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# The Effects of Baby Sign on Child Development

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THE EFFECTS OF BABY SIGN ON CHILD DEVELOPMENT

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2015

THE EFFECTS OF BABY SIGN ON CHILD DEVELOPMENT

by

JOANNA MARIE SCOTT, B.A.

THESIS

Presented to the Faculty of the Graduate School of  
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## **Abstract**

*Introduction:* Although the popular media supports the use of baby sign for enhanced developmental outcomes of children, empirical research verifying the actual effects of baby sign on the areas of communicative, cognitive, social, and physical development, is limited.

Advocates of baby sign suggest pre-lingual symbolic communication may result in accelerated development whereas critics claim definitive conclusions cannot be drawn because of flawed methodology in the research. *Purpose:* The purpose of the present study was to explore whether baby sign has an impact on the developmental growth of children. *Methods:* Using a between groups research design, assessment data were obtained from 40 children between the ages of 5 months and 4 years from three daycare centers in El Paso, Texas. Two conditions were used: a nonintervention control condition and an experimental baby sign trained condition in which day care providers used baby sign with the children. A paired t-test was used to analyze the data.

*Results:* Results indicate baby sign training had a significant impact on gains made from pre to post test in the areas of cognitive, adaptive behavior, and social-emotional development in the children in the experimental group.

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## **Chapter 1: Introduction**

From the first word to the first step, babies make significant developmental strides during the early years of life. They learn to sit, crawl, pull to a stand, and take their first wobbly steps toward toddlerhood. As they develop the motor coordination and cognitive awareness needed to explore and understand their world, they acquire the building blocks of language necessary for communicating their wants and needs meaningfully with those around them. Although this time between infancy and toddlerhood can be exciting for young children as they assert new-found independence, it can also be a period of great frustration due to the limited ability they have to communicate. Receptively, young children know what they want to say but expressively they do not have the motor capabilities required to produce the speech needed to convey their message (Nelson et al., 2012; Sneddon-Doherty, 2008; Capirci et al., 2002; Goodwyn, Acredolo, & Brown 2000).

In order to address this problem, parents have begun looking to the recent trend of baby sign as a possible solution. Websites, popular magazines, and talk show programs promise that baby sign will not only lead to earlier communication of a child's wants and needs but will also enhance their intellectual, social, and physical development (Nelson et al., 2012; Pizer, Walters, & Meir, 2007; Johnston et al., 2005). Specifically, the use of baby sign is expected to increase vocabulary size, improve literacy, accelerate speech and language development, boost IQ scores, increase a child's confidence, reduce frustration/tantrums, and strengthen the parent-child bond. (Nelson et al., 2012; Mueller & Sepulveda, 2013; Johnston et al., 2005; Doherty-Sneddon, 2008; Howlett, Kirk, & Pine, 2010).

Although the media suggests that baby sign will result in significantly improved developmental outcomes, empirical studies verifying the actual effects of baby sign is conflicting

due to methodological flaws inherent in the research (Mueller & Sepulveda, 2013; Doherty-Sneddon, 2008; Johnston et al., 2005; Seal, 2010; Nelson et al., 2012). Further, there is a paucity of research concerning the effects of baby sign on other domains of development. The present study seeks to address this gap by investigating if baby sign affects the cognitive, social-emotional, adaptive behavior, and physical development of young children. Further, the study aims to expand the limited evidence base for the effects of baby sign on communicative development, and improve upon the methodological weaknesses of previous research.

### **1.1 Defining Symbolic Gesture and Baby Sign**

It is important to determine if a distinction should be made between the terms symbolic gesture and baby sign since the existing evidence base is replete with studies on symbolic gesture but lacks studies focused solely on baby sign. Defined as an augmentative communication approach, baby sign is the use of visual-gestural signs between hearing parents and their young hearing children for the purpose of facilitating communication before verbal speech is acquired (Doherty-Sneddon, 2008; Pizer, Walters, & Meir, 2007). In baby sign, key word signs that are functional and relevant to the young child (names of family members, food, toys, animals, emotions) are selected from American Sign Language (ASL) and modified with adjustments in signing space, size, and duration to emphasize a prominent sign and/or word (Seal, 2010). The term baby sign is often used synonymously with symbolic gesture in the literature.

Goodwyn, Acredolo, and Brown (2000) describe symbolic gesture as a physical action that can be used to represent objects and events (e.g. flapping arms for “bird”). Although the definitions of baby sign and symbolic gesture seem relatively straight forward, some researchers object to the terms being used interchangeably. Capirci et al. (2002) suggests that sign language differs from symbolic gesture because it uses a defined set of locations, hand shapes and movements according to language specific rules. Although symbolic gestures as described by

Goodwyn, Acredolo, and Brown (2000) are not specifically borrowed from a rule governed language, it can be argued that they still serve the same function as baby sign. Mueller et al. (2013) asserts that from the child's perspective, there is no difference between a sign or symbolic gesture since the infant is still responsible for matching the gesture or sign to its referent as they do with the spoken word. For the purpose of the present study the definitions of symbolic gesture and baby sign will be used interchangeably with the understanding that the child does not need to make a distinction between the two in order to communicate his or her message effectively.

## **1.2 The Relationship between Gesture and Language Development**

A definitive link between the simultaneous development of gesture and language provides a strong evidence base for the positive impact of symbolic gestures used in baby sign on the facilitation of communication, suggesting a very close relationship exists between the two (Seal, 2010; Pizer et al., 2007; Howlett, Kirk, & Pine, 2010; Nelson et al., 2012; Goodwyn, Acredolo, & Brown, 2000; Capirci, Iverson, Montanari, & Volterra, 2014; Goldin-Meadow, 2010). The connection that emerges between gesture and expressive communication can be attributed to early hand-mouth associations such as when infants first bring their hands or objects to their mouth (Iverson & Thelen, 2013; Doherty-Sneddon, 2003). As early as eight to twelve weeks of age, pre-verbal infants coordinate certain hand and arm movements with their vocalizations (Doherty-Sneddon, 2003; Iversen & Thelen, 1999).

At 26-28 weeks, the first instances of canonical babble are heard when rhythmical movements of the arms such as waving, swaying, and banging occur (Iversen & Thelen, 1999). At 9 months, babies start playing peek-a-boo, raise their arms to request to be lifted and begin to imitate gestural actions such as waving "bye bye" (Doherty-Sneddon, 2003). At around 10

months of age, deictic gestures, such as pointing, reaching, showing, giving, and waving appear. The onset of these gestures precedes the first word which is typically heard at 12 months of age (Doherty-Sneddon, 2003). Gestural use signals an important step in symbolic development, the beginning of intentional communication, and readiness for learning verbal language (Goodwyn & Acredolo 2000; Doherty-Sneddon, 2003; Iversen & Thelen, 1999; Nelson et al., 2012). Volterra et al. (2006) reported that gestural input signals the beginning of representational form and communicative function.

