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Using Baby Sign As A Facilitating Technique To Segment Speech With 4-18-Month-Old Monolingual And Bilingual Hearing Infants-An Extension Study

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USING BABY SIGN AS A FACILITATING TECHNIQUE TO SEGMENT SPEECH WITH 4-18-MONTH-OLD MONOLINGUAL AND BILINGUAL HEARING INFANTS-AN EXTENSION STUDY

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Dedication

This is for you kids, Dasani, Zyenna and Sergio.

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Abstract

The intricacies involved in learning language are astounding, nonetheless, infants are more than capable of accomplishing this feat within their first few years of life. This unbelievable achievement is carried out through numerous milestones and exposure to multiple modalities of stimuli all around them. Through the use of these modalities, be it auditory or visual, infants begin their journey to learn language with the task of extracting words from fluent speech, speech segmentation. Researchers have found that infants as young as 6-months can segment words from the speech stream by using their own name or highly familiar words like *momma* as a cue (Bortfeld, Golinkoff, & Rathbun, 2005). This can also be accomplished by using a speaker's face as a cue (Mueller & Acosta, 2015). Mueller and Acosta (2015) used baby sign as an additional cue for the six-month-old infants in their study. They were the first to report data which demonstrated that prior exposure to baby sign aided infants in extracting unfamiliar words from the speech stream. The purpose of the current study is to expand Mueller and Acosta's (2015) study to examine the impact that baby sign has on the speech segmentation abilities of typically developing hearing infants between the ages of four to18-months. The research questions asked are 1.) Can four to 18-month old children use signing cues and facial cues to facilitate speech segmentation of non-words in running speech? and 2.) Are there age differences related to a child's speech segmentation abilities?

Keywords: baby sign; speech segmentation; language learning

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Chapter 1

Introduction/Literature Review

Infants are born with the innate ability to acquire language. This process comes naturally, requiring no explicit instruction for typically developing infants. One of the greatest accomplishments of the first few years of life is the development of language, as an infant can learn any language their parent speaks, regardless of culture, location, socioeconomic status, etc. Both auditory and visual information and exposure are important in language acquisition. Newborns as young as two-days-old can especially familiarize themselves with the voice of their mother and when introduced to other voices, they can differentiate their mothers voice from unknown speakers, and can also recognize the sounds of their language from that of foreign languages (DeCasper & Fifer, 1980; Moon, Cooper, & Fifer, 1993).

The ability to segment running speech is crucial in the journey to learning language as infants must begin to extract single words and match them to their referent (Jusczyk & Aslin, 1995). Jusczyk and Aslin (1995) reported that infants as young as 7.5-months-old are capable of extracting words from fluent speech, which play a role in their receptive understanding and later on in their expressive language. To add to these findings, authors Hollich, Newman, and Jusczyk (2005) and Mueller and Acosta (2015), found that infant speech segmentation was present with the use of the speaker's face as an additional modality. Mueller and Acosta's (2015) study found that the visual cue of the speaker's face worked for typical developing hearing infants as young as 6-months-old.

If the presentation of the visual cue provided a sensory rich aid in infant speech segmentation on 6-month-olds, would the presentation of additional modalities, such as baby

sign, aid 4-month to 18-month-old infants? The purpose of this study is to verify whether additional modalities such as baby sign can be used as a facilitating technique in infant speech segmentation on infants as young as 4-months-old. The outcomes of the study may provide additional information to extend the knowledge related to baby sign and infant speech segmentation.

1.1 Behavioral experimental techniques

Babies are born pattern seekers, as we have witnessed from a host of methodologies that have provided us with an inkling of insight to a baby's mind and how they understand sounds and language as well as process speech input during their preverbal phase of language acquisition. Some of these experimental studies include high amplitude sucking (HAS), the preferential looking paradigm, habituation, and the head-turn preference procedure (HPP) (Jusczyk, 1985; McCall & Carriger, 1993; Nelson, Jusczyk, Mandel, Myers, Turk & Gerken, 1995; Hirsh-Pasek, & Golinkoff, 1996; Byers-Heinlein, 2014).

The HAS technique, also known as non-nutritive sucking, has been used in studies by researchers to examine what babies know about the sounds of language, and it can be used up to the age of 4-months (Jusczyk, 1985; Byers-Heinlein, 2014). Another technique is the preferential looking paradigm. Through the use of this technique, the researchers are using the inferencing of a baby's discrimination skills by recording their eye fixations on the different stimuli presented (Hirsh-Pasek, & Golinkoff, 1996). Another technique used to study visual stimulus processing or visual discrimination in infants is the habituation paradigm. This technique involves presenting a stimulus to an infant repeatedly until he habituates or visually fixates. The infant is then presented with a new stimulus and the researchers then look to see if

the new stimulus is seen as different, which is measured by their looking time duration to the new stimulus. Researchers have used the habituation paradigm in varied and systematic approaches to examine whether infants create a mapping between the presented sound and/or sight, and then a surprise when a stimulus is changed (McCall & Carriger 1993).

The technique used for the current study is the head-turn preference procedure (HPP). The HPP is a behavioral experimental method also used for phonological prosodic discrimination segmentation using head turns to examine speech processing and can be used on infants as early as birth (Nelson et al., 1995; Byers-Heinlein, 2014). Authors Werker, Polka, and Pegg (1997) reported and described the Conditioned Head Turn procedure (as was termed in their study) and how modifications can be made to test for infant speech perception across multiple ages. The HPP stemmed from the original work by Dix and Hallpike (1947) and Suzuki and Ogiba (1960) and was termed the "peep show audiometry". This procedure has been continuously used throughout infant speech perception research for over four decades and has shown to be an appropriate tool when investigating information processing in infants (Nelson et al., 1995; Nazzi, et al., 2000; Byers-Heinlein, 2014; Mueller & Acosta, 2015). All these different approaches are tools available for researchers and have allowed them to reveal important new information about how babies segment and break apart the language stream, how they map sounds to meanings, and will be able to tell us what babies know about language and the world around them.

