approach "involves direct tactile-kinesthetic cueing applied to the mouth and face; cues inform positions and movement trajectories, thus promoting correct articulation and fluency. Tactile-kinesthetic cues are supported by visual cues and auditory models along with verbal feedback on the quality and success of speech attempts" (Kadis et al., 2014, p. 242). In Kadis et al., (2014), the goal of the study was to measure cortical thickness of 14 children between 3-6 years of age with idiopathic apraxia of speech and to describe any changes in the cortical thickness of these participants when the PROMPT intervention approach was implemented. Regions of interest imaged via magnetic resonance neuroimaging (MRI) included those responsible areas known to support language, speech and oral-motor control. Results of this study demonstrated no significant differences between control group (typically developing children) and idiopathic verbal apraxic children for overall mean cortical thickness within each hemisphere. However, a significant difference was observed in children with idiopathic apraxia as they presented thicker left posterior supramarginal gyri than those children in the control group. A significant thinning of the posterior superior temporal gyrus (or Wernicke's area) was noted for 8 of the participants, area $t(8)=2.42$, $p \leq 0.05$; with only 1 of the 3 controls showing thinning over the 8 week period of intervention. Amount of cortical thickness was not

significantly correlated to performance change on standardized speech measures, $p > 0.05$. Although cortical thickness does not correlate to degree of speech impairment, a thicker left supramarginal gyrus if sustained throughout childhood, may be indicative of immaturity or altered development (Kadis et al., 2014, p. 245). However, in adults the left supramarginal gyrus is associated with speech production and if it sustains injury, speech planning deficits such as apraxia of speech may be endured. This observed change is significant in that it is not only the first study of its kind, but it also complements how this experience evidences the "potential for rapid and robust structural plasticity in childhood" (Kadis et al., 2014, p. 240-241).

In Dale et al., (2013), 4 participants between 3 and 6 years of age participated in PROMPT intervention phases which included tactile-kinesthetic-proprioceptive (TKP) cues, and PROMPT without TKP cues (only auditory visual cues provided) and specifically explored changes in motor behavior, articulation or speech movements and speech intelligibility as well as social activity and participation domains in these children. All four participants who participated improved their performance on untrained probe words significantly (2 SD above baseline) with greater gains in phases where participants included TKP or 'full' PROMPT. According to the articulation subtest of the *Diagnostic Evaluation of Articulation and Phonology* (*DEAP*), no statistically significant score was reached across participants. Socialization skills were documented as "increased" in scores per the *Vineland* confidence intervals for all participants. Effect size measure for the PROMPT intervention as a whole was noted as "large" (0.93-1.00). In the longitudinal study conducted by Grigos et al., (2010), Grigos and colleagues were looked at motor planning and programming levels of speech motor processing through changes in articulatory movements of the jaw of CAS children and typically developing peers. In this study, a 3-year-old CAS participant was followed for 8 months. The participant's jaw movements were

tracked over time as he moved from inaccurate to accurate productions of bilabial sounds (p, b, m). Treatment focused on producing /p, b, m/ appropriately in CV (consonant, vowel), VC (vowel, consonant), and CVC (consonant, vowel, consonant) word combinations. Speech and language therapy was provided using PROMPT intervention with a focus on improving jaw movement. Movement parameters such as jaw duration, velocity, displacement, and stability were analyzed. Results of the study revealed consonant and vowel errors of the CAS participant to have decreased across sessions, but not uniformly meaning that although sound errors decreased error patterns remained inconsistent and included substitutions, distortions and additions. Changes in movement duration varied according to the target (e.g. mom, bob vs pop) but generally decreased over time. Maximum jaw displacement was noted to fluctuate across sessions. Peak opening velocity was noted to have variable significance for target words (e.g. mom vs bob and pop) across sessions, while peak opening velocity was slower for the CAS participant when compared to a control group. Movement stability of the jaw also became similar to that of the control group over time.

Yu et al. (2014) looked at the changes of oral motor control and inter-gestural coordination subsequent to the PROMPT intervention but specifically with the distribution patterns of voice onset time (VOT) for the production of the stop /p/. Yu et al., (2014) set out to determine if a more stable and accurate oral motor control and coordination could be established, if so, then it was believed that speech acoustics would improve and hence influence speech production. Results of the study determined that inter-gestural coordination between the larynx and jaw-lip movement of all participants demonstrated a shift or significant increase after intervention. After intervention, CAS participants also demonstrated less VOT variation. Motor speech control and articulatory accuracy results from formal assessments did not reach a

statistical significance, although pre and post scores of the participants was greater than initial testing prior to intervention.

Three studies engaged participants in biofeedback visual and/or tactile cueing combined with a motor programming approach (Preston et al., 2013; Preston et al., 2016; Preston et al., 2017). In Preston et al., (2016), the participants ages 10-13 were cued to modify their tongue movements during production of target sequences using visual feedback from real time ultrasound imaging. The goal was to evaluate if ultrasound biofeedback of the tongue would 1) facilitate acquisition of rhotic r in singleton and clusters at the syllable and word levels (e.g. air, rain, broom), 2) lead to generalization to untrained targets, and 3) be enhanced with cues for practicing words and phrases with varied prosody. Results concluded a level of accuracy was obtained for facilitating correct sound productions using ultrasound biofeedback, but it was not successful for all participants nor with all treatment targets (word and phrase levels). Due to not all participants reaching word and phrase level items, no data for a within-subject comparison of generalization for prosody was concluded. Limited acquisition and generalization was observed with ultrasound biofeedback for rhotic production of CAS children. In Preston et al. (2013), change in sound production was tracked through the implementation of ultrasound feedback. Ultrasound feedback was used to provide visual feedback of tongue movements for rhotic production the syllable and word level of participants from real time ultrasound imaging. As the participants viewed the ultrasound images, the speech treatment protocol included using traditional intervention approaches such as drill and drill-play activities, sound training through modeling and imitation of words, shaping, phonetic cues and verbal descriptions related to sound movement as well as self-monitoring to change sound production. Results of data revealed 23 of 31 treated sound sequences reached the performance criterion of 80%. An average of five

sessions were needed for these 23 sound sequences to reach performance criterion. Retention of these gains remained at the two-month posttreatment probe. Eight of the 31 treated sound sequences did not meet performance criterion; half of these eight sequences were introduced toward the end of the study period and received three treatment sessions. The study conducted by Preston et al. (2017) looked at facilitating motor learning by evaluating the effect of prosodic variation on speech sound generalization during ultrasound biofeedback using variable practice on speech sound targets. Results of this study demonstrated a growing trend across all six children participants with mild to moderately severe CAS that were treated for prosodic variation.

Another study conducted by Lundeborg and McAllister (2007) described the use of a combination of intra-oral sensory stimulation and electropalatagraphy (EPG) to improve lingual movement, manner and placement of articulation for a severely impaired 5-year-old participant with CAS. Intervention was provided in two steps: step 1) use of an electric toothbrush for stimulation of tongue surface, lips, alveolar ridge followed by assessment and a 3-month period of withdrawal, and step 2) articulatory training with EPG divided into three phases with 5 week withdrawals between each phase. The participants' percentage of phonemes correct increased from 56.62% to 73.3%; a significance of $p < 0.001$. The percentage of words correct was also statistically significant at $p = 0.032$. Assessment of visual deviancy observed in the articulation or movement of probe words was significant ($p < 0.01$) meaning inappropriately articulated words observed decreased. The efficacy of electropalatography as a treatment of rhotic (/r/) productions with children with CAS and other speech factors was also explored by Hitchcock et al. (2017). Results of this study provided mixed and variable results across participants for within-treatment

trials using this instrumentation. Measurements for perceptual and acoustic variables continue to be a challenge for generalization of persistent errored sounds such as the rhotic /r/.

The case study conducted by Rosenbek et al. (1974), also proved to generalize positive effects with the use of motor programming approaches in addition to the use of visual cues and gesture cues for rhythm, intonation, stress, and movement patterns of speech sequences. The number of correct productions on a 20-item sound production task increased from 0 to 20 correct across a 3-month period; overall intelligibility was also subjectively noted to have improved by 3 out of 4 non-familiar judges. The study conducted by Martin et al. (2016), examined changes in phoneme production and perceptions of resilience. The primary goal of this study was to improve the speech intelligibility of 12 children identified with CAS through the use of visual, auditory, motor-kinesthetic and tactile cues. Speech intervention using a phonetic multimodal approach had a statistically significant ($p<.001$) effect on articulation of sounds and mean length of utterance (MLU) and conversely on resilience behaviors as measured by parent perceptions.

Lastly, the unique case study by Vashdi (2014), investigated the use of an initial phoneme cue (IPC) technique with a Hebrew speaking child. The IPC is a word formation technique, originally used as a word retrieval technique for patients with aphasia, and involves prompting the first syllable of the word. The IPC technique uses auditory information to cue the participant to the next phoneme in a word while the visual cue provides the participant with information on how to pronounce the phoneme. The IPC treatment technique accounts for a hierarchal building of a motor scheme (e.g. C or V, to CV). Given that the Hebrew language consists of words mostly two syllables or more, the IPC technique better supports Hebrew common word CVCV formations. The participant was introduced to 11 words with the CVCV format and asked to

imitate without prompting and using the IPC technique. All trials conducted with the IPC technique were successful (96%) versus trials without the IPC technique (20%).

Linguistic category. Six of the studies in this review targeted linguistic and phonological components of speech as an intervention to improve speech production. Four studies implemented an integrated phonological awareness intervention paired with speech production practice. In Moriarity and Gillon (2006), an integrated phonological awareness intervention was examined. The study explored the effect of this intervention on 1) the production of phonemes correct in trained speech items, 2) phonological awareness task accuracy for trained and untrained stimulus, and 3) the ability to enable participants to use phonological awareness and letter-sound skills to improve word decoding performance. Data analysis for two participants showed improved targeted speech production or percentage of phonemes correct (PPC) and phonological awareness skills for both trained and untrained targets. Phonological awareness for phoneme segmentation (e.g., /s/ /t/ /e/ /p/) and phoneme manipulation (e.g., participant places the letter ‘s’ in front of ‘top’) as well as letter-sound skills were noted as significantly improved for two participants. Non-word readings tasks scores for both of these two participants also increased. The third participant demonstrated growth in speech production or PCC, however, results were not statistically significant. The third participant’s phonological awareness skills for phoneme segmentation, phoneme identity and letter-sound knowledge was significant; however, the phonological skill of phoneme manipulation was noted as not statistically significant. The lack of improvement and generalizability of skills to untrained targets for the third participant was noted and attributed to speech severity level (limited vowel and consonant inventory), non-verbal intelligence and/or stimulability of target phonemes.

The study conducted by McNeill, Gillon, and Dodd (2009), an extension of the study conducted by Moriarity and Gillon (2006), involved 12 children with CAS in a phonological awareness approach to improve speech production, letter knowledge and phonological awareness skills. The generalization of intervention targets to untrained, spontaneous speaking contexts, and the reading and spelling process were also explored. These 12 participants engaged in two 6-week intervention blocks separated by a 6-week withdrawal block. All treatment sessions included the phonological awareness tasks of letter-sound knowledge, phoneme identity, segmentation and blending, and phoneme manipulation. Words used in phonological awareness activities were the participant's trained speech probe words (e.g., s cluster). Of these 12, nine participants made significant gains in targeted speech sounds in trained words and demonstrated transfer of at least one speech target to connected speech. Eight participants showed gains in at least one target phoneme awareness skill and demonstrated transfer to novel phoneme awareness tasks. Results for untrained targets for speech and phonological awareness task generalization were mixed across children.

In McNeill et al. (2009), a longitudinal case study of twin boys with CAS using an integrated phonological awareness approach was conducted to explore early reading, spelling and morpho-sytnactic development of these participants. Results of this case study revealed similar significant difference findings. Speech production for percentage of consonants correct (PCC) and percentage of vowels correct (PVC) increased for both participants with noted unintelligible speech characterized by difficulty controlling speech volume, stress pattern concerns and extended pause times at second follow up. Phonological awareness and phonological representation along with early reading and spelling development were noted to improve. Expressive morpho-syntactic development for mean length of utterance (MLU) was

noted as within the expected age range; however, omissions of words (determiners, auxiliary verbs), bound morphemes, word level errors (pronouns, irregular past tense) remained present.

In McNeill et al. (2010), an integrated phonological awareness approach was further examined to evaluate the phonological awareness, letter knowledge, decoding and spelling development in 12 children with CAS diagnosed with severe speech, reading and spelling disorders and compared to a group of children with typical language development. Results revealed phonological awareness, letter knowledge, decoding, and spelling were all noted to have statistically significant improvement over the intervention period; however, at a 6-month follow-up post-intervention, assessments revealed no significant difference.

In Zaretsky et al. (2010), literacy-related cognitive deficits, including working memory capacity and phonological memory in a severe CAS child with borderline IQ were explored. The Zaretsky et al. (2010) case study involved a severely impaired CAS participant who received literacy intervention using the phonological awareness reading program entitled *Basics* which targeted phonological awareness, phoneme-grapheme (letter-sound knowledge) mapping, and reading comprehension. As of the final therapy session and 6 months post-intervention, the participant demonstrated an ability to segment words, identify short and long vowel sounds in isolation with 100%. Reading non-words and decoding remained more challenging. Identification of characters, character emotions and events in narratives, and the ability to use a graphic organizer to comprehend or write a short narrative were identified as “mastered”. Post intervention assessments revealed below average rapid automatic naming (RAN) accuracy and automaticity of informational retrieval (e.g., letter naming, naming numbers), and rapid alternating stimulus (RAS) (e.g. letters/colors/numbers combinations); well below average range of abstract sound manipulation (e.g., isolation of phonemes, tracking phonemes, counting

syllables, and tracking syllables), spelling, and reading fluency accuracy and rate. Working memory or recall and non-word repetition for four or more syllables was below the average range.

Powell (1996) presented a rationale for implementing a modular approach to increasing the speech sound productions of a child diagnosed with developmental apraxia of speech (or CAS). In Powell (1996), implementation of a stimulability approach to expand the phonetic inventory of a 3 year old child was conducted through a modular therapy approach which consisted of a series of modules. These modules included stimulating imitation task of targets, as well as planned activities to evoke, stabilize, generalize and maintain sounds. Results of this approach promoted gains in the participant's phonetic inventory from 11 consonants (biliabial, alveolar, velar) to 17 consonants across various places of articulation (labio-dental, interdental, palatal, 1 additional velar, and 5 additional alveolar).

Combination category. Five studies used a combination of both a motor programming and linguistic approach. A study conducted by Watson and Leahy (1995), documented the treatment techniques used for a period of almost 2 years for a young boy diagnosed with developmental apraxia of speech or CAS aged 3 years 1 month at the start of the study through 5 years 0 months of age. The use of multisensory techniques to facilitate speech and language skills were integrated through the use of sign language, finger spelling, modeling oral motor movements for speech, and the use of visual and tactile cues to initially facilitate the production of sounds and subsequently words. Therapy activities revolved around literacy activities (e.g., signing words in book, reading books, telling stories) and were also supported in the home environment by his mother who had an undergraduate degree in speech-language pathology. Documentation of interruptions in intervention techniques directly provided by the investigator

were noted at the age of 4;1 through 4;6 with the participant resuming intervention at the age of 4;6. By the age of 4;6 the participant had progressed to additional more advanced speech and language goals which included completion of discrimination tasks, appropriate responses to wh-questions, and the ability to produce linguistic concepts (e.g., location concepts). Over the period of time, a stimulation of various modes of communication using meaningful activities, and a deemphasized oral motor or speech production practice tasks were integrated. Growth was noted across all areas, with occasional prompting; production of a variety of syllabic shapes, an increase in phonetic inventory, occasional vowel errors and unusual prosodic patterns were noted. In Iuzzini and Forrest (2010), a stimulability training protocol paired with a modified core vocabulary treatment, which included complex phonological targets, was conducted to measure expansion and consistency of phonetic inventory. An average of 20% increase in percentage of consonants correct was noted; number of sounds added to the inventory increased, the variability of production errors decreased for 3 of the 4 participants; and the relation of inconsistency to the total number of productions also was reduced across participants. The study conducted by Martikainen and Korpilahti (2011) investigated Melodic Intonation Therapy (MIT) and the Touch Cue Method (TCM) motor interventions to target sequencing abilities, with a larger emphasis on constructed words and not on individual sounds. Segmental level analysis revealed an increase in percentage of vowel correct after follow up treatment at 93% and statistically significant at p=.019; percentage of consonants correct after both TCM and MIT reached significant improvement at 73.1% at end of study, (p=.01). Whole word complexity, or phonological mean length of utterance (PMLU), after MIT treatment block increased (p=.001); at the end of TCM intervention PMLU also increased (p=.011). Improvement was maintained; at the end of the follow-up session PMLU reached its highest level of 8.80 (p=.023). The final

article in this category included the case study conducted by Tierney et al. (2016). This study focused on the use of a multimodal approach moving the participant from age appropriate articulation to intelligible speech after treatment, which included the use oro-motor control and imitation, and repetitive mouth movement through use of *Sarah Rosenfeld Johnson's Program*, followed by the *Kaufman Speech Praxis Progr*am, an intervention program which focused sound approximations for words, use of simple sound/syllable combination to more complex sound/syllable productions. Touch cues, the use of sign language with speech prompting (home use), and a weekly home program were also implemented. Results revealed age acceptable speech sound substitutions, increase in phrase length (from single syllables to 8+ syllable phrases) that included accurate use of auxiliary and verb endings; a rare use of sign language and an increase in intelligibility as judged by parents to be at 90%-100% and by a speech therapist at >80%. Results of this study suggested the use of sign language paired with motor programming approaches to support both speech and language development in a child with suspected childhood apraxia of speech. The last study reviewed in this category was a combination study conducted by Singh and Trivedi (2016). Singh and Trivedi (2016) explored the effectiveness of the Nuffield Dyspraxia Program (NDP) with melodic intonation therapy, and a multisensory approach with an 8-year-old CAS Hindi speaker. The participant received treatment twice a week for 1 hour sessions over a period of 7 months. The parent was provided with a list of 20 most familiar words in a child's environment and asked to select five most frequently used words in the participant's environment. Treatment included imitation tasks, visual and tactile cueing, repetition of stimuli, immediate feedback, in addition to fading of cues and supports. Auditory discrimination, perception tasks, and adapted MIT steps were followed along with multisensory input simultaneously. Results of the eclectic treatment revealed improved motor speech tasks

such as word repetition rate, alternating motion rate, vowel prolongation, and non-word repetition accuracy. In addition, prosodic characteristics (e.g., stress), auditory discrimination and overall accuracy of selected stimuli words produced improved.

Rhythmic category. Three studies in this review used prosodic approaches as a form of speech production intervention. Two of these studies specifically implemented the melodic intonation therapy (MIT) approach, a systematic language intervention protocol historically used to treat brain damaged adult patients (e.g., aphasics) which uses an exaggerated intonation/melodic pattern of speech (e.g., stress, rhythm), in conjunction with speech-language therapy (Krauss & Galloway, 1982; LaGasse, 2012). The first study identified under the rhythmic category conducted by Krauss and Galloway (1982) involved two male subjects who participated in traditional speech and language therapy for two months followed by traditional speech and language therapy with MIT therapy as a systemic warm up for two months. The purpose of this study was two-fold: 1.) to determine if traditional speech and language therapy paired with a MIT approach would conclude similar effects in children as evidenced in studies with aphasic adults and 2.) to determine what modifications to the adult MIT protocol could be taken for accommodating the needs of apraxic children. This study revealed significant effect for verbal tasks such as confrontation naming objects with .01 and .03 scores for each participant respectively, and imitation tasks (single words and short sentences) were significant for one participant at .04. Mean length of utterance differences were noted at pre-test 2 to post-test with Chi square values of .02 and .005; increases included sentence length, word and morpheme production, and performance level for both participants. Marked intelligibility gains were noted for both participants using the Porch Index of Communicative Ability in Children test instrument (PICAC). Given that the PICAC is a tool that assesses verbal, gestural, reading, aural

comprehension, and visual matching skills, it's scoring procedure was not notably sensitive to articulation. No separate articulation test was administered. Modifications to the original adult MIT protocol included the use of visual materials to cue the participant in eliciting verbal output in addition to alteration of time spent with various protocol levels.

In contrast to Krauss and Galloway (1982) where the two participants served as controls of each other, LaGasse (2012), explored the speech production of two participants with CAS following MIT therapy sessions when compared to traditional therapy over a 5 week period. Alternating sessions between traditional speech therapy delivered by a speech-language pathologist and MIT treatment sessions delivered between a certified music therapist, concluded mixed results between participants. Given the assessment measures used to analyze the results of 4 MIT sessions and 5 SLP therapy sessions, data for Participant 1 depicted scores on an articulatory control test to be higher after MIT sessions than SLP sessions; however, this only consisted of a 2% gain in correct responses from the first to last session. Participant 1 yet had an overall increase of 7% on the articulatory control test over the course of the study after traditional speech therapy sessions. Participant 2 showed a 15% increase in correct responses on the articulatory control test after speech therapy sessions and 5% increase after MIT sessions. Participant 1 showed more variability in scores than Participant 2 however, both showed growth after speech therapy session when compared to MIT sessions. Participant 1 and Participant 2 data results from the *GFTA-2* and *KLPA-2* showed an increase in raw score across pre and post tests, but this difference was not statistically significant.

The third study within this category used a data-based music therapy approach with a 3-year-old CAS participant. This data-based which entailed behavioral, improvisational and creative approaches in conjunction with musical interventions, visual and interactive aids was

conducted by a music therapist (Beathard & Krout, 2008). A large focus on the interactional relationships, socializations and vocalizations of the participant were closely monitored with evolving adjustments made to the music therapy (e.g., *Hello Song, Old McDonald Had a Farm, Name Song, Button Song, Pop Goes the Bubble, the Letter Song, The Letter Song, Wheels on the Bus*) intervention approach as needed in order to stimulate the participant. Results of this descriptive case study conducted for a total of 24 sessions, revealed an increase in the child's verbal communication, socialization skills, cognitive/emotional skills, and motor skills/movement over the period of 9 months of intervention. See Table 11 for summary of interventions and options for CAS.

Table 11

Interventions and Options Used for Childhood Apraxia of Speech

Intervention/Option	Description
Rapid Syllable Transitions (ReST)	Addresses a) sound consistency through improving accuracy b) rapid and fluent transitions from segment and syllable to the next, and c) accurate production of lexical stress and demands accuracy on all three aspects simultaneously Uses polysyllabic non-words Applies principles of motor learning Procedure: a) each session divided into pre-practice and practice 1) prepractice session: introduce skill and stimuli to be trained and provision of opportunities to attempt skill with clinician support and cuing 2) practice session: a) majority of session b) involves high number of trials (≥100) c) variable practice/train more than one variation of a skill, random order of stimulus presentation d) low frequency feedback on knowledge of results (feedback on accuracy only) presented with 3-5 seconds delay between response and feedback Dosage: 10-12 1 hr sessions 3 times a week (Murray et al., 2015)

Dynamic Temporal and Tactile Cueing (DTTC)	Treatment method based on integral stimulation which facilitates the ability to achieve initial articulatory configuration and then transition to movement. Follows the "watch and do what I do" reinforcement, along with implementation of phonetic placement, tactile cueing, prosodic cuing, and gestural cuing techniques in variation and gradually faded with repeated practice. (Strand et al., 2006)
Cross-linguistic intervention/bilingual intervention	Based on dynamics systems theory which explores the inter-connections between systems; (i.e., two languages of a bilingual child are linked in development) (Gildersleeve-Neumann et al., 2014)
Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT)	Tactually grounded approach used to stimulate muscle activity and guide articulatory movement by touching and manually manipulating a child's external physical structures that are used for speech production (Hayden, 2004)
Nuffield Dyspraxia Programme-3rd Ed. (NDP3)	Commercial intervention product, primarily used in Australia and the United Kingdom, which uses a psycholinguistic framework to address motor planning and programming (move from isolated sound, simple/complex syllable shapes, sentences, and connected speech) of children 4-12 year of age. Linguistic concepts (i.e., phonological contrasts such as minimal pairs and auditory discrimination) with morphosyntactic and phrasal stress stimuli in later steps of the program (Murray et al., 2015). Recommended treatment sessions: 1 hr 1-2x per week with daily home practice (Murray et al., 2015)
Kaufman Speech to Language Protocol	Commercial treatment program which uses approximations of the target to facilitate the development of functional vocabulary until motor learning improves and allows for the use of more complex structures (Gomez et al., 2018)

Touch Cue Method	Speech sound sequencing program which uses topographic indicators by touching a particular area on the lower face or neck. Cues are given simultaneously with auditory and visual stimuli. Cues are paired simultaneously. Clinician provides model and cues to look at clinician's mouth during production. Program moves through syllable hierarchies, multisyllabic words, and multiword utterances in spontaneous speech. Drill play and self-monitoring are emphasized (Bashir et al., 2008)
Concurrent Treatment	Motor learning approach Two phases: 1) *establishment phase* whereby participant learns motor movement of target sound(s) in initial and final position of CV and VC syllables until has 8 out of 10 correct target sound productions 2) *practice phase* whereby participant practices target sound in practice tasks that range over all relevant word positions, in multiple response levels (syllables, words, phrases, sentences and storytelling), produced in imitative or non-imitative responses. Tasks are practices in random order with order changed every session
Integral Stimulation	Method that varies temporal relationship between the stimulus and response, initially providing maximum multisensory cueing, for articulatory movement, then gradually fading cues (Strand et al., 2000)
Principles of Motor Learning	Transfer of knowledge outside of the practice session to novel situations Incorporates 4 principles: 1) precursors to learning a) establishment of trust b) informing participant of goal of treatment c) understanding of tasks and procedures by participant 2) conditions of practice (repetition) a) *blocked practice* or when one target is practiced at a time; valuable when first learning a new skill as it provides repetitive and numerous opportunities for practicing speech movement b) *random practice* or more than one target is practiced in the same activity

c) *mass practice* or length of session and time (e.g., 60-minute session a week)
d) *distributed practice* or length of sessions distributed over the course of a week (e.g., three 20- minute sessions a week)
e) *practice variability* or practicing the speech targets in different word positions within words or phrases, in conversational speech or settings

3) feedback
   a) *extrinsic feedback* or feedback given telling whether the speech target was correctly articulated
   b) *intrinsic feedback* or feedback that comes from assessment of own target articulation performance

4) influence of rate
   a) *slowed* rate to influence success in target production
   b) *increased* rate until speech production similar to connected speech

(Edeal et al., 2011; Skelton et al., 2014)

Dependent variable or speech production and intelligibility level. Various dependent variables were targeted across the studies reviewed. The largest represented dependent variable included in the studies were word with 24% (n=10); followed by word and phrase with 12% (n=7) (see Table 12).

Table 12

Dependent Variable or Speech Production and Intelligibility Level Targeted

Variable/Level	Number of Studies
Syllable	5
Vocalization, phoneme, words	1
Word	10
Word, phrase	7
Phoneme, syllable, word, phrase	2

Phoneme	1
Syllable, word	2
Syllable, word, phrase	1
Phoneme, syllable	1
Utterance length	1
Utterance	2
Syllable, word, sentence	1
Sound, syllable, word	1
Sound	1
Phoneme, phrase	1
Phonological awareness	
Phoneme	2
Speech sounds, oral sequencing, speech print connections, syllabic structure, real and non-word decoding	1
Early reading, spelling, and morphosyntax	1
Phoneme and phoneme grapheme relationship	1

Parental involvement or home programs. Only 5 studies included parents in their intervention approach or incorporated a parent home program (Edeal et al., 2011; Lundeborg et al. 2007; Namasivayam et al., 2015; Tierney et al., 2016; Watson et al., 1995). In Namasivayam

et al. (2015) the study included active participation of the caregiver with the CAS child participant throughout the intervention session. The speech-language pathologist provided the caregiver coaching support and opportunities to practice the session strategies within the session in order for the caregiver to carryover strategies in the home environment. Each session also incorporated follow-up discussions specific to strategy success or challenges in the home. In Lundeborg et al. (2007) homework tasks to support the intervention strategies were provided to parents on a weekly basis, however, specific homework tasks were not specified. In Tierney et al. (2016) the use of a multimodal intervention approach was completed through a weekly home based and center-based environment for the single case participant. Parents, who had introduced sign language to their child at 18 months of age and prior to the study intervention, were encouraged to continue the use of sign language with speech prompting in the home environment. No specific documentation of sign language used or supported was indicated. In the multimodal intervention approach study by Watson et al. (1995) it was noted that the single case participant's mother was trained as a speech-language pathologist at the undergraduate level. Carryover of techniques and principles such as the use of sign language in the home and exposure to print and book reading were reported to be provided throughout the period of the intervention; however, a specific parental program was not outlined. In Edeal et al. (2011) families were asked to participate in practice activities of targeted intervention sounds at home. Home practice tasks were described as being functional and part of the families' daily routines. Other details of the parental home tasks were not provided. Finally, in Singh et al. (2016), the parents were asked to assist in the selection of word stimuli in order to ensure that practice targets were frequently used words within the participant's natural setting. In addition to

assisting in word targets selected, parents were provided with home practice activities that were part of the Nuffield Dyspraxia Programme (NDP) protocol.

Maintenance. A review of maintenance such as follow up or systematic checks over a period of time were examined. Of the 42 studies, 25 studies did not include maintenance procedures and 17 of the studies reviewed included maintenance procedures (Edeal et al., 2011; Gomez et al., 2018; Grigos et al., 2010; Hitchcock et al., 2017; Klick et al., 1985; Martikainen et al., 2011; McCabe et al., 2014; McNeill et al., 2010; Murray et al., 2015; Powell, T.W., 1996; Preston et al., 2013; Preston et al, 2017; Rosenbek et al., 1974; Thomas et al., 2014; Thomas et al., 2016; Tierney et al., 2016; Watson et al., 1995). Across 13 of the studies (Edeal et al., 2011; Martikainen et al., 2011; McCabe et al., 2014; McNeill et al., 2010; Murray et al., 2015; Powell, T.W., 1996; Preston et al., 2013; Singh et al, 2016; Thomas et al., 2014; Thomas et al., 2016; Tierney et al., 2016; Vashdi, 2014; Watson et al., 1995), formal or informal speech and language assessment measures were administered during a lapsed period of time from the conclusion of the intervention. Some examples of formal measures used included the *Goldman-Fristoe Test of Articulation*-2, *Kaufman Speech Praxis Test*, and the *Diagnostic Evaluation of Articulation and Phonology Inconsistency Test (DEAP)*. Some informal measures used to measure maintenance of skills included a sound probe, pseudo-word productions, language sample (i.e. narrative, spontaneous), which included analysis of consonants correct, vowels correct, utterance length, syllable or word shapes used, phonetic inventory and speech intelligibility, were measured. Other studies typically followed up with the study participant parent(s) or familiar communicative partner (e.g. teacher) over a specified period of time (i.e. weeks and months) to measure sustained progress or growth in speech production skills without specifically administering an assessment measure (Grigos et al., 2010, Klick et al., 1985; Rosenbek et al., 1974).

Review of Existing Literature Reviews

Five published literature reviews on the topic of intervention for CAS, treatment outcomes for CAS, increasing speech intelligibility for CAS, motor based intervention protocols in treatment of CAS, as well as efficacy of CAS interventions were identified and analyzed for purpose, participant age, intervention focus and results. One literature review was published in 2008, three in 2014 and one in 2018 (Koehlinger, 2014; Maas, et al., 2014; Morgan & Murray, 2018; Morgan & Vogel, 2008; Murray, et al., 2014). Three literature reviews had explicitly stated participants were between 3-16 years of age (Koehlinger, 2014; Morgan et al., 2008; Morgan et al., 2018) and two literature reviews had unspecified age ranges for participants or indicated participants were "children" (Maas et al., 2014, Murray et al., 2014). The purpose of two of the literature reviews was to examine research designs (Morgan et al., 2008; Murray et al., 2014) whereas three literature reviews examined trends in treatment or optimal approaches to intervention (Koehlinger, 2014; Maas et al., 2014; Morgan et al., 2018). Results of three literature reviews summarize evidence in motor based treatment approach to support speech production (Koehlinger, 2014; Maas et al., 2014; Murray et al., 2014). The literature review completed by Morgan et al., (2008) reports a lack of intervention evidence through the deficiency in RCT and quasi-randomized studies which is attributed to the absence of a definitive diagnostic system, limited understanding of aetiology and low incidence of the disorder. Whereas Morgan and Murray (2018) also state the urgent need for RCT studies, this review additionally states the effectiveness of NDP3 and ReST of children within the ages of 4-12 years with CAS with no other comorbidities, it also calls for more control of study variables such as duration, dose, intensity of treatment, response of subgroups (e.g. age based, genetic diagnosis, speech and language symptomology), impact of timing of treatment, and effects of administrator

of treatment (clinician, parent, teacher aide, participant administered). Table 13 shows published literature reviews.

Table 13

Published Literature Reviews

First Author (year)	Purpose	Participant age & intervention focus	Results
Morgan et al. (2008)	review RCT, quasi-randomized studies; efficacy of intervention	3-16 y/o not specified	0 studies met criteria; lack of intervention evidence as a result of lack of definitive diagnostic system, limited understanding of aetiology and natural history of CAS, low incidence of disorder
Maas et al. (2014)	trends in treatment	"children" motor-based protocol; motor based approach (target selection, integral stimulation ReST, NDP3, PROMPT, biofeedback)	Number of studies unspecified; protocol; motor-speech improvement; many differences between approaches; evidence base varies
Murray et al. (2014)	single-case experimental treatment (SCED); study quality, treatment procedures, treatment outcomes, certainty of evidence	"children" not specified	42 studies; 23 SCED, 19 case report or descriptions, 1 quasi-experimental, 0 RCT; 11 motor approach, 10 linguistic approach, 2 AAC, 7 combined approach, 2 linguistic; integral stimulation (IS)/ DTTC, ReST, and Integrated

			phonological awareness (IPA)intervention demonstrated treatment and maintenance evidence; 2 motor treatments (DTTC/ integral stimulation) oand 1 linguistic treatment (IPA) generalization effects
Koehlinger, (2015)	optimal approach to use in intervention	8 y/o-under unspecified	11 studies (all SCD); greatest volume of evidence in motor learning approaches DTTC/IS, 2 combined approach studies had positive outcomes; insufficient support for combined approach over single approach
Morgan, et al. (2018)	assess efficacy of interventions	3-16 y/o motor-based, linguistic, multi-modal	limited RCT studies; range of studies with limited rigor; NDP3 and ReST has supportive evidence; further studies need consideration of dose, duration, intensity, age, comorbidities, effect of administrator of treatment

Results

The purpose of this literature review was to examine the existent body of literature of intervention models for bilingual and monolingual children between the ages of 3 and 10 years old diagnosed with or suspected of childhood apraxia of speech. While only three studies included participants who spoke a language other than English during the intervention, 39 studies met the other criteria related to intervention approaches when working with children with or suspected of childhood apraxia of speech. Although various intervention approaches were

identified and can be grouped by categories, motor-programming and sensory cueing intervention approaches were the most frequently occurring intervention categories across the body of literature with continually growing trends across categories.