Acredolo and Goodwyn (2000) suggest the benefits of gesture on language development may be due to an increase in joint attention, child directed speech, and practice with symbolic function. Kirk et al. (2013) found that gesturing mothers were more responsive to their infants' gaze and actions due to focusing on their child's nonverbal communicative attempts. Infants with a symbolic communication system such as gesture gain the benefits of increased caregiver responses at earlier ages because they can talk about the things that are personally meaningful to them and their parents or caregivers can shift their focus to match (Acredolo & Goodwyn, 2000). This leads to more opportunities for joint attention which is a necessary precursor for language development and increases the likelihood that the vocal information provided by the parents or caregivers will be internalized by the child (Acredolo & Goodwyn, 2000).

Further, the child with a symbolic communication system learns that gestural movement can stand for something meaningful which teaches them that language is inherently valuable and motivates them to want to communicate (Acredolo & Goodwyn, 2000). Because of general consensus in the literature concerning the importance of gesture for language development, it can be argued that one of the greatest strengths of baby sign is its use of symbolic gestures to facilitate communication.

### **1.3 Symbolic Gesture, Baby Sign, and Language Development**

Since symbolic gestures signal purposeful communication, advocates of baby sign suggest that teaching young children to communicate through symbolic key word signs may facilitate and perhaps accelerate language development (Nelson et al., 2012; Goodwyn, Acredolo, & Brown, 2000; Goodwyn & Acredolo, 1990). Researchers propose that the suggested sign advantage on language development may be attributed to the manual modality since articulation difficulties that delay early word production are not affected in the manual modality (Capirci et al., 2002). Holmes and Holmes (1980) studied a hearing child of hearing parents who used both sign and spoken words to communicate with their child from 26 weeks until 17 months. The child produced his first ten words at least 3 months earlier than a typically developing child and his first fifty words at least 5 months earlier than the expected norm (Mueller & Sepulveda, 2013). By 17 months of age, he had learned 112 words which more than doubled the 50 words of his typically developing peers. Researchers hypothesized the signed component may have been responsible for the child's early acquisition of expressive and receptive language (Holmes & Holmes, 1980). Although the results of this study support the use of baby sign in conjunction with the spoken word for accelerating expressive language development, it is important to note that results of a case study are typically not applicable to the larger population. Specifically, this study was criticized by Nelson et al. (2012) for the absence of baseline vocabulary scores, lack of randomization, and for not reporting if data collectors were blind to the purpose of the study.

In a pilot study examining the vocabulary development and communication of six infants who were taught to use symbolic gestures, Goodwyn and Acredolo, (1990) reported that the six participants who learned 20 signs developed vocabulary at an accelerated rate compared to

norms for typical verbal development. In a subsequent longitudinal study, Acredolo, Goodwyn, and Brown (2000) examined the impact of symbolic gestures on early language development in 103 11-month-old hearing infants. Infants were assigned to one of three groups including a signed training group where children communicated with symbolic gestures, a verbal training group where parents labeled objects during daily routines, and a non-intervention group. Based on a variety of language measures taken over the course of 11 – 36 months, results showed that infants who used symbolic gestures outperformed those in both the non-intervention control and verbal training group for both expressing themselves and understanding others (Nelson et al., 2012). These results are consistent with other findings from the literature suggesting that the early use of gestures has a positive impact on children's linguistic abilities (Kirk & Howlett, 2013; Doherty-Sneddon, 2003; Iversen & Thelen, 1999; Nelson et al., 2012).

Bonvillian, Orlansky, and Novack (1983) also suggested baby sign may accelerate expressive language development. Researchers studied the sign language development of 11 young children across a 16 month period. These participants showed advanced vocabulary development, achieving on average, their first recognizable sign at 8.5 months, the tenth sign at 13 months, and their first sign combination at 17 months. Researchers noted in their study that children who learn to speak without the use of sign did not demonstrate equivalent spoken developmental milestones until 2-3 months later (Bonvillian et al., 1983). Because study participants were children of deaf parents, however, Johnston et al. (2005) questioned the validity of the findings, concluding that children of deaf parents who are consistent signers may be more successful with baby sign than children who have hearing parents and are learning sign for the first time.

Daniels (1994) found that 14 hearing children of deaf parents learned sign more quickly when they were presented with sign in conjunction to the spoken word. Results from the study also indicated that children who had learned ASL in addition to the spoken word during preschool achieved higher than average scores on the PPVT when compared to their non-signing peers. Similar to the findings of Holmes and Holmes (1980), Daniels (1994) concluded the superior scores suggested that simultaneously presenting words visually, physically, and orally enhances a child's vocabulary development.

Further, there is a small but limited evidence base suggesting that the use of gestures may be beneficial for the language development of infants from families with low socioeconomic status (SES). Hoff (2003) suggests that symbolic gesturing in this population may be beneficial since children from families with low SES are less likely to receive the rich linguistic input necessary for healthy language development. In addition, teaching symbolic gestures to parents and children from low SES may help to increase a parent's level of responsiveness to a child's nonverbal cues as well as allow for them to view their child as an independent, intentional communicator (Kirk et al., 2013). Researchers found that gesture training of mothers from low-SES backgrounds resulted in moderate increases in the infants' vocabularies (Kirk, Pine, & Garrick, 2012). In a subsequent study by Kirk et al. (2013), researchers concluded that children with the weakest language abilities made significant gains in their language development scores following symbolic gesture training. Mueller et al. (2013) also found that baby sign had a positive effect on the language development of children in 11 families from low SES. Results of studies by Mueller et al. (2013) and Kirk et al. (2013), support the potential benefits of baby sign on the language development of children from low SES and impoverished linguistic backgrounds.

Although there seems to be a small number of research studies supporting the claimed benefits of baby sign on children's language development, the empirical validity of the studies has been compromised due to methodological insufficiencies. Nelson et al. (2012) reviewed the evidence for website claims about the benefits of teaching sign language to infants and toddlers with normal hearing and concluded that there is not enough research to suggest that teaching sign language to young children with normal hearing results in better developmental outcomes. The researchers reviewed 33 websites promoting baby sign and 82 references cited as supporting research by the websites. Out of the 82 sources listed, only eight were considered empirical research studies and the rest were largely opinion based articles (Nelson et al., 2012). Five of the studies were by Goodwyn and Acredolo and three of the studies were conducted by Daniels. These studies were criticized for methodological weaknesses such as lack of randomization, lack of control for confounding variables and threats to internal validity, and potentially biased methods of data collection such as parent report (Nelson et al., 2012).