1.2 Baby Sign

The development and use of gestures is a precursor to the development of spoken language and has been found to be predictive of language milestones (Clark & Estigarribia, 2011; Singleton & Saks, 2015). All typically developing infants around the world have the same

milestones in regard to spoken language development. For example, by the age of 7 months an infant should have already started babbling and using the combination of vowels and consonants (e.g., /gaga/, /baba/, and /mama/). Regarding gesture use, with the use of a state-of-the-art quantitative Optotrak 3-D motion-tracking technology, Petitto, Holowka, Sergio, Levy, and Ostry (2004) found that hearing infants with Deaf parents who had only been exposed to sign language, babbled systematically on their hands; demonstrating language acquisition through the exposure of just sign language.

Baby sign is a type of formal gesture use and is the physical manipulation of the hands to form gestures that convey meaning allowing an infant and/or toddler to communicate wants, needs, and emotions. Baby sign is defined as the use of visual-gestural signs between hearing parents and their young hearing children (Pizer, Walters, & Meier, 2007). Another definition of baby sign comes from Doherty-Sneddon (2008) where the author describes it as an approach to communication prior to talking, by using keyword signing. An important aspect of baby sign is that the use of "key word signing" is paramount as Doherty-Sneddon (2008) reported many benefits and the facilitation in language development, increase in intelligence, as well as reduction of problematic behavior.

The term baby sign should not to be confused with American Sign Language (ASL). According to the National Association of the Deaf, ASL is a visual language and the shape, placement, and movement of the hands, as well as facial expressions and body movements, all play important parts in conveying information. Unlike ASL, baby sign does not include the syntactic and linguistic components and can be used as symbolic gestures. Baby sign has received a great deal of attention and is being used with typically developed hearing kids (Doherty-Sneddon, 2008).

Pizer, Walters, and Meier (2007) stated that the goal of baby sign is to facilitate earlier, and clearer communication. Parents continue to look for ways to provide scaffolding for their children in their developmental milestones and on ways to communicate with their pre-verbal infants. With the use of baby sign and the accessibility to technology such as the internet so readily available, parents have tools at their disposal to educate themselves on how to incorporate baby sign use with their own children. Using search engines such as Google and Amazon, parents are exposed to a flourishing market of close to 4 billion and thirty thousand results, respectively, in as little as 63 seconds. These results range from products and resources available such as books, videos, websites, and anecdotal reports such as testimonials. The parent's researching these items are being proactive in their child's language development and need to be provided with accurate information. Therefore, researchers/clinicians are responsible in answering parents' questions about the efficacy of introducing or incorporating baby sign into their child's life, as some believe that it is unnecessary (Kirk, Howlett, Pine, & Fletcher, 2013).

Baby sign is a form of visual stimuli that can be presented to anyone, not just individuals who have hearing impairments. Research suggested that using total communication (sign language in conjunction to speech) demonstrated the most promising intervention for language acquisition (e.g., expressive language, requests, increase in MLU, etc.) for children with Autism, Down Syndrome, Intellectual Disabilities, among others. (Layton & Savino, 1990; Bird, Gaskell, Babineau, & Macdonald, 2000; Tan, Trembath, Bloomberg, Iacono & Caithness, 2014; Barrera, Lobato-Barrera, & Sulzer-Azaroff, 1980; Valentino & Shillingsburg, 2011; Pattison, & Robertson, 2016; Dunst, Meter, & Hamby, 2011).

Although there are sceptics who disagree that combing the use of baby sign can facilitate or accelerate spoken language, there is evidence that contradicts them (Acredolo & Goodwyn,

2000; Goodwyn, Acredolo, & Brown, 2000). There are also concerns from those who believe that incorporating an additional modality such as signing, may hinder the normal development of language acquisition for their child (Kirk, Howlett, Pine, & Fletcher, 2013). DiCarlo, Stricklin, Banajee, and Reid (2001) found that verbalizations among toddlers with and without disabilities were not negatively impacted when signing was introduced into their child care facility. Additionally, there are reports of other positive outcomes such as increased expressive and receptive language, increased intellectual mental growth, better parent-child relations such as joint visual attention, infant topic and context maintenance of a conversation, along with concept clarification and discussion (Goodwyn, Acredolo, & Brown, 2000; Acredolo, et al., 1999; Moore, Acredolo & Goodwyn, 2001).

There is still a need to expand this field of research regarding the incorporation of adult-child interactions using baby sign in interventions or to facilitate communication. Anecdotal evidence is available from websites and public opinion, however empirical evidence is lacking.

1.3 Speech Segmentation

Speech segmentation is the process and breakdown of units of spoken language and the identification of the boundaries that occur in a sequence of sounds, such as words, syllables, or phonemes (Nordquist, 2017). The topic of infant speech segmentation and the related linguistic knowledge infants command has been a great area of interest for researchers. The depth and breadth of linguistic constructions acquired and the linguistic processing capabilities of an infant not just in their first year of life (Swingley, 2008) but from birth is astounding and continues to be an area of interest. Across a variety of ages, researchers have found that neonates as young as 7-75 hours old demonstrate perception of vowels; infants as young as two-days-old show a

preference for their native language (Moon, Cooper, & Fifer, 1993; Moon, Lagercrantz, & Kuhl, 2013); newborns show a preference for their mother's voices over that of another female (DeCasper & Fifer, 1980); and recognition of sound patterns in their own names was seen in infants as early as 4.5 month old (Mandel, Jusczyk, & Pisoni, 1995). This demonstration of sound pattern recognition, response to speech sounds, and speech perception by infants are indicators of an infant's discrimination capabilities and a step towards speech segmentation at extremely young ages. This information demonstrates that a vast amount of learning is taking place in the first year of life.