The largest body of articles which met the inclusion criterion in this literature review consisted of the motor-programming intervention model. These intervention studies focused on the principles of motor learning (PML) which included condition of practice, feedback, and influence of rate on the increased performance of the targets and transfer of knowledge and skills to novel situations outside of practice sessions. This specific intervention approach for CAS contributed to positive changes in the speech production outcomes for participants at various levels of speech production tasks such as syllables, words, non-words, and utterances, regardless of severity of disorder (e.g. mild, moderate, severe). Although many of the studies within this category targeted improving segmental errors such as inconsistent errors on consonants and vowels, some studies within this category had an emphasis on the use of temporal parameters of prosody or lexical stress, additional core features of CAS, in conjunction with PML for improving the speech skills of the participants. Many studies within this category attributed prosody or lexical stress to be a persistent characteristic present among the study participants irrelevant to the segmental gains made.

The sensory cueing intervention model by definition involved the use of senses as well as gestures to cue aspects of the targeted speech sound. The use of ultrasound, biodfeedback, multimodal techniques such as correction through visual, tactile or gestural cues, and the prompts for restructuring oral muscular phonetic targets (PROMPT) techniques were noted to impact speech targets of the participants at the syllable, word, and phrase levels. Studies using ultrasound and biofeedback specifically analyzed and measured the coarticulatory transitions and

coordination between sounds and oral motor systems (e.g. tongue, jaw, lips). Although visual technology was noted to be effective, the need for multimodal input was shown to be an explicit contributor to providing segmental gains. The sensory cueing intervention model, which comprised of multimodal techniques and PROMPT, appeared to be more vastly applied to younger children ranging from the ages of 3 through 6 and a half years of age with biofeedback and the ultrasound techniques being applied to older children 9 years of age or greater. For many of these participants, the severity of the CAS disorder was noted to be unspecified which can potentially challenge and require a detailed analysis of participant profiles of CAS characteristics to better understand the application of the intervention model and its techniques.

Conversely, linguistic intervention for CAS appeared to have greater mixed outcomes for speech production. Linguistic intervention models, which have a greater focus on CAS as a language disorder, were used in seven of the studies reviewed. Four of these studies had a focus on phonological awareness intervention for children with CAS. In the study by Moriarity et al., (2006) phonological awareness tasks included identifying phonemes in isolation, identifying beginning and ending phonemes in words, phoneme segmentation and blending, and phoneme manipulation. In this study, two of the three participants significantly improved in phoneme segmentation, however, one participant showed no significant improvement for trained or untrained phoneme manipulation tasks. The lack of positive gains was attributed to the level of severity and non-verbal intelligence characteristics of the participant when compared to the other participants within the study. In McNeill et al., (2009) participant gains for vowel and consonant targets at the single word level were noted with improved consistency of speech production patterns in an integrated phonological awareness task that included letter-sound knowledge, phoneme identity, segmentation, and blending manipulation. Although consistency of errors

were noted, intelligibility of connected speech continued to be decreased due to volume control, stress pattern errors, and morphological errors which commonly characterize children with CAS. In McNeill et al., (2010), the longer term effects of a phonological awareness program yielded concluded positive effects on the CAS child for spelling, phonological awareness, and decoding but these effects were not sustained or generalized in a follow-up check 6 months later. This finding continues to characterize the persistent symptoms of children with CAS. Integrated phonological awareness approaches that promote phonological awareness and decoding development require further exploration as the treatment gains are not consistently maintained. The need to further explore the impact of greater time blocks of intervention under this intervention type and/or the nature of its impact relative to CAS is necessary.

The combination intervention category which is defined by the use of both motor-programming and linguistic approaches, consisted of five studies in this review. The combination intervention category had mixed outcomes on vowel production, speech sound error variability, and variance in speech prosody (Iuzzini et al., 2010; Watson et al., 1995). In Martikainen et al. (2011), the use of melodic intonation (MIT), or sequencing sounds and words using a prosodic element of speech such as melody, tempo, rhythm and stress paired with the Touch-Cue Method (TCM), sequencing of speech sounds supported by giving touches to child's face and neck, noted vowel improvement across the study period and fluctuating results for consonants during the various blocks of intervention; although at the end of the study, gains were noted in speech sound sequencing. In Tierney et al. (2016) the use of sign language paired with a motor planning program for a single case participant, who was 1 year 10 months at the time of the study and 3 years 6 months at the conclusion of the study, demonstrated mild speech and language deficits. At termination of the study, the participant increased in speech intelligibility for phrases and

word productions. This study concluded that the use of sign language, an alternative method of communication, paired with an intense motor planning program contributed to a more reduced level of communicative frustration which was felt contributed to his ability to expand on his expressive language skills and social pragmatic skills. In general, many of these studies incorporated a level of intensity which is often attributed to the principles of motor learning and may need to be further scrutinized to determine its contributed impact on speech outcomes per the intervention.

The least number of studies analyzed in this review included intervention within the rhythmic category. This category emphasizes the use of prosody and patterns such as melody, rhythm, and stress to improve functional speech production. Melodic intonation therapy (MIT), a historically adult therapeutic technique which uses melody and intonation to facilitate language, was adapted with modifications throughout these studies. Modifications for the participants within these studies included the use of visuals, gestures or prolongations in phrase productions (Krauss et al., 1982; Lagasse et al., 2012). The use of rhythmic intervention was noted to be effective in increasing articulation of speech targets and language (e.g. vocabulary, phrase and sentence production, fluency and prosody) which corroborates with the adult protocol findings, however, the level of significance and its appropriateness when used with children with CAS warrant further investigation. In Beathard et al. (2008), a severely delayed non-verbal CAS girl participant was noted to engage in syllabic verbalization and demonstrate an emerging functional vocabulary. In general, these studies found rhythmic intervention to be effective across moderate to severely delayed children with CAS. Adapting the rhythmic intervention to include visual and interactive aids, engaging in playful dialogue and implementing the element of fun through

various play activities was considered important and necessary as the original adult protocol was characterized as monotonous in nature for children (LaGasse, 2012).

Of the participants engaged across the studies reviewed, 35% of the participants were within 5 and 6 years of age. Males across the studies comprised 61% of the participants tallied across all studies reviewed, which corresponds to the figures reported by the U.S. Department of Health and Human Services (2016), noting the prevalence of males ages 3-17 as being more likely (9.6%) to have a voice, speech, language swallowing disorder when compared to girls (5.7%). The diagnosis label has evolved across time since the 1970's with childhood apraxia of speech being predominantly used in the later studies.

Seventy-eight percent of the studies reviewed employed single case research designs among children with CAS, with 12% employing descriptive case studies and only about 2.5% (or 1) of studies utilizing randomized control trials. Although the importance of randomized control trials remains necessary in order to reduce bias and determine effectiveness of intervention, single case research designs continue are used effectively to explore change, especially among bilingual CAS children as this literature is so limited. Studies conducted over longer periods of time, inclusive of maintenance and stability of behaviors, and the use of larger sample sizes continue to be needed to establish therapeutic efficacy across this age group of children identified with childhood apraxia of speech. Reliability and/or treatment fidelity was not always reported across the studies reviewed which, according to Gast and Ledford (2014), a clear and concise description of treatment should be described in sufficient detail in order to allow other investigators to replicate procedures. Given the low number of studies which reported reliability and/or treatment fidelity, this becomes an important marker to consider in future intervention studies.

Many of the studies reviewed implemented varied intervention treatment frequencies, duration and time. In Namasivayam et al. (2015), Edeal et al. (2011), and Thomas et al. (2016), the employment of a motor programming intervention approach was explored to determine the effect of intensity and frequency. In Namasivayam et al. (2015) higher intensity treatment, meaning participant receiving intervention 2x/week for 10 weeks, had greater effects on articulation and functional communication when compared to lower intensity (1x/week for 10 weeks). Similarly, in the study conducted by Thomas et al. (2016) rapid syllable transition (ReST) was used to treat 5 CAS children over a period of 4 times a week for 3 weeks. Findings of the ReST intervention revealed significant improvements in words and pseudo-word productions across a low-dose frequency of treatment. Whereas in the study by Edeal et al. (2011) which reported that the greater amount of production practice, approximately 150 trials per session, had a strong correlation to response to treatment. Essentially, these studies reveal the importance of production practice intensity. However, across the studies reviewed frequency, duration and time of treatment varied significantly. The question of efficacy remains for the dosage, intensity, and frequency as it pertains to treatment for CAS as these variables have not been concisely delineated in the literature.

Although 27 of the 42 studies did not specify the level of severity, 15 studies documented various CAS severity levels and demonstrated various positive outcomes. Even though severity levels may not have been documented, many of the 15 studies described the participant characteristics, conducted various assessments and compared findings to CAS characteristics identified through ASHA 2007 diagnosis standards. The severity level of the participants across many of the studies in this review had an effect on the treatment outcomes with less severe demonstrating greater gains and more severe demonstrating more mixed results. Further control

of participant severity levels needs to be addressed in order to secure efficacious intervention practices for this population. Documenting the CAS child's level of severity and other comorbidities may be significant for selecting an intervention approach as the intervention choice has a direct effect on outcomes and highly related to assessment and diagnosis (Moriarity et al., 2006).

Furthermore, across the literature reviewed, a sizeable variety of assessment tools were used for either establishing pre-test data, or post intervention data. Relative to post intervention, several challenges arose in measuring the growth of treatment outcomes. Although many studies revealed positive outcomes in data analysis, the lack of sensitive assessment tools contributed to gross difficulty in capturing the suggestive treatment outcomes. An appropriate set of measures would include measuring artic, prosody, volitional movements, diadochokinesis, and oral-motor control (LaGasse, 2012). The lack of specificity in assessment measures contributes to not only challenges in the identification of the disorder but also in the documentation of the impact contributed by the independent variable. Assessment measures then becomes critical for the validity of outcome measures.

Five studies included parents in the intervention approach, incorporated a parent home program or provided a specific parent training component. Studies which incorporated parental involvement varied across intervention categories of motor programming, sensory cueing, and combination approaches (Edeal et al., 2011; Lundeborg et al., 2009; Namsivayam, 2015; Tierney et al., 2016; & Watson et al., 1995). Studies which incorporated a parental component reported positive outcomes for speech (Edeal et al., 2011; Lundeborg et al., 2009; Namasivayam et al., 2015). However, details of the training, framework for the training, or the home program assignment or activities were not always delineated. Parental involvement was described from

coaching, reviewing of strategies, to homework or continuation of session based activities. Even though not every study delineated the parental program in detail, support outside of the intervention sessions was noted to contribute to reducing child anxiety and frustration, and also enabled the families to become active contributors to their child's ability in continued sound practice outside of the intervention environment (Namasivayam et al., 2015; Tierney et al., 2016, Watson et al., 1995). The study conducted by Singh et al. (2016) accounted for cultural variability in engaging the Hindi speaking parents in the stimuli selection for intervention. This extension substantiated collaborative efforts within a socio-cultural framework with concerted efforts to maximize the natural contexts of the participant; results of this eclectic study concluded positive gains. Similar variables should be further explored when working with children with various cultural and linguistic backgrounds.

Maintenance procedures to measure generalization of skills learned varied in representation of research designs across studies. Twenty-five of the studies reviewed did not engage in maintenance procedures while those studies that did engage in maintenance procedures found mixed to no generalization at various periods post intervention. The perplexity of the motor learning variable associated with CAS was often cited as a possible indicator to the lack of generalization of dependent variable skills post intervention.

In review of the studies, positive or statistically significant evidence exists for implementing multiple approaches and techniques when treating children with CAS. At present, no one specific approach can be assumed or concluded to be the most effective for treating all children with CAS. There continues to be a large emphasis and caution that should be assumed when targeting the speech production skills of a CAS child. Addressing the child's symptoms, speech characteristics and speech targets uniquely when selecting an intervention approach is

important as certain intervention models may be more or less effective given the client's age, speech level, language use, and severity of delay. See Appendix A for an abbreviated summary.

Discussion

Implications for Research

Many of the studies reviewed applied existing knowledge of adult apraxia of speech principles, frameworks or conditions, such as Melodic Intonation Therapy (MIT) and the principles of motor learning, seeking to replicate or refute its generalization to children with motor speech disorders. Given the lack of clear diagnostic procedures, etiology, low incidence, and uniqueness of the disorder across various levels of speech production (consonant, vowels, sound, syllable, word, etc.), children with persistent speech sound disorders with core impairment in motor movement sequences continue to present challenges in selecting an appropriate treatment approach (Krauss et al., 1982; LaGrasse et al., 2012).

Since evidence- based intervention practices for bilingual children are largely adaptations of monolingual English intervention practices, the lack of clear assessment and intervention procedures from a monolingual perspective becomes even more detrimental to service delivery of bilingual children. Two of the three studies conducted with speakers of a language other than English, discussed the nuances and differences of the language and engaged in target selections that were specific to the language being used in treatment. In the study conducted by Gildersleeve-Neumann and Goldstein (2015), the framework used was not an adaptation of the English language framework but a framework that is more specific to developing bilingual speakers (Gildersleeve-Neumann, 2015). Gildersleeve-Neumann and Goldstein (2015) hypothesized that selecting errored speech sound targets that were represented in both languages at high rates and treating the speech errors in both languages would result in a cross-linguistic generalization to the speech repertoire of the bilingual child. Goals that were chosen as targets

for intervention were selected based on frequency of occurrence in both English and Spanish, as well as the developmental appropriateness of the child. This study engaged two bilingual boys, one who was diagnosed with CAS and the other who was diagnosed with a moderate speech sound disorder not specifically CAS. The language of intervention during this study was both in English and Spanish, but the treatment ratio emphasized Spanish with approximately three of four sessions being provided in Spanish. This emphasis was based on the participants' length of exposure to English, and home and school profiles of each which were described as being strongly influenced and motivated by the language use within the home setting, language use with friends and family and their stronger receptive and expressive Spanish language skills. Results of this study showed that bilingual treatment, regardless of the greater emphasis on Spanish as the language of intervention, was noted as effective in treating the speech sound disorder for both participants. In the study by Vashdi (2014), a 10-year-old girl with autism spectrum disorder and CAS participated in an intervention using the initial phoneme cue technique (IPC) for treating word formation in the Hebrew language. In the English language, a CV format followed by a CVC format and CVCV form demonstrates a growing complexity of motor tasks. A hierarchal process of treatment would entail building the ability to control the motor task and then subsequently creating various motor schemes to eventually build on more complex motor schemes (Vashdi, 2014). Given that the Hebrew language is made up of words that are two syllables or more and few words exist in the CV format or a CVC format, the IPC technique was adapted for treating word formation in the Hebrew for this participant. The IPC technique, usually used as a word retrieval technique for anomia, provides auditory and visual information and is considered sensitive in supporting the syllable formation needed for the production of the CVCV format and Hebrew word structure. This intervention framework

provided a useful and effective technique for this child. Support for this given syllable format was eventually faded and retrieved independently, however, more complex word structures for the Hebrew language continued to require intervention in order to expand her expressive language skills beyond the CVCV word structure.

For a bilingual child with CAS, cultural references will be necessary as bilingual children access two speech and language systems (Gildersleeve-Neumann et al., 2014; Vashdi, 2014). The "two speech sound systems of a bilingual child likely are inter-linked which would allow intervention effects in one language generalize to the other" (Gildersleeve-Neumann et al., 2014). For a bilingual child with speech needs, efficacy of treatment will rely on language environments and language needs (Gildersleeve-Neumann et al., 2014). The emphasis on language of intervention should be based on the age, length of exposure to English, home and school profile of the child with CAS (Gildersleeve-Neuwmann et al., 2014). Results show that bilingual treatment is effective in treating speech sound disorders in Spanish-English speaking children yet too few studies have examined this specifically (Gildersleeve-Newumann et al., 2014).

More research is needed to provide practicing speech-language pathologists with knowledge in identifying and treating children with CAS. Notably, the lack of a clear etiology and agreed upon characteristics for the identification of CAS exacerbated by the terminology classification variations and alternatives used across the literature, contribute to the prelude of complexities with not only the diagnosis of this population but also the treatment. Given the complexities of the CAS disorder, the various intervention approaches need to be better understood so that speech language pathologists can address the unique needs of this population. Greater gains in understanding of the treatment and element complexities specific to the child,

could potentially influence the speech production skills at all levels of communication for the CAS child.

Parental involvement and home programs require a more in depth analysis in relation to the apportionment and implementation. Methods, preparation, and its causal effects warrant further exploration. Specific delineation of parental involvement framework may be necessary in order to support generalization in implementation of support strategies at home. A clearer and more specific outline of expectations, strategy implementation and use can contribute to increased favorable speech outcomes for a child with CAS. An increased level of production practice and frequency can be assumed by the child with CAS when parents are provided with learned strategies to facilitate and support continued practice of speech targets in the home environment.

Implications for Practice

If children with CAS are to improve their overall speech intelligibility, it is important to engage in clinical practices that are effective in meeting their needs. Given the limited number of conclusive intervention models to support monolingual English speaking children with motor speech disorders, the lack of studies to guide intervention approaches for bilingual children with motor speech disorders is not surprising. A speech-language pathologist working with bilingual children with speech sound disorders requires a specific knowledge base and set of skills and procedures from those required when working with a monolingual child with speech sound disorders (Verdon et al., 2015). Preservice SLP programs and practicing SLP's may require significant knowledge and skills to better identify and treat children with CAS as procedural differences may include challenges from the referral, assessment, intervention, educational training, and even the ability to access and work with interpreters (Verdon et al., 2015).

Given the representation of CAS on school speech-language pathologists (SLP) caseloads, access to evidence-based practice for treatment at the group level becomes of concern given that many of the studies reflected outcomes based on individual session implementation. Given the nature of school setting speech-language pathologists caseloads, individual sessions may not be plausible. When working with bilingual CAS students, cultural and linguistic variables will also need to be considered (Gildersleeve-Neumann et al., 2015; Vashdi, 2014). The impact of English intervention models may be adapted but will require modifications to meet the specific characteristics of the language, the child's verbal needs, environment, and overall language use. Thus, again emphasizing the need for specialized skills by speech-language pathologists working with bilingual children with CAS and the recognition of individual differences given the linguistic background of the child along with the nuances of bilingual language development.

Innovative approaches to treatment of children with CAS is important as symptoms may continue to persist throughout life (Ballard, 2010). Thus, marking the significance of parental involvement and home program development exploration for continued support of children with CAS. Recognizing the limited number of studies which incorporated parents and implemented home programs, further research needs to be conducted to explore how parents can become more involved and contribute to the frequency, intensity and support of the child's verbal development, socialization, and overall expressive language success across all communicative partners and environments.

Moreover, children with CAS have been found to exhibit reduced literacy skills specifically reading, spelling, and writing and are targeted for speech and language therapy. The effects of a linguistic approach with an integrated phonological awareness approach has a

growing body of literature of positive outcomes for supporting phonological awareness skills, letter knowledge, and decoding skills, however, caution is warranted as results were mixed and not necessarily generalizable (McNeill et al., 2009; McNeill et al. (2010); Zaretsky et al. (2010). School based speech-language pathologists may have to implement multiple intervention approaches to support the needs of the CAS student not only at the oral level but also at more advanced language levels such as reading, spelling and writing which can adversely be effected as a result of persistent speech sound disorders such as CAS.

It is essential to explore viable and evidence-based intervention practices when working with children with CAS. Multiple variables and frameworks should continue to be examined. Providing all children diagnosed with or suspected with CAS the appropriate intervention approach and techniques will contribute to their improved verbal output and communication skills across all contexts and environments.

III. RESEARCH PAPER

The Implementation of Video-Self Modeling for Devleoping Bilingual Children with or Suspected of CAS

Speech sound disorders continue to be common developmental conditions affecting anywhere btween 2%-25% of children between the ages of 5 to 7 years of age (ASHA 2007; Sices et al., 2007). Although specifically the prevalence of childhood apraxia of speech, a speech sound disorder, is unclear it is evident in the literature that speech sound disorders can have a strong impact on children academically and socially (ASHA, 2007; Lewis et al., 2004, Verdon et al., 2015). Challenges with speech production have an effect on phonological awareness skills and in turn literacy development such as reading and writing (ASHA, 2007; McNeill et al., 2009; McNeill et al., 2010; Zaretsky et al., 2010). Moreover, speech intelligibility due to impacted accuracy of speech productions can effect oral language and consequently negatively impact the child's ability to effectively engage in social interactions (ASHA, 2007; Skebo et al., 2013; Verdon et al., 2015).

Given the vastly growing U.S. population, the non-English languages continue to populate public schools, and in turn, legal and ethical considerations need to be assumed when servicing and educating the culturally and linguistically diverse population (ASHA, 1985; Ford, 2012; IDEA, 2004;Waitoller, 2014). Given the current membership of speech-language pathologists within the American Speech-Langauge Hearing Association ill equipped to provide services to bilingual children, the need for evidence based intervention practices for treating bilingual children with special needs is of concern (ASHA, 2016).

Current intervention models cited in the literature for treating childhood apraxia of speech can be grouped by categories: motor-programming, sensory cueing intervention,

linguistic intervention, rhythmic, and combination models; with motor programming and sensory cueing intervention approaches showing the greater body of studies conducted. The motor-programming category intervention is best described as including the conditions of practice, feedback, and rate influence over the performance of speech targets and the transfer of knowledge and skills to various speech situations (Edeal, et al., 2011; Skelton et al., 2014). The sensory cueing intervention model is by definition a model by which the use of senses as well as gestures cue the speech target whereby visual, tactile, gestures or physical prompts may be used to impact the speech production target (ASHA, 2019). These two intervention model categories have been used effectively in combination to increase the speech production of children with CAS (Dale & Hayden, 2013; Klick, 1985, Martin et al., 2016; Rosenbek et al., 1974; Vashdi, 2014; Yu et al., 2014). Although studies have been successful in the use of motor programming and sensory cueing intervention approaches, to date, a limited number of intervention studies have been idientified to treat bilingual children identified with or suspected of CAS (Gildersleeve-Neumann & Goldstein, 2015; Singh & Trivedi, 2016; Vashdi, 2014)

The complexties in treating bilingual children need to be taken in to account and therefore a culturally responsive approach to treating a bilingual and bicultural student is imperative (Mahari de Silva et al., 2018). Bilingual children's speech systems may occur under variable environments, language history, language use, and language proficiency levels (Gildersleeve-Neumann, 2005; Pieretti & Roseberry-McKibbin, 2016 Thelen, 2003). As it is explained by the principles within the Dynamic Systems Theory, variabilities across children and their development can occur at many levels and at different time scales. Thus, the cross-linguistic effects on dual-language and speech development should be accounted for particulary in the selection of bilingual intervention practices (Gildersleeve-Newumann & Goldstein, 2015).

No research has directly used video self-modeling as a sensory cueing intervention approach to treat pre-school aged bilingual children diagnosed with or suspected of childhood apraxia of speech. Video self-modeling is the concept of providing video models to an individual self-engaging in the desired behaviors or skill of interest (Bellini & Akullian, 2007). Albert Bandura in 1977, initially theorized that children who attended to a model were in fact more likely to imitate that model or behavior if motivated by that model. If the self becomes the model, the child has a visual of himself or herself executing the behavior correctly, which may in fact then increase one's self-efficacy (Bandura, 1977; Dowrick, 2012). Video self-modeling has been documented to have a positive behavior change across a variety of physical, social, and educational variations (Bellini et al., 2007; Buggey & Ogle, 2012; Edwards & Lambros, 2018; Hepting & Goldstein, 1996; Kehle et al., 2011,).

The lack of existing literature for intervention techniques for developing bilingual children diagnosed with or suspected of childhood apraxia of speech is evident. The purpose of this study was to evaluate how a sensory cueing intervention model such as video self-modeling effected the speech production of pre-school aged developing bilingual children with identified or suspected childhood apraxia of speech. The research question of this study was:

1. What are the effects of a sensory cueing method with a video self-modeling component on the speech production tasks of developing bilingual (English/Spanish) children with suspected apraxia of speech?

Method

Participant Selection, Setting and Materials

After receiving approval from the University Institutional Review Board from the University of Illinois at Chicago, recruitment of child subjects and parents to participate in this

study began (see Appendix B). Participants for this study included bilingual (English/Spanish) children with identified or suspected childhood apraxia of speech. The researcher, an experienced bilingual (English/Spanish) speech-language pathologist conducted the study baseline, intervention, and follow-up/maintenance phase. All data were collected by the researcher.

Child with Identified or Suspected Childhood Apraxia of Speech

Participants included three developing bilingual (English/Spanish) children. Child participants met the following criteria: (a) were between the ages of 3-5 years old, (b) identified with or suspected of childhood apraxia of speech, (c) demonstrated a moderate to severe level of inconsistent errors on consonants in repeated productions of syllables or words, (d) able to attempt direct imitation, (e) able to focus on examiner's face and video for at least two minutes at a time, (f) demonstrated joint attention and, (g) demonstrated limited English/Spanish oral skills. A review of existing IEP and assessments reports including speech-language therapy, other related services (e.g., occupational report, psychological report) and existing comorbidities was conducted.

Recruitment of Participants. Participants were recruited for the study through three steps: 1) distribution of study IRB email script and flyer information to case managers, and speech-language pathologists in surrounding school districts within the principal investigator's professional network. The email message asked the case managers and speech language pathologists to print and send home (or email the parent) the flyer with children who they believed may be eligible for the study. 2) Upon receiving nominated potential participants from local speech-language pathologists and/or case managers, interested parents were contacted and a telephone screening was conducted (Questions: Is your child between the ages of 3 and 5, has

your child been identified or suspected with CAS, does your child say many sounds incorrectly, do they speak Spanish and some English?) 3) If all inclusion criteria were met, eligibility for the study was shared with the parent. Next, a meeting was set up at a location of their choice to provide details of the study and respond to questions. If the parent expressesed interest in participating in the study, consent forms were provided and the appropriate signatures were collected (see Appendix C). Upon confirmation of the next meeting date, a current assessment of the child's speech production and language skills for both English and Spanish was conducted.

Participant Profile Information. All names used for the participants in this study are pseudonyms.

Mimi. At the onset of the study, Mimi was a 4 year 6 month old girl identified for special education services under the diagnosis of Developmental Delay. Mimi received Early Intervention Services at the age of 2 years old and received speech, developmental and occupational therapy services once a week. She transitioned from the Early Intervention Program and was enrolled in a half day 5 days a week Multi-Needs Special Education classroom within an Early Childhood Program where the language of classroom instruction was English. Within the Early Childhood Program she received weekly occupational therapy services, physical therapy, social work services and speech and language services under her Individualized Education Program. Mimi had a Touch Chat augmentative device which she used in the classroom for communication breakdown and repairs. Mimi's family is from Mexico and speak primarily Spanish in the home. Mimi and her 10 year old sibling speak primarily Spanish with developing English skills. All spoken and written communication with Mimi's parents was in Spanish. Both her 10 year old sibling and 2 year old sibling were identified with delayed speech and language skills. Maternal uncles and grandfathers have a positive history of speech and language delays.

Mimi was reported to say her first words at 12 months of age (e.g, mama, papa, bye) and then these words were no longer produced at 16 months of age. Mimi's Individualized Education Program per the current school year outlined speech and language goals to include increasing receptive and expressive language skills through vocabulary identification and expressing her needs through a total mode of communication.

Cayden. At the onset of the study, Cayden was a 5 year 0 month old boy identified for special education services under the diagnosis of Developmental Delay. Cayden received developmental therapy and speech and language services weekly in the home while enrolled in the Early Intervention Services Program at 2 years of age. He transitioned from the Early Intervention Program at the age of 3 and was enrolled in a half day 5 days a week Multi-Needs Special Education classroom within an Early Childhood Program where the language of classroom instruction was English. Within the Early Childhood Program he received weekly speech and language services under his Individualized Education Program. Cayden had a Touch Chat augmentative device which he used in the classroom to make his needs and wants known. Cayden's family is from Mexico and speak primarily Spanish in the home. Cayden has 3 siblings: a 13 year old brother, an 11 year old brother, and a newborn sister. Siblings speak primarily Spanish in the home with parents and may speak either English or Spanish between each other. All spoken and written communication with Cayden's parents was in Spanish. A fraternal family history of speech and language delays exists. Cayden's Individualized Education Program per the current school year outlined speech and language goals to include increasing listening comprehension skills by answering "what doing" questions, who and where questions during various classroom activities.

Nate. At the study onset, Nate was 3 years and 3 months of age. He received speech and language services, developmental and physical therapy once a week in the Early Intervention Services program for one year until he aged out at 3 years of age. He transitioned to his home school Preschool Program at the age of 3 and was enrolled in a half day 5 days a week Early Childhood Program where the language of classroom instruction was English. Within the Early Childhood Program he received weekly speech and language services. Parents are both natives of Meixco. Both English and Spanish are spoken by Nate's family however, Spanish is the preferred language spoken in the home. All spoken and written communication with Nate's parents was in Spanish. Parents described Nate to be clumsy and known to fall and run into things often. He reportedly said his first word at 2 and a half years of age. No family history of speech and language delays exist. Nate's Individualized Education Program, at the time of the study, outlined speech and language goals to include increasing receptive and expressive language skills through vocabulary identification and labeling as well as expanding his utterance length.

Setting. Per the request of all parents**,** this study was conducted in the home of each participant. Parent homes were located within a 10-mile radius of a large metropolitan urban city. The study was conducted within the room of choice of the family member (e.g., living room, dining room, kitchen table) which was equipped with a table and chair. Child-researcher interactions occurred as they sat across or neighboring each other.

Materials. The iMovie video editing software application sold by Apple for Mac and iOS application was used as the recording and editing device for the creation of digital videos. This application has the capacity to import videos and photo files from a hard drive. This application allows for selecting clips, adding titles, music and special effects such as fading. Color

correction, stabilization of shakiness and the ability to manipulate the speed (fast or slowed) are permissible. Manipulation of audio can also be controlled such as increasing and decreasing audio level and reducing background noise of recorded clips. The iMovie application can be used on Apple products such as the MacBook Pro and iPad Pro. The edited video was displayed on a 12.9 inch iPad Pro monitor. Additionally, a tripod and iPhone 10 were used to video record each session. Various turn-taking toys and games (e.g., Pop-Up Pirate, Baby Shark Fishing Game, Shark Bite, Ants in the Pants, Banana Blast) were also used throughout each session.

Research Design

An A-B-A-B withdrawal design was selected as the research design most suitable in evaluating the functional relation of video self-modeling use and speech production gains for bilingual children identified with or suspected of childhood apraxia of speech. The A-B-A-B design provides a clear and convincing demonstration of experimental control because of its repeated introduction and withdrawal of an intervention (Gast & Ledford, 2014). The A-B-A-B design ends in an intervention condition and provides two opportunities to replicate the effects of intervention (B1 to A1 and; B2 to A2) which can contribute to casuality of change in behavior or dependent variable and enhance the internal validity findings (Gast & Ledford, 2014).

Intervention effects on speech production were identified, defined and monitored concurrently and continuously across target and non-target behaviors. Upon attainment of the criterion level of 85% across 3 consecutive sessions for the first behavior, the intervention would be applied to the second behavior. Following criterion level responding with the second behavior, the intervention would then be applied to the third behavior. This systematic and sequential application of the independent variable across behaviors would continue until all target behaviors (e.g. CV, CVCV, CV.CVCV or VC.CVCV) were exposed to the same

intervention (Gast & Ledford, 2014). The study included four phases: (a) baseline, (b) first intervention phase (i.e. implementation of video self-model sensory cue intervention), (c) withdrawal of intervention and obtainment of second baseline, d) introduction of second intervention phase; and a follow-up/maintenance phase (i.e. continued accurate speech production gains by child).

Independent Variable

The sensory cueing intervention with video self-model for the first child began upon establishing a stabilized baseline. The independent variable required establishment of at least 20% of productions or one instance of production sound within a syllable or word at time of baseline for creation of self-model video recording.

Dependent Variable

The dependent variable was selected based on pre-test measures which included targeted sound at the CV syllable shape, and CVCV word level. Spanish speech sound targets selected for each participant complied with those sounds with expected mastery for their age and syllable shape appropriate for the language (Goldstein & Cintron, 2001). The next hierarchal level was targeted (e.g., CV, CVCV, CV.CVCV, VC.CVCV) to achieve target sound at a functional phrase level. The video self-model was made specific to the syllable, word and phrase targets with the potential to have a total of 5 CV, CVCV and CV.CVCV or VC.CVCV videos.

Procedure

Pre-Test Measures. Various formal and informal pre-testing were conducted across all participants. A thorough case history which included evaluating developmental history, language use, language exposure, and parent concerns was obtained. The parent questionnaire *Intelligibility in Context Scale* (McLeod et al., 2012) English and Spanish versions to measure

speech intelligibility per parent report was also obtained. Speech and language assessments consisted of both formal and informal measures in both English and Spanish. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), the *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), the *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) were conducted. Informal assessment measures included *The Strand 10-point checklist* (Shriberg et al., 2012), an oral peripheral examination with diadochokinetic measures, a language sample analysis (percentage of consonants correct, percentage of vowels correct, speech intelligibility), a phonetic inventory, a syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases (in Spanish and English) were conducted (Kayser, 1998). An informal quick screen measure for determining the participants' attention to a video screen was also obtained. Additionally, a child and adult questionnaire was collected to inform social vailidy (see Appendix D).

Intervention

Pre-Test Measure Findings

Mimi. An oral peripheral examination of lip, tongue, jaw teeth, hard and soft palate, were noted to be unremarkable. A phonetic inventory of sounds excluded from her phonetic repertoire included the following Spanish /k, g, ŋ, ß, ð, ɣ, tʃ ɾ, r/ (9 of 18 included) and the following in English /k, g, f, θ, ð, s, z, ʃ, tʃ, dʒ, r, h/ (12 of 24 included); all Spanish 5 vowels were included in the inventory; 3 of the 11 English vowels excluded were /ɔI, ʊ, ɔ/. If the sound did not occur two times in the sample, then it was not represented. A language sample analysis revealed poor speech intelligibility at the conversational level. Mimi's percentage of consonants correct at the word level for Spanish was 24.06 with a speech severity rating of severe and at the word level in

English at 10.06 with a speech severity rating of severe (Shriberg et al., 1997). The percentage of vowels correct in English was 52.27% and the percentage of vowels correct in Spanish was 49.11% (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "usually" understand her, family members, friends, teachers and others unfamiliar with Mimi understand her only at "at times", extended family members "rarely" understand her, others familiar with her understand her "rarely". A syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases in Spanish and English were conducted (Kayser, 1998); according to *The Strand 10-point checklist* for characterizing CAS (Shriberg et al., 2012), Mimi's speech contained vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), results raw score of 92 with a standard score of 58 and a percentile rank of 0.3. The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), results revealed a raw of 111 and a standard score of 40 with a percentile rank of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel et al., 2004) results were calculated. The sentence structure subtest results were a raw score of 0 with a scaled score of 1 and a percentile rank of <0.1, Word structure subtest raw score of 0 with a scaled score of 1 and a percentile rank <0.1; Expressive vocabulary subtest raw score was 0 with a scaled score of 1 and a percentile rank of <0.1. The Core language index score was 3 with a standard score of 45 and a percentile rank of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculate to obtain the Core Lanugage Score: Conceptos básicos raw score was 9 with a scaled score of 11 and a percentile rank of 37; Estructura de palabras raw score was 0 with a

scaled score of 1 and a percentile of <0.1; Recordando oraciones subtests results raw score was 0 with a scaled score of 2 and a percentile of 0.2. Core Language Score was a standard score of 68 with a percentile rank of 2. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), no basal was established, thus no scores reported. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 42 with a standard score of 100 and a percentile rank of 50. When presented with a 2 minute children's video on the iPad video screen, Mimi was able to sustain attention without difficulty.