In addition, a systematic review of the evidence by Johnston et al. (2005) evaluated 17 research studies on the effectiveness of pre-lingual signing for typically developing, hearing infants and found that all studies reviewed did not support claims that signing facilitates and enhances developmental outcomes in young children. Without concrete evidence based on sound methodology, caring parents may be disappointed if baby sign does not result in the developmental outcomes they might expect for their children. In order to help parents have realistic expectations of teaching baby sign to their infant, more studies of a higher methodological quality are necessary (Nelson et al., 2012; Johnston et al., 2005). Such studies would need to include blinding, random assignment to comparison groups, and better control for history and threats to internal validity. Until such research is completed, parents should



understand that existing research cannot be used to bolster the credibility of the benefits of baby sign.

In an attempt to improve upon methodological weaknesses of previous studies on baby sign, Kirk and Howlett (2013) conducted the first longitudinal randomized controlled trial to determine the effects of baby sign on language development. However, the researchers did not find that teaching parents to use baby sign resulted in accelerated linguistic development in their study of 40 eight-month old infants. Parents and infants were assigned to one of four conditions including a symbolic gesture training (SG), British Sign Language training (BSL), verbal training (VT), and no condition (NC). Results showed that infants exposed to gesture training or BSL did not differ significantly in gains in language development from the VT and NC groups. Researchers did find a significant difference, however, between the expressive communication scores for boys with low language ability. This suggests that baby sign may benefit children who are at risk of language delay or disorder.

The recent study by Kirk and Howlett (2013) was criticized by Mueller et al. (2013) for having questionable treatment integrity and methodology. Specifically, parents were provided with minimal training, mothers were not asked for input on what signs were most relevant for their families, gestures and signs were only used a few times a week, and implementation of sign was never discussed or practiced. In addition, mothers only reported using gestures/signs with their children a few times a week which may not have been enough to have any effect (Mueller et al., 2013). A question was also raised about how treatment groups were established in the study. As mentioned by Mueller et al. (2013), the authors did not highlight any reason for having a sign language group in addition to a symbolic gesture group. Because studies on baby sign to date have been found to have flawed methodology, definitive conclusions in support of

the use of baby sign on language development cannot be drawn. Therefore, decisions about whether to teach baby signs to hearing infants in order to accelerate their language development are currently based on opinion (Nelson et al., 2012).

#### **1.4 Baby Sign and Cognitive Development**

Baby sign websites claim that baby sign will facilitate brain development, enhance memory, increase speed of spatial reasoning, and lead to higher IQ scores in young children, but lack the necessary empirical support to back these assertions other than book chapters, book listings, newspaper articles, online articles, presentations, anecdotal experience, and personal expertise (Nelson et al., 2012). Some websites for instance, direct the online viewer to studies of school-aged children or even adults to support claims made about baby sign. The website, [www.babysign.co.uk](http://www.babysign.co.uk) asserts increases in brain activity and then refers the online viewer to a neuroimaging study of adult deaf signers of American Sign Language (Doherty-Sneddon, 2008).

Currently, only one relevant study to date suggests baby sign may enhance cognitive development. Goodwyn and Acredolo (2000) administered the WISC-III intelligence test to children eight years of age from their previous longitudinal study. Children who had received sign training scored twelve points higher than their same age peers on the intelligence test. Doherty-Sneddon (2013) suggested this evidence supports the notion that cognitive development is driven by the development of language and communication. Nelson et al. (2012), however, critiqued findings by Goodwyn and Acredolo (2000) because the researchers did not mention if the children had received any educational training between the time of the original and follow up study. Further, because scores from the verbal training group were not obtained nor were they reported, researchers could not determine if children from the sign group had a cognitive advantage from the start (Nelson et al., 2012; Johnston et al., 2005).

Although there is a scarcity, albeit almost lack of empirical support verifying that baby sign can enhance cognitive development, Johnston et al. (2005) suggests the social benefit of early signing may pose an advantage since the frequency of caregiver-infant interaction predicts cognitive growth. In addition, Garcia (1999) claimed that baby sign would lead to bilingualism in ASL and childhood bilingualism has known cognitive benefits. Further, several studies do show that gesture use can be an effective way of gauging a child's mental development (Goldin-Meadow, 2000; Vallotton & Ayoub, 2009; Doherty-Sneddon, 2003).

Gestural use provides insight into a child's unspoken thoughts and reveals their knowledge about the external world (Doherty-Sneddon, 2003; Iversen & Thelen, 1999; Goldin-Meadow 2000; McNeill, 1992). Piaget thought clues about a child's underlying knowledge and mental development could be acquired by attending to their non-verbal signals. He asserted that once an infant understands how vocal and gestural signs can be used to represent specific referents, words usually emerge (Doherty-Sneddon, 2003). In addition to demonstrating understanding, gestures may also contribute to cognitive change through two distinct advantages (Goldin-Meadow, 2000). First, gesture allows the listener to react to unspoken thoughts a child may have, providing the child with rich linguistic input necessary for future gains while treating the child as an intentional communicator (Goldin-Meadow, 2000). This is critical since the interpretations placed on an infant's actions are important for driving mental and communicative development (Doherty-Sneddon, 2003). Secondly, gesture may play a direct role in the learning process by enabling the young learner to explore complex ideas with less cognitive effort (Goldin-Meadow, 2000). When speakers encounter difficulty in lexical retrieval, the production of gestures helps activate a 'visuo-spatial representation of the concept' which triggers a lexical representation in memory and leads to successful speech production (Iverson & Thelen, 2013).

For young children who are just acquiring language, the use of baby sign may serve to help establish an early visuo-spatial representation of a concept in their semantic schemas. Further, gesture may contribute to the thinking process itself (Goldin-Meadow, 2000). Given the relationship between gesture and cognition, baby sign might serve as a mechanism of cognitive growth in the development of young children (Goldin-Meadow, 2000).