Jusczyk, Cutler, and Redanz (1993) examined an infant's response to stressed (strong) initial syllables, as these make up the majority of words in English. The authors found that a preference develops due to an increasing familiarity with the prosodic features of a native language in infants by nine months of age, but this phenomenon was not documented in infants who were six months of age. This was determined from their work as American infants listened significantly longer to words with strong-weak stress patterns than to words with weak-strong stress patterns.

The first empirical evidence of infant speech segmentation seen in infants as young as 7.5-months-old was reported by Jusczyk and Aslin (1995). The authors' findings provided us with valuable research that to this day, has been continued. They reported that infants as young as 7.5-months-old are capable of extracting words from fluent speech. Work by these researchers has established the foundation for continued research into speech segmentation. Their original work included the implementation of providing a visual recording by a Caucasian female speaker presenting one of four passages while using infant directed speech. Infant directed speech is important in that when speaking to infants, using exaggerated acoustic patterns, prosodic

variation, raised pitch and intonation variation in one's voice has been continuously reported to be preferred over adult-directed speech (Floccia, Keren-Portnoy, DePaolis, Duffy, Luche, Durrant, White, Goslin & Vihman, 2016).

Utilizing the HPP along with the familiarized passages, Bortfeld, Golinkoff, and Rathbun (2005) continued work to determine whether infants as early as six months are capable of segmenting fluid speech. The authors reported that the infants were capable and recognized the word that followed a familiar name, but not a word that followed a novel name. Thus, providing evidence that word learning is taking place not just at 7.5-months but as young as 6-months; infants can extract words from the speech stream when they occur after their own name or after a highly familiar word like *momma* (Bortfeld, Golinkoff, & Rathbun, 2005).

Speech segmentation is an area of research that continues to grow as findings reveal evidence for the processes related to the development of language acquisition in infants. A recent longitudinal study by authors Singh, Reznick, and Xuehua (2012), used only auditory stimuli and a similar paradigm as Jusczyk and Aslin (1995) in the familiarization task as well as the HPP in 7.5-month old infants. The results of the study provided evidence that there is a link between infant word segmentation and later vocabulary development.

Language is learned however, not only through auditory means but also through multimodal exposure. It is critical for researchers to also examine the effects of multimodal cues related to the speech segmentation abilities of infants. Using the seminal work of Jusczyk and Aslin (1995) as well as incorporating a visual cue (sign), authors Mueller and Acosta's (2015) found that 6-month-old infants demonstrated word segmentation. The authors presented seventeen 6-month-old infants with video passages with three conditions: 1) speaker's face (face only), 2) hands (sign only), or 3) both (face and signs). The results go on to concur with the

previous findings that infants pre-exposed to sign, can use both the face and sign cues to assist in speech segmentation. One limitation of the study is aspect ratio differences in the presentation of the face+sign condition. The individual in the face+sign video was substantially further from the camera relative to the other two video stimuli.

1.4 Purpose of the study

Previous researchers have found that incorporating cues in different modalities such as word stress, familiar words, signs, facial cues, and movement along with speech, may aid in the segmentation of speech for infants (Hollich et al., 2005; Mueller & Acosta, 2015). Because the use of baby sign continues to grow, there is a need to examine the effects of its use on the linguistic environment of typically hearing children and their parents. The research questions asked are: 1) Can four-18-month old children use signing cues and facial cues to facilitate speech segmentation of non-words in running speech? 2) Are there age differences related to a child's speech segmentation abilities?

Chapter 2

Methods

The study proposal was submitted to and approved by The Institutional Review Board (IRB) at the University of Texas at El Paso (UTEP). All research was conducted in accordance with the approved submission of the proposal. The IRB reference code number for this study is 1051792-1.

2.1 Participants

Ten infants ages four to 18 months participated in the study. Inclusionary criteria consisted of primary language spoken in home was English or Bilingual (English and Spanish). All infants had to be typically developing based on the Ages and Stages Questionnaire – 3rd Edition (ASQ-3) (Squires & Bricker, 2009). Participants were excluded if they presented with any diagnosed medical condition such as autism or other genetic abnormalities or sensory deficits such as blindness or hearing loss. One child was excluded due to extreme fussiness during testing leaving nine remaining participants.

Nine infants between the ages of five months and 2 days to 16 months and 13 days participated (6 females and 3 males). The participants identified as White (2), Hispanic (6) and Pacific Islander (1). The mean age of the infants was 10 months and eleven days. No infants were removed from the study due to factors of attrition. Parents level of education included finishing middle school (1), college (5), and graduate/professional education (3). The parents reported the level of income as follows; Less than $20, 000 (3), $40,001 to $60,000 (2), $60, 001 to $80, 000 (3), and over $80,001 (1).

2.2 Participant Recruitment

Participants were recruited with the use of flyers with information about the study,

participant characteristics, and contact information. The flyers were distributed to day care providers, doctor's offices, and stores in the El Paso, Texas area. No funding was available at the time of the study and participation was done voluntarily. Upon interest in the study parents contacted the researcher to set up an initial appointment.

2.3 Design

A continuation of the Mueller and Acosta (2015) study was conducted. In this quasi-experimental study, the effects of three different conditions on infants' looking time were compared. The conditions included 1) Sign + Face, 2) Sign only, and 3) Face only. The independent variables were the six videos of the familiarized passages (Sign + Face, Sign only, and Face only). The dependent variables were the measured looking time from each participant towards the familiarized words and control words during the assessment portion of the study. All the participants were presented with videos that included each of the three conditions (Sign + Face, Sign only, and Face only) in a randomized order. A testing phase was implemented after the presentation of a familiarization video for every condition, consisting of the presentation of nonsense words for the HPP.