Cayden. An oral peripheral examination of lip, tongue, jaw teeth, hard and soft palate, were noted to be unremarkable. A phonetic inventory of sounds excluded from her phonetic repertoire included the following in Spanish /g, ß, ð, tʃ ɾ, r/ (12 of 18 included) and the following in English /θ, ð, dʒ, r/ (20 of 24 included); all Spanish vowels were included in the inventory, 2 of the 11 /ʊ̆, aʊ̆ / were excluded English vowels. If the sound did not occur two times in the sample, then it was not represented. A language sample analysis revealed poor speech intelligibility at the conversational level. Cayden's consonants percentage of consonants correct at the word level for English was 40.25% and percentag of consonants correct for Spanish was 40.14% both percentage results fall within the severe range (Shriberg et al., 1997). Percentage of vowels correct in English is 81.82% and percentage of vowels correct for Spanish was 82.14% (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "usually" understand him, as well as friends, and acquaintances. Immediate and extended family members in addition to the classroom teacher was reported to "always" understand him. Strangers, as reported only "sometimes" understand him. A syllable repetition and/or labeling task for 1, 2, and 3 syllable

words and phrases in Spanish and English was conducted (Kayser, 1998); using *The Strand 10-point checklist* for characterizing CAS (Shriberg et al., 2012) to evaluate her speech, Mimi's speech contained vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), results raw score of 79 with a standard score of 62 and a percentile rank of 0.6. The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), results revealed a raw of 85 and a standard score of 45 with a percentile rank of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel et al., 2004) results were calculated. The sentence structure subtest results were a raw score of 1 with a scaled score of 1 and a percentile rank of <0.1, Word structure subtest raw score of 0 with a scaled score of 1 and a percentile rank <0.1; Expressive vocabulary subtest raw score was 0 with a scaled score of 1 and a percentile rank of <0.1. The Core language index score was 3 with a standard score of 45 and a percentile rank of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculate to obtain the Core Lanugage Score: Conceptos básicos raw score was 2 with a scaled score of 1 and a percentile rank of 0.1; Estructura de palabras raw score was 0 with a scaled score of 1 and a percentile of <0.1; Recordando oraciones subtests results raw score was 1 with a scaled score of 2 and a percentile of 0.1. Core Language Score was a standard score of 47 with a percentile rank of <0.1. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), Cayden obtained a raw score 22 with a standard score of 82 and a percentile rank of 11. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 33 with a standard score of 88 and a percentile rank of 21. When presented

with a 2 minute children's video on the iPad video screen, Cayden was able to sustain attention without difficulty.

Nate. An oral peripheral examination of lip, tongue, jaw teeth, hard and soft palate, were noted to be unremarkable. A phonetic inventory of sounds excluded from her phonetic repertoire included the following in Spanish /b, g, m, n, ŋ, ß, ð, ɣ, x, ɾ, r/ (7 of 18 included) and the following in English /g, θ, ŋ, v, ð, z, ʃ, ɾ/ (16 of 24 included); all Spanish and English vowels were included in the inventory. If the sound did not occur two times in the sample, then it was not represented. A language sample analysis revealed poor speech intelligibility at the conversational level. The percentage of consonants correct (PCC) in English at the word level was 27.67% and the percentage of consonants correct in Spanish was 18.31% both percentage scores fell within the severe range (Shriberg et al., 1997). The percentage of vowels correct (PVC) for English was 53.54% and in Spanish the percentage of vowels correct (PVC) was 78.57% (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "always" understand him. They indicated that immediate and extended family members, his friends, acquaintances, and the classroom teacher only "sometimes" understand him and strangers "rarely" understand him. A syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases in Spanish and English was conducted (Kayser, 1998); according to *The Strand 10-point checklist* for characterizing CAS (Shriberg et al., 2012), Nate's speech contained vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, lexical stress errors, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017) results revealed a raw score of 106 with a standard score of 60 and a percentile rank of 0.4.

The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015) results revealed a raw of 103 and a standard score of 63 with a percentile rank of 1. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel et al., 2004) results were calculated. The sentence structure subtest results were a raw score of 2 with a scaled score of 4 and a percentile rank of 2, Word structure subtest raw score of 0 with a scaled score of 2 and a percentile rank 0.4; Expressive vocabulary subtest raw score was 0 with a scaled score of 2 and a percentile rank of 0.4. The Core language index score was 8 with a standard score of 57 and a percentile rank of 0.2. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculate to obtain the Core Lanugage Score: Conceptos básicos raw score was 1 with a scaled score of 3 and a percentile rank of 1; Estructura de palabras raw score was 0 with a scaled score of 3 and a percentile of 1; Recordando oraciones subtests results raw score was 0 with a scaled score of 4 and a percentile of 2. Core Language Score was a standard score of 60 with a percentile rank of 0.4. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), no basal was established, thus no scores reported. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 45 with a standard score of 113 and a percentile rank of 81.

Baseline (A1) & Video Creation

Baseline (A1). In order to obtain baseline across five consecutive sessions, child speech productions of target sound at syllable, word and phrase level stimuli were observed. The investigator a) observed and collected data on the child speech productions of target stimuli words produced at the syllable, word and phrase levels. At least five data points of a predictable pattern of at least one behavior with acceptable stability in level and trend was obtained prior to implementing the intervention phase (Gast & Ledford, 2014).

Baseline Criterion. Results of the pre-test assessments measures served as 1) baseline for treatment efficacy of data collection, 2) target selection for participants, 3) measurement of pre and post comparison of intervention (conclusion of treatment) 4) measurement of effects of intervention on dependent variable (speech target syllable, word, phrase).

Video Creation. An iMovie video was created for the syllable shape and word targets for each child participant. During the baseline phase, a video recording of each target production was conducted for each session. Recorded video of a production obtained during the the first baseline phase was used to create the intervention video. Upon obtainment of 20% of the target production or at least one production, the video was customized and trimmed using Quick Time Player, stored as a file then imported onto the iMovie program. Once in the iMovie program, transition images, age appropriate tunes, and imports of the child target production were created This process was completed for all 5 targets within the hierarachal level of syllable shape (nonsense word) and syllable shape word. Data continued to be collected throughout the baseline phase (A1).

Intervention Target Selection

An analysis of the subjects speech sounds was conducted via the use of the GFTA-English and GFTA-Spanish, production of Spanish and English wordlist of 1, 2, and 3 syllables, and the connected speech sample. A phonetic inventory was documented per the participants speech sample. An analysis of the participants sounds produced was then compared to the shared sounds systems between languages to determine sounds that were specific to each language. An analysis was conducted using all noted formal and informal assessment measures to determine which sounds and syllable shapes were produced with high or low frequency across all English and Spanish assessments. Given the results, a target sound was selected based on age of mastery

and frequency used. For example, child's age and sounds produced or not produced were compared to the developmental chart (Goldstein, 1999) to determine appropriateness of the sound selected. Once the sound target was selected, syllable shapes were reviewed and compared for appropriateness and heirarachal levels (Goldstein & Citron, 2001; Marquart et al., 2002). For example, Mimi's target was at the CV level given the complexity of her sound target, level of occurrence, and age of mastery (Goldstein, 1999). In Spanish, CV is a common syllable word shape (Goldstein & Citron, 2001). For Cayden, the CVC syllable word shape was selected as a target. Although final consonants in Spanish are not as frequent in occurrence in English, the target /n/ was selected given it's frequency as 1 of 5 Spanish consonant ending sounds, but also in it's occurrence in verb conjugation (Fabiano-Smith & Goldstein, 2010; Gildersleeve-Neumann et al., 2009). For Nate, the target of C1V1C2V2 (or CV with variegated consonant and vowel) was selected given his difficulty with transitioning from consonant target and vowels. Target words were carefully chosen with attempts made to not only include a variety of vowels but also to include actions and nouns in common with their bilingual communicative environment.

Intervention (B1)

During the intervention phase, the child was first shown the pictorial stimulus picture, and provided with a verbal prompt to produce the target. If the target was not produced, then the video model of the target was presented on the iPad. The child was then reprompted to look at the video, upon activation by the researcher. Data were collected at the attainment of a correct or incorrect response. This was continued until there was a level of stability. Eight data points were obtained for each child. The results were reported as percentages of the session.

Baseline 2 (A2)

During the baseline phase, the child was first shown the pictorial stimulus picture, and provided with a verbal prompt to produce the target. If the target was not produced, then the child was provided a verbal model of the target, and then reprompted for the production of the target. Data were collected at the attainment of a correct or incorrect response. This was continued until there was a level of stability. In the case of Cayden and Nate, 5 data points were obtained whereas with Mimi because three data points were at 0, the decision to move to B2 was completed because of stable data points. The results obtained were reported as a percentage of correct and incorrect responses.

Intervention 2 (B2).

During the B2 intervention phase, the same procedure as B1 was conducted. However, a one and a half second pause was added between the target syllable and/or words within the video self-model in addition to allowing the child control of the video self-model activation. The child was allowed to activate the iPad at least 3 times before being reprompted to produce the target. If no activation response was provided by the child due to a distraction, the child was reprompted to look at the video. The purpose for this change went beyond maintaining motivation but also manipulating the pace of the syallable and/or word model so that the child could process the motor planning of the target. Data were collected at the attainment of a correct or incorrect response. This was continued until there was a level of stability. Eight data points were obtained for each child. The results were reported as a percentage of correct and incorrect responses obtained.

Maintenance. At 1 week post the last intervention within the study, a 10 minute follow up or systematic checks over a period of 3 consecutive sessions was examined. The same sound target probes were utilized to measure permanance of behaviors.

Intervention Phase

With the intent to control the dosage of intervention (Morgan et al., 2018), the participants engaged in the video self-model intervention in Spanish for at least 3 weekly 40 minute sessions across 24-26 consecutive sessions. At the start of each session, 10 minutes of the session involved a warm up activity in which the researcher and the child engaged in floor and/or table play with various age appropriate toys and games. This warm up activity served as an opportunity for the child to develop a level of trust and comfort with the researcher and environment and was conducted in the Spanish language. Fewer minutes were needed in the warm up activity as the level of rapport developed across sessions.

During the baseline establishment (Session 1 through 5), the child was presented with a labeling task for 1, 2, and 3 syllable words (in Spanish) that contained the identified target sound (e.g., /k/) in the initial position of words. These 15 images adapted from *Lessonpix Custom Learning Materials, Inc.* were displayed in a 5x5 colored tile with the word target written only on the back and not visible to the child. Spontaneous productions were prompted at least two times. If the child did not provide a spontaneous response, a delayed imitation or auditory cue was provided (see Table 4 for sensory cue types and description). For example, the researcher prompted the child in Spanish with: ”Esto es una cama. “**¿**Qué es esto? (This is a bed. What is this?). Additionally, the child was prompted to produce 5 functional phrases spontaneously when presented with a still image. These functional phrases were imported and illustrated through the use of *Lessonpix Custom Learning Materials, Inc.*and displayed in a 5x5 colored tile. The researcher prompted the child with a question prompt in Spanish to elicit the stimulus phrase (CV.CVC) containing the target sound such as “**¿**Dónde te bañas? (where do you bathe?) to obtain the target phrase “mi tina” (my bathtub). If the child did not provide a spontaneous

response, a delayed imitation or auditory cue was provided. For example, “Tu puedes decir, mi.tina” (you can say, my bathtub); the child was then reprompted with the question phrase “**¿**Dónde te bañas? (where do you bathe?). During these sessions, various age appropriate turn taking games were played in order to reinforce and maintain the child’s participation and interest in tasks. These pictured tasks were paced per child’s tolerance and researcher gauging of attention to task prior to taking a turn at the game. The syllable, word and phrase productions elicited were tracked in the establishment of the baseline phase.

During these trials, it was expected the child would produce the sound target at least once at the consonant level. The researcher incorporated footage of child engaged in appropriate target production with researcher prompt. These video excerpts were captured, clipped and edited for use in intervention with self-modeling techniques after establishment of baseline. Recorded video was viewed specific to the syllable level in which the errored target exists (e.g., /ka/). Estimated length of video is 2 seconds and will subsequently increase with increase in hierarchal level complexity (e.g., CV, CVCV, CV.CVCV or VC.CVCV phrase) for a total of 9 seconds of recorded self-model; an additional 3 seconds total of music at beginning, and between word and phrase levels for a maximum of 12-15 seconds. Once baseline was achieved, each session entailed 1) a warm up session, 2) transitioning child to a structured play based activity 3) prompting for production of target, 3) if production was incorrect, the child was verbally prompted to view the video-self model of CV, CVCV, or CV.CVCV or VC.CVCV targets, 4) reprompting for production of target was done, and 4) a turn at a game and/or activity after the production of the target to ensure and maintain attention and motivation to task was allowed.

During the 10 minute warm up session, the child was engaged with the researcher in various age appropriate toys and/or activities in order to develop a rapport. A timer was used to

mark the beginning and end time of this 10 minute period. After the expiration of these 10 minutes, the child was introduced to a pictorial visual schedule to allow the child to be aware of the transition to a new task. The child was presented with two highly preferred games and asked to make a choice between the two as the selected game of choice. After the child and researcher took a turn at the game, the child was shown a representative picture of the target and prompted with "dime lo que ves". Upon obtaining an incorrect response, the researcher prompted with "mira el video". The 12-15 second video was shown in the immediate field and within arms length of the child. The researcher then showed the picture (e.g., CV, CVCV pictured word) again to the child and reprompted with "dime lo que dices tu/Tell me what you say". Data was collected on the response. The child took a turn at the game regardless of attaining a correct or incorrect response. This pattern was continued until mastery of given level was achieved at 85% or greater across three consecutive sessions. Upon meeting criterion for the given level, the next hierarchal level was to be targeted (e.g., CV, CVCV, CV.CVCV, VC.CVCV). The video always began with 3 seconds of a cheerful age appropriate and attention attaining music, the video-self model of the child taking part in the targeted sound and level of production then began. The video self-model will then begin with 1) a child friendly melody to attract and sustain attention, 2) video self-model of the syllable, 3) the video then moved to a colored page, 4) video self-models of the word was displayed, 5) video then moved to a colored page 6) and finally video self-model of short phrases 7) followed by picture of self cheering with music. If the child had not met, criterion at the word or syllable level a phrase was not shown. The videos were made specific to the syllable, word and/or phrase targets with the potential to have a total of 5 CV, CVCV and CV.CVCV or VC.CVCV videos. Verbal praise was provided upon obtaining his attention to the video and response elicited. Random recorded age appropriate music was heard

and displayed on the iPad after his production was elicited. Upon reaching the criterion level of success across 3 consecutive sessions, the next behavior was to be targeted (e.g., CVCV) and the video length would cumulatively increase (e.g., CV 2 seconds to CVCV 5 seconds to CV.CVCV 9 seconds). This pattern continued throughout the remaining 30 minutes of each session. See Appendix E for example procedure protocol.

Fidelity and Reliability

Fidelity

In Swanson et al. (2013, p. 1), "intervention fidelity refers to the delivery of an intervention or program as designed". In Swanson et al., (2013, p. 1), "collection and reporting of fidelity data in research reports are critical for determining why interventions succeed or fail". After reviewing video recording of each session, a tally of 1) the number of presentations of the video self-model cues and prompts at intervention was taken, and 2) the number of cues and verbal prompts at baseline and intervention 3) the amount of time between cues and prompts at both baseline and intervention were tallied. Implementation of fidelity checks was completed for 30% of intervention and baseline sessions by another trained bilingual speech-language pathologist. Video recordings of each session were tallied using the fidelity checklist found in Appendix F. Fidelity of implementation was at 97%.

Reliability

Data was collected across all participants and phases. The researcher reviewed recorded videos and compared to collected data on 30% of sessions at both baseline and intervention phases conducted across all the participants. The criterion for coding agreement was set at or above 80% for each session to be considered reliable. The intra-rater reliability percentage for observation data was calculated by dividing the total number of agreements by the number of

agreements plus disagreements and multiplying by 100. If the reliability percentage fell below the 80% criterion level, a review and correction of data collection was to be conducted. Intra-rater reliability agreemet was 94.4%.

Social Validity

Wolf (1978) argues the importance of assessing social validity or pursuit of social relevance, noting that this social importance was a "judgement that only society was qualified to make". Wolf (1978) suggested the judgments of social validity were assumed on three levels: (1) the social significance of the goals, (2) the social appropriateness of the procedures, (3) and the social importance of the effects.

Children with speech sound disorders were interviewed in Spanish or English, dependent on their personal preference after session 2 (first intervention) and after the last session of the second intervention phase. The child was asked questions adapted from McLeod et al. (2013), discussing their views about their own speech productions, interactions with people at home, school and in their community, and their views of the study activities. In order to provide a child-friendly and reduced speech demand for answering the questions, a Likert pictorial questionnaire was provided. Three emoticons were presented before them after the question had been asked. The child was allowed to point to the emoticon that matched his response. Parent participants also completed a questionnaire at the conclusion of the second intervention phase. A 5- point Likert type scale was adopted to learn their views on supporting their child's speech and their views of the study activities. The questions asked were modified and adapted from Case (2000) and available in both English and Spanish. See Appendix C for questionnaires.

Results

Data Analysis

Data were graphed and analyzed regularly after each intervention session by the researcher. The percentage of correct and incorrect productions were calculated and displayed on a line graph (see Figure 4, 5, 6). The number of words produced by the child was tallied and displayed on a line graph (see Figure 13, 14, 15).

When conducting a visual analysis of the data, two basic properties of data were analyzed critically which included level and trend (Gast & Ledford, 2014). Visual analysis of the graphic data for the percentage of correct and incorrect productions of the correct and incorrect speech productions across all participants followed the general guidelines of within-condition analysis and between adjacent condition analysis (Gast & Ledford, 2014). The functional relation between the independent variable and the dependent variable were assessed and analyzed for trend and level using these general guidelines. Within-condition analysis was calculated for (a) condition length, (b) level (i.e. median, stability envelope, mean, range) (c) trend (trend direction, stability) (Gast & Ledford, 2014). A careful analysis of level and trend will permit a reliable determination of experimental control (Gast & Ledford, 2014). Additionally, a freehand method and split middle method was used in estimating trend (Gast & Ledford, 2014).

A between adjacent conditions analysis was conducted to determine what effect, if any, a change in condition (i.e. baseline to intervention) had on the dependent variable (Gast & Ledford, 2014). The following was calculated: (a) level change, (b) change in trend direction (c) percentage of non-overlapping data (Gast & Ledford, 2014). As with within-condition analysis, a freehand method and split middle method was used in estimating trend (Gast & Ledford, 2014) (see Appendix G). The outcomes of dependendent variables are represented in Figures 4, 5, and 6 respectively as a percentage of syllable shapes produced (e.g., CV, CVCV, CVC).

The average number of verbal prompts at baseline and intervention combined are displayed in Figure 7.

The social validity surveys and questionnaires administered to the parents and children were analyzed. The average of each response obtained from the parent survey is displayed in Table 15. The range and average of each response obtained from the child questionnaire is also displayed in Figure 16 and Figure 17.

Figure 4

Percentage of Syllables Correct Mimi

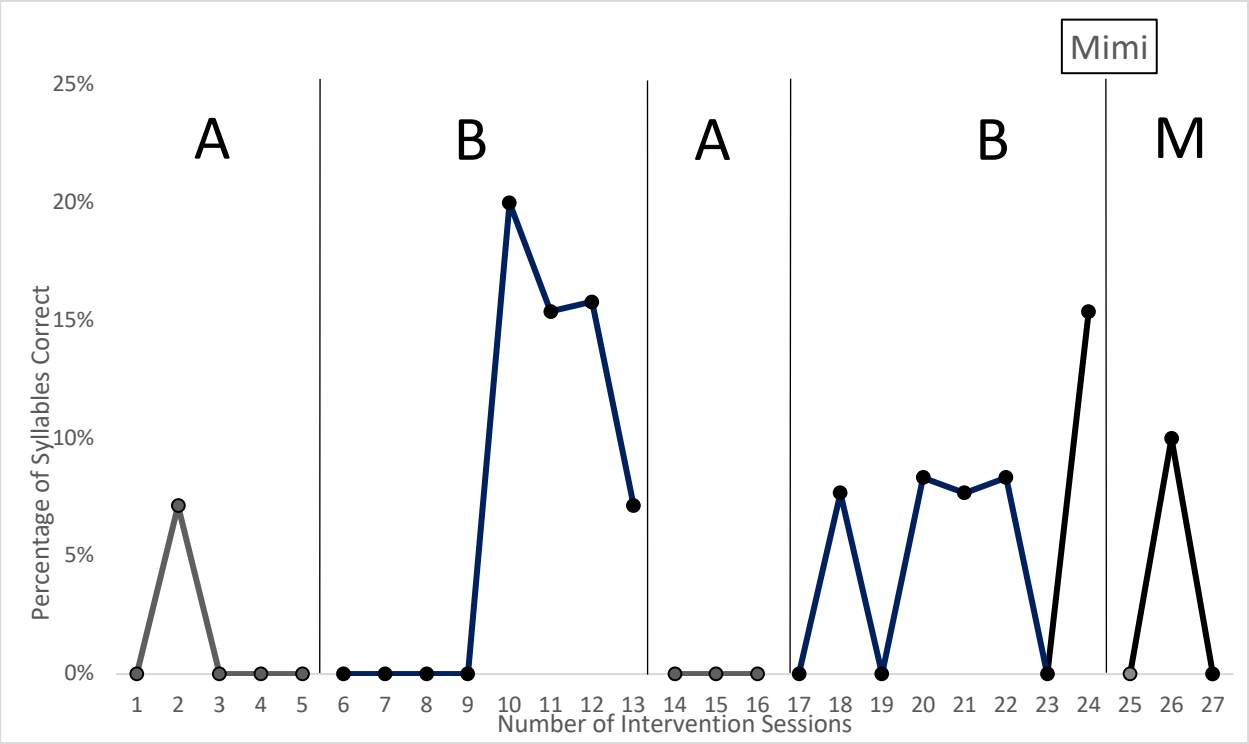


Figure 5

Percentage of Syllables Correct Cayden

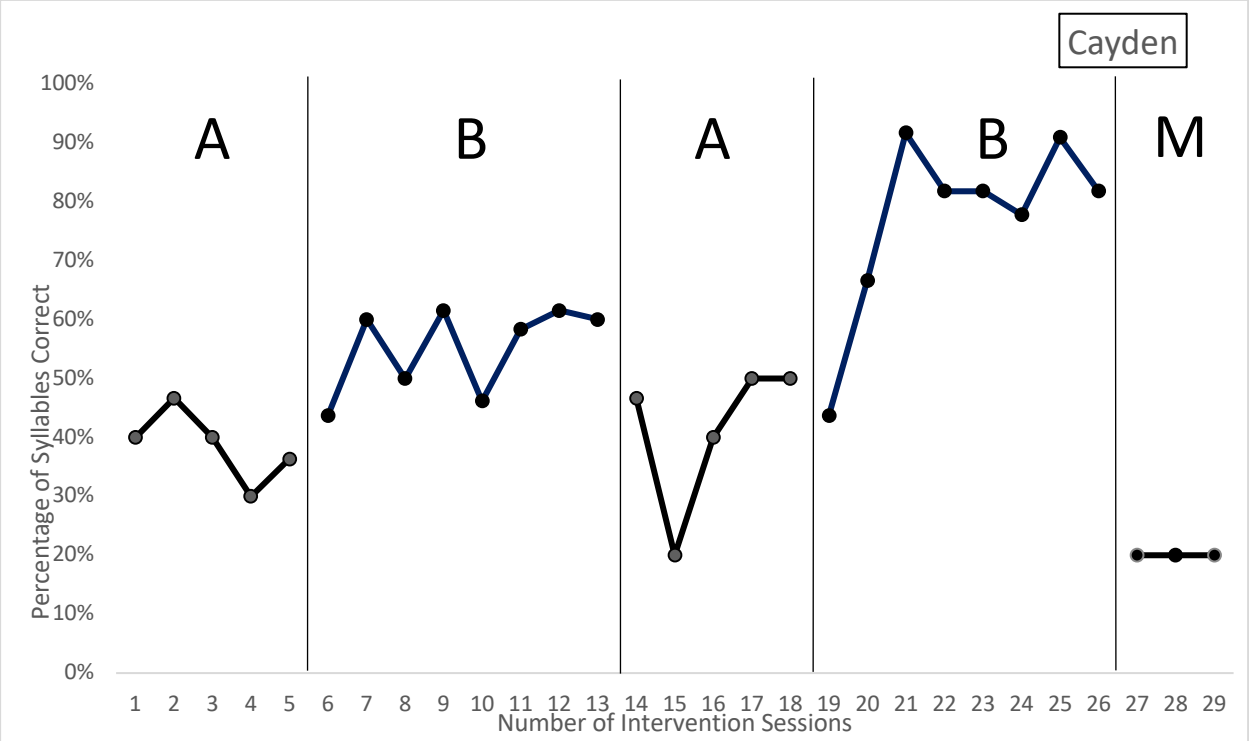
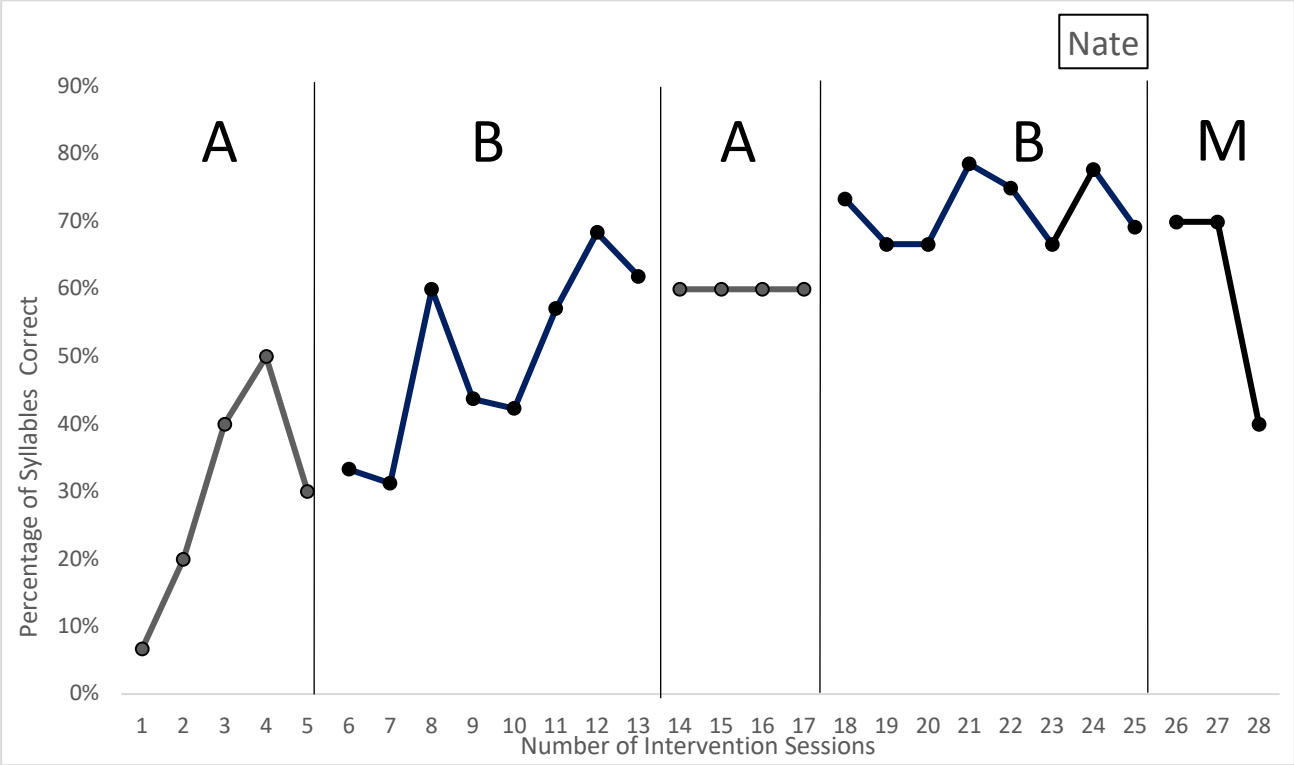


Figure 6

Percentage of Syllables Correct Nate



Participant 1: Mimi

Baseline. Mimi completed 5 basline sessions at phase 1 (A1) and 3 baseline sessions at phase 2. Mimi produced correct CV syllable shaped responses 0.014 (range = 0-0.071) of the time across baseline A1 and 0.00 (range = 0.000-0.000) at baseline A2. The percentage of incorrect number of syllable shape produced was .9857 at A1 and 1.00 at A2. The trend line during baseline remained stable and decelerated over phase A1. The trend line at A2 was stable and zero-celerating over phase A2.

Intervention. After intervention B1, the data demonstrated an increase in the percentage of productions. Mimi produced .073 correct CV syllable shaped responses (range=0-2.00). During the intervention phase B1, the trend line was variable with an accelerating or improving direction. At intervention phase B2, Mimi produced .059 CV syllable shaped responses (range =

0.00-.154) with variable stability and improving direction. The percentage of non-overlapping data points (PND) was calculated to determine if the video self-modeling was an effective intervention for Mimi. The PND was 37.5%-62.5% which suggests that video self-modeling was only partly effective. The PND showed greater effects during phase B2 at 62.5%.

Maintenance. Additional probes were administered to determine the child participants ability to produce the target syllable shape at 1 week post intervention across 3 consecutive sessions. Mimi did not achieve criterion at 1 week post intervention. The largest percentage of CV syllable shapes produced by Mimi was at the second maintenance session where she achieved 1 correct production or 10% of the time.

Post Test Results. A phonetic inventory of sounds excluded from her phonetic repertoire included the following in Spanish /g, ŋ, ð, ɣ, s, x, tʃ ɾ, r/ (9 of 18 included) and the following in English /k, g, ŋ, ð, z, ʃ, tʃ, dʒ, j/. All Spanish vowels and English vowels were included in the inventory. A language sample analysis revealed poor speech intelligibility at the conversational level. The percentage of consonants correct at the word level improved from pre test with Spanish at 28.17 and a speech severity rating of severe; and English post test percentage of consonants correct also improving with 24.52 and a speech severity rating of severe (Shriberg et al., 1997). The percentage of vowels correct (PVC) was increased when compared to pre-testing with a percentage of 76.14% in English and 87.50% in Spanish (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "usually" understand her, along with immediate and extended family members, teachers and friends; other acquaintences and strangers only "at times" understand her. A syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases in Spanish and English were conducted (Kayser, 1998). According to *The Strand 10-point checklist* for

characterizing CAS (Shriberg et al., 2012), Mimi's speech continued to contain vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), results raw score of 89 with a standard score of 56 and a percentile rank of 0.2. The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), results revealed a raw of 114 and a standard score of 40 with a percentile ranke of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel et al., 2004) results were calculated. The sentence structure subtest results were a raw score of 9 with a scaled score of 59 and a percentile rank of <0.1, Word structure subtest raw score of 0 with a scaled score of 1 and a percentile rank <0.1; Expressive vocabulary subtest raw score was 0 with a scaled score of 1 and a percentile rank of <0.1. The Core language index score was 9 with a standard score of 59 and a percentile rank of 0.3. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculated to obtain the Core Lanugage Score: Conceptos básicos raw score was 1 with a scaled score of 1 and a percentile ranke of 0.1; Estructura de palabras raw score was 0 with a scaled score of 1 and a percentile of <0.1; Recordando oraciones subtests results raw score was 0 with a scaled score of 1 and a percentile of 0.1. Core Language Score was a standard score of 45 with a percentile rank of <0.1. The CELF-Preschool Spanish test results are a decrease in performance and could be reflective of her distractibility during the assessment despite attempts to redirect her attention. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), no basal was established, thus no scores reported. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 54 with a standard score of 107 and a percentile rank of 68. (See Table 14 and 15)

Participant 2: Cayden

Baseline. Cayden completed 5 basline sessions at phase 1 (A1) and at phase 2 (A2). Cayden produced correct CVC syllable shaped word responses 0.386 (range = 0.3000-0.4667) of the time across baseline A1 and 0.413 (range = 0.200-0.500) at baseline A2. The percentage of incorrect number of syllable shape produced was .614 at A1 and .587 at A2. The trend line during baseline remained stable and accelerated over phase A1. The trend line at A2 was stable and decelerating over phase A2.

Intervention. After intervention B1, the data demonstrated an increase in the percentage of productions. Cayden produced .552 correct CVC syllable shaped word responses (range=.3000-.6154). During the intervention phase B1, the trend line was stable with an accelerating or improving direction. At intervention phase B2, Cayden produced .770 CVC syllable shaped word responses (range = 0.4375-.9167) with stable trend and accelerating direction. The percentage of non-overlapping data points (PND) was calculated to determine if the video self-modeling was an effective intervention for Cayden. The PND was 87.5% which suggests that video self-modeling was effective in improving Cayden's CVC word responses. The PND showed equal effects during phase B1 and B2.

Maintenance. Additional probes were administered to determine the child participant's ability to produce the target word at 1 week post intervention. Cayden did not achieve criterion at 1 week post intervention. Cayden only achieved .20 percentage of CVC words correct at all 3 maintenance probes.

Post Test Results. A phonetic inventory of sounds excluded from his phonetic repertoire included the following in Spanish /g, ß, ð, ɣ, ɾ, r/ (9 of 18 included) and the following in English /v, θ, ð, ʃ, tʃ, dʒ, ɾ / (17 of 24 included). All Spanish vowels were included in the inventory;

English vowels /aʊ, ɔ/ were excluded from the inventory (9 of 11 included). A language sample analysis revealed poor speech intelligibility at the conversational level. The percentage of consonants correct (PCC) slightly increased to 42.14% in English and 47.18% respectively in Spanish with a corresponding still within the severe severity level (Shriberg et al., 1997). In contrast, the percentage of vowels correct decreased for both English and Spanish with a PVC of 71.59% in English and a PVC of 82.14% in Spanish (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "usually" understand him, as well immediate family members, his friends, and teachers. The extended family members, acquaintances, and strangers only sometimes understand him. A syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases in Spanish and English were conducted (Kayser, 1998); according to *The Strand 10-point checklist* for characterizing CAS (Shriberg et al., 2012), Mimi's speech continued to have vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), results raw score of 71 with a standard score of 63 and a percentile rank of 0.7. The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), results revealed a raw of 87 and a standard score of 40 with a percentile ranke of <0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel, Wiig, and Secord, 2004) results were calculated. The sentence structure subtest results were a raw score of 6 with a scaled score of 4 and a percentile rank of 2, Word structure subtest raw score of 2 with a scaled score of 1 and a percentile rank of 0.1; Expressive vocabulary subtest raw score was 2 with a scaled score of 1 and a percentile rank of 0.1. The Core language index score was 6 with a standard score of 53 and a percentile rank of

0.1. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculate to obtain the Core Lanugage Score: Estructura de palabras raw score was 0 with a scaled score of 1 and a percentile of <0.1; Recordando oraciones subtests results raw score was 1 with a scaled score of 2 and a percentile of 0.1; Conceptos y siguiendo direcciones raw score of 0 with a scaled score of 1 and a percentile rank of <0.1. Core Language Score was a standard score of 45 with a percentile rank of <0.1. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), Cayden obtained a raw score 27 with a standard score of 87 and a percentile rank of 19. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 46 with a standard score of 98 and a percentile rank of 45. (See Table 14 and 15)

Participant 3: Nate

Baseline. Nate completed 5 basline sessions at phase 1 (A1) and 4 baseline sessions at phase 2 (A2). Nate produced correct CVCV syllable shaped word responses 0.293 (range = 0.0667-0.5000) of the time across baseline A1 and 0.600 (range = 0.6000-0.6000) at baseline A2. The percentage of incorrect number of syllable shape produced was .707 at A1 and .400 at A2. The trend line during baseline remained variable and decelerating over phase A1. The trend line at A2 was stable and decelerating over phase A2.