### **1.5 Baby Sign and Motor Development**

Before examining the evidence that exists regarding the effects of baby sign on motor development, it is important to consider at what stage of development baby sign may have the most potential to positively impact motor development in young children. Mueller et al. (2013) suggests it may be advantageous to integrate baby sign between the ages of 8 and 12 months since babies can perform more sophisticated tasks such as moving from sitting to standing, locating objects of interest by moving their head, and indicating wants and needs by gesturing and pointing. Introducing baby sign during this developmental period may be advantageous since gross motor development could promote the development of fine motor skills (Mueller, 2013). This notion is supported by the case study from Holmes and Holmes (1980) where researchers attributed the child's early production of the sign for "Daddy" at 6.2 months to the child having better gross than fine motor control. This allowed him to use gross motor control rather than a fine motor act to express himself. This is consistent with conclusions made by researchers in the study by Johnston et al. (2005) suggesting that the manual mode of communication is thought to be easier than oral communication for young infants due to the acquisition of their early gross motor skills relative to their fine motor control of articulatory actions.

Only two studies to date have examined the effects of baby sign on motor development in young children. The first was conducted in 1983 by Bonvillian, Orlansky, and Novack. The second was recently conducted by Mueller et al. 2013 and will be discussed toward the conclusion of the literature review. According to Bonvillian, Orlansky, and Novack (1983) there is a significant correlation between early speech and motor development. In general, the processes of early speech and motor development are seen as occurring in concert with one another. In addition, growth in spoken language occurs shortly after a child experiences a spurt in motor development and some of the literature suggests that the infants' achievement of motor milestones such as sitting, crawling, standing, and walking is closely tied to the acquisition of spoken language milestones (Bonvillian et al., 1983). Further, children who are delayed in motor development often have subsequent language delays (Bonvillian et al., 1983). Although speech and motor development are closely related, it is important to note that maturation of Broca's Area, the area responsible for controlling expressive communication, progresses at a slower rate than the motor region. Consequently, a young child develops motor control of the hands before motor control of the voice (Bonvillian et al., 1983).

Because the development of speech and motor skills are closely related, Bonvillian et al. (1983) felt it was important to record the progress of young children who signed in attaining different motor milestones in their study. Results from their study showed slightly accelerated motor development in 11 young children of deaf parents who were studied across a 16 month period. Johnston et al. (2005), however, found that methodological weaknesses negated significant differences between the motor development of children who signed and children who did not in their critical review of the study. Therefore, more studies are needed to evaluate the

effects baby sign may have on motoric development since the study by Bonvillian et al. (1983) was limited.

## **1.6 Baby Sign and Social-Emotional Development**

When considering how baby sign may positively influence the social-emotional development of children, it is important to discuss this idea in the context of Vygotsky's Social Development Theory. This theory consists of three major tenets. First, social interaction plays a vital role in development. Second, the child is guided by parents, peers, and siblings who serve as tutors for the child since they are more knowledgeable. Third, these tutors scaffold the child's learning through the zone of proximal development, always challenging the child to aim just beyond what can be accomplished independently (Doherty-Sneddon, 2003). Baby sign addresses each of the three tenets of Vygotsky's Social Development Theory. It increases opportunities for social interaction, allows the child to direct the caregiver's attention to what the child wants to talk about while also yielding linguistically rich feedback from the parent, caregiver, or "tutor," and it scaffolds the child's learning of language by allowing the caregiver to infer intent behind the child's actions. Further, Vygotsky proposed that symbols such as gestures are tools for interaction and mental tools for thought. He suggested that earlier symbol skills support later social skills (Valloton & Ayoub, 2009). In a study by Valloton and Ayoub (2009) researchers found that symbol skills (words and gestures) predicted children's development of social skills. Consistent with Vygotsky's claims, they concluded that providing infants and toddlers with symbolic tools earlier may help them to engage parents more, build knowledge of social-emotional concepts, and assist in their understanding of the social-emotional world (Valloton & Ayoub, 2009).

Researchers suggest that baby sign may provide children with socially appropriate ways to communicate wants and needs (Pizer et al., 2007). This could be especially important for children who have difficulty with communication and engage in frequent emotional outbursts as a result. Since claimed benefits of baby sign include improved parent-child relationships and a reduction in problematic behaviors such as tantrums, it can be concluded that baby sign would have the potential to positively impact the social-emotional development of children (Mueller et al., 2013). Instead of crying, whining, or banging on objects, the signs “drink, snack, more, and all done” can lead to clearer communication and a more acceptable way to communicate wants and needs (Pizer et al., 2007). In addition, sign teaches politeness formulas since a child can be taught the signs for please and thank you which can be used in public (Pizer et al., 2007).

A recent study by Mueller et al. (2013) found baby sign may help improve the parent-child bond, ease frustration of parents, and enhance relationships between child and caregiver. This countered a previous study conducted by Howlett et al. (2011) where researchers found that the use of symbolic gestures placed unwanted stress on new mothers. Limitations such as a lack of control group and small sample size, however, make it difficult to generalize the results of the Mueller et al. (2013) study. More studies are needed to evaluate if baby sign would in fact have a positive impact on the social-emotional development of children. The present study aims to determine if baby sign leads to enhanced social-emotional development in young children and facilitates their ability to establish strong relationships through meaningful interactions.

### **1.7 Baby Sign and Developmental Outcomes**

A recent study by Mueller et al. (2013) suggests that baby sign training has a positive impact overall on the communicative, cognitive, motor, and social-emotional development of children. In the study, children between the ages of six months to two years and five months

participated in a baby sign workshop with their parents. A pre-post test design was used to evaluate the effects of baby sign training on child development. The data suggested that the baby sign training had a positive impact on the overall development of the children. Similar to other empirical studies on baby sign mentioned, however, the research was not without its limitations. The study had a small sample size and lacked a control group which made it difficult to determine if positive changes were due to baby sign alone and not to maturation. Further, the wide age range of the participants made it difficult to establish a clear pattern of the relationship between baby sign training and developmental progression (Mueller et al., 2013). Mueller et al. (2013) concludes that more research is necessary to fully understand the effects of baby sign on child development.

## **1.8 The Current Study**

The purpose of the present study was to determine if baby sign affects the cognitive, social-emotional, physical, adaptive behavior, and communicative development of young children. Further, researchers aimed to improve upon the limitations of the Mueller et al. (2013) study by establishing a control group, increasing sample size, and establishing more evenly matched participants of similar age. A daycare setting was specifically selected since 11 million children under the age of five attend daycare (US Census Bureau, 2011). Because such a large number attend daycare, the potential impact baby sign could have in this setting is promising. Although the present study is the first to implement baby sign training with day care providers, Girolametto, Weitzman, & Greenberg (2003) found that child-caregiver interactions play an important role in developmental progress. Researchers found that training caregivers to be more responsive to children's communicative attempts resulted in the children talking more, interacting with peers more often, and producing more combinations of words (Girolametto et



al., 2003). Since baby sign training involves teaching caregivers to use naturalistic interaction strategies similar to those utilized by Girolametto et al. (2003), a day care setting seemed ideal for the present study. Researchers asked: Does a baby sign workshop for daycare providers result in higher scores on tests of children's cognitive, language, social-emotional, adaptive behavior, and physical development?