2.4 Stimuli

The stimuli consisted of three passages that were six sentences long from the Kingdom, Hamlet, and Doctor passages (Appendix B) as previously used in prior studies (Jusczyk et al.,1999; Mueller & Acosta, 2015). Within the passages, one word was deleted and replaced with a one syllable, nonsense word to control for previous word knowledge (see Mueller & Acosta, 2015). The words contained first emerging consonant sounds and the vowels used were monophthong, allowing for vocal quality to remain rather constant (i.e., / jɪp, hɛs, rɑl, tɪg, kɛf,

bɑn, fɪm, tʃɛm, dɑʃ, ʃɪb, wɛk, and sɑr/). Child-directed speech (motherese) was used in the familiarization task.

The speaker for the familiarization videos was a female monolingual (English) speaker, and to avoid any distractibility, she wore a black shirt, no earrings, no nail polish, no lipstick and had her hair in an up-do away from her face. The same individual present in the familiarization videos, recorded the nonsense words used in the testing portion of the experiment. The English recordings of the three passages that were used in the familiarization portion of the experiment, along with the audio recordings of the familiarized nonsense words and the control nonsense words which were used in the assessment portion of the experiment were recorded in a home recording/photo studio using a white background. The device used for both video and audio recordings was a Nikon D7100.

The time it took for the speaker to read the passage ranged from 19 to 25 seconds with a mean of 24.21 seconds. The researcher also improved upon the limitations of the Mueller and Acosta's (2015) study by ensuring the aspect ratio of the videos in the three conditions was consistent. Equalization of the screen ratio was done for all three conditions when the video was presented to the infant. In all three conditions the speaker's entire upper body was visible. Taking into consideration the production of signs, the authors continued to use Mueller & Acosta's (2015) choice of relatively simple gestures that use both hands, handshapes mirror each other, and are unlike any typical ordinary gesture (e.g., SPAGHETTI and MACHINE) in the first and second conditions (sign + face and sign only).

During the testing portion of the study, the speech stimuli consisted of single word repetitions of the target and control words. To continue with consistency, the same female

speaker from the familiarized passages in child- directed speech was recorded saying the single word repetitions. The word presentation order as well as the side in which they were presented (left side and right side) was also randomized for each infant.

2.5 Consent/Questionnaires

The ASQ-3 is used to screen the developmental performance in areas of communication, gross motor skills, fine motor skills, problem solving, and personal-social skills in children between the ages of one month to 5.5 years of age. This questionnaire was used to determine that the child was typically developing. Inclusion criteria included only typically developing children, so if the participant did not pass the ASQ-3 screener, the participant did not proceed with the study. In addition to the ASQ-3, the parents completed an informal language exposure form to determine the child's language dominance. A demographic questionnaire asked questions of the parent in regard to primary language, secondary language, ethnicity, level of education, and family income. Regarding the child's development and sign exposure, the questionnaire included pregnancy term length, interest in baby sign, number of signs parent knows, number of signs child expressively used and amount of time per day using signs.

2.6 Setting

The location of the study was The University of Texas at El Paso Speech, Hearing and Language Clinic. Two different locations within the UTEP Speech, Hearing and Language Clinic were set up for each of the sections of the study, one for the familiarization portion of the study and the other for the testing portion of the study.

The familiarization task took place in a room in the clinic that was arranged with a desk that held a laptop with a 15-inch monitor. The parent was seated in a chair facing the laptop screen as the infant sat on their lap while being presented the familiarization videos. A video

recording system was used to record the infants during the familiarization process that may be further analyzed in a latter study. To control for extraneous variables such as the laptop keyboard, the researcher, and distractions by multiple parents, siblings, or background noise additional steps were taken. A white paper was laid directly on top of the keyboard and the researcher sat directly behind the parent to avoid any distraction to the infant. Only one parent went into the room with the infant and any other parent or siblings were situated in another room with an additional researcher. The noise was controlled by closing the door to the familiarization room to ensure that the familiarization passages were the only audio heard by the infant.

The second part of the study required three research assistants and took place in a double-walled, 6'x 6' audiometric booth also located in the UTEP Speech, Hearing and Language Clinic. The sound proof booth was arranged emulating Nelson et al., (1995) traditional three-sided booth used in the head-turn preference procedure. To diminish visual distraction for the infant, the booth set-up consisted of white walls, (the wall that contained the 2-way window was covered with a white sheet), a chair for the parent facing the sheet, two speakers mounted high on opposite walls, and the animated visual reinforcement audiology (VRA) toys mounted above the speakers. A white sheet was used to block the infants' view of the research assistant and the camera set up. The white sheet had two strategically placed holes; one of the holes was for the researcher to observe the infants' head orientation, and the other hole was for the video camera. The research assistant simultaneously monitored the infant's gaze and behavior as well as video recorded. On the opposite side of the booth, behind the 2-way window, two research assistants controlled the speech stimuli and head turn visual cues. The assistants communicated through the use of hand signals.

2.7 Procedure

Upon arrival to the UTEP Speech, Hearing and Language Clinic, the parents were introduced to the study and were informed of the study procedures and signed the consent forms to participate. The parents of the infants were given The University of Texas at El Paso (UTEP) Institutional Review Board (IRB) consent, language dominance form, demographic form and the ASQ-3 form which corresponded to the child's age in months. After the consent was obtained, the researcher then provided the parent with the ASQ-3 screener. All children scored as typically developing according to the screener. A Language Profile Questionnaire was presented to determine the language exposure the child was receiving throughout their day. The final form provided to the parents consisted of a demographic form. Throughout and in between the presentation of the forms, the graduate student would provide time for questions. Any additional questions were addressed after the forms were completed.