Intervention. After intervention B1, the data demonstrated an increase in the percentage of productions. Nate produced .498 correct CVCV syllable shaped word responses (range=.3125-.6842). During the intervention phase B1, the trend line was variable with an accelerating direction. At intervention phase B2, Nate produced .717 CVCV syllable shaped word responses (range = 0.6667-.7857) with stable trend and accelerating direction. The percentage of non-overlapping data points (PND) was calculated to determine if the video self-modeling was an

effective intervention for Nate. The PND was 50 during phase B1, but increased to 100% at B2 suggesting that video self-modeling was having an improving effect on Nate's CVCV word responses.

Maintenance. Additional probes were administered to determine the child participants ability to produce the target syllable shape at 1 week post intervention. Nate achieved achieve a a criterion of .70 percentage of CVCV words correct across all 3 probe sessions at 1 week post intervention.

Post Test Results. A phonetic inventory of sounds excluded from his phonetic repertoire included the following in Spanish / ŋ, ß, ð, l, ɾ, r/ (12 of 18 included) and the following in English / ŋ, θ, ð, z, dʒ, s / (18 of 24 included). All Spanish vowels were included in the inventory; English vowels /ɔ/ was excluded from the inventory (10 of 11 included). A language sample analysis revealed poor speech intelligibility at the conversational level. In Spanish, the PCC improved from pre test to 28.17% with a speech severity rating of severe; and in English the percentage of consonants correct also improved to 24.52% consonants correct and a speech severity rating of severe (Shriberg et al., 1997). The percentage of vowels correct in English improved significantly to 80.68% which falls within the mild-moderate level of severity, and in Spanish the PVC was 86.61% which continued to fall within the mild-moderate range of severity level (Shriberg et al., 1997). Speech intelligibility was rated by the parents using the *Intelligibility in Context Scale* (McLeod et al., 2012). Parents reported to "usually" understand him, along with extended family members and teachers. Parents indicated that immediate family members, friends, acquaintances, and strangers only understand him "sometimes". A syllable repetition and/or labeling task for 1, 2, and 3 syllable words and phrases in Spanish and English were conducted (Kayser, 1998); according to *The Strand 10-point checklist* for characterizing

CAS (Shriberg et al., 2012), Nate's speech continued to contain vowel distortions and errors, distorted sound substitutions, difficulty with initial or transitionary movement, groping behaviors, increased difficulty with multisyllabic words, lexical stress errors, and slowed diadochokinetic rates. The *Goldman Fristoe Test of Articulation-3 Spanish* (Goldman & Fristoe, 2017), results raw score of 90 with a standard score of 66 and a percentile rank of 1. The *Goldman Fristoe Test of Articulation-3* (Goldman & Fristoe, 2015), results revealed a raw of 93 and a standard score of 66 with a percentile ranke of 1.2. A slight increase in standard score results were noted between pre and post test GFTA-3 Spanish and GFTA-3. The *Clinical Evaluation of Language Fundamentals-Preschool -2* (Semel et al., 2004) results were calculated. The sentence structure subtest results were a raw score of 2 with a scaled score of 4 and a percentile rank of 2, Word structure subtest raw score of 0 with a scaled score of 2 and a percentile rank 0.4; Expressive vocabulary subtest raw score was 0 with a scaled score of 2 and a percentile rank of 0.4. The Core language index score was 8 with a standard score of 57 and a percentile rank of 0.2. The *Clinical Evaluation of Language Fundamentals-Preschool -2 Spanish* (Wiig et al., 2009), results were calculated to obtain the Core Lanugage Score: Conceptos básicos raw score was 3 with a scaled score of 5 and a percentile ranke of 5; Estructura de palabras raw score was 0 with a scaled score of 3 and a percentile of 1; Recordando oraciones subtests results raw score was 1 with a scaled score of 5 and a percentile of 5. Core Language Score was a standard score of 66 with a percentile rank of 1. Per the *Expressive One Word Picture Vocabulary Test-4 Spanish-Bilingual* (Martin & Rapalyea, 2014), no basal was established, thus no scores reported. The *Receptive One-Word Picture Vocabulary Test-4 Spanish-Bilingual Edition* (Martin & Rapalyea, 2014) raw score was 48 with a standard score of 106 and a percentile rank of 66. (See Table 14 and 15)

Table 14

Pre & Post Test Measure Observations

Characteristics of CAS

	Nate	Mimi	Cayden
1. Vowel Distortions	x	x	x
2. Voicing errors			
3. Distorted substitutions	x	x	x
4. Difficulty with initial or transitionary movement	x	x	x
5. Groping	x	x	x
6. Intrusive schwa			
7. Increased difficulty with multisyllabic Words	x	x	x
8. Syllable segregation			
9. Slow speech rate and or slow diadochokinetic rates	x	x	x
10. Equal stress or lexical stress errors	x		

Adapted from Shriberg, L.D., Strand, E.A., Fourakis, M., Jakielski, K.J., Hall, S.D., Karlsson, Mabie, H.L., McSweeney, J.L., Tilkens, C.M., & Wilson, D.L. (2017). A diagnostic marker to discriminate childhood apraxia of speech from speech delay: I. Development and description of the pause marker. *Journal of Speech, Language and Hearing Research,* 60, S1096-S1117. https://doi.org/10.3109/02699206.2012.655841

Table 15

PCC and PVC Words Pre and Post Test Results

	Spanish		English	
	PCC/PVC		PCC/PVC	
	Pre	Post	Pre	Post
Mimi	26.06/49.11	28.17/87.50	10.06/52.27	24.52/76.14
Rating	Severe/ Mod-severe	Severe/ Mod-severe	Severe/ Mod-severe	Severe/ Mod-severe
Cayden	40.14/87.50	47.18/82.14	40.25/81.82	42.14/71.59
Rating	Severe Mild-mod	Severe/ Mild-mod	Severe Mild-mod	Severe Mild-mod
Nate	18.31/78.57	28.17/86.61	27.67/63.64	35.22/80.68
Rating	Severe/ Mild-mod	Severe/ Mild	Severe/ Mod-severe	Severe/ Mild-mod

Number and Average of Verbal Prompts and Video Presentations

The total number of verbal prompts at baseline and at intervention combined are displayed on Figure 7. The highest number of verbal prompts across participants was during session 10 or B1 for Nate with a total number of 72 verbal prompts and a tally of 19 video self-model presentations which resulted in a perentage of 57.69% incorrect and 42.31% correct for that given session (see Figure 7). The lowest number of verbal prompts across participants was at session 3 baseline A1 for Nate with a total numer of 9 verbal prompts which resulted in a percentage of 60% of words incorrect and 40% of words correct (see Figure 7). The mean average of verbal prompts for Nate was 29, the mean average of verbal prompts for Mimi was 42 and, for Cayden the mean average of verbal prompts was 26 was per session. The highest number of video self-model presentations (n=40) was noted for Mimi at session 21 or

intervention phase B2. The highest number of video self-model presentations for Nate (n=30) and Cayden (n=39) were at sessions 19 and 18 respectively (see Figure 9).

For Nate, at intervention 1 (B1), on average there were 12 video self-model presentations with a corresponding averge of 9 correct and 9 incorrect targets produced. During intervention 2 (B2), on average there were 22 video self-model presentations generated across sessions with a corresponding 10 correct targets produced and 4 incorrect targets produced across sessions (See Figure 10). Similiarly, as the intensity of the intervention appeared to have no effect on Mimi's correct words produced her number of incorrect responses declened. During B2 he produced on average 1 correct response and 16 incorrect responses (see Figure 11). Cayden showed equally showed improvement in his incorrect responses given an increase in intervention intensity (n=27). Cayden demonstrated more correct responses (n=9) and a decline in incorrect responses (n=3) (see Figure 12). A greater number of video models was presented across sessions at B2, however, the increase in number of video model presentations had an effect on the total number of incorrect word targets produced. Essentially, the accuracy rate of correct productions produced versus incorrect responses increased. The possibility of the intensity of intervention models having a direct effect on correct speech targets was highly likely. The greater intensity of video models shown allowed for less trials of speech targets to be had, yet, the less number of trials presented resulted in greater speech outcomes.

Figure 7

Total Number of Verbal Prompts at Baseline and Intervention

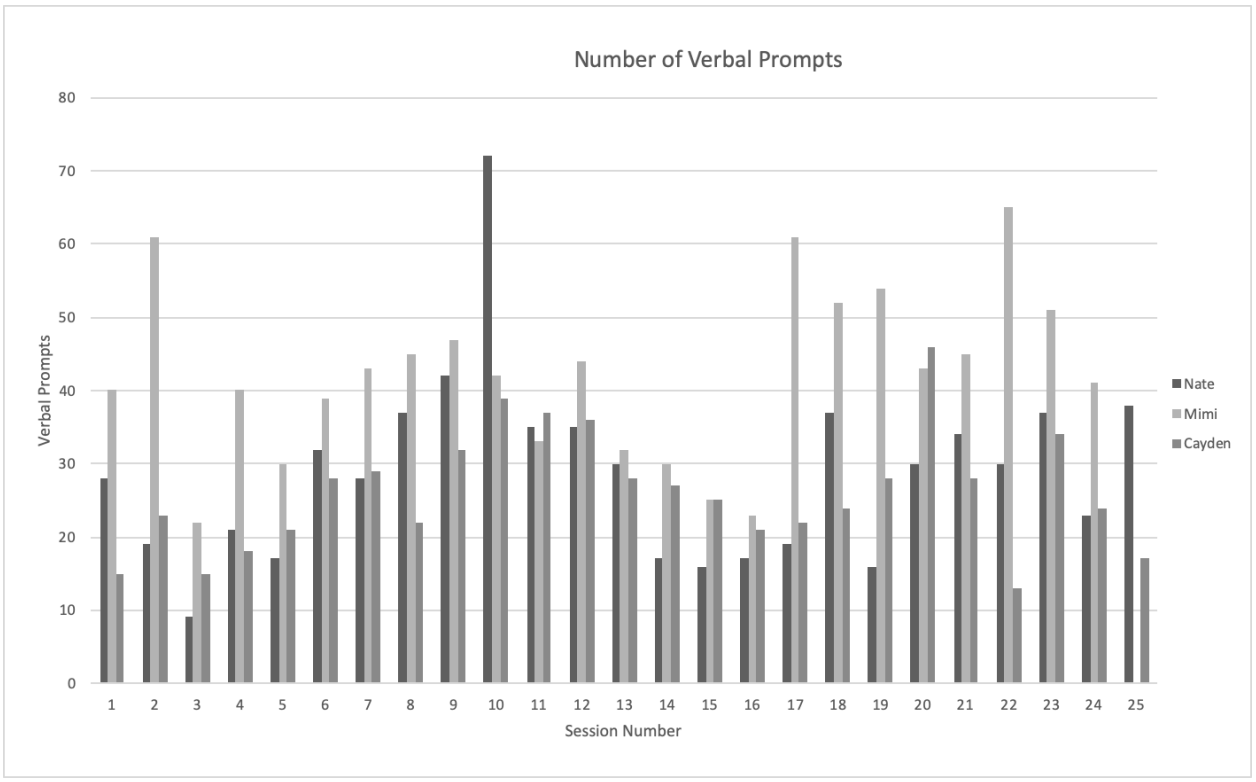


Figure 8

Average Verbal Prompts Per Session

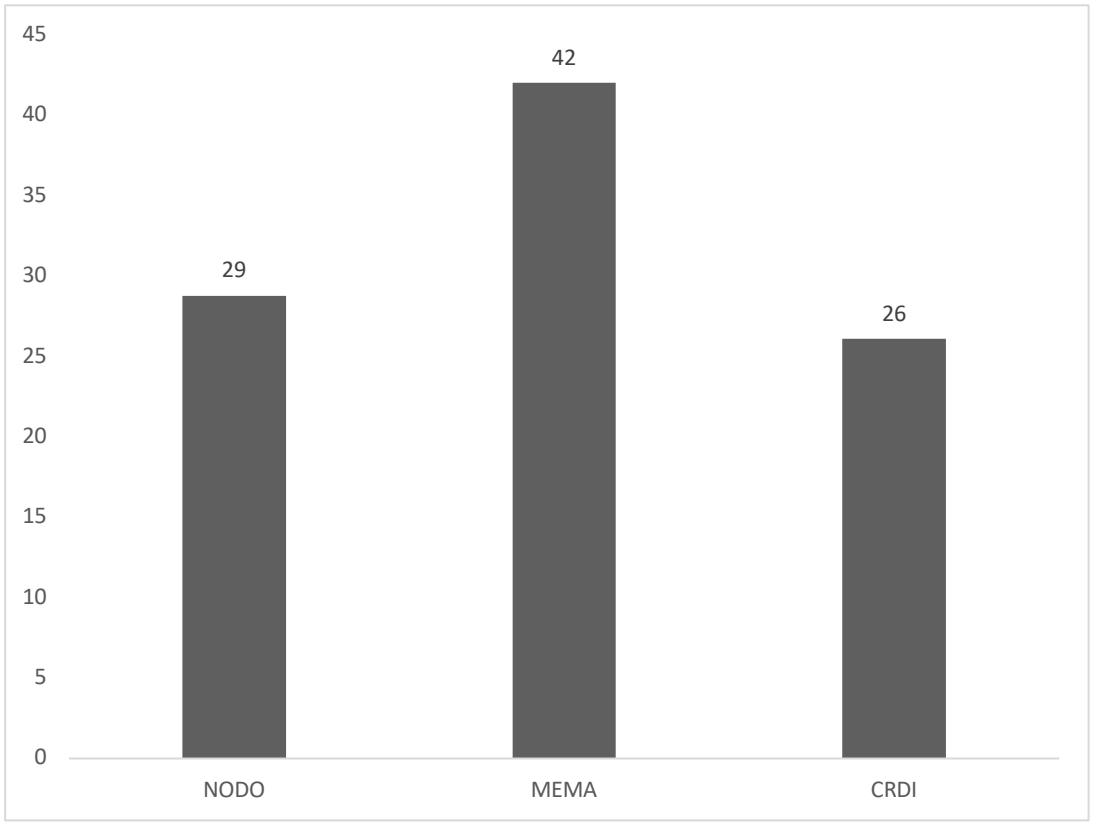


Figure 9

Number of Video Self-Model Prompts at Only Intervention

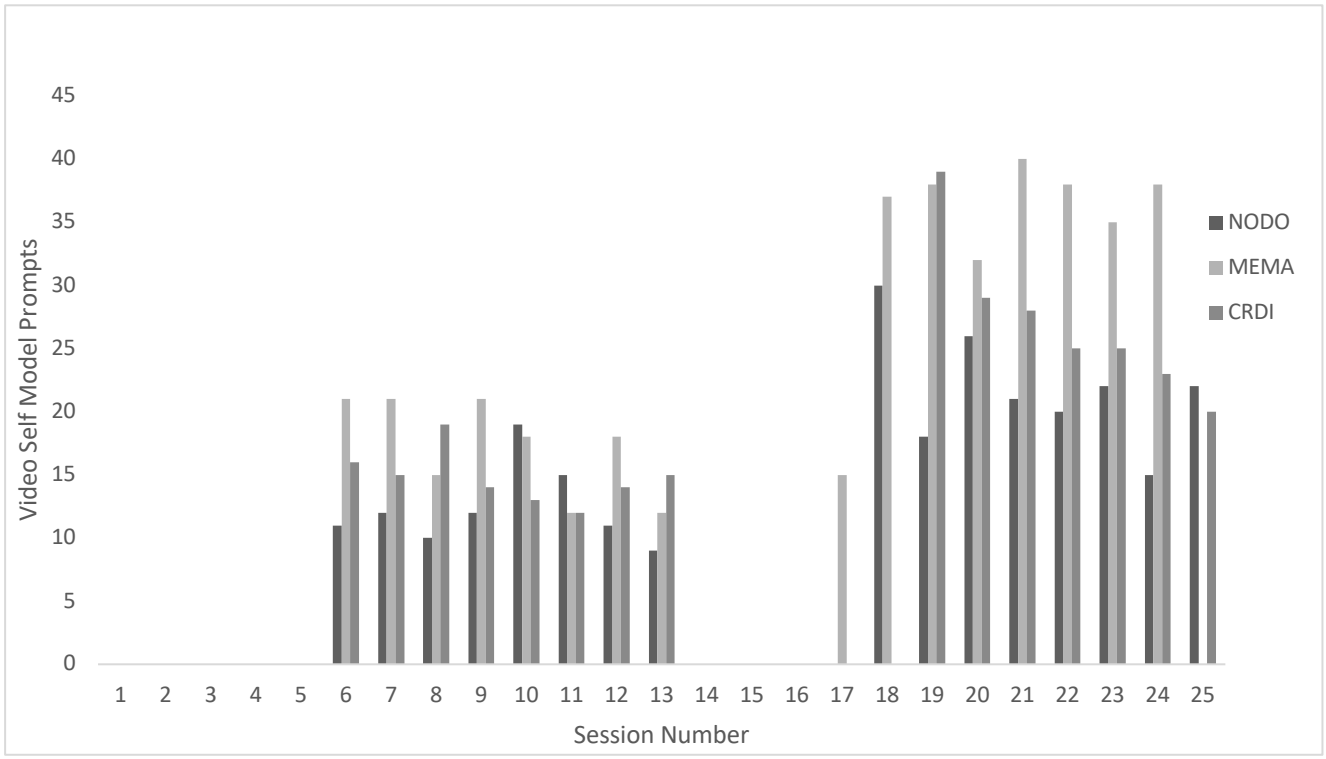


Figure 10

Nate Average Number of Words Correct per Video Self-Model Presentation

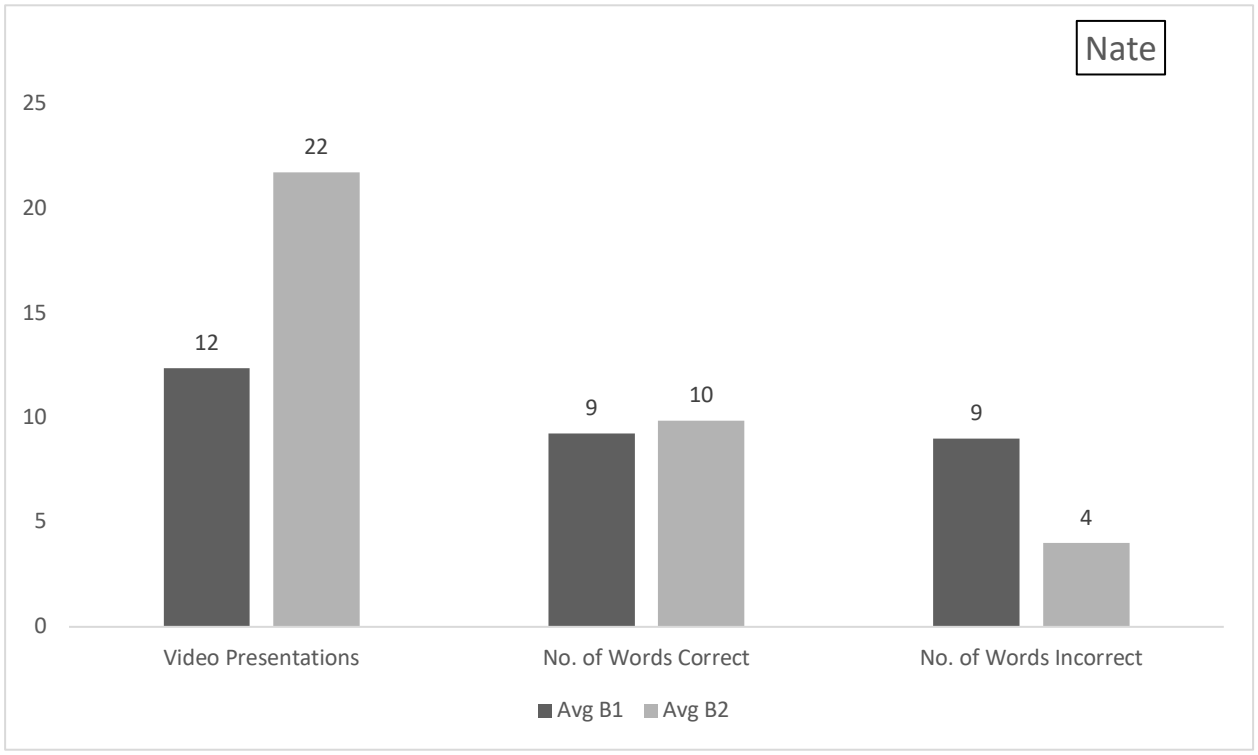


Figure 11

Mimi Average Number of Words Correct Per Video Self-Model Presentation

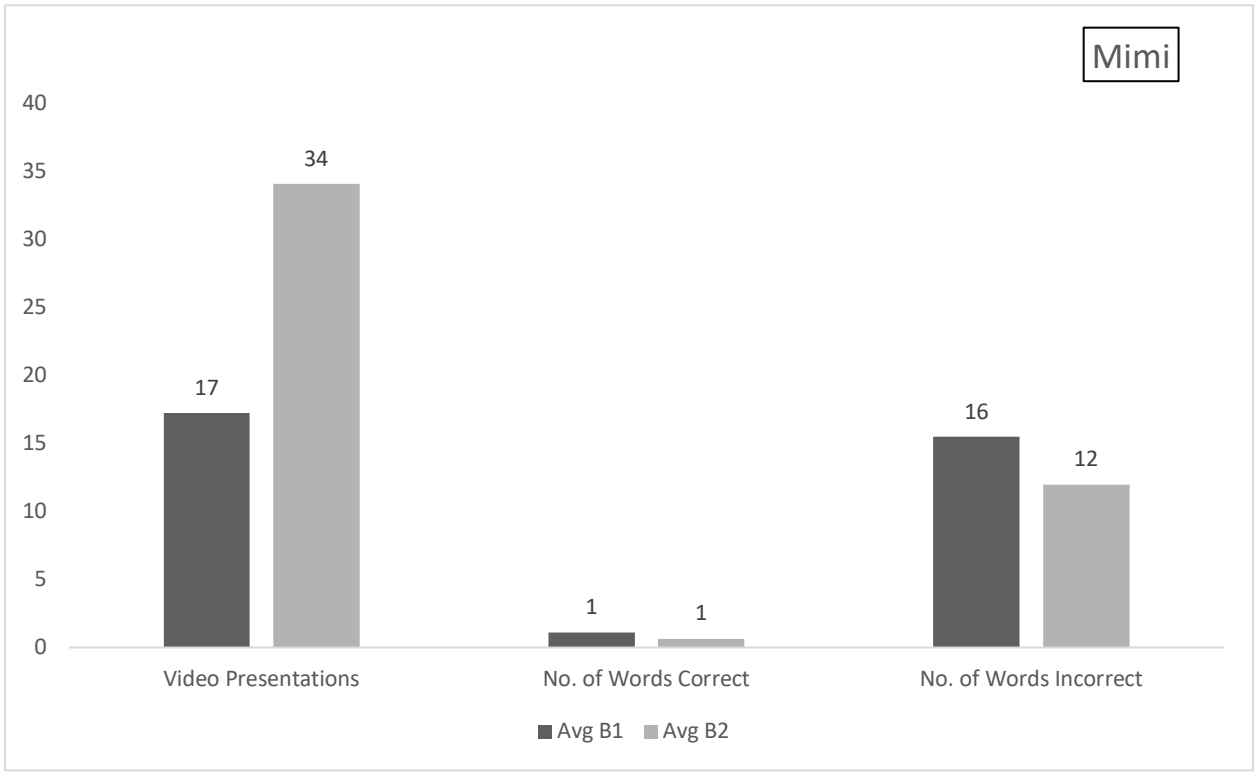


Figure 12

Cayden Average Number of Words Correct Per Video Self-Model Presentation

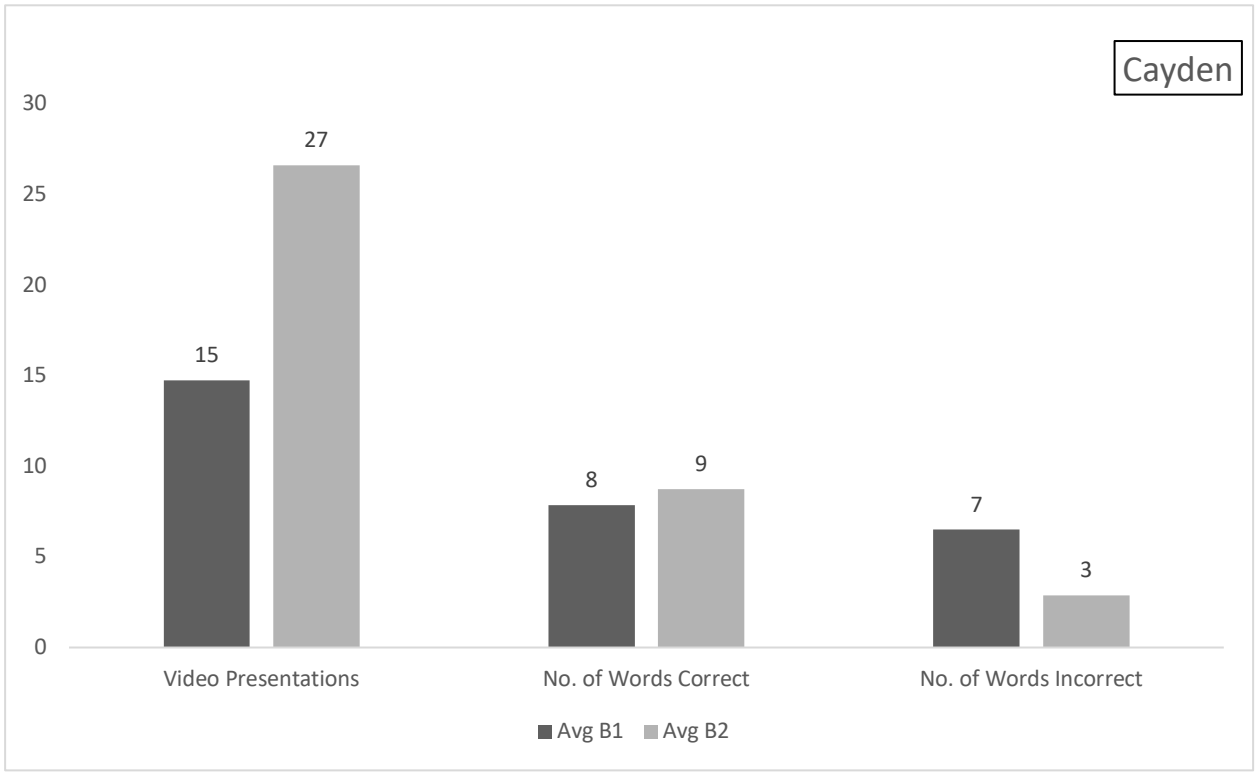


Figure 13

Cayden Total Number of Words Correct and Incorrect

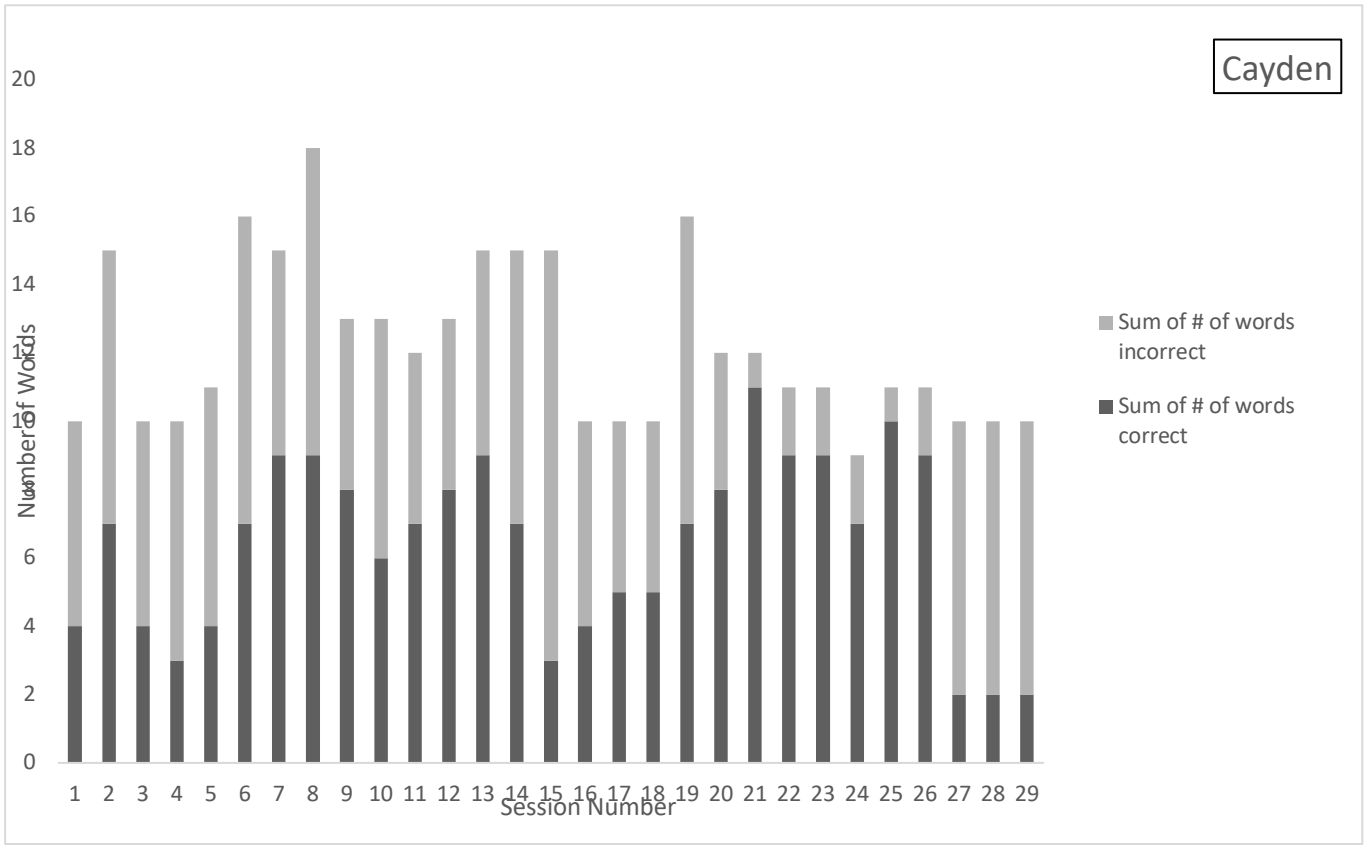


Figure 14

Mimi Total Number of Words Correct and Incorrect

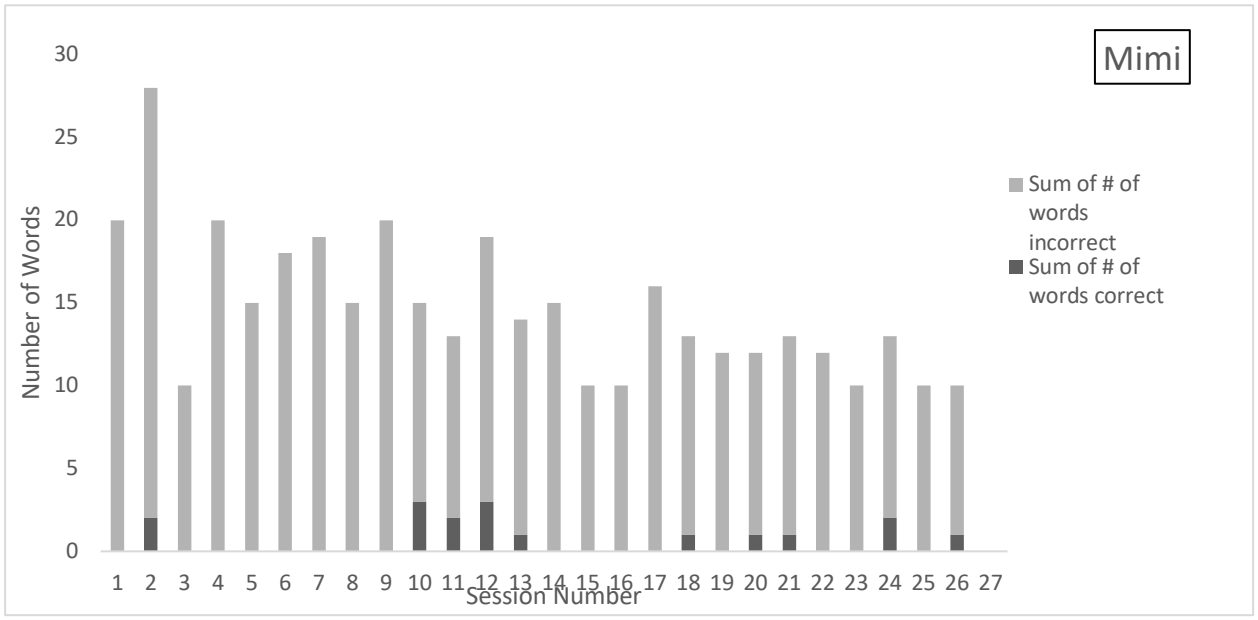
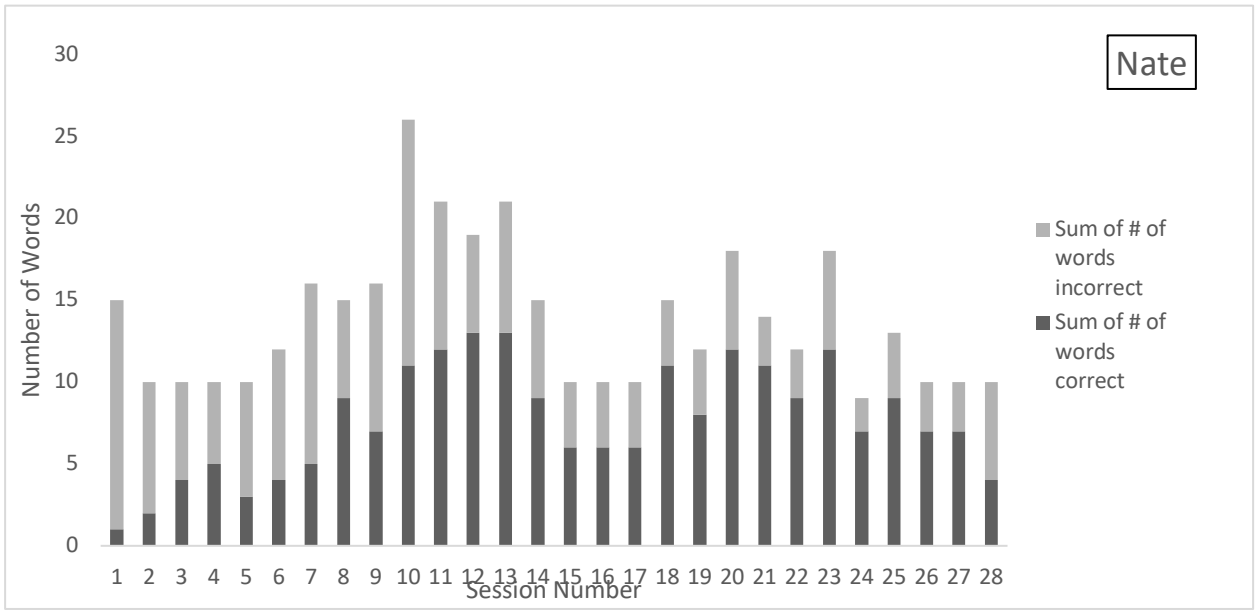