The researchers hypothesized that baby sign would have a positive impact across all domains of early child development.

## Chapter 2: Methods

### 2.1 Participants

A convenience sample consisting of 40 children (23 males and 17 females) between the ages of 5 months and 4 years participated in this study (Table 1). Children in the experimental and control groups were matched for age. An unpaired t-test was used to establish age equivalence and showed there were no significant differences between age ( $p = .17$ ). Participants were enrolled in part and full time childcare in 3 urban centers located in Central and North Eastern El Paso from communities where Spanish and English are spoken on a daily basis. Thirty seven participants were enrolled in daycare weekly and three participants from the experimental group had a “drop in” status with variable attendance. Family members learned about the opportunity for their children to participate in a baby sign workshop at an information booth at the daycare facility. Researchers distributed a flyer explaining the purpose of the workshop and provided interested families with an opportunity to sign up for the study. Out of the 63 families who indicated interest, 46 families scheduled developmental assessments for their children as part of the study on baby sign.

During the course of the study, five participants did not respond to researcher’s attempts to schedule a post test for reasons unspecified and were therefore withdrawn from the study. One participant’s assessment data was not included from the study since the dominant language spoken at home was neither Spanish nor English and researchers were unsure of the amount of assistance provided to the child by the parent during pretesting assessment. The final convenience sample numbered 40 children.

Twenty participants from the day care center in Central El Paso were designated as the experimental group and twenty participants from 2 day care centers in Central and North Eastern El Paso served as the control group. All children were typically developing as reported by their

parents and came from families who spoke either English or bilingual Spanish/English as their primary language. Two participants, one from the control group and one from the experimental group had been exposed to sign language during infancy. Because the children had not learned more than 5-10 signs, however, their assessment data were still included in the study. None of the participants had any known cognitive impairments or deafness.

**Table 1.** Demographic information

<i>Participant</i>	<i>Gender</i>	<i>Age at Pre-Test (months)</i>	<i>Participant</i>	<i>Gender</i>	<i>Age at Pre-Test (months)</i>
E1	F	4	C1	M	5
E2	M	7	C2	M	5
E3	M	11	C3	F	9
E4	F	11	C4	M	14
E5	M	12	C5	M	18
E6	M	13	C6	M	19
E7	F	14	C7	M	26
E8	F	21	C8	F	28
E9	M	21	C9	M	22
E10	F	23	C10	F	30
E11	M	26	C11	F	32
E12	M	27	C12	F	35
E13	M	29	C13	F	36
E14	F	31	C14	F	36
E15	M	33	C15	M	37
E16	F	33	C16	F	37
E17	M	35	C17	F	41
E18	M	42	C18	M	41
E19	F	42	C19	M	43
E20	M	46	C20	M	45

\*E=Experimental

\*C= Control

## **2.2 Experimental Design**

A between groups design was utilized in order to evaluate the effects of baby sign on the development of children. The Developmental Assessment of Young Children (DAYC) created by Voress and Maddox (1998) was administered to all children in the experimental group one week before and six weeks after daycare providers participated in a baby sign workshop. Researchers administered the DAYC to the control group six weeks following the first administration of assessments with no intervention.

## **2.3 Dependent Measures**

The dependent variable was the raw scores collected from each participant during the pre and post-test administration of the DAYC. Normed on 1,269 children from 27 different states, the DAYC is a valid standardized instrument which evaluates children from 0 to 48 months in the areas of communicative, cognitive, social-emotional, adaptive behavior, and physical development. The assessment possesses little error and was found to have a high degree of reliability for content homogeneity, performance over time, and scorer variability.

## **2.4 Independent Variable**

The independent variable was a free four hour instructional baby sign workshop taught to daycare providers in the experimental group once a week for two weeks. The workshop took place in one of the classrooms at the daycare site for the experimental group. During the workshop, daycare providers learned approximately 200 baby signs and were given examples of how to implement the signs with children in the day care setting. Signs taught during the workshop were identical to those used in the study by Mueller & Sepulveda (2013) and included the first 35 signs to emerge in deaf children who use ASL as their first language (Anderson &

Reilly, 2002). Signs were presented in themes including family members, meal time, toys, animals, emotions, and miscellaneous (signs requested by the daycare providers).

During the first meeting, daycare providers were given introductory information regarding baby sign and encouraged to use the signs that they felt would be easiest to implement during daily routines with the children. Researchers emphasized that daycare providers were free to pick and choose the signs that worked best for them so that implementation could be as stress-free as possible. Individual signs were presented in power point slides modeled by researchers and daycare providers were encouraged to follow along in their binders. Following instruction of the signs, daycare providers were prompted to practice the signs with researchers before practicing the signs with one another. During practice sessions, researchers monitored progress, provided feedback on sign production, answered questions, and offered additional assistance to help day care providers practice the signs correctly. Sign mastery was then assessed by the presenters where the daycare providers were asked to demonstrate the sign for a given word or to produce the word for a given sign. Two days following the baby sign workshop, researchers helped daycare providers to implement the signs in their classrooms with the children.

## **2.5 Materials**

Materials included a power point presentation for each week displaying the word and picture of the sign, binders with worksheets describing how to produce the sign and ways to implement the sign in the daycare setting, a DVD featuring graduate students from the UTEP Speech Language Pathology Program modeling the production of all the signs presented in the workshop, and a video clip of the principal investigator using signs with her 1.5 year old son.

Daycare providers were given posters with illustrations of the signs to post in their rooms and refer to as needed.

## **2.6 Procedure**

Since the current study was an extension of the research completed by Mueller et al. (2013), the procedure for the present study was similar in format. After providing informed consent, the DAYC was administered in the day cares and/or homes of the participants one week before the baby sign workshop and six weeks after the workshop. Data for the pre and post assessment were collected based on observation of the child's ability to demonstrate the skills on the assessment through play and/or parent report. Data collection was video recorded should the need arise for an additional rater to view testing administration. Examiners consisted of graduate and undergraduate students from UTEP's Speech Language Pathology Program who were trained to use the DAYC. All examiners were aware of the purpose of the study.