2.8 Conditioning/Familiarization (Pre-Test)

Upon completion of all the forms, only one parent and the child were directed to the familiarization room. A video with one of the three conditions (face only, sign + face, sign only) was presented to the infant to familiarize them with the target nonsense words. Prior to the familiarization process the parent was instructed to sit on the chair facing the computer monitor while placing their child on their lap and avoid cueing of any kind. Once situated, the researcher started the presentation of the first two familiarization videos for the first condition. For example, in the Sign + Face condition, the videos that contained the nonsense words *ral* and *tɪg* were presented. To avoid distracting the child during this section of the study, the researcher stood behind the parent, away from the line of sight of the child. This session was videotaped to ensure that the child was watching the screen. Once both of the familiarization videos were presented, the parent and their child were escorted into the audio booth to proceed with the testing phase of

the study and testing for this condition. After the testing phase for the first condition was completed, the parent and child were again escorted back to the familiarization room to proceed with the second condition. Testing and familiarization continued until all three conditions were completed.

2.9 - Testing

After the familiarization passages were viewed, the participant and parent moved to the audio booth for the testing portion of the study. Three research assistants were needed to present the speech stimuli for the testing portion of the study. Two research assistants were responsible for the presentation of the stimuli by working the audiometer, VRA toys and a CD player. The other research assistant was situated behind the sheet to monitor the infant's behavior, ensure the infant was orienting to midline, and operated the video camera. The parents were instructed to sit in a chair while seating their infants on the middle of their laps facing forward toward the white sheet. The parent was required to wear headphones playing classical music to prevent the parent from cueing the child to turn toward the stimuli.

The research assistants communicated using a series of hand signals through a two-way mirror. Once the testing was ready to begin, the research assistant standing behind the white sheet (for the remainder of the paper will be called RA1), presented a small toy to orient the child's attention to midline. Once the child's head turned toward midline, RA1 signaled the research assistant manning the VRA toy (for the remainder of the paper will be called RA2) then triggered one of the VRA toys in the audio booth to flash until the infant turned their head at least 30° towards the blinking light as determined by RA1. The speech stimulus was then presented for the child for a maximum of 30 seconds and included the two nonsense

familiarization words and two nonsense control words played at 60 dB HL on the mounted speaker on the same side as the triggered VRA toy. If the child quickly looked away for less than 2 seconds but oriented back to same sound source, the presentation of the stimulus continued playing. The quick lapse of time was not incorporated in the analysis of total orientation time. The trial was complete when the infant turned away from the sound source for longer than 2 seconds or once the 30 seconds had lapsed. The parent and child would finish the condition once each of the four-nonsense test and control words were presented for that condition. Then, the parent and child moved back to the familiarization room for presentation of the familiarization videos for the next condition.

The same procedures were followed for the next two conditions. Participants were provided with breaks at any time for feeding or changing if required.

2.10 Data Analysis

To calculate the infants' orientation times, a recording of the testing portion of the study was obtained and the infants' gaze was analyzed. The recordings were then analyzed using the Head-Turn Preference Procedure (HPP) by Nelson, et al. (1995), to measure the time the participants spent looking towards the sound source (mounted speaker) that produced the nonsense target and control words. Initial start time began once the infant's head turned more than 30° towards the sound source and ended when the infant's head turned away more than 30° from the sound source. Measurement of time was taken in milliseconds and included times that the infant quickly looked away for less than 2 seconds. Orientation times stopped once the participants looked away from the sound source for more than 2 seconds and no longer than the 30 second maximum presentation time.

2.11 Reliability

2.11.1 Inter-rater Reliability

To measure inter-rater reliability, a second rater measured orientation times for 30% of the testing videos that were recorded. Training of the second rater was completed. A training video was used. The researcher and rater both viewed the video to provide examples of the orientation times. The researcher answered any questions that the second rater posed. The second rater was then provided with a second video and independently measured the orientation times. Once high reliability was established during the training, the second rater was allowed to independently measure orientation times for 30% of the videos. The researcher met with the second rater to operationally define the behaviors. A blind approach was taken, in that the research assistant participating in this study was uninformed of the test and control words, which allowed for their use as a second rater.

Similar to the Mueller and Acosta (2015) study, agreements were defined as the orientation times within 30 milliseconds. Inter-rater reliability for looking times was 85%.

Chapter 3

Results

A total of nine children participated in the study. Recall, one child was excluded due to fussiness. Per parental report 7/9 reported English as the primary language in the household, 8/9 reported to be Bilingual (seven Bilingual English/Spanish, one Multilingual English/American Sign Language/Signed English). Out of all the parents seven reported to have interest in baby sign, while one reported "maybe" and one reported "no interest". Out of the seven that had interest in baby sign, one parent reported knowing more than 1000 signs, one parent reported knowing 20 signs, three parents reported knowing more than 10 signs, and two parents reported knowing three signs. Parents also reported on the number of signs used by their children. One parent reported that their child uses 24 signs, one parent reported that their child uses 2 signs, and two parents reported that their children use 1 sign each. Regarding the amount of time per day using signs, two parents report 4-7 hours per day, two parents reported 1-3 hours per day, and four parents reported less than one hour per day. See Table 1 below.

Table 1

Parental report of sign knowledge and use

Parental knowledge of signs	Child sign use	Child's age (years; months)	Amount of time spent using signs/day
1000	24	1; 0	4-7 hours
20	0	0; 9	Less than 1 hour
12	0	0; 5	Less than 1 hour
10	1	0; 8	1-3 hours
10	1	0; 11	Less than 1 hour
3	0	0; 9	Less than 1 hour
3	2	1; 5	4-7 hours

3.1 Orientation times

SPSS 21 was used for all analyses. A series of paired t-tests were run. A significance level of <0.05 was set a priori. Firstly, the differences between the mean of the looking times of all the control words vs. the familiarized words were compared across all the conditions. The difference was not significant (p=0.24). The differences between the means of the looking times for each condition were also compared. Again, no significant differences were found. See the Table 2 below.