Figure 15

Nate Total Number of Words Correct and Incorrect



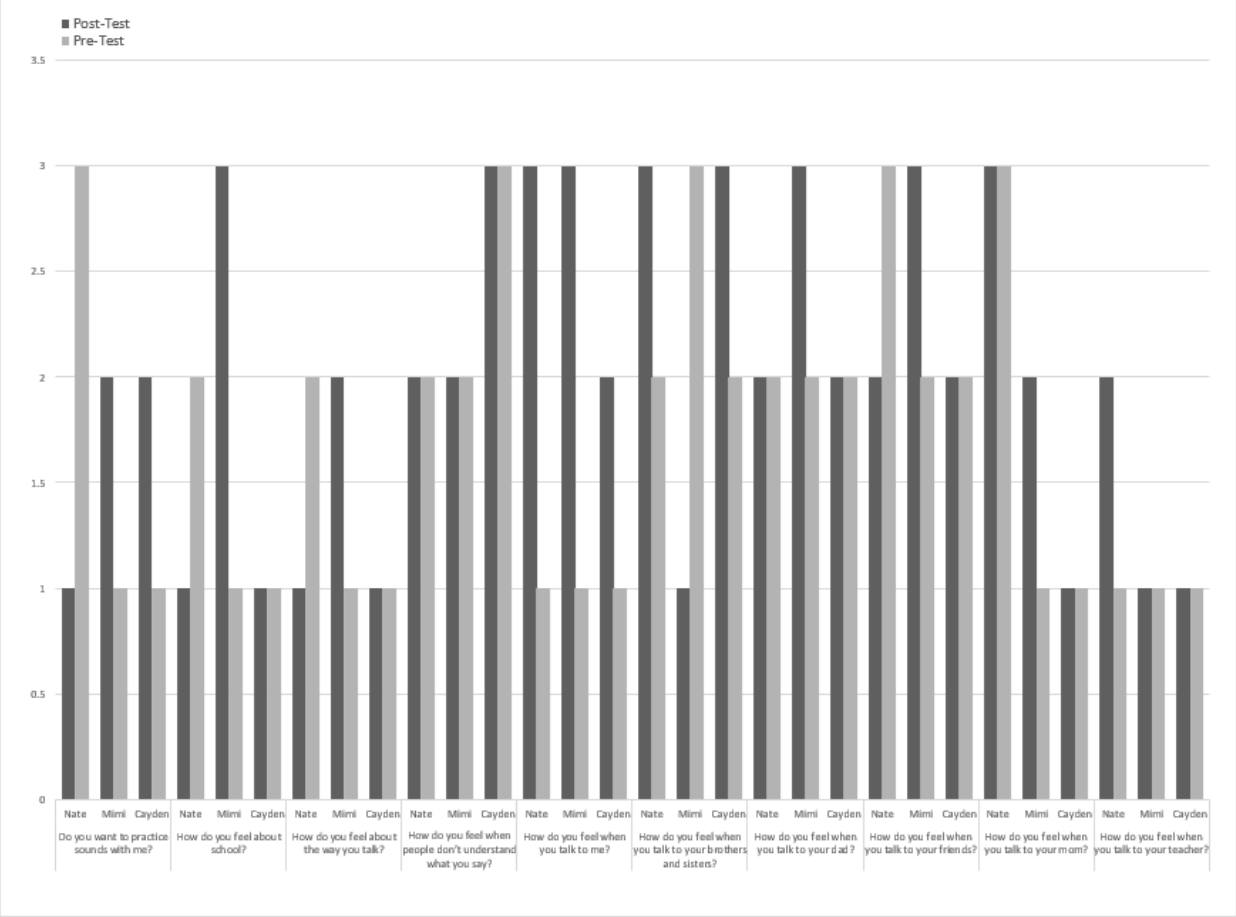
Social Validity

Three emoticons were presented before the child participant before being asked questions about their own speech productions, interactions, with people at home, school and in their community, and their views of the study activities. The child participant was allowed to point to the emoticion that matched his/her response. Emoticon responses matched images of *happy, indifferent and sad*.

Child Pre/Post Social Validity Questionnaire Individual Results

Figure 16

Social Validity Interview Questionnaire Results



Mimi. At pre-test, Mimi indicated she felt "happy" about the way she talked, when she talked to her mom, talked to her teacher, talked to the researcher; felt "happy" toward school, and felt "happy" practicing her sounds with the researcher. She felt "indifferent" when talking to her friends, talking with her dad, when others don't understand what she says; and felt "unhappy" when she talks to her brothers and sisters. At post -test, Mimi indicated she felt "indifferent" about the way she talked, when she talked to her mom, when others did not understand her, and towards wanting to practice her sounds with the researcher. She felt "happy" when spoke with her brothers an sisters, and when she talked with her teacher. She felt "sad" when she talked with her friends, her father, with the researcher and toward school.

Nate. At pre-test, Nate indicated he felt "happy" when he talked to his teacher, and when he talked with the researcher. He felt "indifferent" about the way he talked, when he talked to his brothers and sisters, when he talked with his dad, when people don't understand what he says, and he felt "indifferent" about school; he felt "unhappy" when he talked with friends, his mom, and felt "unhappy" in wanting to practice sounds with the researcher. At post -test, Nate indicated he felt "happy" about the way he talks, towards school, and wanting to practice his sounds with the researcher. He felt "indifferent" when talking with his friends, when speaking with dad, when others don't understand him, and when he speaks with his teacher. He felt "unhappy" when he talked with his brothers and sisters, speaking with his mom, and when he talks with the researcher,

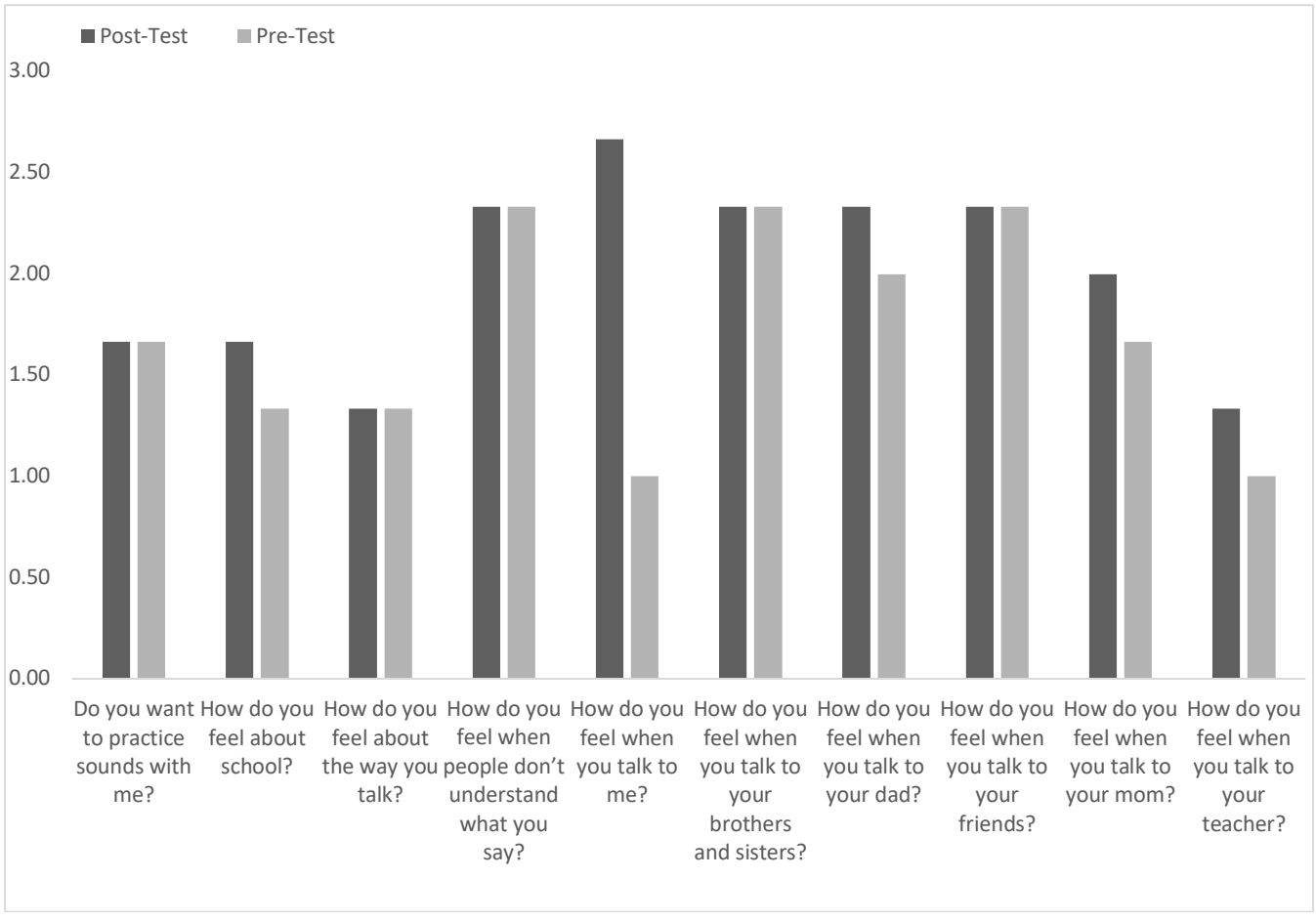
Cayden. At pre-test, Cayden indicated he felt "happy" about the way he talked, when he talked to his mom, when he talked to his teacher, when he talked to his teacher, and towards school. He felt "happy" about school and felt "happy" practicing sounds with the researcher. He felt "indifferent" when he talked with friends, and talked to his dad. He felt "unhappy" when he

talked with his friends, and when people don't understand what he says. At post -test, Cayden indicated he felt "happy" about the way he talked, when he talked to his mom, when he talked to his teacher, and towards school. He felt "indifferent" when he talked with friends, talked with his dad, when talking with the researcher and with practicing his sounds. He felt "unhappy" when he talked with his brothers and sisters, and when others don't understand what he says. Results from the social validity child participant interview pre-test and post-test surveys are in Figure 17.

Child Pre/Post Social Validity Interview Average Results Across Participants

Figure 17

Average Social Validity Results



Note. Happy=1; indifferent=2; sad=3.

Parent Pre/Post Social Validity Questionnaire

At pre-test, no anectodal notes from Nate or Mimi's parent was provided; Cayden's family indicated "todo esta bien". At pre-test, all parents felt participating in this study was "very worthwhile", "strongly agreed" that it was important to be involved in the sessions, "agreed" that they have been actively involved in other treatment sessions besides this one, "agreed" the child benefitted from the parent being in the treatment sessions, "agreed" it was important for the speech-language pathologist to share advice, "agreed" they were motivated to keep using this strategy, "agreed"; "agreed" this strategy helped their child be better understood, "agreed" it was important for them to learn how to help their child outside of speech therapy, "agreed" it was important for the speech-language pathologist to speak both English and Spanish. At post-test, all parents continued to feel that participating in this study was "very worthwhile", "agreed" that it was important to be involved in the sessions, "agreed" that they have been actively involved in other treatment sessions besides this one, felt "neutral" the child benefitted from the parent being in the treatment sessions, "strongly agreed" it was important for the speech-language pathologist to share advice, "strongly agreed" they were motivated to keep using this strategy, "agreed"; "strongly agreed" this strategy helped their child be better understood, "agreed" it was important for them to learn how to help their child outside of speech therapy, "agreed" it was important for the speech-language pathologist to speak both English and Spanish. No additional comments were provided by the parents. See Table 16 for parent social validity survey results.

Table 16

Parent Social Validity Survey Results

	Parent Responses	
Survey Items	Pre-Test (n=3)	Post-Test (n=3)
Participating in this study:	5	5
It is important to be involved in the sessions.	5	4.6
I have been actively involved in other treatment sessions besides this one.	4	4.3
My child benefits from me being in the treatment sessions.	4	3.67
It is important for the speech-language pathologist to share advice on treatment.	4.6	5
I am motivated to keep using this strategy.	4.6	5
This strategy helped my child be better understood.	4.6	5
It is important for me to learn how to help my child outside of speech therapy.	4.6	4.6
It is important for my speech-language pathologist to speak both English and Spanish.	4.6	4.6

Discussion

This study examined the impact of video self-modeling as a sensory-cueing intervention approach to improve the speech production of developing pre-school aged bilingual children. The findings revealed that when a video self-model is used as a sensory cueing intervention using cross-linguistic speech targets, accuracy for those selected speech targets increases. These results suggest a functional relationship between the video self-model and the cross-linguistic speech target accuracy outcomes. Furthermore, these results suggest that video self-modeling can be an effective intervention approach to use when working with pre-school aged developing bilingual children.

These outcomes certainly contribute to the limited existing body of literature of intervention approaches when working with bilingual children identified with or suspected of

CAS using a culturally responsive approach. As has been shown in previous studies, sensory cueing intervention approaches have an impact on children speech production outcomes (Dale & Hayden, 2013; Grigos & Kolenda, 2010; Kadis et al., 2014; Klick,1985; Lundenborg & McAllister, 2007; Martin et al., 2016; Rosenbek et al., 1974; Vashdi, 2014). This study shows how a video self-modeling sensory cueing intervention approach that accounts for cross-linguistic patterns within a bilingual environment can impact the speech productions at the CV, CVCV, and CVC levels across frequent session repetitions. Additional research, however, is warranted to evaluate if speech production outcomes can generalize to other speech level hierarchies and speech transitional movement patterns as these were not only selected on an individual basis for each child but also these child participants did not engage in this intervention at the phrase level.

Prior to the intervention phases, all child participants demonstrated limited and variable errors in their speech sound productions at baseline. During the B1 intervention improving speech outcomes were noted for all children, however, an accelerating pattern was noted in the speech production outcomes for Nate and Cayden at intervention phase 2. Although Mimi did not demonstrate an accelerating trend, her results demonstrated a stable level of accuracy for targeted productions when presented with the video self-model intervention approach particularly noted during the second intervention phase. This lack of improvement may have been attributed to escalating interruptions within the intervention environment in addition to her distractibility to the tasks at hand. Overall, the growth patterns noted for both Cayden and Nate were promising as there was increased consistency in their ability to produce the speech sound targets more accurately and consistently over time.

In addition, the maintenance or follow up phase which was conducted 1 week post intervention, although only encouraging for Nate, addresses the need for continued frequency and intensity of intervention sessions. Results of 3 consecutive maintenance sessions, for both Cayden and Mimi, did not meet criterion level. Given that Cayden and Mimi had both been diagnosed with developmental delays and received or had a history of additional specialized services in addition to specialized classroom instruction placement, the effects of children with a developmental delay diagnosis requires further generalization techniques and strategies to be explored.

Furthermore, the intensity of the video self-models shown appeared to have a correlation to speech outcomes. As was demonstrated in the second intervention phase (B2), with the increase of video models came the number of trials being presented being minimized, as a result the accuracy of the targets produced were noted to be more correct. However, an increase in the number of verbal prompts was additionally noted in intervention phase 2. Thus, although the intensityof video self-models increased, the frequency in which the targets were presented required modification as the child participants grew more inattentive during this intervention phase. This finding is significant in that the need to remove the monotony of the study protocol was required in order to keep the child's interest to the task and video self-models.

Pre and post test measures for percentage of consonant correct and peracentage of vowels correct showed cross-linguistic improvement across consonants for Nate and Mimi, however, the severity rating continued to remain mostly within the severe level across participants. Moreover, several inconsistencies and imprecisions of responses obtained at the word level at both pre and post test measures were found, which is in parallel with the characteristics of the childhood apraxia of speech diagnosis. Gains across percentage of consonants correct warrant caution in

interpretation as often the child participants required a delayed imitation to respond as their expressive vocabulary, despite the standardized measure to provide a question prompt was deficient. Mimi appeared to have changes in pre and post test measures in English which concurs with her preferred language use, whereas Nate demonstrated changes in his Spanish pre and post measures as also concurred with Spanish as being his more preferred language used. Cayden demonstrated rather equal deficiencies for both English and Spanish particularly across his percentage of consonants correct for both English (41.52) and and Spanish (43.66). Other pre and post test assessment measures showed minimal to no change in speech and language performance across participants, which may be due to the lack of sensitivity and specificity in measuring speech production and language growth for these participants.

Social validity data results obtained from parents revealed that participating in this study felt it was very worthwhile, important for the speech-language pathologist to be share advice on treatment, were motivated in using this strategy, strongly agreed that this strategy helped their child be better understood and strongly agreed that it was important for them to learn how to help their child. These reports obtained from the parents reveal a shared interest in not only improving the speech outcomes of the children but also their vested interest in supporting their child's speech needs. The survey item of my "child would benefit from the parent being in the treatment sessions" was noted as neutral by the parents. The finding was interesting and could have a direct relationship to the study given the intervention environment for this study as the parental presence in the room where the intervention took place often distracted the child or impacted their level of focus during the video self-modeling intervention sessions. The child social validity questionnaire reported that children felt indifferent to sad when people don't understand them, talking with mom, dad or siblings. Yet, Nate and Cayden felt mostly happy about the way they

talked. Although initially Cayden and Mimi were motivated to practice their sounds with the researcher, this eventually moved to an indifferent status. Thus, their level of motivation was shifting. It is unknown if the diagnosis of Developmental Delay for Cayden and Mimi played a role in or affected the reliability of the social validity outcomes.

Implications for Practice

There are several implications for practice as a result of this intervention study. This study was intended to contribute to the existing body of literature as a scarce variety of intervention approaches exist for the developing bilingual child identified with or suspected of CAS. Provision of a bilingual model for improving the cross-linguistic speech production outcome was proposed. This study incorporated how a sensory cueing intervention approach could be delivered in the home language with implications for dual language gains.

Clearly, the need to engage the child in fun and engaging activities needs to be taken into account (Strand, 2019). Adaptations to traditional trajectories such as the use of technology indeed created an environment suitable for preschool aged children (Edwards et al., 2018, Bellini & Akullian, 2007; Hong et al., 2017; Mason et al., 2016). Although the element of the technology was motivating and each child participant was initially very excited about seeing themselves in the video as was witnessed by their smiles, pointing at self and in one instance kissing the screen, it became imperative to maintain their attention and interest. As these children were of pre-school age, their level of attention and focus to the task was at times challenging. As the novelty of the introduction of the video self-model began to alter, it became imperative to incorporate turn taking toys and games that would eventually be of high interest to the participant as the intensity and frequency of the sessions grew and the perceived difficulties with

speech outcomes became more apparent. Although games consumed some intervention time, it was important to gauge the child's interest as maintaining their level of motivation was crucial.

Additionally, child access to the iPad needs to be considered. In the case with all of the participants, the iPad served as an intriguing technological tool. Often the child reached to take it from the researcher's hand, and manipulated functions for their personal gain. While allowing the child to activate the video was motivating, and allowed the child some control of the video self-model activation, considerations for eliminating distractions needed to also be maintained. Moreover, the individual participant activation of the iPad allowed the child not only needed pause times, but also processing time between video self-models as often the subjects practiced in unison with the video or rehearsed the productions before being prompted.

Furthermore, because no corrective feedback was given to the child participant immediately following an incorrect response, child participants began to recognize when they were not correct and often sought feedback after the final prompt; as such a level of self-awareness began to emerge. Nevertheless, considerations of feedback in the form of verbal praise for their work and intentions needs to be considered when using any intervention approach so to eliminate the unemotional component of the intervention practice.

Parents of the child participants were given the open option to select the place for the intervention study. Given the parent work schedules, lack of transportation, and/or childcare needs for other siblings, the choice for the study intervention was made open to the parent. Although at times the level of distractions with enacting the intervention study were in multitude, the benefits were numerous. The initial trust development between the child participant and the researcher was gained near immediately. Being invited into the home of the child participant provided an opportunity for the child to immediately be within a natural and comfortable

environment. This development of rapport often lead to fading of the warm up stage of the intervention study between the child participant and the researcher. Often, upon arrival the child participant lead the researcher to the table and anxiously awaited to begin the session in the hope to engage in the planned speech session toys and games. The relationship and level of trust developed and attained between the researcher and the family members was also beneficial. The parents often engaged in rapport development conversation, offered various levels of hospitality, and opened a forum for discussion relevant to their child's needs. Additionally, being immersed in the home environment also allowed for observations of other home-life and routine activities which contributed to responsive and functional selections of word targets. Allowing the researcher to recognize the communicative contexts in which the child communicated, such as language choices made, language models, and crucial communicative partners was an extreme asset as communication breakdown and repairs of the child participant were often witnessed.

Limitations and Future Research

There were many limitations in this study. Obviously, the sample size in this study was limited to 3 developing bilingual children between the ages of 3 and 5 years old. In order to conclude strong generalization of this intervention approach across the population of developing bilingual children between the ages of 3 and 5 years old, a larger sample size is warranted. Increasing the sample size under a randomized control research approach is ideal as it has been documented that a minimal body of randomized control intervention research exists for CAS and obviously even less for bilingual children with CAS (Morgan et al., 2018).

Although improving trends were noted across the child participants during the use of video self-modeling, the generalization of the speech outcomes was less apparent. Perhaps, the need to expand time blocks and/or video self-modeling intervention sessions would allow the

child participant more opportunities to practice the speech production targets and potentially impact the generalization during maintenance tasks. Furthermore, expansion of time blocks could also impact the ability to reach the criterion value in order to move on to the next hierachal level in speech production. The need to explore the next level of speech hierarchy and determine adequacy of the intervention approach at functional speech levels is necessary.

Selection of speech targets is complex. Given the speech sound systems of a bilingual child and the limited resources available to make sound decisions for target selections warrants further investigation. Although current literature exists on the development of bilingual speech systems, the cross-linguistic effects for target selections for treating CAS continues to be a challenge (Marquardt et al., 2002; Goldstein, B. & Cintron, P., 2001; Fabiano-Smith & Goldstein, B., 2010). Functional word selections, language specific word and phrase choices, and syllable shape hierarchies continues to be of concern as these have a direct impact on speech intelligibility and in negotiation of communication contexts.

Engagement of parents in the intervention process was a clear limitation in this study. As parents were highly visible during this intervention study, the lack of an incorporated home program as a parallel component to the intervention study was a definite necessity. Although the appropriation and outline of home programs has not been clearly delineated in the literature, parental involvement in the treatment of their children with CAS could only advance the frequency of advancement of speech outcomes for their children. Future research should incorporate methods and programs in which speech-language pathologists can guide parents and support bilingual children with speech sound disorders. The possibility of speech-language pathologists creating video self-modeling interventions as a home program should be explored.

The social validity of the video self-model intervention approach should also be explored further. Perhaps interviewing parents and other family members specifically to learn of the communicative contexts in which the child needs to be better understood should be conducted. Taking into account the perspectives of the parents and family, words and phrases that are essential in their communicative environment should be considered as opposed to the researcher making the final selections of the word targets. Acknowledgment of word targets specific to language use(s) in the environment of the child could potentially improve the child's view and perspective of their own speech behaviors when communicating with others.

Conclusion

This is the first known study to evaluate the use of video self-modeling with developing bilingual children with or suspected of CAS. The findings of this study showed that the video self-modeling sensory cueing intervention which contained a cross-linguistic approach to target selections and conducted in the Spanish language had an improving effect on the speech outcomes of preschool aged developing bilingual children identified with or suspected of CAS. Although growth was noted in the speech outcome patterns of those children who participated in the study, more research needs to be explored specifically with a larger sample size to secure generalization across a variety of speech contexts. More research is needed to identify cross-linguistic target selections and to understand transitionary speech movements for target selections across dual languages, as well as understanding the impact of language use of intervention, and the influence of time blocks on speech production outcomes. Appropriate interevention models for treating bilingual children identified with or suspected of CAS is critical. In conclusion, findings from this intervention approach reveals that video self-modeling

may be an effective method for treating pre-school aged bilingual children identified with or suspected of CAS.

IV. Practice Paper

The Use of Video Self-Models with Bilingual Pre-School Aged Children Identified with or Suspected of CAS

Pre-school aged children often are identified with speech sound disorders (Sices et al., 2007). It has been estimated that 2%-25% of children between the ages of 5 and 7 years old, are noted to have a speech delay or a speech sound disorder (ASHA, 2007; Sices et al., 2007). Childhood apraxia of speech (CAS), as defined by the American Speech-Language Hearing Association is a "neurological pediatric speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits. The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound productions and prosody" (ASHA, 2007). According to Strand (2019), children with severe speech sound disorders present various challenges to speech language pathologists. Often children with CAS do not respond to traditional methods of treatment (Strand, 2019; Strand et al., 2006). Evidence-based intervention models become critical in the service delivery for improving speech skills of children with childhood apraxia of speech (CAS) as it is the responsibility of the certified speech-language pathologist to not only make the primary diagnosis of CAS, but also to design and implement the treatment programs needed for improvement and progress (ASHA, 2007, p.3).

As non-English languages continue to comprise an increasing percentage of students in public schools, legal and ethical considerations need to be assumed (U.S. Census, 2013). According to the American Speech-Language Hearing Association (ASHA) 2014 Schools Survey Report, English language learners represent about 6-8% of the speech-language pathologist caseload population in the western regions of the country and 14%-20% of English language learner students on speech-langauge pathologist caseloads in the northeastern,

midwestern, and southern regions of the country. Furthermore, according to the ASHA 2016 Schools Survey, only 8% of speech-language pathologists (n=1689) reported feeling very qualified to address cultural and linguistic influences on service delivery outcomes. This survey is a significant finding as the cultural and linguistic diversity of our nation continues to grow and the skills needed by speech-language pathologists to address the needs of their existing caseload continue to be vast.

As documented per the Individuals with Disabilities Education Act (2004), additional special needs factors including the child's language needs and mode of communication should be considered for both assessment and direct instruction services. Over 30 years ago, the "Clinical Management of Communicatively Handicapped Minority Populations" position statement by ASHA (1985), called for assessment and intervention of speech and language disorders should be conducted in the client's primary language. "Limited English proficient" children, as defined by ASHA (1985), include individuals who are proficient in their native language but not in English. Noting that a true communication disorder is marked by limited communication competence in both languages, ASHA asserted that these individuals should be assessed in both languages to determine language dominance and that the language of intervention would be determined by the results of the assessment.

It is the position of ASHA that apraxia of speech exists as a distinct diagnostic type of childhood speech sound disorder that warrants research and clinical services" (ASHA, 2007, p.1). Although there is an existing body of literature of intervention models and approaches, the existing body of literarture for treating developing bilingual children with or suspected of childhood apraxia of speech is limited (ASHA, 2019; Koehlinger, 2015; Maas et al., 2014; Morgan et al., 2008; Morgan et al., 2018; Murray et al, 2014). The following section provides an

approach for treating preschool aged developing bilingual children with or suspected of childhood apraxia of speech using a video self-model internvention approach.

Using a Video-Self Model to Treat Childhood Apraxia of Speech

Video modeling is "a technique that involves demonstration of desired behaviors through video representation of the behavior" (Bellini & Akullian, 2007, p. 266). Video self-modeling (VSM) has been documented to be an evidence based intervention that is effective in promoting behavior change (Bellini & Akullian, 2007; Edwards et al., 2018; Hong et al., 2017; Mason et al., 2016). The individual watches the video and then imitates the model in the demonstration (Bellini et al., 2007). Although, traditional articulatory intervention has consisted of using adult models during production practice or imitation and drill practice by rectifying errored manner and placement, this approach consists of the child serving as his own model and allowed to imitate himself successfully performing the behavior (Kamhi, 2006; Wren et al., 2018).

The idea of video modeling (VM) or self-modeling (VSM) was derived from the concept first introduced by Albert Bandura in 1977 who theorized on modeling, or observational learning. Bandura (1977) believed children who attended to a model were in fact able to imitate that model or behavior if motivated by the model. According to Ortiz et al. (2012) the concept of video modeling provides individuals with a model of the desired behavior or skill of interest and see correct execution in order to mirror that behavior. It is theorized that when the self becomes the model, the student has a visual of himself or herself executing the behavior correctly, which may then in turn increase the student's self-efficacy (Bandura,1977; Dowrick, 2012). The use of video self- modeling has been explored with various complex disorders and has been noted as a technique which has produced positive results across a variety of behaviors, disability types, and ages (Buggey & Ogle, 2012; Mason et al., 2013).

Bilingual Speech System Considerations

Various factors and considerations need to be accounted for when treating bilingual children with speech sound disorders which need to be accounted for in order to meet their bilinguistic needs (Gildersleeve-Newumann, 2015). As with all children with speech sound disorders, the goal of a bilingual child with a speech sound disorder is to essentially increase their overall speech intelligibility (ASHA, 2007; Gildersleeve-Neumann & Goldstein, 2015; Goldstein & Gildersleeve-Neuwmann, 2015, Kohnert, 2007). According to Fabiano-Smith and Goldstein (2010), bilingual children likely have a speech system that accesses both the English and Spanish languages. There are fewer consonants in Spanish than in English and only 5 permissible true vowels /a, e, i, o, u/ (Gildersleeve-Neumann et al., 2009). Although there are shared sounds across both languages, each language has its own distinct consonants and vowels (Fabiano-Smith & Goldstein, 2010; Gildersleeve-Neumann et al., 2009). See Table 17 for speech sounds shared between the English and Spanish languages. See Table 18 for unshared speech sounds between the English and Spanish languages.

Table 17

Shared Speech Sounds Between English and Spanish

Sound Classes	Shared Sounds
Plosives	/p, b, t, d, k, g/
Nasals	/m, n/
Fricatives	/f, s, ð /
Affricate	/tʃ/
Lateral Liquids	/l/
Glides	/w, j/

Note. Adapted from Fabiano-Smith, L., & Goldstein, B., (2010). Phonological acquisition in bilingual Spanish-English speaking children. *Journal of Speech, Language, and Hearing Research,* 53, 160-178. https://doi.org/10.1044/1092-4388(2009/07-0064)

[a]Modifcations of sounds may be warranted due to variations in Spanish dialects.

Table 18

Unshared Speech Sounds Between English and Spanish

Sound Classes	Unshared English	Unshared Spanish
Nasals	/ŋ/	/ɲ/
Fricatives	/v, ʒ, z, ʃ,θ, h/	
Spirants		[ß], [ɣ]
Affricate	/dʒ/	
Nonlateral liquids	/ɹ/	
Flap/Tap		/ɾ/
Trill		/r/

Note. Adapted from Fabiano-Smith, L., & Goldstein, B., (2010). Phonological acquisition in bilingual Spanish-English speaking children. *Journal of Speech, Language, and Hearing Research,* 53, 160-178. https://doi.org/10.1044/1092-4388(2009/07-0064)

[a]Modifcations of sounds may be warranted due to variations in Spanish dialects.

It is important to consider that bilingual English-Spanish speaking children acquire sounds in a simple to complex fashion; and permissible syllable and word shapes differ distinctly (Fabiano-Smith & Goldstein, 2010; Gildersleeve-Neumann et al., 2009). See Table 19 for syllable shapes.

Table 19

English and Spanish Syllable Shapes

Language	Feature
English[a]	CV, VC, CVC, CVCV, CCVC, CVCC, CCV, CCCVC
Spanish[b]	C, CV, VC, CVC, CCVC

Note. Adapted from Marquart, T.P;. Sussman, H.M., Snow, T., & Jacks, A. (2002). The integrity of the syllable in developmental apraxia of speech. *Journal of Communication Disorders*, 35, 31-49. https://doi.org/10.1016/s0021-9924(01)00068-5 Adapted from Goldstein, B. & Cintrón, P. (2001). An investigation of phonological skills in Puerto Rican Spanish-speaking 2-year-olds. *Clinical Linguistics & Phonetics,* 15(5), 343-361. https://doi.org/10.1080/02699200010017814

[a]English data for syllable shapes. [b]Spanish data for syllable shapes.

Furthermore, it is important to recognize that unlike English, there are fewer complex word final clusters (r, s, d, l, n) and in general consonant clusters are more limited in type and frequency in Spanish (Fabiano-Smith & Goldstein, 2010; Gildersleeve-Neumann et al., 2009).

Conducting Video Self-Model Intervention

Materials

A video editing software such as the iMovie video editing software application sold by Apple for Mac and iOS application is recommended for use as the recording and editing device for the creation of digital videos. The iMovie application has the capacity to import videos and

photo files from a hard drive. This application allows for selecting clips, adding titles, music and special effects such as fading. Color correction, stabilization of shakiness and the ability to manipulate the speed (fast or slowed) are elements to consider when creating the videos. iMovie video editing has the functions for manipulating and controlling video audio such as increasing and decreasing audio level and reducing background noise of recorded clips. The iMovie application can be used on Apple products such as the MacBook Pro and iPad Pro in order to display final video on the screen. Additionally, a tripod and video recording device can be used to video record each session.

Target Selection Considerations

Particular analysis should be completed to determine the child's speech sound target(s). Upon completion of formal and informal analysis of the child's speech repertoire, considerations for target selection should include a) analysis of shared and unshared Spanish and English sound systems, b) evaluating sounds produced to age of mastery, c) determining syllable word shapes produced and not produced appropriate for the language of intervention. Target words should be carefully chosen with attempts made to not only include a variety of vowels but also to include actions and nouns in common with their communicative environment.