Two days following the workshop, researchers visited the daycare once a week for two hours to help the daycare providers implement the signs with the children in their classrooms. Researchers played with the children while talking and using signs in context during story book reading, games, meal time, and free play activities. For example, during play time a researcher might ask a child, "Oh are you playing with a ball? How fun! That's a ball." Every time the word "ball" was mentioned, the researcher would produce the sign. During implementation, the daycare providers were free to observe, ask additional questions, and/or practice signing with the children and the researchers. Six weeks following the baby sign workshop, post testing was administered at the daycare or at the infants' homes. Data was collected, analysed, and compared to the control group. Following completion of the study, all participating families and

day care teachers were offered a free baby sign workshop identical to the one given to daycare providers in the experimental group.

## **2.7 Statistical Analysis**

A parametric unpaired t-test was first used to analyze for differences between the post-test scores between the experimental and control group. Additional statistics were also calculated using a paired t-test to look at differences within the groups from pre to post test since participants were measured at two time points.

## **2.8 Inter-rater Reliability**

Inter-rater reliability was calculated for 25% of the assessments. The second rater was a graduate student in UTEP's Speech-Language Pathology Program who was trained to administer the DAYC. The inter-rater reliability was 98%. Variable answers from families accounted for minor differences in how examiners scored the assessments.

### Chapter 3: Results

Descriptive statistics for the pre-test raw scores on the five DAYC subtests are presented in Table 2. The averages for the pre-test scores measured across the five subtests for the experimental group are as follows: cognitive development ( $M = 30.6$ ,  $SD = 13.11$ ), physical development ( $M = 51.7$ ,  $SD = 15.54$ ), social-emotional development ( $M = 32.95$ ,  $SD = 14.49$ ), communication development ( $M = 36.4$ ,  $SD = 18.23$ ), and adaptive behavior development ( $M = 27.2$ ,  $SD = 11.61$ ). The averages for the pre-test raw scores across the five subtests for the control group are as follows: cognitive development ( $M = 36.25$ ,  $SD = 15.48$ ), physical development ( $M = 55.45$ ,  $SD = 13.67$ ), social-emotional development ( $M = 37.8$ ,  $SD = 15.38$ ), communication ( $M = 43.4$ ,  $SD = 19.08$ ), adaptive behavior development ( $M = 34.6$ ,  $SD = 16.58$ ). Table 2 does not depict any significant differences at pre-test other than adaptive behavior. The control group was higher than the experimental group at pre-test.

Descriptive statistics for the post-test raw scores on the five DAYC subtests are presented in Table 3. The averages for the post-test raw scores across the five subtests for the experimental group are as follows: cognitive development ( $M = 34.85$ ,  $SD = 14.03$ ), physical development ( $M = 54.9$ ,  $SD = 13.07$ ), social-emotional development ( $M = 37$ ,  $SD = 12.66$ ), communication development ( $M = 42$ ,  $SD = 17.02$ ), and adaptive behavior development ( $M = 33.05$ ,  $SD = 11.28$ ). The averages for the post test-raw scores across the five subtests for the control group are as follows: cognitive development ( $M = 37.8$ ,  $SD = 14.48$ ), physical development ( $M = 58.45$ ,  $SD = 13.92$ ), social-emotional development ( $M = 39.15$ ,  $SD = 14.17$ ), communication development ( $M = 46.45$ ,  $SD = 20.21$ ), and adaptive behavior development ( $M = 36.7$ ,  $SD = 15.93$ ).



**Table 2.** Mean (S.D.) pre-test scores for DAYC subtest by group

DAYC subtest	Experimental Group	Control Group
	Mean scores (S.D.) <i>n</i> = 20	Mean scores (S.D.) <i>n</i> = 20
Cognitive	30.6 (13.11)	36.25 (15.48)
Physical	51.7 (15.54)	55.45 (13.67)
Social-Emotional	32.95 (14.49)	37.8 (15.38)
Communication	36.4 (18.23)	43.4 (19.08)
Adaptive Behavior	27.2 (11.61)	34.6 (16.58)

**Table 3.** Mean (S.D.) post-test scores for DAYC subtest by group

DAYC subtest	Experimental Group	Control Group
	Mean scores (S.D.) <i>n</i> = 20	Mean scores (S.D.) <i>n</i> = 20
Cognitive	34.85 (14.03)	37.8 (14.48)
Physical	54.9 (13.07)	58.45 (13.92)
Social-Emotional	37 (12.66)	39.15 (14.17)
Communication	42 (17.02)	46.45 (20.21)
Adaptive Behavior	33.05 (11.28)	36.7 (15.93)

Statistical results for the unpaired t-test, depicted in Table 4, show that there were no significant differences found between the pre-test mean raw scores comparing the experimental group with the control group. Results comparing the mean raw scores of the experimental vs. control group at pre-test are as follows: social-emotional development ( $p = .15$ ), cognitive development ( $p = .11$ ), communication development ( $p = .12$ ), and physical development ( $p = .21$ ). Differences between mean raw scores for adaptive behavior at pre-test, however, did approach significance ( $p = .05$ ). Results comparing the mean raw scores of the experimental vs. the control group at posttest are as follows: Adaptive behavior ( $p = .22$ ), social-emotional development ( $p = .2$ ), cognitive development ( $p = .25$ ), communication development ( $p = .2$ ), and physical development ( $p = .3$ ).

**Table 4.** Unpaired t-test

Subtest	Pre-Test p-value	Post-Test p-value
Cognitive	0.11	0.25
Physical	0.21	0.3
Social-Emotional	0.15	0.2
Communication	0.12	0.2
Adaptive Behavior	0.05	0.22

Significance ( $p < .05$ )

A paired t-test was used to look at differences within each group from pre to post test. Results showed that there were significant differences in the mean scores from pre to post test for the experimental group but not for the control group in the areas of social-emotional, cognitive, and adaptive behavior development. These results are depicted in Table 5.

**Table 5.** Single tailed paired t-test

Subtest	Experimental Group $p$ -value	Control Group $p$ -value
Cognitive	0.0007*	0.16
Social-Emotional	0.003*	0.15
Adaptive Behavior	0.0000004*	0.07

Significance\* ( $p < 0.05$ )

## **Chapter 4: Discussion**

The purpose of the study was to determine whether baby sign had significant effects on communication, cognitive, social-emotional, adaptive behavior, and physical development in typically developing hearing children in a daycare setting. Researchers hypothesized that baby sign would have positive effects across all domains of development. To restate the research questions, the researchers asked 1) Does baby sign result in an accelerated rate of receptive and expressive language development? (2) Does baby sign result in more advanced cognitive levels? (3) Does baby sign promote earlier development of gross motor skills and increase performance on fine motor tasks? (4) Does baby sign result in faster acquisition of skills for emotional expression, social politeness, and social competence? Based on the statistical outcomes of the unpaired t-test, the data suggests that overall, the experimental group did not significantly outperform the control group in the areas of communication, physical, cognitive, social-emotional, and adaptive behavior development.