Table 2

T-test results per condition

Condition	P-value
Sign condition	0.48
Face condition	0.34
Face+Sign condition	0.20

Due to the wide age range of children, separate analyses were conducted on the younger

group (ages 0;5 to 0;11) and on the older group (ages 1;0 to 1;5). A Wilcoxon Sign Rank test was used as the number of data points was small and normalcy could not be assumed. Differences between the means of the overall looking times of the control vs. the familiarized words were again not significant (young group, p=0.08; older group, p=0.48).

Finally, a Wilcoxon Sign Rank test was run on the looking times of only those participants whose parents reported knowing more than 10 signs (N=5). The differences between the means of the looking times of the control vs. the familiarized words were not significant (p=0.41).

Chapter 4

Discussion

The purpose of this study was to examine the impact that baby sign has on the speech segmentation abilities of typically developing hearing infants between the ages of four to18-months. Expanding on Mueller and Acosta's (2015) study, the researchers asked the following questions: 1) Can four to 18-month old children use signing cues and facial cues to facilitate speech segmentation of non-words in running speech? and 2) Are there age differences related to a child's speech segmentation abilities?

This study allowed the inclusion of participants between a broad range of ages for infants from four to 18-month-olds. During their development, infants experience different communicative milestones. Between four to six months, infants can follow sounds with his/her eyes, respond to changes in the tone of the speaker's voice, babble in a speech-like way and use many different sounds (including sounds that begin with bilabials /p, b, and m/), and babble when excited or unhappy. Between eight to 12-months infants can link gestures and vocalizations to convey fairly specific messages. Later, around 12-months to 18-months they start producing their first meaningful words and communication is intentional but still heavily nonverbal (Hulit, Howard, & Fahey, 1993). Ultimately, in terms of language development the children who participated in the current study were all going through different milestones and were exhibiting different linguistic behaviors.

The first question addressed the infant's speech segmentation of non-words in running speech with the assistance of an additional visual cue, be it a sign or a face. The findings did not

show any statistical significance for any differences in the looking times of the infants. This was somewhat surprising; however, any significant differences may not have been obtained given the small sample size and the variability in the ages of the participants.

When looking further at the infants' exposure to sign, the researcher found that participant number three was the only child exposed to sign since birth. His mother reported being a teacher at a school for the Deaf and she continued to expose her children to sign additionally on a daily basis in all contexts. The mother reported to knowing over 1000 signs and that her son knew 24 signs already by the age of 12 months and she recognized ASL as a second language in her household. Her incorporation of sign in their daily lives in their communication with her infant was noticed throughout the study as he was non-verbally communicating with the research assistant by requesting (MORE+DINOSOAUR). Although his verbal communication at this age was not fully developed, he was still able to communicate through the use of sign. This participants' data also demonstrated the preference that using an additional cue such as Sign and the Face+Sign. This participant's looking times trended in a direction that followed the initial hypothesis.

The second question asked was if there are age differences related to a child's speech segmentation abilities? As previously discussed, the children in the study most likely were going through different milestones at different times, and at their own rate. Data suggests that typically developing children have similar stages that they all go through in their language development (Hulit, Howard, & Fahey, 1993). Although additional analysis attempted to tease apart the effects of age for our current participants, no significant results were found.

4.1 Theoretical Implications

Providing children with a rich linguistic environment will strengthen and assist with their language development. Incorporating baby sign to this linguistic environment additionally to verbal language may provide the parent as well as the child with the opportunity for more one-on-one and face-to-face interactions. This can in turn assist with joint attention or joint referencing. Incorporating additional visual stimuli such as the face to capture the child's attention and to help in establishing a communicative relationship with their caregiver (Hulit, Howard, & Fahey, 1993). Based on the results of the current data, no correlations can be made regarding the use of baby sign and an infant's ability to segment the speech stream.

4.2 Future research

Clearly, future research should include greater numbers of participants at different ages. Additional research is also needed to determine whether a child needs a significant amount of sign exposure at an early age to assist in speech segmentation. Therefore, future research needs to look into how much sign exposure is necessary. During this study, the participant whom had sign exposure since birth, although his articulators were not fully developed to communicate verbally the word dinosaur, his one hand sign of DINOSAUR and a combination of MORE, provided with him with the means to non-verbally communicate a 2-word request combination. Children around 12-months to 18-months start producing their first meaningful words and communication is intentional but still heavily nonverbal (Hulit, Howard, & Fahey, 1993). However, this was an ideal example of pre-speech communication.

Another area where additional research is necessary is in the reported languages of the participants. Six of the nine participants reported to being Spanish bilinguals and future research is also necessary to determine if there is a difference when presenting the passages either in Spanish or in a child's second language.

4.3 Limitations

This study was limited by its small sample size. Sample size may have been enlarged, however was limited to nine infants due to the limited compensation for participants and time constraints. When scheduling the participants, time constraints involved having the parent take time off of work. The time off of work may have cause a financial strain, and the study did not provide for any monetary compensation for their time. Although a larger sample size would have been preferable, the study was limited due to the variation in ages. The broad range from four months to 18-months of age makes it difficult for the researcher to compare the findings as each child is going through different milestones in their language development. Getting more participants within the same ages in the range would allow for a more accurate comparison between groups.

Another limitation may have included the continued use of a modified head turn procedure. While Kemler Nelson et al., (1995) used computerized software, all calculations in the current study were completed manually following Mueller and Acosta's (2015) study. An additional oversight in the study that may have added to the limitations was in the passages presented. In Mueller and Acosta's (2015) study six different passages were used, while in this study only three were presented. The participants heard the same passage with two different words, whereas in Mueller and Acosta's (2015) study, the participants heard two different passages for each condition.