Attainment of Targets for Self-Model Video

Upon analysis and agreement of target selection, create 5, 5x5 colored tile images of the target selections assuring a concrete representation of the target word. These images can be created from a pictorial software such as *Lessonpix Custom Learning Materials, Inc.*. Label the word target by name on the back, so as to not be visible to the child. During this basline phase, video recording of the the picture presentations should be conducted. Prompt for spontaneous productions at least two times. If the child does not provide a spontaneous response, a delayed

imitation or auditory cue should be provided. For example for CVCV word targets, the researcher can prompt the child in Spanish with: ”Esto es una cama. “¿Dime lo que ves? (This is a bed. Tell me what you see?). During these sessions, various age appropriate turn taking games should be played in order to reinforce and maintain the child’s participation, motivation and interest in the task. These pictured tasks should be paced per child’s tolerance and researcher gauging of attention to task prior to taking a turn at the game. A similar protocol can be used for various levels of speech productions.

Video Creation

Recorded video of a production obtained during the baseline should be used to create the intervention video. Upon obtainment of 20% of the target production or at least one production, the iMovie can be developed. Customize and trim the video using Quick Time Player, store this video as a file then import it onto the iMovie program. Once in the iMovie program, transition images, age appropriate tunes, and imports of the child target production can be created. Transition images should be constructed at the beginning and throughout the 3 images of the self production of the target seen within the video. Inclusion of at least a 1.5 second pause marker between each modeled target is recommended. Include a cheerful audio file at the beginning for at least 3 seconds and at the end of the video. Be sure to include transition markers or a colored page as a 1.5 second marker break between the 2-3 second video image of the child producing the target. The video self-model in summary should inlcude 1) a child friendly melody to attract and sustain attention, 2) video self-model of the syllable or word target, 3) the video then moves to a colored page, 4) video self-models of the word is displayed 3 times consecutively with 1.5 second pause markers, 5) video then moves to a colored page 6) followed by picture of self

cheering with music. This process should be completed for all 5 targets within the hierarachal level or syllable shape.

Intervention Protocol

Intervention sessions should be 40 minutes in length. The initial 10 minutes at the start of the session should include a warm up activity between the speech-langauge pathologist and the child. This warm up activity should serve as an opportunity for the child to develop a level of trust and comfort with the speech-language pathologist. This warm up activity can include floor and/or table play with various age appropriate toys and games. It is anticipated that fewer minutes may be required in the warm up activity as the level of rapport is developed across intervention sessions. A timer should be used to mark the beginning and end time of this 10 minute period.

After the expiration of these 10 minutes, introduce the child to a pictorial visual schedule to allow the child to be aware of the transition to a new task. Present the child with two highly preferred games and ask the child to make a choice between the two games as the selected game of choice. After the child and researcher take a turn at the game, show the child a representative picture of the target and prompt with “dime lo que ves”. Upon obtaining an incorrect response, prompte with “mira el video”. Show the 12-15 second video on the iPad Pro in horizontal fashion within the immediate field and at arms length of the child. Child is encouraged to view the video at least 3 times before required to provide a response. Show the child the picture (e.g., CV, CVCV pictured word) again and reprompt with “dime lo que dices tu/Tell me what you say”. Collect data upon attaining a response. See Appendix H for practitioner data collection form. Allow the child an opportunity to take a turn at a motivating and reinforcing game regardless of attaining a correct or incorrect response. Upon the child growing comfortable with

the activation feature of the iPad Pro, allow him to self activiate the video. Verbally praise child for correct production and effort.

Continue this pattern until mastery of given level is achieved at criterion level at 85% or greater across three consecutive sessions. Upon meeting criterion for the given level, the next hierarchal level should be targeted (e.g., CV, CVCV, CV.CVCV, VC.CVCV). Upon reaching the criterionlevel of success across 3 consecutive sessions, the next behavior is to be targeted (e.g., CVCV) and the video length would cumulatively increase (e.g., CV 2 seconds to CVCV 5 seconds to CV.CVCV 9 seconds). See Appendix I for session lesson plan example. See Appendix J for practitioner example intervention protocol example.

Additional Considerations

Maintenance of Child Interest. Wulf (1999) documented that observing a motor act faciliatates performance of that given act. Essentially, Wulf (1999) continues to elaborate and explains that observation allows for a cognitive representation of the task and thereby facilitates subsequent practice trials. Nevertheless, it becomes imperative for children with CAS to focus on the video self-models during the intervention or practice phases as the core of the intervention relies on the image of self producing the given targets. As a result, it becomes important to gauge the interest of the child through fun and engaging yet, simple turn taking activities. Regardless of the rigor and intensity of practice desired during the session, the interest of the child to the task remains a high priority so to continue to draw and maintain the child's attention.

Conclusion

The video self-modeling intervention approach was designed to treat bilingual children identified with or suspected of childhood apraxia of speech. As the representation of culturally and linguistically diverse populations continue to comprise the speech-language pathologists'

caseload, it becomes imperative to seek innovative approaches and evidence based practices to support the unique linguistic needs of those children served. As speech-language pathologists continue to hold paramount the welfare of their clients, seeking culturally sensitive and responsive interventions is key. This intervention approach is proposed with clinical and research based applications and considerations as speech-language pathologists continue to work with bilingual children with complex speech sound disorders.

V. RESEARCH STATEMENT

This dissertation is composed of five chapters. Chapter 1 introduces childhood apraxia of speech (CAS) and delineates the various factors and variables to consider when providing intervention to developing bilingual children identified or suspected of CAS. Chapter 2 illustrates a comprehensive systematic literature review of the existing literature specific to intervention models and techniques for monolingual and bilingual children between the ages of 3 and 10 years of age diagnosed with CAS. Chapter 3 describes a single-case research design study that explores the use of a video-self modeling intervention and its impact on Spanish syllables and word productions of developing bilingual children between the ages of 3 and 5 years old identified with or suspected of CAS. Chapter 4 consists of a paper, intended for speech-language pathologists, which describes the use of video self-modeling as an intervention model when working with developing bilingual children identified with or suspected of CAS. Finally, Chapter 5 describes my professional journey which led me to becoming a researcher, and also explains my research agenda and future professional and research goals.

Professional Journey

Professional Experience

I entered the field of speech-language pathology never imagining the path that my career would take me on. Reflecting back on my own educational experience, I am reminded of being the student in a state university master's level speech-language pathology graduate class who often demonstrated curiosity in the influence of cultural and linguistic variables and factors that could potentially impact service delivery. As a graduate student then, I recognized the importance these variables could have in my professional practice and zealously sought to learn more on this topic which was of special interest to me and which I felt so passionately about, yet,

to my dismay embodied such a limited existence of research literature. During my time as a master's level graduate student, I dedicated a large portion of my academic inquiry seeking not only the knowledge and skills needed to be a successful entry-level speech-language pathologist, but also sought mentorship through the academic and clinical faculty to guide me in the direction required to conduct speech and language services in an ethical manner to a disproportionately identified and served population; the culturally and linguistically diverse.

Through the privilege of working in both the school and university settings, I gained an appreciation of the needs, challenges, demands and responsibilities of a being a service provider and instructor. As a service provider, I dedicated my practice to serving bilingual (English/Spanish) communicatively impaired children with various disabilities and severities within the school environment. I consistently dealt with limited access and availability of resources and materials appropriate for assessment and intervention practices. Given the concerns with disproportional identification among bilingual children, the need for appropriate assessment and interevention practices was not only imperative but a stagnant problem. As a clinical supervisor in academia, I had the opportunity to supervise graduate students who were assigned to my caseload for either intervention and/or assessments. Clinical supervisory responsibilities often required students to provide service delivery to clients for which they had no course or experiential background in which naturally heightened their level of anxiety and or their level of confidence in delivering intervention or assessment as prescribed. Students often had to not only rely on the supervisor for explicit guidance and knowledge for both the client's diagnosis and intervention but also take advantage of additional educational opportunities to familiarize themselves with the disability, assessment tools, and/or intervention techniques. I created learning environments that promoted discussions and teachable opportunities through

various innovative means for current and future student assignments specific to bilingual topics which proved to be beneficial and welcomed in addition to developing and teaching courses specific to cultural awareness and ethical practices in treating and assessing multicultural and multilingual communicatively disordered populations.

As a speech-language pathologist, it was important to not only recognize the needs of the community which I served, but also to look beyond the immediate present and commit to life-long learning. As a bilingual-bicultural speech-language pathologist who provided bilingual services to bilingual children, I always looked beyond the here and now. Given the limited resources and existing literature in bilingual assessment and intervention practices discovered throughout my professional career, my desire for more knowledge led me to seek and search through my own discovery. Because of the ethical responsibility I uphold in serving individuals, I have not only committed to life-long learning but also in sharing that knowledge with others through teaching. Throughout my professional history, I have dedicated my career to learning and researching how cultural and linguistic differences impact the provision of services by speech-language pathologists. I have equally devoted a large portion of my career educating, teaching, mentoring, and providing knowledge to prepare other bilingual and monolingual speech-language pathologists when working with communicatively diverse populations. As I continue my professional journey and reflect on my professional accomplishments and ambitions, I aspire to actively participate in influencing and cultivating the current and future generation of speech-language pathologists through my research.

Doctoral Studies and Scholarship

My purpose for obtaining a doctoral degree was to contribute to the body of literature which guides evidence-based practice when working with the culturally and linguistically diverse population. As a professional who strived to provide the highest level of care to children with special needs, the lack of empirical data to support clinical decisions when providing services to culturally and linguistically diverse special needs individuals was of concern. As a speech-language pathologist, I consistently faced the challenge of a minimal existence of literature to guide assessment and intervention practices when working with bilingual children with communication disorders. With a thorough appreciation of the scientific basis which drives our decisions as speech-language pathologists, the challenges of having an ill body of empirical studies to support applied clinical decisions when working with culturally and linguistically diverse individuals adversely affects service provision. As I am ethically bound in maintaining the welfare of those individuals served, it has become a personal goal to narrow the literature gap. The recognition of client centered and focused outcomes continues to be of paramount interest to me, hence, my drive to contribute to the profession as a researcher, scholar, and teacher.

During my time in the doctoral program, I completed all doctoral core coursework, research methodology coursework, special education seminars, various electives within an English language learner concentration, and various research projects and independent studies. Research projects, independent studies, and literature review have all included topics with an emphasis on assessment and/or intervention practices specific to the bilingual (English/Spanish) population. Titles such as *Oral Language Development Second Language Literacy Development* (Spring 2013), *Discourse Among ELL's with Disabilities During Language Arts* (Spring 2014), *Engaging Parents and their Preschool Children in Bilingual Early Literacy* (Fall 2014),

Language Choices and Decisions by Bilingual Parents with Communicatively Impaired Children (Spring 2015), and *Parents and Children with Autism and their Language Choices* (Summer 2015) were among the scholarly activities explored. These topics were of high interest to me as they represented major questions, issues and concerns that were prevalent in the school setting.

In 2015, I was awarded the University of Illinois at Chicago College of Education Community Engagement Grant in the amount of $5000.00. As creating and establishing collaborative relationships between parents and school educators was of high importance to me, these funds were used to develop and implement a literacy program known as *Paginas Con Mi Familia ("Pages with my Family).* This program was intentioned to promote positive community relationships among teachers, minority parents and students within an exceptional school. The program emphasized the importance of literacy skill development as it pertained to bilingual learners from dual language backgrounds. I conducted workshops and learning experiences for bilingual preschool aged children and their monolingual Spanish parents over a four-week period first in March of 2015 and then again in April of 2015.

I have shared knowledge through peer reviewed poster presentations and/or seminars at professional conferences such as the Illinois Speech-Language Hearing Association, the American Speech-Language Hearing Association, and the Council for Exceptional Children. These presentation titles included *Evaluating Spanish Spelling Ability in Bilingual Speakers: Test or Free Writing?* (2013); *English Language Learners and Childhood Apraxia of Speech: Review of Intervention Models* (2018); *The Use of Simulated Interpreter-Standardized Patient Encounter to Understand Students' Cross-Cultural Communication Skills (*Nov. 2019*)*; *Intervention Models for Bilingual and Monolingual Children with Childhood Apraxia of Speech: A Systematic Review* (Nov. 2019); and *Video Self-Modeling as a Sensory-Cueing Intervention for*

developing bilingual (English/Spanish) children with identified or suspected childhood apraxia of speech (Feb. 2020). Furthermore, as clinical faculty at MWU, I also served on thesis capstone projects and as a thesis committee member, for various peer reviewed poster presentations of mentored research projects at professional conferences such as the Illinois Speech-Language Hearing Association, and the American Speech-Language Hearing Association which included: *Bilingual parent perception and satisfaction with SLP services* (2016, 2017*); Spatiotemporal dynamics of verb naming in bilingual individuals: A pilot study* (2016); *Effectiveness of targeting pragmatic language in children with genetic disorders* (2017), and *Diagnostic practices for childhood apraxia of speech: A survey* (2019).

While enrolled in the doctoral program and employed at Midwestern University, I coordinated the *Let's Talk Camp* at Midwestern University (MWU), which was an intensive intervention summer program for children identified with or suspected of childhood apraxia of speech (CAS) and other comorbities such as autism spectrum disorder and sensory processing disorders. I fostered and established relationships with the Apraxia Connection, a local community organization, by embedding an educational component highlighting specific themes for parents of children with highly unintelligible speech and/or suspected of childhood apraxia of speech as a component in the camp program. These educational components or workshops were preplanned collaboratively with representatives of the Apraxia Connection. This program and collaboration eventually grew to be recognized in and out of state with continued referrals to the MWU Speech-Language Institute. As a result of this program, my interest for intervention practices when working with the CAS population peaked as evidence based practices were crucial in the development and execution of the program. This desire to learn more about intervention practices when working with children with CAS led to my interest in conducting a

comprehensive systematic review of literature specific to intervention models when working with bilingual children between the ages of 3-5 years old. Delving into this literature and encompassing the questions and concerns which I had encountered in my work setting and explored in my doctoral studies, led me to propose a study which evaluated video self-modeling as an intervention model, a technique typically known to be used often with individuals with autism spectrum disorders, and apply the known sensory-cueing framework to bilingual children with CAS.

Future Research Goals

Upon earning my doctoral degree, my plan is to continue exploring childhood apraxia of speech intervention practices with a large emphasis on bilingual children. Given the cultural and linguistic demographic changes across the United States, the current membership of the American Speech-Language Hearing Association with respect to identified bilingual speech-language pathologists and those members who feel ill prepared to provide services to bilingual/multilingual children, the need for evidence based intervention and assessment practices is critical. The identification and treatment complexities of childhood apraxia of speech are vast, yet, when coupled with a child who is a developing bilingual, the complexities are multifaceted. I plan to expand my current research by examining elements that were prominent variables in the video self-modeling intervention process and which contributed more specifically to cultural responsive practices. I am highly interested in exploring the process and selection of cross-cultural speech targets, exploring word choice selection, effects of language(s) used in intervention and potential effects on speech outcomes of developing bilingual children with CAS, and the language choices made by CAS children and their parents. I would like to further explore the influence of selection of speech targets and word choices and the outcomes

specific to children's access to their environment and implications for speech intelligibility across known and unknown communicative contexts. Exploring the use and impact of a video self-modeling intervention on various speech hierarchal levels and lengthened speech productions as a marker for measuring successful speech outcomes. Additional future research goals further include determining the effects and causality of intervention with expanded time blocks on speech outcomes.

I also plan to expand on the social appropriateness, goal significance, and social effects of intervention as it pertains to both the bilingual children with CAS and their parents. I would like to explore and capture the intervention perceptions of children and the parents of CAS children by conducting thorough interviews and observations. I would like to measure the impact of treatment goals and procedures from the perspective of the child, the parent, family members, and other stakeholders. I would like to not only expand upon the questions currently being asked in my proposed child and parent social validity questionnaires but also include numerous other individuals in order to gain a better understanding of socially valid variables that likely were unrecognized.

As materializing and the dissemination of knowledge to current and future practitioners holds high importance to me, I intend to publish all research findings in peer-reviewed journals as well as presenting at regional, national and international conferences.

Research Agenda

Research to practice is central to my research agenda. My research agenda expands from my experiences as a bilingual speech-language pathologist who provided services to communicatively disordered bilingual children. The need to not only increase cultural awareness and cultural sensitivity practices in treating communication disordered bilingual children but also

enabling others the ability to demonstrate the practice of cultural competence through my research drives my research agenda.

Given the exisiting literature on intervention models and the scarcity of evidence based intervention models available for practice with bilingual disordered children, it becomes important to explore the viability of cross-linguistic implications and other variables that apply more specifically to developing bilingual children. Truly, the need for research on how to establish and make decisions specific to speech target selections, words chosen, and language(s) of intervention are primary to the treatment of bilingual children identified with or suspected of CAS. Given the current literature, an abundance of adopted intervention frameworks based on English based CAS theory and paradigms continues to be adapted in the intervention models when treating bilingual children with communication disorders. As a result of this, a more definitive outline of procedures and guidelines are required and necessary for adequate intervention practices exclusive to the linguistic needs of a bilingual child. My research agenda includes exploring the communicative contexts and environments exclusive to the communicatively impaired bilingual child with CAS.

Given the specialization and specific knowledge base and skill set required of speech-language pathologists to engage in procedures specifically for working with bilingual children with CAS, I hope to develop and execute preservice programs for speech-langauge pathologists working with bilingual children with CAS as well as developing programs which involve collaborative intervention techniques that include the bilingual child with CAS and their parents as well as speech-language pathologists.

Given that oral languge development is the stepping stone to an eventual establishment of reading and writing, I am highly interested in following the literacy development of the bilingual

children with CAS who I have established relationships with during this study. Literacy development, as it is well cited in the literature, can be of gross challenge to developing bilingual children with CAS. My potential research includes exploring a bilingual literacy intervention approach for bilingual children with CAS that integrates phonological awareness development such as letter-sound knowledge, phoneme identity, segmentation, and blending manipulation of these bilingual learners in order to support their transition to more demanding literacy tasks such as decoding, fluency and reading comprehension.

Furthermore, parental involvement and home programs for bilingual children with CAS requires a more in depth analysis. I intend to explore various methods, preparation, and causal effects of parental involvement in the intervention practices of bilingual children with CAS. As was evidenced in my systematic literature review, a delineation of parental involvement is necessary in order to determine its correlation between continued practice of speech targets in the home environment and overall generalization. Given the need for children with CAS to engage in frequent practice to support motor learned behaviors, the eventual involvement of parents as part of the intervention process becomes an area to investigate more thoroughly. The recognition of parents as a stakeholder in the eventual progression and successful speech outcomes of their child with CAS becomes an area that will require a clear scheme for appropriation.

Career Goals

Upon completion and attainment of my doctoral degree, I hope to secure a tenure-track assistant professor position within a diverse urban metropolitan university which would allow me a platform to exercise my desire to move forward research specific to communication disordered bilingual children. As passion was the driving force which inspired me as a novice clinician to seek a doctoral degree, I recognize how passion can drive and influence an individual such as

myself to becoming a strong practitioner, scientist, scholar and teacher. My ideal position would allow me to cultivate the energy and passion of future speech-language pathology students entering the field while shaping professional identities, providing fundamental knowledge and skills for working specifically with communicatively impaired bilingual children through innovative practices and trajectories, quality curriculum, meaningful pedagogy, clinical education, as well as critical mentorship to students who are charged with honoring and upholding paramount the welfare of all individuals served.

Furthermore, I am equally interested in inter-disciplinary collaborations between various health science disciplines. As children with CAS tend to have comorbidities or other exisiting conditions in addition to motor planning difficulties, I am highly interested in working within a university environment where the college or university community consists of other disciplines with whom I can jointly work with to accomplish my research agenda and possibly create new research lines. Moreover, I would like to expand upon international educational program development and clinical experiences of speech-language pathology graduate students in Guatemala. Realizing international student immersion education possibilities as well as the sustainability of patient care from not only a speech and language perspective but also from a concerted interdisciplinary effort is appealing.

Ultimately, an ideal academic position would allow me an opportunity to teach courses in bilingual assessment and intervention practices, a motor speech course, a speech sound disorders course, and a multicultural/multilingual course. I believe in my potential and am motivated to help develop and transform the identities and practices imbued with the commitment to transform learning and clinical experiences of all students.

Conclusion

As an academician, I will continue to research bilingual intervention practices, specifically for developing bilingual children with CAS. My plan is to continue to explore and examine the implementation and intervention practices for developing bilingual children with CAS. I will continue to explore variables and factors which could potentially contribute to valid intervention practices for children with CAS, methods in which other stakeholders can participate in specialized practices, and extend knowledge for developing the appropriate skill sets needed to ascertain successful speech outcomes and social competence for bilingual children with communication disorders.

Appendix A:
Abbreviated Summary of All Articles Reviewed

Reference	Research Design	Participant age, severity, history of therapy, language spoken	Dependent variable, independent variable	Maintenance	Parent Involvement/Home Program	Results
Ballard et al. (2010)	Within-subject experimental design with multiple baselines	10;10, 9;2, 7;8, mild to moderate, yes English	Syllable, Motor-programming	No	No	Positive effects for duration contrasts across syllables in treated three-syllable strings; generalization to less complex three-syllable strings
Beathard & Krout (2008)	Descriptive clinical case study	3 y/o, unspecified, yes, English	Vocalization, phonemes, words, Rhythmic	No	No	Increase in verbal communication, socialization, cognitive/emotional skills, motor skills/movement
Case & Grigos (2016)	Experimental design	5;0-6;10, Varied, unspecified, English	Word, Motor-programming	No	No	Short-and-long term changes in consonant accuracy and consistency. No lip and jaw movement change over time. Jaw movement duration longer in CAS; movement stability differed between low and high complexity words across both groups
Dale & Hayden (2013)	Single subject (ABB and ACB design)-within & between subject comparisons	3;6-6;0, unspecified, English	Words, phrases, Sensory cueing	No	No	PROMPT as a whole (with TKP) to facilitate greater effect than without.
Edeal and Gildersleeve-Neumann (2011)	AB-single subject (alternating treatment)	6;2 and 3;4, unspecified, yes, English	Syllable, Motor-programming	Yes	Yes	High frequency practice of speech targets generated outcomes
Gildersleeve-Neumann & Goldstein (2015)	Multiple baseline (single subject experimental design)	5;8, 5;6, moderate to severe, yes, English/Spanish	Phoneme, syllable, word, phrases, Motor-programming	No	No	Cross-linguistic effects for vowels, consonants and utterances
Gillon & Moriarty (2007)	Controlled multiple single subject w repeated measures--pre/post	6;0, 7;0, 6;10, unspecified, yes, English	Phono awareness, Linguistic	No	No	All 3 participants improved phonological awareness skills 2 participants generalized to a non-word reading task
Gomez et al. (2010)	Multiple baseline	4:4, 5:8, unspecified, yes, English	Word, phrases, Motor programming	Yes	No	Mixed results for C1V1C2V2 polysyllabic words, C1V1C2V2+CVC; phrases not met
Grigos et al. (2010)	Single case--within participant comparisons	3;2, unspecified, yes, English	Syllable, word, Sensory cueing	Yes	No	Phoneme-specific changes included increases in jaw velocity and stability over time with PROMPT
Hitchcock et al. (2017)	Multiple baseline across subjects	6:10-9:10, unspecified, yes, English	Syllable, word, sensory cueing	No	No	Mixed results with EPG
Iuzzini & Forrest (2010)	Single subject multiple baseline across subjects' design	3;7 & 6:10, severe, unspecified, English	Phoneme, syllable, Combination	No	No	Increase in PCC; phonetic inventory increased; variability of errors decreased; inconsistency of productions reduced
Kadis et al. (2014)	single case--within subject	3;9-6;6, severe, unspeficied, English	Word, Sensory cueing	No	No	Thinning of the left posterior superior temporal gyrus (Wernicke's area) with PROMPT intervention
Klick (1985)	Case study (6 months)	5;6, unspecified, unspecified, English	Words and phrases, Sensory cueing	Yes	No	ACT effect on carrier phrase and words; 6 months post novel utterance productions reported
Krauss & Galloway (1982)	Case study (A and B design)	unspecified unspecified, yes, English	Utterance length, Rhythmic	No	No	Increase in, imitation tasks for single words and short sentence; intelligibility gains noted
Lagasse (2012)	Single case experimental design with alternating treatments (ABABABABABA)	6:0, 5;0, unspecified, yes, English	Words, phrases, Rhythmic	No	No	Smaller trend with use of MIT 2-5% with 7 & 15% increase in responses when compared to traditional speech therapy

Lundeborg & McAllister (2007)	Multiple baseline	5:00 unspecified, yes, English	Phoneme Sensory cueing	No	Yes	PCC increased; percentage of words correct statistically significant; visual deviancy significant
Maas & Farinella (2012)	Alternating treatment single-subject design--multiple baseline/Withdrawl	7;9, 5;0, 6;11, 5;3, moderate to mod-severe to severe, unspecified, English	words, phrases, Motor-programming	No	No	Mixed findings between random and blocked practice schedule
Maas et al. (2012)	Alternating treatment single-subject design—multiple baseline	5;4, 8;4, 7;3, 6;4, mod-severe, severe, unspecified, English	words, phrases, Motor-programming	No	No	Low frequency provided feedback enhances learning in some but not all; younger or more severe CAS benefit from high frequency feedback
Martikainen & Korpilahti (2011)	Single case (alternating design A-B-A-B withdrawal)	4;7, unspecified, yes, English	Syllables, words, sentences, Combination	Yes	No	MIT and TCM gains in PCC and PVC; PMLU increased; improvement maintained for PMLU
Martin et al. (2016)	Repeated measures/pre-post test model	3;0-10, unspecified, yes, English	phoneme, Sensory cueing	No	No	Multimodal approach positive effect in phoneme production and perceptions of resilience behaviors
McCabe et al. (2014)	Single case AB	8;6, 6;7, 6;6, 5;5, unspecified, English	Word, Motor-programming	Yes	No	ReST 2x week positive effect lexical stress maintenance varied
McNeill et al. (2009)	Case study (pre-post)	4;5, unspecified, yes, English	Phono awareness, Linguistic	Yes	No	PCC and PVC increased; phono awareness and representation with early reading and spelling improved; MLU age appropriate but not free of morpho-syntactic errors
McNeill et al. (2009)	Controlled multiple single subject design with repeated measures, using AB (baseline-intervention) format	4:0-7:0, unspecified, unspecified, English	Phono awareness, Linguistic	No	No	Significant gains in target speech sounds and transfer to connected speech. Eight participants showed gains in at least target phoneme awareness skills and transfer to novel phoneme awareness tasks
McNeill et al. (2010)	Single subject design--repeated measures (pre- post)	4:0-7:0, severe, unspecified, English	Phono awareness, Linguistic	Yes	No	Improvement in phonological awareness, decoding and spelling immediately post intervention was maintained; 6 month follow up no significant difference
Moriarty & Gillon (2006)	Multiple single-subject design (pre-post) repeated measures	6;3, 6;10, 7;3, severe, yes, English	Phono awareness, Linguistic	No	No	2 participants significantly improved trained and untrained phoneme segmentation, 1 participant no improvement in trained or untrained phoneme manipulation
Murray et al. (2015)	Randomized control trial	4:0-12:0, unspecified, unspecified, English	Words, Motor-programming	Yes	No	Intense ReSt and NDP3 strong evidence and generalization for words
Namasivayam et al. (2015)	Experimental design (pre-and post)	2:8-4:6, moderate to profound, unspecified, English	Word, Motor-programming	No	Yes	Higher intensity treatment (2x/week) led to significantly better outcomes than with 1x/week (lower intensity) intervention. Intensity treatment did not have an effect of speech intelligibility at the word or sentence level. Effect sizes for the higher intensity treatment groups was larger.
Powell (1996)	Case study descriptive	4:0, unspecified, yes, English	Sounds, syllables, words, Linguistic	Yes	No	Gains in phonetic inventory across various places of articulation

Preston et al. (2016)	Multiple baseline	10;0-13;0, unspecified, English	Phoneme, syllable, word, phrases, Sensory cueing	No	No	Ultrasound effective for rhotic production but not generalized to all target levels; no generalization to untreated words
Preston et al. (2017)	Alternating treatments	8-16 y/o, mild-moderate, unspecified, English	Syllable, word, phrase, sensory cuing	No	No	Ultrasound bio-feedback positive effect on sound targets
Preston et al. (2013)	Multiple baseline	9:10-15:0, unspecified, yes, English	Syllable, word, Sensory cueing	Yes	No	Biofeedback mixed results for treated sequences
Rosenbek et al. (1974)	Case study	9:0, unspecified, yes, English	phonemes, phrases, Sensory cueing	Yes	No	Positive effect on number of correct sound productions with visual, gesture cues use and motor programming
Singh & Trivedi (2016)	Multiple baseline	8:0, unspecified, unknown, Hindi	word, combination	No	Yes	Improved motor behaviors, word accuracy
Skelton & Hagopian (2014)	Multiple baseline	4:0, 6:0, moderate, mod-severe, severe, unspecified, English	Word, Motor-programming	No	No	Randomized variable practice positive effect on word production
Strand & Debertine (2000)	Multiple baseline	5:0, severe, yes, English	utterances, Motor-programming	No	No	Steady improvement for target utterances; variability noted in time required; improvement maintained
Strand et al. (2006)	Multiple baseline	5;7, 5;8, 5;5, 6;1, severe, yes, English	Utterances, Motor-programming	No	No	DTTC significant effect on functional intelligible utterances
Thomas et al. (2014)	Multiple baseline	4;8-8:0, unspecified, yes, English	Word, Motor-programming	Yes	No	Low-dose frequency ReST treatment similar effects to high dose-frequency treatment; ReSt treatment resulted in l acquisition for real words across all participants and 2 of 4 children generalized to untreated pseudo words
Thomas et al. (2016)	Multiple baseline	5:5-11:2, unspecified, yes, English	Word, Motor-programming	Yes	No	Telehealth and face-face treatment similar acquisition of pseudo-words; generalization to untreated behaviors; stage at 4 months follow-up
Tierney et al. (2016)	Case study-descriptive	3:0, unspecified, yes, English	Syllable, Combination	Yes	Yes	Age appropriate speech sound substitutions, increase in phrase length, increases in connected speech intelligibility
Watson & Leahy (1995)	Case study-descriptive	3;1-5;0, unspecified, yes, English	Syllables, Combination	Yes	Yes	Positive effects for syllable shape, phonetic inventory; occasional vowel errors and prosodic pattern
Yu et al. (2014)	Experimental design (Pre-post)	5:1, mod to severe, no, English	Syllable, Motor-programming	No	No	PROMPT positive effect on control and inter-gestural coordination in voiced stop
Zaretsky et al. (2010)	Case study-descriptive	8;5, unspecified, yes, English	Phono awareness, Linguistic	No	No	Phonological skills for segmenting, identifying short and long vowels at 100%; reading non-words, decoding, short term memory, sound manipulation below average

Appendix B:
IRB Approval Letter

Approval Notice
Initial Review – Expedited Review

September 16, 2019
Elia Olivares
Special Education

RE: **Protocol # 2019-0762**
"Video Self-Modeling for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech"

Dear Ms. Olivares:

Members of Institutional Review Board (IRB) #2 reviewed and approved your research protocol under expedited review procedures [45 CFR 46.110(b)(1)] on September 11, 2019. You may now begin your research.

Your research meets the criteria for approval under the following category(ies): Protocol reviewed under expedited review procedures [45 CFR 46.110] Category: 5, 6, 7

Please note the following information about your approved research protocol:

Protocol Approval Date:	September 11, 2019
Approved Subject Enrollment #:	3
Performance Sites:	UIC
Sponsor:	None
Institutional Proposal (IP)#:	Not applicable

Research Protocol(s):

a) Initial Review Application: Video Self-Modeling for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech,06/27/2019

Documents that require an approval stamp or separate signature can be accessed via OPRS Live. The documents will be located in the specific protocol workspace. You must access and use only the approved documents to recruit and enroll subjects into this research project.

Recruitment Material(s):

a) Email, Version 2, 09/06/2019
b) Flyer English, Version 2, 09/06/2019
c) Telephone Screening Spanish, Version 2, 09/06/2019
d) Telephone Screening English, Version 2, 09/06/2019
e) Flyer Spanish, Version 2, 09/06/2019

Informed Consent(s):

a) Research involves activities related to screening, recruitment, or determining eligibility per 45 CFR 46.116(g)

Assent(s):

a) Assent English, Version 2, 09/06/2019
b) Assent Spanish, Version 2, 09/06/2019
c) A waiver of assent has been granted under 45 CFR 46.116(f) for children due to their young age (verbal assent will be obtained and procedures in place for child dissent); minimal risk; written parent/guardian permission will be obtained.

Parental Permission(s):

a) Video Self Model Spanish, Version 2, 09/06/2019
b) Video Self Model, Version 2, 09/06/2019

Additional Determinations for Research Involving Minors: The Board determined that this research satisfies 45CFR46.404, research not involving greater than minimal risk. Therefore, in accordance with 45CFR46.408, the IRB determined that only one parent's/legal guardian's permission/signature is needed. Wards of the State may not be enrolled unless the IRB grants specific approval and assures inclusion of additional protections in the research required under 45CFR46.409. If you wish to enroll Wards of the State contact OPRS and refer to the tip sheet.

Please remember to:

→ **Use only the IRB-approved and stamped consent document(s) when enrolling new subjects.**

→ Use your **research protocol number** (2019-0762) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with the policies of the UIC Human Subjects Protection Program (HSPP) and the guidance ***Investigator Responsibilities***.

Please note that the UIC IRB has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS office at (312) 996-1711 or me at (312) 355-0816. Please send any correspondence about this protocol to OPRS via OPRS Live.

Sincerely,

Alison Santiago, MSW, MJ
Assistant Director, IRB # 2
Office for the Protection of Research Subjects

cc:
Norma Lopez-Reyna (Faculty Advisor), Special Education, M/C 147

Appendix C:
Consent Form Approved

University of Illinois at Chicago

Video Self-Modeling for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech

ASSENT TO PARTICIPATE IN RESEARCH

HI! My name is Elia Olivares and I am a PhD student in special education at the University of Illinois at Chicago. I will be doing a study which means I will be working with other children like you. I am here to ask you if you are interested in doing this study with me. I will start by asking you some questions, we call this testing so that I can hear your sounds and how you put these sounds together when you talk. I will also be learning about how you share your thoughts and ideas to others. When we are done with that, you and I will play in a room. I will show you some pictures and ask you to tell me what you see and you and I will keep playing. I will have an iPad and record your words. I will take the iPad and make videos of you talking and saying words and then many words together. The videos will have a little music and show you saying the words of pictures I show you. After seeing the video, I will ask you again to say the words of pictures I show you. We will still play with different toys and games.

This will help me learn and teach other children how to say words when they play with other speech teachers.

Is this something you want to do?

Your mom/dad said it was okay for you to play and talk with me. I want to know if this is something you want to do. You can say yes or no or nod your head yes or no.