The paired t-test did capture significant differences within the test performance of the experimental group in three of the five areas of development (cognitive, social-emotional, and adaptive behavior) and no significant differences were noted between the pre to post test scores in the control group. Reasons for this will be explained but first the research questions for the five areas of development will be addressed.

### **4.1 Baby Sign and Language Development**

The data from the present study do not support the evidence base suggesting that baby sign may accelerate and enhance language development. Differences between pre and post test scores were not significant for the experimental group. These results support research by Kirk et al. (2013) suggesting that symbolic gesture training does not advance expressive and receptive

language development. There are several factors to perhaps explain why the children did not demonstrate significant growth for communication development.

First, education level of the families for the experimental group may explain why a significant effect for baby sign was not found in the communication subtest. Kirk et al. (2013) reported high education of mothers to be a potential reason why significant differences in language development were not found in the language test scores of children who were trained to use symbolic gesture. Education level is used as a marker of socioeconomic status (SES) and directly affects infant language development (Kirk et al., 2013). Educated parents may be more likely to know how to read and talk to their children in order to facilitate language. As noted by Kirk et al. (2013), when the quality and quantity of linguistic input is high, gestural intervention may not be necessary for typically developing hearing infants. Because children in the experimental group attended a daycare located on a university campus, their parents are either students or faculty. It is possible that the benefits of baby sign did not have a significant effect in these children since they have grown up in linguistically rich environments.

In addition, the length of time that elapsed between the pre and posttest may have not been long enough to yield significant differences for communication. In the current evidence base on baby sign, the majority of studies examine children's language development over an extended period of time. Goodwyn, Acredolo, and Brown (2000) found significant differences in children's language performance over the course of 11 – 36 months, Holmes and Holmes (1980) observed changes over 17 months, and Bonvillian et al. (1983) studied changes for 16 months. However, Kirk et al. (2013) did not find any significant changes in the children's language outcomes during a 12 month study with the exception of three infant boys who demonstrated increased expressive communication abilities. Allowing more time to elapse

between pre and posttest in the present study may have yielded more significant results for communication.

A third possibility is that some of the test items of the DAYC for communication require the children to demonstrate knowledge of words and concepts that were not covered in the baby sign workshop. For example, naming playmates, whispering, understanding big and little, plurals, and identifying familiar characters were not discussed during the workshop. It would be of interest for researchers to analyze if there were improvements on DAYC items specific to language measures (e.g. speaks 50 words, has vocabulary similar to same age peers, points to 15 or more pictures of common objects when they are named, etc.). Finally, as seen in Table 1, 23 of the 40 participants were between the ages of 24 and 48 months and already speaking. Although children of any age can potentially benefit from baby sign, children use baby sign less as verbal communication increases.

#### **4.2 Baby sign and Cognitive Development**

Although significant differences were not found between the average pre and post test scores for cognitive development, significant differences were found when comparing the mean scores made by the experimental group from pre to post test ( $p = .0007$ ) with the control group ( $p = .15$ ). Since the present study utilized a control group, it strengthens the findings by Mueller et al. (2013) who found that baby sign had a positive impact on the cognitive development of children. This study also sets an important precedent in the existing evidence base. It is the first of its kind to suggest that the use of baby sign in a daycare setting may serve an important role in facilitating children's cognitive development.

There are several possible reasons for the advantage of baby sign on cognitive development in the present study. First, baby sign may result in an increased number of

caregiver-infant interactions which is a predictor of cognitive growth (Johnston et al., 2005). Second, baby sign allows a child to explore complex ideas about the world with less cognitive effort (Goldin-Meadow, 2000). This can be illustrated by the following example. When a child signs “cookie,” he or she does not have to exert all cognitive resources (attention, planning, decision making, memory, discrimination, etc.) on obtaining the desired cookie. Instead, the child can focus on the attributes that make the cookie important and meaningful (taste, texture, color, size, shape, speech or facial characteristics of the person who is giving the cookie etc). Instead of exhausting all available cognitive resources on figuring out how to get their wants and needs met, children who use baby sign are free to explore the world around them and increase their growing knowledge base. Further, the child who uses baby sign can prompt the caregiver to provide information about the child’s topic of interest, facilitating increased information about the world (Goldin-Meadow, 2000).

### **4.3 Baby Sign and Physical Development**

Results from the present study do not support the hypothesis that baby sign enhances physical development. There were no significant differences found between the pre and post test scores of the experimental and control groups nor were there significant differences found between gains made from pre to post test scores for both groups. These findings counter those found by Bonvillian, Orlansky, and Novack (1983), suggesting that baby sign resulted in accelerated motor milestones. Although results found by Mueller et al. (2013) suggested that baby sign had a positive impact on children’s physical development, the addition of a control group in the present study suggests that perhaps maturation may have accounted for the improvement noted by researchers.

#### **4.4 Baby Sign and Social-Emotional Development**

Similar to cognitive development, significant differences were not found between the pre and post test scores of the experimental and control groups but significant differences were found in the gains made from pre to post test for the experimental group ( $p = .003$ ) in the area of social-emotional development. Results of the present study support research by Mueller et al. (2013) suggesting that baby sign has a positive impact on children's social-emotional development. The use of baby sign increases opportunities for joint attention during social interaction, allows the caregiver to infer intent behind a child's actions, increases responsiveness to a child's actions, and provides children with social scripts for alleviating frustrating situations (Acredolo and Goodwyn, 2000; Goldin-Meadow, 2000; Kirk et al. 2013; Pizer et al., 2007). These explanations for why baby sign improves children's social-emotional development are supported by anecdotal reports by day care providers in the current study. Following the baby sign workshop, six out of seven daycare providers reported more eye contact was observed with the children. One individual commented that the children seemed to have more eye contact due to the hand movements that always caught their attention. These findings are consistent with Mueller and Sepulveda (2013) who reported that more eye contact was the most common change observed by parents who taught their children to use baby sign. Eye contact is important since it is a precursor of joint attention which is necessary for facilitating language development and developing healthy social interactions.