Lastly, controlling for the state of the infant's behavior and health was an additional variable that one cannot control. Many participants cancelled appointments due to illness which contributed to the small sample size. Additionally, reactions to the stimuli may have changed throughout the study due to fatigue, hunger or other states in which we had no control over.

4.4 Conclusion

Although the results of this study did not support previous research, much more work still must be completed to gain a better understanding of how baby sign may be affecting the linguistic environment of children. Specifically, how is exposure to baby sign affecting a child's development of language in the area of speech segmentation. The results from one participant who had been exposed to much sign, demonstrated trends in the looking times in the Sign and Face+Sign condition supporting previous findings that incorporating an additional visual cue such as the face and/or sign can assist in extracting words from fluent speech when exposed early on in development. Results are also important in that it may be evidence that the current study's methodology has improved upon the limitation on Mueller and Acosta's (2015) study. In their study, they recommended correcting the aspect ratio to one of the conditions. In this study all three conditions were corrected and when presented each were consistent in the aspect ratio.

Using facilitating techniques such as sign can be beneficial, yet these techniques do not have to be applied just to non-typically developing children, but also could be used with typically developing children also. However, it is recommended that further, and more extensive research be conducted to study the long-term effects of such an intervention within this population. Not only is it in the scope of Speech-Language Pathologists to provide services to children, but also to bring awareness and help parents understand how children understand the world.

References

Bahrick, L. E. (2001). Increasing specificity in perceptual development: Infants' detection of nested levels of multimodal stimulation. *Journal of Experimental Child Psychology*, *79*(3), 253-270.

Bortfeld, H., Morgan, J. L., Golinkoff, R. M., & Rathbun, K. (2005). Mommy and me familiar names help launch babies into speech-stream segmentation. *Psychological Science*, *16*(4), 298-304.

Brady, N. C. (2007). Infants can be taught to use manual signs to communicate requests and doing so may replace crying. *Evidence-Based Communication Assessment and Intervention, 1*(3), 119-120.

Byers-Heinlein, K. (2014). High amplitude sucking procedure. In P. J. Brooks, & V. Kempe, [Eds.], Encyclopaedia of Language Development. Thousand Oakes, CA: Sage Publications., 263-264.

Clark, E. V., & Estigarribia, B. (2011). Using speech and gesture to introduce new objects to young children. *Gesture, 11*(1), 1-23.

DeCasper, A. J., & Fifer, W. P. (1980). Of human bonding: Newborns prefer their mothers' voices. *Science, 208*(4448), 1174-1176.

DiCarlo, C. F., Stricklin, S., Banajee, M., & Reid, D. H. (2001). Effects of manual signing on communicative verbalizations by toddlers with and without disabilities in inclusive classrooms. *Journal of the Association for Persons with Severe Handicaps, 26*(2), 120-126.

Doherty-Sneddon, G. (2008) The great baby signing debate: Academia meets public interest. *The Psychologist, 21*(4), 300-303.

Eimas, P. D., Siqueland, E. R., Jusczyk, P., & Vigorito, J. (1971). Speech perception in infants. *Science, 171*(3968), 303-306.

Floccia, C., Keren-Portnoy, T., DePaolis, R., Duffy, H., Delle Luche, C., Durrant, S., ... & Vihman, M. (2016). British English infants segment words only with exaggerated infant-directed speech stimuli. *Cognition, 148*, 1-9.

Gogate, L. J., Bahrick, L. E., & Watson, J. D. (2000). A study of multimodal motherese: The role of temporal synchrony between verbal labels and gestures. *Child development, 71*(4), 878-894.

Goldin-Meadow, S. (2015). Gesture as a window onto communicative abilities: Implications for diagnosis and intervention. *Perspectives on Language and Learning and Education, 22,* 50-60.

Goodwyn, S. W., & Acredolo, L. P. (1993). Symbolic gesture versus word: Is there a modality advantage for onset of symbol use? *Child Development, 64*, 688-701.

Goodwyn, S. W., & Acredolo, L. P. (1998). Encouraging symbolic gestures: A new perspective on the relationship between gesture and speech. In Goldin-Meadow, S (Ed), Iverson, J (Ed), *The nature and functions of gesture in children's communication* (pp.61 73). San Francisco, CA: Jossey Bass.

Goodwyn, S., Acredolo, L., & Brown, C. (2000). Impact of symbolic gesturing on early language development. *Journal of Nonverbal Behavior, 24*(2), 81-103.

Haahr, M. (n.d.). True Random Number Service. Retrieved July 24, 2018, from https://www.random.org/lists/

Hirsh-Pasek, K., & Golinkoff, R. M. (1996). The intermodal preferential looking paradigm: A window onto emerging language comprehension.

Houston-Price, C., & Nakai, S. (2004). Distinguishing novelty and familiarity effects in infant preference procedures. *Infant and Child Development*, *13*(4), 341-348.

Howlett, N., Kirk, E., & Pine, K. J. (2011). Does 'wanting the best' create more stress? The link between baby sign classes and maternal anxiety. *Infant and child development*, *20*(4), 437-445.

Hulit, L. M., Howard, M. R., & Fahey, K. R. (1993). *Born to talk: An introduction to speech and language development*. New York, NY: Merrill.

Jusczyk, P. W., Cutler, A., & Redanz, N. J. (1993). Infants' preference for the predominant stress patterns of English words. *Child development, 64*(3), 675-687.

Jusczyk, P. W., Friederici, A. D., Wessels, J. M., Svenkerud, V. Y., & Jusczyk, A. M. (1993). Infants□ sensitivity to the sound patterns of native language words. *Journal of memory and language, 32*(3), 402-420.

Jusczyk, P. W. (1985). The high-amplitude sucking technique as a methodological tool in speech perception research.