Yes ___

No ___

Refusal behaviors observed: Crying____ Not detaching from parent_____ Other:___

Universidad de Illinois en Chicago
Proporcionar Asentimiento Para la Participación en la Investigación

Auto-modelado de Video para Niños Bilingües (Inglés/Español) con Apraxia del Habla Infantil Identificada o Sospechada

ASENTIR A PARTICIPAR EN LA INVESTIGACIÓN

¡HOLA! Mi nombre es Elia Olivares y soy estudiante de doctorado en educación especial en la Universidad de Illinois en Chicago. Haré un estudio, lo que significa que trabajaré con otros niños como usted. Estoy aquí para preguntarle si está interesado en hacer este estudio conmigo. Comenzaré haciéndole algunas preguntas. Llamamos a estas pruebas para poder escuchar sus sonidos y cómo se combinan estos sonidos cuando habla. También aprenderé sobre cómo comparte sus pensamientos e ideas con otros. Cuando terminemos con eso, tú y yo jugaremos en una habitación. Te mostraré algunas fotos y te pediré que me digas lo que ves y tú y yo seguiremos jugando. Tendré un iPad y grabaré tus palabras. Tomaré el iPad y haré videos de ustedes hablando y diciendo palabras y luego muchas palabras juntas. Los videos tendrán un poco de música y te mostrarán las palabras de las imágenes que te muestro. Después de ver el video, te pediré nuevamente que diga las palabras de las imágenes que le muestro. Seguiremos jugando con diferentes juguetes y juegos.

Esto me ayudará a aprender y enseñar a otros niños a decir palabras cuando juegan con otros maestros de habla.

¿Es esto algo que quieres hacer?

Tu mamá/papá dijo que estaba bien que tú jugaras y hablaras conmigo. Quiero saber si esto es algo que quieres hacer. Puedes decir sí o no, o mover la cabeza, sí o no.

Sí ____

No ____
Comportamientos de rechazo observados: Llorando____ No separándose de los padres_____
Otro(s): ___

Universidad de Illinois en Chicago
Información y Consentimiento para Participación en el Estudio de Investigación de Conducta Social

Auto-modelado de Video para Niños Bilingües (Inglés/Español) con Apraxia del Habla Infantil Identificada o Sospechada

Se le ha pedido participar en un estudio de investigación. Los investigadores estan obligados proveerle un formulario de consentimiento como este para explicarle lo que consiste el estudio de investigación, que participación es voluntaria, describir los riesgos y ventajas de participar, y ayudarle a tomar una decisión informada. Con confianza, consulte con los investigadores cualquier pregunta que tenga.

Nombre y Titulo del Investigador Principal: Elia Olivares, doctoral student
Departamento y Institución: Special Education Department, University of Illinois at Chicago
Domicilio e Información de Contacto: 1040 West Harrison Street, Chicago, IL 60607

¿Por qué se me pide participar?
Se le pide participar como sujeto en un estudio de investigación porque indicó que es padre de un niño identificado o sospechoso de apraxia del habla infantil entre los 3-5 años y que su hijo puede ser elegible para participar.

Se le pide participar su hijo/a como sujetos en un estudio de investigación sobre niños bilingües (Inglés/ Español) de 3 a 5 años de edad diagnosticados o sospechosos de Apraxia del Habla Infantil para aprender si los niños muestran cambios en su discurso después de ver diciendo palabras y frases mediante el uso de videos de iPad. El sujeto de padre(s) se les pedirá que complete una entrevista por teléfono, complete una encuesta y comparta información sobre su hijo, y quedarse con su hijo durante toda la temporada del estudio incluyendo los examenes al principio y la fase final. Su hijo/a se le pedir pedirá que complete pruebas al principio y al final del estudio, mire videos de 12-15 segundos de ellos mismos practicando sonidos en palabras y frases durante atraves de actividades de juego.

Su participación en esta investigación es voluntaria. Su decisión de participar o no, no afectará sus relaciones actuales o futuras con la Universidad de Illinois en Chicago. **Si usted decide participar, tiene opción de cancelar en cualquier momento sin afectar esa relación.**

Aproximadamente 3 sujetos de edad 3-5 años y hasta 6 padres pueden estar involucrados en esta investigación de la UIC.

¿Cuál es el objetivo de esta investigación?
Los investigadores estan tratando de entender mas sobre sobre niños bilingües (Inglés/ Español) de 3 a 5 años de edad diagnosticados o sospechosos de Apraxia del Habla Infantil para aprender si los niños muestran cambios en su discurso después de ver diciendo palabras y frases mediante el uso de videos de iPad.

¿Qué procedimientos están involucrados?
Esta investigación se realizará en la casa de los participantes o en el lugar de su elección, como una biblioteca pública local, donde se puede organizar un espacio tranquilo e ininterrumpido.

Tendrá que venir al sitio de estudio por lo menos un total de 27 visitas aproximadamente o durante un período de aproximadamente 9-10 semanas.

Además de la fase de reclutamiento, hay tres fases más en el estudio: la fase de prueba, la fase de intervención y la fase posterior a la intervención. Se requerirá que su hijo participe en las fases de evaluación, intervención y posintervención.

Durante la fase de prueba, el investigador llevará a cabo una entrevista con los padres y luego completará otras pruebas formales e informales con su hijo para determinar sus niveles actuales de habla y lenguaje además de asegurar la apraxia infantil del diagnóstico del habla. Esta información se recopilará y analizará específicamente para aprender sobre los sonidos, palabras y frases que se utilizarán en el estudio. Esta fase requerirá que el investigador trabaje con su hijo durante un mínimo de 3-4 horas. Las pruebas se realizarán durante un período de 2 días o dependerán del nivel de fatiga de las pruebas de su hijo. Se les pide a los padres que proporcionen al momento de evaluar cualquier Programa Educativo Individualizado (IEP), Plan de Servicio Familiar Individualizado (IFSP) e informes de evaluación que incluyen terapia del habla y lenguaje u otros servicios relacionados (por ejemplo, informe ocupacional, informe psicológico) y comorbilidades existentes.

Una vez completada la prueba, se discutirá con usted la fecha y hora de inicio para comenzar la fase de intervención. Durante esta fase de intervención, se le pedirá a su hijo que participe en diversas actividades de juego y luego se le pedirá que diga sonidos, palabras y frases específicas en español. En este momento, el investigador registrará las respuestas para crear modelos de video de las producciones del niño. Esto ocurrirá dentro de los primeros 3-5 días por un total de 3-5 horas.

Después de estos 3-5 días, el investigador comenzará con 10 minutos de juego libre con su hijo y luego pasará a mostrarle videos cortos de sí mismo en un iPad que diga las palabras y frases objetivo mientras juega con varios juguetes, juegos y ocupaciones. Se contarán las producciones correctas e incorrectas de los objetivos y frases de palabras en

español. Las sílabas objetivo, palabras y frases observadas serán registradas. Cada palabra y frase producida por el niño será codificada y contada. Además, el número de intentos y la latencia en que se obtuvo la precisión en el CV (C es consonante, V es vocal), CVCV y CV.CVCV o VC.CVCV se contarán los niveles de frase; así como la tasa de presentaciones de modelos de video durante los ensayos para respuestas correctas e incorrectas obtenidas del niño. Estos datos se recopilarán, revisarán y registrarán en cada producción obtenida. Este procedimiento de recopilación de datos se realizará para cada sesión. Esto sucederá a lo largo de 3 sesiones semanales de 40 minutos durante 8 semanas consecutivas.

Luego se producirá un descanso de una semana, y se le pedirá a usted y a su hijo que regresen para una sesión de seguimiento para ver qué sonidos, palabras y / o frases se mantienen en su discurso. Durante la fase de seguimiento, se realizará una observación de tres segmentos de seguimiento de 10 minutos de la producción de sílabas, palabras y frases capacitadas de su hijo una semana después de que se complete la fase de intervención. Se realizará una actividad de calentamiento similar entre el participante y el investigador antes del segmento de 10 minutos con el fin de restablecer la confianza y la comodidad con el niño dentro del entorno, totalizando aproximadamente una sesión de 40 minutos.

Durante la fase de exámenes, el investigador le pedirá a usted y a su hijo que participen en una encuesta que aborde temas como puntos de vista sobre producciones del habla, interacciones con otros y puntos de vista de las actividades. Esta encuesta se le pedirá a usted y a su hijo al principio y al final del estudio.

Los padres completarán, the *Intelligibility in Context Scale* que tomará aproximadamente 5-10 minutos y completará un cuestionario para padres de 10 minutos antes y después del estudio. Antes del comienzo del estudio, el niño será evaluado durante aproximadamente 3-4 horas en un día o distribuido en 2 días. El estudio de intervención puede comenzar 1-3 días después de que se hayan completado las pruebas. Los investigadores se comunicarán con los padres por correo electrónico o por teléfono para verificar la hora y el lugar de su elección para el estudio.

Se requiere que los padres permanezcan en las instalaciones durante la totalidad de las pruebas y el estudio; aproximadamente un total de 3-4 horas para la prueba y un total de 3 sesiones semanales de 40 minutos en un período de 8 semanas consecutivas o aproximadamente 4 horas en las que el niño participará en el estudio.

Los niños participarán en el estudio de intervención que durará aproximadamente 40 minutos cada 3 veces por semana y se llevará a cabo durante un período consecutivo de 8 semanas.

La sesión de seguimiento, que será la última visita, se llevará a cabo 1 semana después de la conclusión del período de 8 semanas. En este momento, el niño participará en una

sesión de seguimiento de 40 minutos. Se le pedirá al padre y al niño que completen el cuestionario del padre y el niño que requerirá aproximadamente 10 minutos cada uno.

Se estima que el compromiso de tiempo total para ambos padres e hijos será de aproximadamente 9.5 horas durante un período de aproximadamente 9-10 semanas.

¿Cuáles son los riesgos y molestias potenciales?
Los riesgos principales que presenta este estudio de investigación es la pérdida de la privacidad (otras personas ajenas al estudio pueden descubrir que usted es un sujeto) y / o confidencialidad (otras personas ajenas al estudio pueden descubrir lo que hizo, dijo o la información recopilada sobre ti durante el estudio).

Es posible que se sienta incómodo con algunas de las preguntas que le pueden hacer y / o que deba discutir. Esta investigación incluye algunos elementos sobre el desarrollo del habla y las preocupaciones. Puede omitir y / o no responder a cualquier pregunta que pueda incomodarlo.

Durante la prueba o intervención, su hijo puede sentirse incómodo con el investigador.

Puede haber riesgos del estudio que no se conocen en este momento.

Se me informará acerca de nueva información que pueda afectar mi decisión de participar?
Durante el transcurso del estudio, se le informará de cualquier resultado significativo nuevo de investigación (ya sea bueno o malo), tales como los cambios en los riesgos o beneficios derivados de la participación en la investigación o nuevas alternativas a la participación, que podrían causar que usted cambie su decisión acerca de continuar en el estudio. Si recibe información nueva, deberá obtenerse de nuevo su consentimiento para seguir participando en este estudio.

¿Hay beneficios de tomar parte en la investigación?
Este estudio no está diseñado para beneficiar directamente. Los resultados del estudio pueden usarse para ayudar a otros patólogos del habla y el lenguaje a aprender más sobre las prácticas que se usan cuando se trabaja con niños con el mismo trastorno del habla identificado en varias clínicas, escuelas u otros entornos.

Es posible que participar en este estudio de investigación no lo beneficie directamente, pero es posible que el enfoque que se evalúa sea más efectivo que los enfoques/ capacitación comparativos actuales.

¿Qué otras opciones existen?
Usted tiene la opción de no participar en este estudio. Este estudio de investigación no está diseñado para proporcionar tratamiento o terapia, y usted tiene la opción de decidir no participar o participa en cualquier momento sin ninguna consecuencia

¿Qué pasa con la privacidad y la confidencialidad?
Las personas quienes saben que usted es sujeto de investigación son miembros del equipo de investigación. Así que ninguna información acerca de usted será compartida con otros sin su autorización por escrito, o si necesario, para proteger sus derechos o el bienestar (por ejemplo, si usted se lastima y necesita atención de emergencia o cuando la Oficina UIC para la Protección de Sujetos de Investigación supervisa el proceso de investigación o consentimiento) o si es requerido por la ley.

Información del estudio que le identificara individualmente y el formulario de consentimiento firmado por usted serán examinados o copiados para analizar la investigación por:

- Representantes del comité universitario y la oficina que revisa y aprueba los estudios de investigación, la Junta de Revisión Institucional/Institutional Review Board (IRB) y la Oficina para la Protección de los Sujetos de Investigación/Office for the Protection of Research Subjects.
- Otros representantes del Estado y la Universidad responsables de la supervisión ética, regulatoria o financiera de la investigación.
- Agencias reguladoras del gobierno, como la Oficina de Protección de la Investigación Humana/Office for Human Research Protections (OHRP).

Un posible riesgo de la investigación es que su participación en la investigación o información sobre usted y su salud podría ser conocida a personas ajenas a la investigación. Su encuesta, entrevista, datos recopilados de registros y / o grabaciones de audio se almacenarán en la carpeta de Box y se protegerán con contraseña para evitar el acceso de personal no autorizado.

Todos los datos identificables serán destruidos después del análisis de datos.

Si usted divulga el abuso real o supuesta, negligencia, o explotación de un niño o anciano discapacitado, el investigador o cualquier miembro del personal del estudio debe, y será reportado a los Servicios de Protección Infantil (es decir, el Departamento de Familia y Servicios Sociales), Servicios de Protección de Adultos, y/o la agencia de policía más cercana.

¿Cuáles son los costos para participar en esta investigación?
No hay costos para usted por participar en esta investigación.

¿Me reembolsarán por cualquiera de mis gastos o me pagarán por mi participación en esta investigación?
No se le ofrecerá el pago por participar en este estudio.

¿Puedo retirarme o ser eliminada del estudio?

Si usted decide participar, es libre de retirar su consentimiento y discontinuar participación en cualquier momento.

Por favor contacte al investigador, Elia Olivares por teléfono en 630-212-2712 or por correo electrónico egarci19@uic.edu

Los investigadores y / o financiadores también tienen derecho a detener su participación en este estudio sin su consentimiento si:
• Creen que es lo mejor para usted;
• Debía objetar cualquier cambio futuro que pudiera hacerse en el plan de estudio.

Si decide no seguir participando en el estudio y no desea que se use su información futura, debe informar a la investigadora Elia Olivares por escrito a la dirección en la primera página. Al investigador, Elia Olivares, aún pueden usar su información recopilada antes de su notificación por escrito.

¿A quién debo contactar si tengo preguntas?
Póngase en contacto con los investigadores Elia Olivares Investigador Principal en 630-212-2712, o por correo electrónico egarci19@uic.edu; o Norma Lopez-Reyna Patrocinador de la Facultad en 312-996-4526 o por correo electrónico nlr@uic.edu:

• si tiene alguna pregunta acerca de este estudio o su participación en él,
• si tiene preguntas, inquietudes o quejas sobre la investigación.

¿Cuáles son mis derechos como sujeto de investigación?
Si usted siente que no ha sido tratado de acuerdo con las descripciones en este formulario, o si tiene alguna pregunta sobre sus derechos como sujeto de investigación, incluyendo preguntas, preocupaciones, quejas, o para ofrecer de entrada, puede llamar a la Oficina para la Protección los Sujetos de Investigación (OPRS) al 312-996-1711 o 1-866-789-6215 OPRS (llamada gratis) o por correo electrónico al uicirb@uic.edu.

Si tiene preguntas o preocupaciones sobre sus derechos como sujeto de investigación, quejas, o para ofrecer opiniones, puede llamar a la Oficina para la Protección de Sujetos de Investigación (OPRS) al 312-996-1711 o 1-866-789-6215 (llamada exento) o mande e-mail para el OPRS al uicirb@uic.edu.

Recuerde:
Su participación en esta investigación es voluntaria. Su decisión sobre su participacion no afectará sus relaciones actuales o futuras con la Universidad. Si decide participar, usted es libre de retirarse en cualquier momento sin afectar dicha relación.

Firma del Sujeto o Representante Legalmente Autorizado
He leído (o alguien me ha leído) la información anterior. Se me ha dado la oportunidad de hacer preguntas y mis preguntas han sido contestadas a mi satisfacción. Estoy de

acuerdo en participar en esta investigación. Se me dará una copia de este formulario firmado y fechado.

Firma Fecha

Nombre—en Letra Impresa

Firma de la persona que obtiene el consentimiento Fecha (debe ser igual que del sujeto)

Nombre de la persona que obtiene el consentimiento—en Letra Impresa

Firma del Testigo Fecha (debe ser igual que del sujeto)
(incluya solamente si es requerido por IRB)

Nombre del Testigo—en Letra Impresa (incluya solamente si es requerido por IRB)

University of Illinois at Chicago
Research Information and Consent [Parental Permission] for Participation in Social, Behavioral, or Educational Research
Video Self-Modeling for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech

Principal Investigator/Researcher Name and Title: Elia Olivares, doctoral student
Faculty Advisor Name and Title: Norma Lopez-Reyna, Ph.D., Associate Professor, Special Education
Department and Institution: Special Education Department, University of Illinois at Chicago
Address and Contact Information: 1040 West Harrison Street, Chicago, IL 60607

About this research study
You are being asked to participate in a research study. Research studies answer important questions that might help change or improve the way we do things in the future.

Taking part in this study is voluntary
Your participation in this research study is voluntary. You may choose to say "no" to this research or may choose to stop participating in the research at any time. Deciding not to participate, or deciding to stop participating later, will not result in the loss of any services, class standing, and/or professional status to which you are entitled, and will not affect your relationship with the University of Illinois at Chicago (UIC) and/or University of Illinois Hospital and Health Sciences System (UI Health), or any of the agencies or organizations collaborating in this research.

This consent form will give you information about the research study to help you decide whether you want to participate. Please read this form and ask any questions you have before agreeing to be in the study.

You are being asked to participate in this research study because you indicated that you are a parent of a child identified with or suspected of childhood apraxia of speech between the age of 3-5 and that your child may be eligible to take part. No more than 3 preschool age children and up to 6 parent subjects will be enrolled in this research study.

Note: This research includes subjects who are minors. If you are a parent, guardian, or legal representative, the terms "you" or "your" refer to the research subject for whom you are responsible.

Important Information

This information gives you an overview of the research. More information about these topics may be found in the pages that follow.

WHY IS THIS STUDY BEING DONE?	The researcher hopes to learn if the use of a video model as an intervention approach is effective for treating bilingual children with or suspected of childhood apraxia of speech. A study conducted by Gildersleeve-Neuman and Goldstein (2015), found that treating speech sound disorders in both English and Spanish resulted in positive changes for the speech accuracy of the bilingual child for treated and non-treated error patterns; this in turn, contributed to the assumptions of interaction of languages as speculated by the Dynamic Systems Theory.
WHAT WILL I BE ASKED TO DO DURING THE STUDY?	In addition to the recruitment phase, there are three more phases to the study: the Testing Phase, the Intervention Phase, and the Post-Intervention Phase. Your child will be required to participate in the Testing, Intervention and Post-Intervention Phases. During the testing phase, the researcher will conduct a parent interview with you the parent, and then complete other formal and informal tests with your child in order to determine their current speech and language levels in addition to securing the childhood apraxia of speech diagnosis. Testing will be conducted over a 2 day period or dependent on your child's testing fatigue level. This phase will require the researcher to work with your child for a minimal of 3-4 hours. Parents are asked to provide at the time of testing any existing Individualized Educational Program (IEP), Individualized Family Service Plan (IFSP) and assessment reports including speech-language therapy, or other related services (e.g. occupational report, psychological report) and existing comorbidities. This information will be gathered and analyzed specifically for learning about the sounds, words and phrases to use in the study. After the testing is completed, the start date and time will be discussed with you to begin the intervention phase. During this intervention phase, your child will be asked to engage in various play activities, and then prompted to say specific sounds, words and phrases in Spanish. At this time, the researcher will be recording responses to create video models of the child's productions. This will occur within the first 3-5 days totaling 3-5 hours. After these 3-5 days, the researcher will begin with 10 minutes of free-play with your child and then move to showing your child short videos of themselves on an iPad saying the target words and phrases

	all while playing with various toys, games and activities. This will happen throughout 3-weekly 40-minute sessions across 8 consecutive weeks. A one-week break will then occur, and you and your child will be asked to return for a follow up session to see what sounds, words and/or phrases are being maintained in his/her speech. The researcher will ask that you and your child participate in a survey addressing topics such as views about speech productions, interactions with others, and views of the activities.
HOW MUCH TIME WILL I SPEND ON THE STUDY?	Parents will complete The *Intelligibility in Context Scale* which will take approximately 5-10 minutes and complete a 10-minute parent questionnaire before and after the study. Before the start of the study, the child will be tested for approximately 3-4 hours in a day or distributed across 2 days. The intervention study can begin 1-3 days after the testing has been completed. The researchers will contact the parent via email or telephone to verify the time and place of their choice for the study. Parents are required to stay on the premises during the entirety of the testing and the study; approximately a total of 3-4 hours for the testing and for a total of 3 weekly 40 minute sessions across a period of 8 consecutive weeks or approximately 4 hours in which the child will partake in the study. The children will participate in the intervention study which will last approximately 40 minutes each 3 times a week and conducted over a consecutive 8-week period. The follow-up session, which will be the last visit, will be conducted 1 week after the conclusion of the 8-week period. At this time, the child will participate in one 40 minutes follow up session. The parent and child will be asked to complete the parent and child questionnaire which will require approximately 10 minutes each. It is estimated that the total time commitment for both parent and child will be approximately 9.5 hours over a period of approximately 9-10 weeks.
ARE THERE ANY BENEFITS TO TAKING PART IN THE STUDY?	Your child may not directly benefit from participating in this study. The study results may be used to help other speech-language pathologists learn more about practices used when working with children with the same identified speech disorder in various clinics, schools, or other settings.

	Being in this research study may not benefit you directly, but it is possible that the approach being evaluated may turn out to be more effective than current comparative approaches/training.
WHAT ARE THE MAIN RISKS OF THE STUDY?	The primary risks presented by this research study are breaches of privacy (others outside of the study may find out you are a subject) and/or confidentiality (others outside of the study may find out what you did, said, or information that was collected about you during the study). You may be uncomfortable with some of the questions you may be asked and/or asked to discuss. This research includes some items about speech development and concerns. You can skip and/or not respond to any questions that may make you uncomfortable. During the testing or intervention, your child may be uncomfortable with the researcher. There may be risks from the study that are not known at this time.
DO I HAVE OTHER OPTIONS BESIDES TAKING PART IN THE STUDY?	This research study is not designed to provide treatment or therapy, and you have the option to decide not to take part at all or you're your participation at any time without any consequences.
QUESTIONS ABOUT THE STUDY?	For questions, concerns, or complaints about the study, please contact Elia Olivares at 630-212-2712 or email at egarci19@uic.edu. You may also contact the faculty sponsor, Dr. Lopez-Reyna by phone at 312-996-4526 or by email at nlr@uic.edu. If you have questions about your rights as a study subject; including questions, concerns, complaints, or if you feel you have not been treated according to the description in this form; or to offer input you may call the UIC Office for the Protection of Research Subjects (OPRS) at 312-996-1711 or 1-866-789-6215 (toll-free) or e-mail OPRS at uicirb@uic.edu. If you have questions or concerns regarding your privacy rights under HIPAA, you should contact the University of Illinois HIPAA Privacy Office at (844) 341-2201 or hipaa@uillinois.edu.

Please review the rest of this document for details about these topics and additional things you should know before making a decision about whether to participate in this research. Please also feel free to ask the researchers questions at any time.

What procedures are involved?

This research will be performed at the participants' home, or location of their choice such as a local public library, where a quiet, uninterrupted space can be arranged.

During this study, Elia Olivares and her research team will collect information about your child for the purposes of this research. The testing conducted before the start of the intervention study will be gathered to learn about your child's speech skills as well as your concerns specific to how your child speaks.

Child correct and incorrect productions of Spanish word targets and phrases will be tallied. The target syllables, words and phrases observed will be recorded. Each word and phrase produced by the child will be coded and tallied. Additionally, number of attempts and latency in which accuracy was obtained at the CV (C is consonant, V is vowel), CVCV and CV.CVCV or VC.CVCV phrase levels will be tallied; as well as the rate of video model presentations during trials for correct and incorrect responses obtained from the child. This data will be collected, reviewed and recorded across each production elicited. This data collection procedure will be conducted for each session.

During the follow-up phase, a three 10-minute segment follow-up observation of your child's production of trained syllables, words, and phrases containing the target will be conducted one week after the intervention phase is complete. A similar warm up activity between the participant and the researcher will be conducted prior to the 10 minute segment in order to reestablish trust and comfort with the child within the environment, totaling approximately a 40 minute session.

What about privacy and confidentiality?

Efforts will be made to keep your personal information confidential; however, we cannot guarantee absolute confidentiality. In general, information about you, or provided by you, during the research study, will not be disclosed to others without your written permission. However, laws and state university rules might require us to tell certain people about you. For example, study information which identifies you and the consent form signed by you may be looked at and/or copied for quality assurance and data analysis by:

- Representatives of the university committee and office that reviews and approves research studies, the Institutional Review Board (IRB) and Office for the Protection of Research Subjects.
- Other representatives of the State and University responsible for ethical, regulatory, or financial oversight of research.
- Government Regulatory Agencies, such as the Office for Human Research Protections (OHRP).

A possible risk of the study is that your participation in the study or information about you might become known to individuals outside the study. Your survey, interview, data collected from records, and/or audio-recordings will be stored in Box folder and password protected to prevent access by unauthorized personnel.

All identifiable data will be destroyed after data analysis.

Please remember that there is an exception to protecting subject privacy and confidentiality if child, elder, and/or disabled adult abuse or neglect of an identifiable individual, or the threat of imminent self-harm or harm to others is disclosed. If such information is disclosed, the researchers may be obligated to inform the appropriate authorities.

What are the costs for participating in this research?
There are no costs to you for participating in this research.

Will I be reimbursed for any of my expenses or paid for my participation in this research?
You will not be offered payment for being in this study.

Can I withdraw or be removed from the study?
If you decide to participate, you have the right to withdraw your consent and leave the study at any time without penalty.

Please contact the researcher Elia Olivares by phone 630-212-2712 or by email at egarci19@uic.edu to report your desire to be removed or withdraw from the study.

The researchers and/or funder also have the right to stop your participation in this study without your consent if:

- They believe it is in your best interests;
- You were to object to any future changes that may be made in the study plan.

If you choose to no longer be in the study and you do not want any of your future information to be used, you must inform the researcher Elia Olivares in writing at the address on the first page. The researchers Elia Olivares may still use your information that was collected prior to your written notice.

What other things should I know?
Parents/Guardians, please be aware that under the Protection of Pupil Rights Ace, 20 USC 1232(c)(1)(A), you have the right to review a copy of the questions asked of or materials that will be used with your child. If you would like to do so, you should contact Elia Olivares at 630-212-2712 or email egarci19@uic.edu to obtain a copy of the questions or materials.

Remember:
Your participation in this research is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University. If you decide to participate, you are free to withdraw at any time without affecting that relationship.

Signature of Subject *OR* Signature of Parent/Guardian/Legal Representative
I have read the above information. I have been given an opportunity to ask questions and my questions have been answered to my satisfaction. I agree to participate in this research. I will be given a copy of this signed and dated form.

Signature Date

Printed Name

Printed Name of Minor

Signature of Parent, Guardian, Legal Representative Date of Signature

Printed Name of Parent, Guardian, Legal Representative

Signature of Person Obtaining Consent Date (must be same as subject's)

Printed Name of Person Obtaining Consent

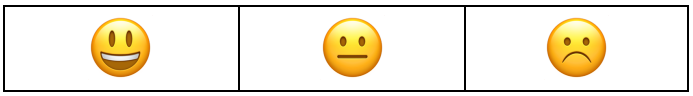
Appendix D:
Social Validity Questionnaires

Speech Production
Social Validity Questionnaire – Child

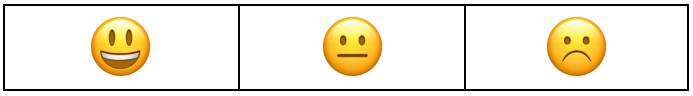
Name/ID: _____ Date: _____ Pre Post

Please circle the feeling that best answers the question. Your comments are very important to me.

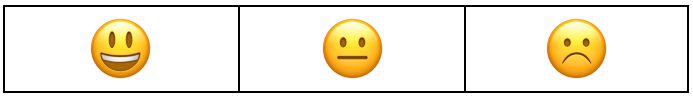
1) **How do you feel about the way you talk?:**



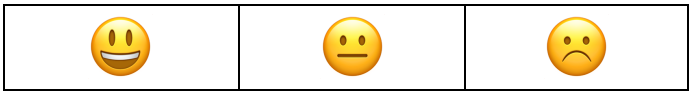
2) **How do you feel when you talk to your friends?:**



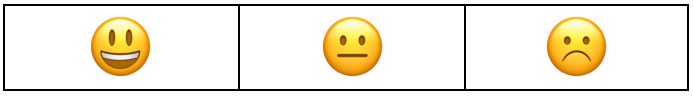
3) **How do you feel when you talk to your brothers and sisters?:**



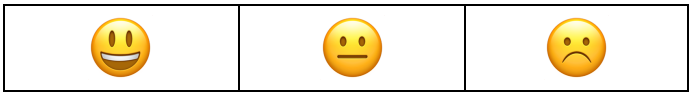
4) **How do you feel when you talk to your mom?:**



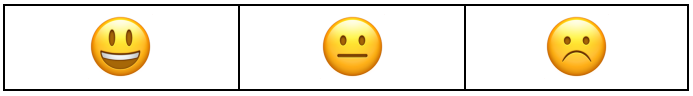
5) **How do you feel when you talk to your dad?:**



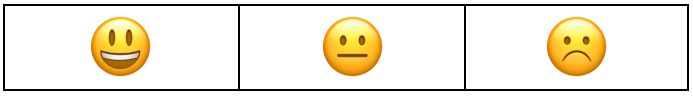
6) **How do you feel when people don't understand what you say?:**



7) **How do you feel when you talk to your teacher?:**



8) **How do you feel when you talk to me?:**



9) **How do you feel about school?:**

10) Do you want to practice sounds with me?:

Other things you want to share about being in this study:

_____

_____

_____

_____

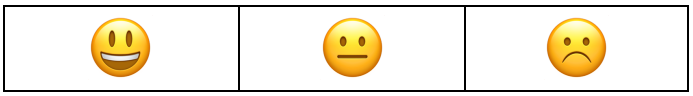
Thank you!

Speech Production
Social Validity Questionnaire – Child (Spanish)

Nombre/ID: _____ Fecha: _____ Pre Post

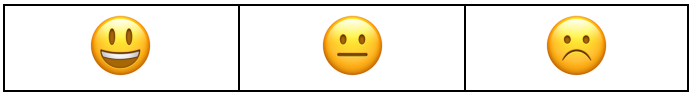
Favor de marcar con un circulo el dibujo que responde a la pregunta. Tus respuestas son muy importance para mi.

1) **¿Cómo te sientes con la manera que hablas?:**

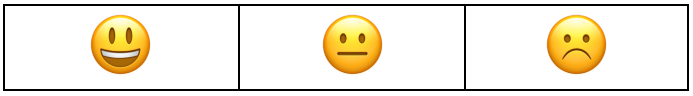


2) **¿Cómo te sientes cuando hablas con tus amigos?:**

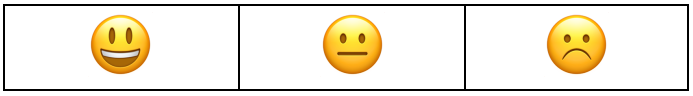
3) **¿Cómo te sientes cuando hablas con tus hermanos/as?**



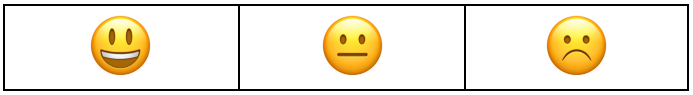
4) **¿Cómo te sientes cuando hablas con tu mamá?:**



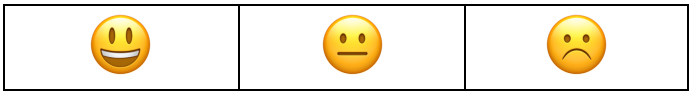
5) **¿Cómo te sientes cuando hablas con tu papá?:**



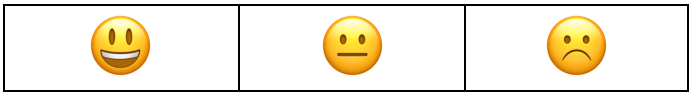
6) **¿Cómo te sientes cuando otra gente no te entiende?:**



7) **¿Cómo te sientes cuando hablas con tu maestra?:**



8) **¿Cómo te sientes cuando hablas conmigo?:**



9) **¿Cómo te sientes acerca de la escuela?:**

10) ¿Quieres practicar sonidos conmigo?:

Otras cosas que quieres compartir acerca de este estudio:

_____

_____

_____

_____

¡Gracias!

THE UNIVERSITY OF ILLINOIS AT CHICAGO EDUCATION

Speech Production
Social Validity Questionnaire – Parent

Name: _____ Date: _____ Pre Post

Please complete the survey by circling the number that corresponds to the phrase that closely matches your opinion. Your comments are very important to me.

1) Participating in this study:

1	2	3	4	5
A significant waste of time and effort	A slight waste of time and effort	Neither beneficial nor harmful	Beneficial	Very worthwhile

2) It is important to be involved in the sessions.:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

3) I have been actively involved in other treatment sessions besides this one.:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

4) My child benefits from me being in the treatment sessions:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

5) It is important for the speech-language pathologist to share advice on treatment:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

6) I am motivated to keep using this strategy:

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

7) This strategy helped my child be better understood.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

8) It is important for me to learn how to help my child outside of speech therapy.

1	2	3	4	5

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

9) It is important for my speech-language pathologist to speak both English and Spanish.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Additional comments:

_____

_____

_____

_____

_____

Thank you for being part of this study!

THE UNIVERSITY OF ILLINOIS AT CHICAGO EDUCATION

Speech Production
Social Validity Questionnaire – Parent (Spanish)

Nombre: _____ Fecha: _____ Pre Post

Favor de marcar con un circulo la frase que mejor contesta su opinion. Sus respuestas son muy importantes para mi.

1) Participación en este estudio:

1	2	3	4	5
Una perdida de mi tiempo y esfuerzo significativo	Una leve perdida de tiempo e esfuerzo	Ni beneficioso ni perjudicial	Beneficioso	Muy valoroso

2) Es importante ser involucrado en las sesiones :

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

3) He sido participante activo en otras sesiones de terapia aparte de esta.:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

4) Mi hijo/a aprovecha de mi participación en sesiones de tratamiento.:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

5) Es importante que la terapista del habla y lenguaje comparte consejos del tratamiento del habla.:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

6) Estoy motivado en usar estas estrategias:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

7) Estas estrategias ayudaron a mi hijo/a ser mejor entendido.

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

8) Es importante para mi aprender como ayudar a mi hijo/a afuera de las sesiones del habla y language.:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

9) Es importante que mi terapista del habla y lenguaje hable ingles y español.:

1	2	3	4	5
Muy en desacuerdo	En desacuerdo	Neutral	De acuerdo	Totalmente de acuerdo

Otros comentarios:

_____

_____

_____

_____

¡Gracias por ser parte de este estudio!