#### **4.5 Baby Sign and Adaptive Behavior**

Similar to cognitive and social-emotional development, there were no significant differences found between the experimental and control groups at post-test for adaptive behavior but there were significant differences found between the gains made from pre to post-test for the

experimental group ( $p = .0000004$ ). Interestingly, significant differences were found as well between the pre-test scores, indicating the control group scored higher than the experimental group prior to intervention. Since the experimental group still emerged with higher, significant gains from pre to post test, however, the difference between the two groups at pre-test strengthens the findings, suggesting that baby sign significantly affects children's adaptive behavior development. This is also corroborated with anecdotal reports from daycare providers. When asked if daycare providers had seen any change in the children's language or communication, one individual reported that children in her classroom were fighting less and using signs to communicate instead. Children were no longer crying because they could not make their needs and wants understood. Instead, they were calmly using signs to let their daycare provider know what was needed. These reports, in addition to significant findings of the present study, suggest that the use of baby sign can lead to clearer communication and a more acceptable way to communicate wants and needs (Pizer et al., 2007). It is possible that this results in the child's increased ability to adapt to the changing world around him or her. Results are also consistent with research by Mueller et al. (2013) who found that baby sign resulted in improved scores of the children's adaptive behavior.

Although children in the experimental group did not outperform the control group in ways that the researchers had hypothesized, the children who used baby sign with the daycare providers still made higher gains from pre to post test in the areas of cognitive, social-emotional, and adaptive behavior development. These findings raise new topics of discussion and provide interesting directions for future research. If baby sign does play a role in how a child thinks, interacts, and adapts, as suggested by results of the present study, then perhaps children who use baby sign see the world differently. These differences may shape how they interact with others



and adapt to the changing world around them. If this is the case, then these differences may be too subtle to be detected by assessments like the DAYC which are designed to identify global developmental differences. This may explain why there were no significant differences found between groups at post-test but there were significant differences found from pre to post test for the experimental group for cognitive, social-emotional, and adaptive behavior development.

Future researchers may want to consider how to assess subtle differences that may exist between children who do and do not use baby sign in order to determine whether those differences affect development. In the study by Kirk et al. (2013) researchers assessed video-taped interactions between children and their mothers and found that gesture training resulted in subtle changes in how the mothers and children interacted. The mothers were more responsive to their children, attentive to nonverbal communication acts, and inferred meaning behind their child's actions, encouraging autonomy (Kirk et al. 2013). Researchers proposed the symbolic gestures used by the children provided mothers with valuable insight into their children's mental abilities which facilitated the social interaction. Comparing videotaped interactions between children and mothers who do and do not use baby sign may be one way to assess whether baby sign results in subtle differences that affect development.

The current study's findings are consistent with previous results found by Mueller et al. (2013) suggesting baby sign has a positive impact on child development. This study expands upon the previous research of Mueller et al. (2013) by providing a control group, increasing sample size, and focusing on establishing more evenly matched groups based on age. The presence of a control group in the current study bolsters the credibility of baby sign being the variable responsible for the positive changes in cognitive, social-emotional, and adaptive behavior development. In addition, increasing the sample size from 11 to 40 typically

developing hearing children allows results to be more applicable to the larger population. Further, involving a sample size with less variability in terms of age increases the likelihood that the significant results found in the performance of the experimental group were due to baby sign and not to individual differences among participants. Also, because available literature on how baby sign affects cognitive, adaptive behavior, and social-emotional development is scarce, this study sets an important precedent for establishing how baby sign can benefit these unexplored areas of child development. Finally, since researchers did find that baby sign had a significant effect on the cognitive, social-emotional, and adaptive behavior development of the children, this study strongly supports the use of baby sign in a day care setting. Since an increasing number of children are spending more time in daycare, the potential benefits of using baby sign in this setting are highly promising.

#### **4.6 Limitations**

Although findings were significant within the experimental group, the study did possess some limitations. First, the sample of participants measured was based on a sample of convenience rather than on randomness. Since participants were combined from 3 day cares, they were not randomly selected nor were they randomly assigned. In addition, researchers did not have control over how often the daycare providers used the signs with the children. Following the conclusion of implementation, researchers did not ask daycare providers about how often they were using the signs with the children nor were daycare providers held accountable to using the signs. Since daycare providers already have a highly demanding job, researchers did not want to place undue stress on the staff members. Establishing a non-invasive way to monitor how often signs were implemented and to hold daycare providers accountable to using the signs would have strengthened the current findings.

Further, although significant results were established in the pre to post test scores of the experimental group for social-emotional, cognitive, and adaptive behavior development, the control group did not receive any additional intervention. Therefore, it is difficult to know if baby sign is the most effective method for enhancing these areas of development when compared to other interventions. More research is necessary to understand how baby sign compares to other typical interventions intended to enhance developmental growth. Adding another group to the study that would receive an intervention other than baby sign would have bolstered the findings of the research.

Age of the participants was another limitation. Since 23 of the 40 participants were between the ages of 24 and 48 months and already speaking, baby sign did not seem to have an effect on communication development. Perhaps if researchers had included a sample size of children between the ages of 5 and 36 months, more of a treatment effect may have been observed. Goodwyn et al. (2000) found significant effects for language development in a group of 103 infants between the ages of 11 and 36 months of age.

Finally, when the DAYC was administered, if a child did not demonstrate the skill described, researchers relied on parent report for the data. This could be potentially problematic as parent bias may have impacted scoring results. A final limitation of the study was the variability of examiners. Four different students from UTEP's undergraduate and graduate speech language pathology program conducted assessments. Although strong inter-rater reliability was established, it would have been ideal to have a consistent examiner throughout the assessment process. Due to demanding school schedules as well as limited availability of families, it was difficult for one examiner to be available to test all participants.

#### **4.7 Future Research**

More research is needed to further understand how baby sign affects children's development. Future research on baby sign should focus its efforts on finding ways to identify subtle differences in children who sign rather than global ones. For this purpose, participants in the current study were videotaped during naturalistic play with their parents. Researchers are hopeful that the video footage might reveal subtle differences between the children who signed and did not sign. In addition, it would be important to see if baby sign may be particularly beneficial for children who are late talkers so future researchers might examine the effects of baby sign on participants who have lower language abilities. As noted by Mueller et al. (2013), the potential impact baby sign research could have on children diagnosed with a language delay or disorder could be highly significant. Further, the effects of baby sign on the developmental outcomes of children should be evaluated in a longitudinal study to fully understand the long term benefits of teaching children baby sign.

## **Chapter 5: Conclusion**

The purpose of this study was to determine if baby sign affects the early developmental outcomes of children in a daycare setting. The results of the study indicate that children who were taught baby sign by their day care providers made more significant gains from pre to post test on measures for cognitive, adaptive behavior, and social-emotional development as compared to their non-signing peers. Results of the study strongly support the use of baby sign with children who attend daycare. Researchers conclude that baby sign does benefit a child's cognitive, adaptive behavior, and social-emotional development.

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## **Vita**

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