Kirk, E., Howlett, N., Pine, K. J., & Fletcher, B. C. (2013). To Sign or Not to Sign? The Impact of Encouraging Infants to Gesture on Infant Language and Maternal Mind-Mindedness. *Child Development, 84*(2), 574-590.

Lowry, L. (2016). The Importance of Gestures. Retrieved February 4, 2018, from http://www.hanen.org/Helpful-Info/Articles/The-Importance-of-Gestures.aspx

Mandel, D. R., Jusczyk, P. W., & Pisoni, D. B. (1995). Infants' recognition of the sound patterns of their own names. *Psychological Science, 6*(5), 314-317.

McCall, R. B., & Carriger, M. S. (1993). A meta-analysis of infant habituation and recognition memory performance as predictors of later IQ. *Child development, 64*(1), 57-79.

Moon, C., Cooper, R. P., & Fifer, W. P. (1993). Two-day-olds prefer their native language. *Infant behavior and development, 16*(4), 495-500.

Moon, C., Lagercrantz, H., & Kuhl, P. K. (2013). Language experienced in utero affects vowel perception after birth: A two-country study. *Acta Paediatrica, 102*(2), 156-160.

Mueller, V., & Acosta, A. (2015). Infants' use of baby sign to extract unfamiliar words from the speech stream. *Early Child Development and Care, 185*(6), 943-951.

National Association of the Deaf. (n.d.). Retrieved October 17, 2016, from https://nad.org/issues/american-sign-language/what-is-asl

Nazzi, T., Nelson, D. G., Jusczyk, P. W., & Jusczyk, A. M. (2000). Six-Month-Olds' Detection of Clauses Embedded in Continuous Speech: Effects of Prosodic Well-Formedness. *Infancy*, *1*(1), 123-147.

Nelson, D. G. K., Jusczyk, P. W., Mandel, D. R., Myers, J., Turk, A., & Gerken, L. (1995). The head-turn preference procedure for testing auditory perception. *Infant behavior and development*, *18*(1), 111-116.

Nordquist, Richard. (2017, May 8). Phonological Segments. Retrieved from https://www.thoughtco.com/segment-phonology-and-phonetics-1691934

Petitto, L. A., Holowka, S., Sergio, L. E., Levy, B., & Ostry, D. J. (2004). Baby hands that move to the rhythm of language: hearing babies acquiring sign languages babble silently on the hands. *Cognition, 93*(1), 43-73.

Pizer, G., Walters, K., & Meier, R. P. (2007). Bringing up baby with baby signs: Language ideologies and socialization in hearing families. *Sign language studies, 7*(4), 387-430.

Seidl, A. (2007). Infants' use and weighting of prosodic cues in clause segmentation. *Journal of Memory and Language*, *57*(1), 24-48.

Singh, L., Steven Reznick, J., & Xuehua, L. (2012). Infant word segmentation and childhood vocabulary development: a longitudinal analysis. *Developmental Science*, *15*(4), 482-495.

Singleton, N. C., & Saks, J. (2015). Co-speech gesture input as a support for language learning in children with and without early language delay. *SIG 1 Perspectives on Language Learning and Education, 22*(2), 61-71.

Spss, I. (2012). IBM SPSS statistics version 21. *Boston, Mass: International Business Machines Corp, 126*.

Squires, J., & Bricker, D. (2009). Ages & stages questionnaires, (ASQ-3). *A parent-completed child monitoring system. 3rd ed. Baltimore: MD: Brookes*.

Suzzcki, T., & Ogiba, Y. (1960). A technique of pure tone audiometry for children under three years of age. *Conditioned orientation reflex (CO R.) audiometry, Rev. Laryng, 81*(33), 1960-2.

Swingley, D. (2008). The roots of early vocabulary in infants' learning from speech. *Current Directions in Psychological Science*, *17*(5), 308-312.

The Wilcoxon Signed-Ranks Test Calculator. (n.d.). Retrieved June 18, 2018, from http://www.socscistatistics.com/tests/signedranks/Default.aspx

Werker, J. F., Polka, L., & Pegg, J. E. (1997). The conditioned head turn procedure as a method for testing infant speech perception. *Early Development and parenting, 6*(34), 171-178.

Appendix

A.

Nonsense word list
jɪp
hɛs
rɑl
tɪg
kɛf
bɑn
fɪm
tʃɛm
dɑʃ
ʃɪb
wɛk
sɑr

B.

Nonsense word pairs + Condition (designated sign)	
(bɑn/ kɛf)	Sign only (SPAGHETTI)
(rɑl, tɪg)	Face+sign (MACHINE)
(jɪp, hɛs)	Face only

C. Familiarization Passages and Assigned Conditions

Passage #1 (jɪp, hɛs) – face only
Your (jɪp, hɛs) is in a faraway place. The prince used to sail to that (jɪp, hɛs) when he came home from school. One day he saw a ghost in this old (jɪp, hɛs). The (jɪp, hɛs) started to worry him. So he went to another (jɪp, hɛs). Now in the big (jɪp, hɛs) he is very happy.

Passage #2 (bɑn/ kɛf)– sign only
The (bɑn/ kɛf) saw you the other day. He's much younger than the old (bɑn/ kɛf). I think your (bɑn/ kɛf) is very nice. He showed another (bɑn/ kɛf) your pretty picture. That (bɑn/ kɛf) thought you grew a lot. Maybe someday you'll be a big (bɑn/ kɛf).

Passage #3 (rɑl, tɪg) – face and sign
Your (rɑl, tɪg) lies just over the hill. Far away from here near the sea is an old (rɑl, tɪg). People from that (rɑl, tɪg) like to fish. Another (rɑl, tɪg) is in the country. People from that (rɑl, tɪg) really like to farm. They grow so much that theirs is a very big (rɑl, tɪg).

Vita

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