THE UNIVERSITY OF ILLINOIS AT CHICAGO EDUCATION

Appendix E:
Session Lesson Plan Example

Participant:	CV Target:
Date:	CVCV Target:
Session #:	CV.CVCV Target VC.CVCV Target:

Warm-Up Activity	**Duration:** 10 min	**Materials:** Kitchen Set Toy food Apron Visual Schedule Timer	Notes:
Word Shape: CV (repetitive syllable with consonant change + vowel change)	**Duration**: 30 min	**Targets:** Café Queso Quito Come Cuna	Notes:
Phrases: (upon 85% attainment) 1. Tu cuna 2. Yo quito 3. El come 4. Mi queso 5. Tu cafe		**Question Prompt:** 1. Donde duerme el bebe? 2. Que haces? 3. Que hace el? 4. Que comes? 5. Que toma ella?	Notes:
Additional Materials: • Visual timer • iPad • Target cards • Pop Up Pirate • Banana Blast • Fish Feud • Shark Attack			

Appendix F:
Fidelity Checklist

Directions: Check "Yes" for each strategy observed.

Strategy	*Baseline*	*Intervention*	*General Behavior*
1. Used 5 Target Syllable shape or words			
2. Distracting items removed from child			
3. Provided verbal prompt to child			
4. Presented picture stimulus cards			
5. Allowed child a turn at game after production			
6. Allowed child to respond after the verbal prompt			
7. If production incorrect, provided a delayed model, followed by a verbal prompt			
8. Placed iPad in horizontal fashion			
9. iPad activated (by examiner and/or child) upon verbal prompt			
10. If target production incorrect, reprompted with verbal prompt to watch video			

Appendix G:
Within Conditions and Between Conditions Data

Mimi Percentage of Syllable Targets Produced

	A1	B1	A2	B2
Within Conditions				
Condition Length	5	8	3	8
Level				
Median	0.000	0.036	0.000	0.076
Stability Envelope Range	0.000-0.000	0.0250-0.0464	0.000-0.000	0.0538-0.1000
Mean	0.014	0.073	0.000	0.059
Range	0-0.071	0-2.000	0-0.000	0-.154
Trend				
Direction	Accelerating, decelerating	Zero-celerating, accelerating	Zero-celerating	Accelerating
Stability	Stable	Variable	Stable	Variable
Multiple paths within trend	Yes	Yes	No	Yes
Between Conditions	*Baseline (A1) to Intervention (B1)*		*Baseline to Intervention*	
Changes in Trend				
Direction Change		Positive		Positive
Effect		Accelerating		Accelerating
Stability Change	Stable	Variable	Stable	Variable
Change in Level				
Relative Change	0-0	0, No Improvement	.0385-0.000	+.0385, Improving
Absolute Change	0-0	0, Not Improving	0-0	0, Not Improving
Median Change	0.036-0.00	+0.036 Improving	.076-0.0	+0.076 Improving
Mean Change	0.073-.014	+.059 Improving	.059-0.00	+.059 Improving
Data Overlap				
PND	3/8*100	37.5%	5/8*100	62.5%
POD	5/8*100	62.5%	3/8*100	37.5%

Cayden Percentage of Word Targets Produced

	A1	B1	A2	B2
Within Conditions				
Condition Length	5	8	5	8
Level				
Median	0.400	0.592	0.467	0.8182
Stability Envelope Range	0.2800-0.5200	0.4142-0.7692	0.3247-0.6067	0.5727-1.0636
Mean	0.386	0.552	0.413	0.770
Range	0.3000-0.4667	.3000-.6154	0.2000-0.500	0.4375-.9167
Trend				
Direction	Decelerating, Accelerating	Accelerating	Decelerating	Accelerating
Stability	Stable	Stable	Stable	Stable
Multiple paths within trend	Yes	No	Yes	No
Between Conditions	*Baseline (A1) to Intervention (B1)*		*Baseline (A2) to Intervention (B2)*	
Changes in Trend				
Direction Change		Positive		Positive
Effect		Accelerating		Accelerating
Stability Change	Stable	Stable	Stable	Stable
Change in Level				
Relative Change	.55-.3318	+0.2182 Improving	.7917-.5000	+.2917 Improving
Absolute Change	.4375-.3636	+0.0739 Improving	.4375-.5000	-0.0625 Deteriorating
Median Change	.592-.400	+.192 Improving	.8182-.467	+0.3512 Improving
Mean Change	.552-.386	+.166 Improving	.770-.413	+.357 Improving
Data Overlap				
PND	7/8*100	87.5%	7/8*100	87.5%
POD	1/8*100	12.5%	7/8*100	12.5%

Nate Percentage of Word Targets Produced

	A1	B1	A2	B2
Within Conditions				
Condition Length	5	8	4	8
Level				
Median	0.300	0.504	0.600	0.7128
Stability Envelope Range	0.21-0.39	0.3531-0.6555	0.4200-0.7800	0.4990-0.9267
Mean	0.293	0.498	0.600	0.717
Range	0.0667-0.5000	0.3125-0.6842	0.6000-0.6000	0.6667-0.7857
Trend				
Direction	Accelerating, decelerating	Accelerating	Decelerating	Accelerating
Stability	Variable	Variable	Stable	Stable
Multiple paths within trend	Yes	No	Yes	No
Between Conditions	*Baseline (A1) to Intervention (B1)*		*Baseline (A2) to Intervention (B2)*	
Changes in Trend				
Direction Change		Positive		Positive
Effect		Accelerating		Accelerating
Stability Change	Variable	Variable	Stable	Stable
Change in Level				
Relative Change	0.45625-.4000	+0.05625 Improving	0.6667-0.6000	+0.0667 Improving
Absolute Change	0.3333 -0.3000	+0.0333 Improving	0.7333-0.6000	+0.1333 Improving
Median Change	0.504-0.300	+0.204 Improving	0.7128-0.6000	+0.1128 Improving
Mean Change	0.498-0.293	+0.205 Improving	0.717-0.600	+0.117 Improving
Data Overlap				
PND	4/8*100	50 %	8/8*100	100%
POD	4/8*100	50%	0/8*100	0%

Appendix H:
Data Collection Form

Study Data Coding Form

Participant:
Date:
Session No.:

Time Lapse Between Videos	Correct Tally	Production(s)	Incorrect Tally	# of Verbal Prompts	# of Video Presentations
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Tally of Correct Productions					
Tally of Incorrect Productions					
Tally of Video Presentations					
Tally of Verbal Prompts					

Practitioner Data Collection Form

Participant:
Date:
Target Level:
Session No.:

Prompted Targeted	Response 1	Response 2 (post video)	# of Video Presentations Tally	Correct Tally	Incorrect Tally
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Total Tally of Correct Productions					
Total Tally of Incorrect Productions					
Total Tally of Video Presentations					

Appendix I:
Example Session Intervention Protocol

Session 1

Assessments conducted

Session 2 Baseline (sessions 2-6)

(End of session 2 child completes social validity questionnaire)

Warm Up Activity (10 minutes)

Researcher and child will play with various toys (e.g., building blocks, kitchen set, etc.)

Transition (show visual schedule, present two highly preferred toys)

E: Researcher shows picture cards representing CV, CVCV and CV.CVCV or VC.CVCV stimulus items. Researcher shows child pictured items and prompts for spontaneous response. engages the child in a delayed response. If no spontaneous response, a delayed imitation model will be provided. Video will be obtained at session 2 to secure responses for creation of video model.

E: (shows picture) ¿Dime lo que ves? (Tell me what you see?)

C: /kito/

Child spontaneously respond correctly; move to next picture card.

If child responds incorrectly or not at all, 1) reprompt; 2) if yet no response after second prompt provide auditory cue provide delayed imitation model

E: Es /kito/. ¿Dime lo que ves? (This is /kito/. Tell me what you see?).

C: child responds /kito/ (or similar)

Researcher provides verbal praise

E: Estas trabajando muy bien! (You are working well).

Move on to next CVCV shape until all completed. Follow same procedure as above for spontaneous responses obtained or no response obtained. Upon completing CVCV syllable and meeting criterion level, move to next hierarchal level.

E: (moved to phrase level). Question prompts required.

E: ¿Qué haces? (What do you do?)

C: Yo quito (CVCV)

Spontaneous response. Move to next word.

If incorrect response or no response, 1) reprompt;2) if yet no response after second prompt provide auditory cue

E: Esto es yo quito. ¿Qué haces? (This is yo quito. What is this?)

C: yo quito

Session 7 Intervention (sessions 7-14)

(word level)

E: We are going to work on the /k/ sound.

E: (Reprompt showing picture) Dime, ¿Qué lo que ves? (Tell me what you see?) (show picture)

C: /quito/

If spontaneous response correct 1) provide verbal praise, 3) take turn at game, 4) move to next word.

If incorrect: 1) repromp with "mira el video", 3) show video at least 3 times, 3)reprompt with Dime lo que ves? 4) if incorrect move to next word and provide praise for working hard. 5) if correct, provide verbal praise and/or celebratory music on iPad

E: Dime lo qué ves? (Tell me what you see?) *(show picture of quito)*

C: child incorrect

E: Show video (3 times)

E: Reprompt with "Dime lo qué ves?" (Tell me what you see?)

E: if correct provide verbal praise

Take turn at game (if correct or incorrect)

(Repeat)

Upon establishing criterion of 85% accuracy across 3 consecutive sessions: move to phrase level

Repeat above procedures and include question prompts to elicit phrase response.

<u>Session 15 Withdraw Intervention (sessions 15-19)</u>

Obtain Baseline

Repeat above baseline procedures

Session 20 Intervention (sessions 20-27)

Repeat intervention procedures of sessions 7-14

(Parent completes social validity questionnaire at end of session 27)

Session 28 Follow Up/Maintenance (session 28-30)

1 week post intervention

Present syllable, word and phrase stimuli picture cards.

Conduct post intervention measures (session 28)

Appendix J:
Practitioner Example Intervention Protocol

1. Warm Up Activity (10 minutes)

2. Practitioner and child will play with various toys (e.g., building blocks, kitchen set, etc.)

3. Transition (show visual schedule, present two highly preferred toys)

4. Begin collecting responses at baseline

E: Researcher shows picture cards representing CV, CVCV and CV.CVCV or VC.CVCV stimulus items. Researcher shows child pictured items and prompts for spontaneous response. engages the child in a delayed response. If no spontaneous response, a delayed imitation model will be provided. Video will be obtained at session 2 to secure responses for creation of video model.

E: (shows picture) ¿Dime lo que ves? (Tell me what you see?)

C: /kito/

Child spontaneously respond correctly; move to next picture card.

If child responds incorrectly or not at all, 1) reprompt; 2) if yet no response after second prompt provide auditory cue provide delayed imitation model

E: Es /kito/. ¿Dime lo que ves? (This is /kito/. Tell me what you see?).

C: child responds /kito/ (or similar)

Researcher provides verbal praise

E: Estas trabajando muy bien! (You are working well).

Move on to next CVCV shape until all completed. Follow same procedure as above for spontaneous responses obtained or no response obtained. Upon completing CVCV syllable and meeting criterion level, move to next hierarchal level.

E: (moved to phrase level). Question prompts required.

E: ¿Qué haces? (What do you do?)

C: Yo quito (CVCV)

Spontaneous response. Move to next word.

If incorrect response or no response, 1) reprompt;2) if yet no response after second prompt provide auditory cue

E: Esto es yo quito. ¿Qué haces? (This is yo quito. What is this?)

C: yo quito

5. Upon completion of video, begin intervention

E: We are going to work on the /k/ sound.

E: (Reprompt showing picture) Dime lo que ves? (Tell me what you see?) (show picture)

C: /quito/

If spontaneous response correct 1) provide verbal praise, 3) take turn at game, 4) move to next word.

If incorrect: 1) reprompt with "mira el video", 3) show video at least 3 times, 3)reprompt with Dime lo que ves? 4) if incorrect move to next word and provide praise for working hard. 5) if correct, provide verbal praise and/or celebratory music on iPad

E: Dime lo qué ves? (Tell me what you see?) *(show picture of quito)*

C: child incorrect

E: Show video (3 times)

E: Reprompt with "Dime lo qué ves?" (Tell me what you see?)

E: if correct provide verbal praise

Take turn at game (if correct or incorrect)

(Repeat)

Collect data upon obtainining response. Move on to next CVCV shape until all completed.

Follow same procedure as above for spontaneous responses obtained or no response obtained.

Upon completing CVCV syllable and meeting criterion level, move to next hierarchal level.

Upon establishing criterion of 85% accuracy across 3 consecutive sessions: move to phrase level

Repeat above procedures and include question prompts to elicit phrase response.

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VITA
ELIA OLIVARES

EDUCATIONAL PREPARATION:
University of Illinois at Chicago, Chicago, IL
Doctor of Philosophy, Candidate
Expected Date of Graduation: May 2020
Area: Special Education
Research Focus: Assessment and Intervention Practices of English Language Learners
Dissertation Topic: Video Self-Modeling as a Sensory-Cueing Intervention for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech

Illinois State University, Normal, IL
Master of Science, August 1998
Major: Speech-Language Pathology

Bachelor of Science, May 1996
Major: Speech-Language Pathology

CERTIFICATIONS AND LICENSURE:
- American Speech-Language-Hearing Association Certificate of Clinical Competence
- Special Teaching Certificate IL Type 10 (1998-2011)
- School Service Personnel Certificate IL Type 73
- Illinois State Licensure (License No. 146.006157)
- Illinois Transitional Bilingual Teaching Certificate (Feb. 2002-Feb.2007)

RESEARCH INTERESTS:
- English Language Learners and Low-Incidence Neurogenic Based Disorders
- English Language Learners and Early Literacy
- English Language Learners and Childhood Apraxia of Speech
- English Language Learners and Oral Language Development

RELEVANT COURSEWORK:
- Philosophical Foundations of Educational Inquiry
- Proseminar in Special Education
- Essentials of Quantitative Inquiry in Education
- Methods of Instruction & Assessment in Young Children with Disabilities
- Special Topics in Curriculum and Instruction: Action Research in ELLs
- Seminar in Research Issues with English Language Learners: Education of ELLs in U.S. Context
- Principles of ABA and Experimental Analysis of Behavior
- Seminar on Theory and Research in Special Education
- Analysis of Behavior in Applied Contexts

PROFESSIONAL EXPERIENCE:

I'MMErsion Speech Therapy, LLC, Plainfield, IL (June 2019-present)
Founder/Director

- Develop and created business contracts
- Create legal forms, authorizations, and consents for service
- Negotiate contracts with subcontractors
- Engage in marketing practices for reaching clients and referral sources
- Provide speech and language services to early childhood aged children
- Supervise Clinical Fellow in IL School District 87

Midwestern University, Downers Grove, IL (August, 2013-2019)
Clinical Associate Professor

- Initiating faculty for MWU Multispecialty Clinic Speech-Language Institute
- Participated in the CAA accreditation process
- Secured promotion from Clinical Assistant Professor to Clinical Associate Professor
- Supervised graduate students at the MWU Speech-Language-Institute (2013-2019)
- Coordinated Let's Talk Summer Camp Program (2015 to 2018)
- Interviewed potential graduate student cohorts (2014, 2015, 2017)
- Course Director for Practicum Seminar I and II, Clinical Methods II
- Supervised standardized patients SLPPD Child Language Intervention (2016), SLPI 0624 Hearing/Aural Rehabilitation Course (2014)
- Developed and coordinated clinical simulation experience for interpreter-standardized patient encounter (2018)
- Revised and maintained MWU Clinical Supervisor Manual
- Developed Allscripts Electronic Health Record Tutorial Manual for clinical staff and graduate students (2013)

LinguaHealth/GrupoLingua, Evanston, IL (August, 2011-2013)
Regional Manager

- Oversaw designated IL geographic region of company based school speech-language pathologists
- Responsible for growing and managing team of speech-language pathologists
- Supervised speech-language pathologist clinical fellowships
- Educated, trained and mentored speech language pathologists

Bilingual Speech Language Pathologist

- Provided bilingual diagnostic and therapeutic services at West Aurora District #129 Exceptional Schools: Todd Early Childhood Center, and Hope D. Wall School
- Provided intervention services to multiply impaired children with severe and profound speech and language disabilities
- Evaluator on Transdisciplinary Play-Based Assessment Team

Bilingual Therapies, Inc., Skokie, IL (August 1998 – 2006; August 2010-June 2011)
Bilingual Speech Language Pathologist, Team Leader

- Provided bilingual diagnostic and therapeutic services for various elementary schools in IL School District U-46, Aurora East School District 131 and Two Rivers Head Start East Aurora
- Assessed and staffed bilingual children in Chicago Public Schools-summer of 1998
- Provided intervention services to multiply impaired children with severe and profound speech and language disabilities
- Recruited speech language pathologists
- Supervised clinical fellow speech language pathologists, speech language pathologist assistants, and bilingual speech language pathologists
- Chairperson for Bilingual Symposiums
- Exhibitor at American Speech Language Hearing Association conventions in Illinois, California and Florida
- Supervised graduate student 10-week school practicum
- Committee member for development and creation of a bilingual Pre-K speech screener at Aurora East District #131
- Developed speech and language screening tool for bilingual Spanish/English school aged students at Illinois School District U46

Northern Illinois University, DeKalb, IL (August 2001 to August 2005, August 2006-2010)
Clinical Supervisor

- Supervised monolingual and bilingual graduate students at the NIU Speech-Language- Hearing Clinic
- Developed and organized the interpreter/translator program
- Coordinated and implemented bilingual graduate interest program/partnership
- Mentored bilingual and monolingual graduate students
- Translated NIU Speech-Language-Hearing Clinic clinical forms
- Developed partnership program for speech and language assessment of bilingual children within DeKalb School District #428
- Developed competency criteria for prospective bilingual SLP student clinicians
- Developed and graded Day 2 comprehensive examination-multicultural question

School Practicum Coordinator

- Secured school placements for speech pathology graduate students
- Conducted site visits of student placements
- Monitored student performance at placed practicum site

Janelle Publications, DeKalb, IL (April 2009-2013)
Bilingual Speech Language Pathologist Reviewer

- Reviewed and edited the Spanish Structured Photographic Expressive Language Test-3rd Ed.; a Spanish morphology and syntax assessment measure
- Proofread Spanish published materials

TEACHING EXPERIENCE:

Midwestern University

- Developed and co-instructed the *Cultural and Linguistic Diversity Course in Communication Disorders* Graduate Course (2017, 2018)
- Developed and instructed the *Clinical Methods II in Speech-Language Pathology* course (2015)
- Co-Instructed *Clinical Methods I in Speech-Language Pathology* course (2016-2017)
- Instructed *Clinical Practicum Seminar I and II in Speech-Language Pathology* course (2015-2019)
- Co-Course Director for *Clinical Methods I* (2014)
- Contributed to comprehensive examination questions-child language and autism (2016)

Northern Illinois University

- Developed and instructed the *Multicultural Aspects in Communication Disorders* Graduate Course (Summer 2002, Spring 2003, Spring 2004, and Spring 2006, Summer 2011)
- Developed and instructed the *Assessment and Intervention: a Latino Focus* Graduate Course (Summer 2010)

SPECIALIZED PROFESSIONAL DEVELOPMENT:

- Supervising SLPA's in Illinois-ISHA Webinar (2017)
- Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) Training-Introduction (2017)
- It Takes Two to Talk: Hanen Certified
- Esperanza Training Program –Trained in the Spanish multisensory structured language approach for reading, writing and spelling for Pre-K, K, 1-3, & WOW vocabulary program. hosted and developed by Dr. Elsa Cárdenas-Hagan.
- Systematic Analysis of Language Transcripts (S.A.L.T) Spanish training, Presenter Raul Rojas
- Dynamic Assessment Workshop, Presenter Dr. Elizabeth Peña
- Dynavox Technology: Overview of Augmentative Devices
- Parent/Caregiver Implemented Interactive Language Intervention: An Introduction to the Hanen Approach
- Supporting Children with Autism Disorder and their Families, Attendee
- Early Identification of Autism, Attendee
- IL Child and Family Connections Early Intervention Training
- Recruitment and Retention of Minority Students, Attendee
- Extramural Funding Information Workshop: NIU Office of Sponsored Projects-Attendee

- Practical Treatment Strategies for Bilingual Students with Language Disorders, Presenter Celeste Roseberry–McKibbin, ASHA 2003
- Shaping Education Policy for Latinos in Illinois Conference, Attendee
- Picture Exchange Communication Systems Training Pyramid Educational Systems (2001)
- Effective Second Language Acquisition Workshop, Presenter Dr. Stephen Krashen
- Institute on Best Practices in Bilingual Speech-Language Assessment, New Mexico State University, developed and directed by Dr. Hortencia Kayser (2000)
- Bilingual Therapies Bilingual Symposium, Attendee (2001-2007, 2010, 2011, 2016)

GUEST LECTURES:

Olivares, E. (November, 2018). *Childhood Apraxia of Speech (CAS): Interventions*. Invited to speak to graduate students in SLPPD 0519 Pediatric Speech Sound Disorders at Midwestern University, Downers Grove, IL.

Olivares, E. (April, 2018). *Systematic Literature Review: Perspectives of a Multiple Step Process*. Invited to speak to first year doctoral students in SPED 564 Proseminar in Special Education at University of Illinois at Chicago, Chicago, IL.

Olivares, E. (November, 2017). *Artic/Phono Considerations for Assessment and Intervention of Bilingual English/Spanish Speakers.* Invited to speak to graduate students in SLPPD 0519 Pediatric Speech Sound Disorders Articulation and Phonology at Midwestern University, Downers Grove, IL.

Olivares, E. (April, 2017). *Engaging Parents and Their Preschool Children in Bilingual Early Literacy*. Invited to speak to graduate students in SLPPD 0633 Language, Literacy, and Learning at Midwestern University, Downers Grove, IL.

Olivares, E. (November, 2016). *Artic/Phono Considerations for Assessment and Intervention of Bilingual English/Spanish Speakers.* Invited to speak to graduate students in SLPPD 0520 Disorders of Articulation and Phonology at Midwestern University, Downers Grove, IL.

Olivares, E. (September, 2016). *Multicultural Issues: SLP's Serving the Culturally and Linguistically Diverse*. Invited to speak to graduate students in SLPPD 0540 Clinical Methods I at Midwestern University, Downers Grove, IL.

Olivares, E. (November, 2015). *Artic/Phono Considerations for Assessment and Intervention of Bilingual English/Spanish Speakers.* Invited to speak to graduate students in SLPPD 0520 Disorders of Articulation and Phonology at Midwestern University, Downers Grove, IL.

Olivares, E. (September, 2015). *Multicultural Issues: SLP's Serving the Culturally and Linguistically Diverse*. Invited to speak to graduate students in SLPPD 0540 Clinical Methods I at Midwestern University, Downers Grove, IL.

Olivares, E. (February, 2015). *Considerations of Assessment and Intervention of Bilingual English/Spanish Speakers.* Invited to speak to graduate students in SLPI 0521 Child Language Assessment at Midwestern University, Downers Grove, IL.

Olivares, E. (June, 2014). *Collaborating with Interpreters and Translators*. Invited to speak to graduate students in SLPI 0653 Practicum Seminar II at Midwestern University, Downers Grove, IL.

Olivares, E. (April, 2014). *Increasing Positive Parent Interactions in a Therapeutic Setting.* Invited to speak in SLPI 0551 Practicum Seminar I at Midwestern University, Downers Grove, IL.

Olivares, E. (March, 2014). *Behavior Management with Speech-Language Impaired Clients*. Invited to present to graduate students in SLPI 0551 Practicum Seminar I at Midwestern University, Downers Grove, IL.

Olivares, E. (February, 2014). *Bilingualism and Second Language Acquisition*. Invited to speak to graduate students in SLPI 0521 Child Language course at Midwestern University, Downers Grove, IL.

Olivares, E. (September, 2013). *Multicultural Issues: SLP's Serving the Culturally and Linguistically Diverse*. Invited to speak to graduate students in SLPI 0540 Clinical Methods in Speech-Language Pathology I at Midwestern University, Downers Grove, IL.

Olivares, E. (November, 2011). *Yo y mi Hijo/a: Una Mirada a la Comunicación*. Invited to speak to Latino parents regarding speech and language development and language strategies for children at West Aurora School District #129, Aurora, IL. (in Spanish)

Olivares, E. (July, 2009). *Culturally and Linguistically Diverse Students: Language Difference vs. Language Disorder.* Invited to speak to undergraduate students enrolled in Introduction to Communicative Disorders Course at Northern Illinois University, DeKalb, IL.

Olivares, E. (July, 2009). *Picture Exchange Communication Systems: Part II*. Invited to speak to graduate students at Northern Illinois University, DeKalb, IL.

Olivares, E. (April, 2009). *Picture Exchange Communication Systems: Part I*. Invited to speak to graduate students at Northern Illinois University, DeKalb, IL.

Olivares, E. (February, 2009). *Speech and Language Screenings for Audiologists.* Invited to speak to Au.D. graduate students at Northern Illinois University, DeKalb, IL.

Olivares, E. (September, 2007). *Culturally and Linguistically Diverse Students: Language Difference vs. Disorder.* Invited to speak to undergraduate students enrolled in Introduction to Communicative Disorders Course at Northern Illinois University, DeKalb, IL.

Olivares, E. (August, 2007 & 2008). *Just a Pinch of SALT*. Invited to speak at 2-day graduate student orientation at Northern Illinois University, DeKalb, IL.

Olivares, E. (August, 2007 & 2008). *Diagnostic Overview*. Invited to speak at 2-day graduate student orientation at Northern Illinois University, DeKalb, IL.

Olivares, E. (March, 2007). *Clinical Considerations When Working with Bilingual English Spanish Populations.* Invited to speak at Spring Banquet at Northern Illinois University, DeKalb, IL.

Olivares, E. (November, 2006). *Collaborating with Interpreters and Translators.* Invited to speak to graduate students at Northern Illinois University, DeKalb, IL.

Garcia, E. (July, 2004). *Working with Culturally and Linguistically Diverse Populations.* Invited to speak at Pro-Care Inc. new employee training weekend in Las Vegas, NV.

Garcia, E. (February, 2004). *Multicultural Considerations in Communicative Disorders.* Invited to speak to graduate students in speech language pathology at Northern Illinois University, DeKalb, IL.

Garcia, E. (October, 2004). *Cultural Variables which Impact Service Delivery.* Invited to speak to undergraduate students at Northern Illinois University, DeKalb, IL.

Garcia, E. (July, 2003). *Partnership Between Northern Illinois University and Bilingual Therapies, Inc.: An Innovative Training Program.* Invited to present poster presentation for Bilingual Therapies, Inc. Caribbean Sea Symposium.

Garcia, E. (February, 2002). *Clinical Considerations: Meeting the Needs of Limited English (LEP) Proficient Students.* Invited to speak at the Illinois Speech Language Hearing Association.

Garcia, E. (March, 2001). *Assessment and Intervention of the Bilingual Population*. Invited to speak at Illinois State University, Normal, IL-Global Connections.

RESEARCH PRESENTATIONS:

Olivares, E. & Lopez-Reyna, N. (accepted February, 2020). *Video Self-Modeling as a Sensory-Cueing Intervention for Developing Bilingual (English/Spanish) Children with Identified or Suspected Childhood Apraxia of Speech*. Poster presentation at Council for Exceptional Children Conference, Portland, OR.

Olivares, E. & Lopez-Reyna, N. (November, 2019). *Intervention Models for Bilingual and Monolingual Children with Childhood Apraxia of Speech: A Systematic Review*. Poster presentation at American Speech-Language Hearing Association Conference, Orlando, FL.

Horton, R., & Olivares, E. (November, 2019). *The Use of a Simulated Interpreter-Standardized Patient Encounter to Understand Students' Cross-Cultural Communication Skills.* Seminar presentation at American Speech-Language Hearing Association Conference, Orlando, FL.

Olivares, E., & Lopez-Reyna, N. (February, 2018). *English language learners and childhood apraxia of speech: Review of intervention models*. Poster presentation at Council for Exceptional Children, Tampa, FL.

Scholtens, K., del Toro, C., Olivares, E., Cuellar, M. (February 2017). *Bilingual parent perception and satisfaction with SLP services.* Poster presentation at Illinois Speech-Language Hearing Association Conference Rosemont, IL.

Martinez, A., Schultz, H., del Toro, C., Cuellar, M. & Olivares, E. (February, 2017). *Effectiveness of targeting pragmatic language in children with genetic disorders*. Poster presentation at Illinois Speech Language Hearing Association Conference, Rosemont IL.

Scholtens, K., del Toro, C., Olivares, E., Cuellar, M. (November, 2016). *Bilingual parent perception and satisfaction with SLP services.* Poster presentation at American Speech Language Hearing Association Conference Philadelphia, PA.

Hodson, J., Wilson, J., Cuellar, M., del Toro, C., & Olivares, E. (November, 2016). *Spatiotemporal dynamics of verb naming in bilingual individuals: A pilot study*. Poster presentation at American Speech Language Hearing Association Conference Philadelphia, PA.

Olivares, E. (March-April, 2015). *Paginas Con Mi Familia.* Provided parent education workshops on bilingual literacy development to primarily Spanish speaking parents of preschool age children at Todd Early Childhood Center in West Aurora School District, Aurora, IL. (in Spanish)

Tattersall, P., Olivares, E. & Moore, B. (February, 2013). *Evaluating Spanish spelling ability in bilingual speakers: test or free writing?* Poster presentation at Illinois Speech-Language Hearing Association Convention Rosemont, IL.

Tattersall, P., Olivares, E. & Moore, B. (November, 2013). *Evaluating Spanish spelling ability in bilingual speakers: test or free writing?* Poster presentation at American Speech-Language Hearing Association Conference Chicago, IL.

OTHER SCHOLARLY ACTIVITIES:

- *Intervention Models for the Bilingual and Monolingual Pediatric Population Diagnosed with or Suspected of Childhood Apraxia of Speech: A Systematic Literature Review*. Summer 2018
- *Language Choices and Decisions by Bilingual Parents with Communicatively Impaired Children*. Research Project. Spring 2015
- *Parents and Children with Autism and Their Language Choices.* Research Project. Summer 2015

- *Discourse Among ELL's with Disabilities During Language Arts.* Independent Study. Spring 2014
- *Oral Language Development and Second Language Literacy Development.* Literature Review. Spring 2013
- Developed *Bilingual Intervention/Assessment Manual*. Independent Study. Spring 1998

MENTORED STUDENT THESIS PROJECTS:

Master's Thesis Committee for Alyssa Mazurek. Diagnostic Measures and Tools Used by Speech-Language Pathologists for Diagnosing Childhood Apraxia of Speech. Completed Spring 2019.

Master's Thesis Committee Member for Kaitlyn Scholtens. Parent Perception and Satisfaction with Speech Language Pathology Services: A Pilot Study. Completed Spring 2017.

Master's Thesis Committee Member for Julie Hodson. Spatiotemporal Dynamics of Verb Naming in Bilingual Individuals: A Pilot Study. Completed Spring 2016.

CO-MENTORED CAPSTONE PROJECTS/INDEPENDENT STUDIES:

Midwestern University

Research Capstone Project. Melodic Intonation Therapy in Russian Speaking Children. Completed in Spring 2015.

Northern Illinois University

Independent Study. Bilingual (Spanish/English) Phonology Assessment and Intervention. Completed in Spring 2008.

Research Capstone Project. Personal FM Assistance for Non-Native English Listeners' Speech Perception in Noise. Completed in Spring 2010.

AWARDS/RECOGNITION:

- Illinois Board of Higher Education Diversifying Higher Education Faculty in IL Fellowship Award *Tuition plus $15000 stipend* 2019 school year
- Illinois Board of Higher Education Diversifying Higher Education Faculty in IL Fellowship Award *Tuition plus $15000 stipend* 2018 school year
- Illinois Board of Higher Education Diversifying Higher Education Faculty in IL Fellowship Award *Tuition plus $13000 stipend* 2017 school year
- University of Illinois at Chicago Tuition Waiver *$2500.00* Summer 2017
- Recipient of the University of Illinois at Chicago College of Education Community Engagement Grant (*Awarded $5000*) in 2015
- Illinois Speech Language Hearing Association nomination for the Division for Professional Affairs in 2002
- Illinois State University Minority Professional Opportunity member, honors, and scholarship recipient

- Illinois State Consortium for Educational Opportunities Fellowship Award *$10,000*/year in 1997
- Bilingual Therapies, Inc. Clinician of the Month

SERVICE:

- Midwestern University Diversity Education Committee (2015-2016, 2017-2019)
- American Speech-Language-Hearing Association Language and Learning in School-Age Children and Adolescents Committee (2015)
  - Reviewer of 2016 ASHA Convention Topics
- Midwestern University Speech-Language Pathology Graduation Banquet Committee (2015-2019)
- Midwestern University National Student Speech-Language Hearing Association
  - School Supplies for Children in Guatemala-Chair
  - SLP Professional Panel-Panelist (2017)
  - Mentored and Supervised at Community Health Fair (2015)
  - Yearly donation for New Cohort Luncheon
- Midwestern University Speech-Language Institute Clinic Committee (2013-present)
  - Federal Work Study Supervisor (2013-2019)
  - Clinical Supervisor Manual (maintain, edit, revise)
  - Development of Rubric for Written Documentation Committee (2015)
- Midwestern University Speech-Language Institute Admissions Committee (2015-2019)
  - Interview graduate student candidates
  - Provide Clinic Tours (2013-2019)
- Midwestern University Wellness Fair (2014, 2015)
- Midwestern University/DOCARE Medical Mission, Guatemala (2015)
  - Ambassador for Downers Grove, IL SLP Program
  - Coordinated and participated in MWU/DOCARE/AMA meeting with Guatemalan Government Officials
- Hosted Kareen Gudiel, Director of the Asociación Guatemalteca por el Autismo (Autism Association of Guatemala) at Midwestern University Speech-Language Institute (2015)
- Illinois Speech-Language-Hearing Association-Multicultural Committee (2017-present)
- Collaborate with Apraxia Connection for MWU Let's Talk Camp Parent Education Seminars (2015-2018)
- Coordinated and Mentored Students at St. Joseph School Downers Grove, IL Speech-Language Screenings (2015, 2016)
- Coordinated and Mentored Students at Montessori School Downers Grove, IL Hearing Screenings (2014)
- Participated in DuPage Federation Language Access Resource Center (LARC) and Midwestern University Multi-Specialty Clinic Collaboration Meeting (2016)
- Northern Illinois University Open House recruitment/informational meetings for prospective graduate students in Department of Communicative Disorders

- Exploring Majors Fair student recruitment booth
- ASHA Student Recruitment booth
- El Valor/Leap Systems/NIU Minority Recruitment Discussion Committee

PROFESSIONAL AFFILIATIONS:

- American Speech-Language-Hearing Association
- Illinois Speech-Language-Hearing Association
- American Speech-Language Hearing Association Hispanic Caucus
- ASHA Special Interest Group Division of Cultural and Linguistic Diversity
- ASHA Special Interest Group Division of School-Based Issues
- Council for Exceptional Children
- National Association of Bilingual Education (past member)
- Illinois Association of Multilingual Multicultural Education (past member)

FOREIGN LANGUAGE ABILITIES:

- Spanish proficiency (understand, speak, read, write)

EXTRA-CURRICULAR

- Midwest Edge Dance Studio Competition Mom/Leader
  - Organize, support and lead school aged dance girls in state level dance competitions
  - Communicate with families of school aged dance girls