

THE PRELINGUISTIC DEVELOPMENT OF MULTIPLE BIRTH, LOW BIRTH WEIGHT,
AND PREMATURE INFANTS: CLINICAL APPLICATION OF FOUNDATIONAL
RESEARCH

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

UNIVERSITY OF FLORIDA

2010

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To the Quad Lew's, their big brothers, and their devoted parents

ACKNOWLEDGMENTS

First and foremost, I thank my brother, sister-in-law and their incredible family for their involvement, support and encouragement throughout the duration of this study. The vision for this research comes from their children and their inspirational view on life. I also thank my sister and brother-in-law for all their efforts in maintaining the safety of the external hard drive and my sanity. I thank my thesis advisors for their endless knowledge and advice. The completion of this study would not have been possible without their direction and guidance. I would like to thank my classmates within the Department of Communication Sciences and Disorders for their encouraging words and technical support. I wouldn't have survived the last two years without them. Lastly, I would like to thank my Georgia Bulldog for his positive attitude and for playing Beatle's music on his guitar while I worked through the craziness.

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Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Arts

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By

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August 2010

Chair: Kenneth Logan

Major: Communication Sciences and Disorders

Over the past two decades, the rate of multiple birth, premature, and low birth weight deliveries has increased (Martin, 2009). To date, however, there is relatively little information that parents, caregivers, and healthcare professionals can access related to the development of prelinguistic skills within these populations. Parents, caregivers and healthcare professionals would benefit from foundational research aimed at investigating the prelinguistic development of multiple birth infants. Such research could lead to the creation of accessible resources that are designed to educate parents and professionals on key prelinguistic growth and development of this population.

The goal of this thesis is to expand research on the prelinguistic development of multiple birth infants. Data are presented to report on a longitudinal case series of a set of quadruplets. The infants were administered two formal tests between the ages of 6 and 14 months and their interactions with each other and with adult caregivers were videotaped during this same period. Based on the formal testing, the infants show delays in regards to prelinguistic development, which supports previous research done

on low birth weight and premature infants; however, by the age of 14 months the infants were all typically developing. The results provide a basis for understanding the dynamic nature of the prelinguistic development of infants with multiple birth status. Results from the longitudinal study of the quadruplets will also yield preliminary insights into the challenges associated with collecting data with this population, as well as additional details about the communicative development of children from multiple-birth, premature, and low-birth-weight pregnancies.

CHAPTER 1 INTRODUCTION

Multiple Birth, Prematurity, and Low Birth Weight

Rates

In 2009, the U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC) published its finalized data regarding 2006 birth data. The data in this report represent U.S. births across settings and various birth classifications, including multiple birth, low birth weight (LBW) and prematurity rates (Martin et al., 2009). The 2006 data show that there was an increase in LBW rates as well as premature birth rates relative to previous years for those categories. Multiple birth rates, however, remained stable as compared to previous rates (Martin et al., 2009). Specific details about the prevalence of these rates are presented in the following sections and are based on 2006 birth data provided by the CDC.

Low birth weight rates

The World Health Organization defines LBW infants as infants who are born weighing less than 2,500 grams or 5 pounds 8 ounces (World Health Organization ICD-10, 2007). The average birth weight for singletons born in the United States in 2006 was 3,298 grams (Martin et al., 2009). From 2000 to 2006, the rate of LBW infants had progressively increased by 9%. Of 4,265,555 births in the United States in 2006, 8.3% were LBW births, which is up from 2005 (8.2%) and which represented an increase of 24% since the mid-1980s (Martin et al., 2009). The 2006 rate (8.3%) is the largest recorded for the LBW category in the United States for the past four decades (Martin et al., 2009).

Premature birth rates

In 2006, premature birth rates accounted for 12.8% of the 4,265,555 births in the United States (Martin et al., 2009). A birth is classified as premature if the gestation period is less than 37 weeks (World Health Organization ICD-10, 2007). In the United States, prematurity rates have increased by 20% since 1990, when the rate was only 9.7% (Martin et al., 2009). More specifically, the number of late preterm births (or births with a gestation period of 34 to 36 weeks) has increased by over 25% during this time frame. This could be due in part to the increase in multiple birth rates (listed in the next section) over the past few decades as well as an increase in medical intervention, such as cesarean deliveries performed, earlier in the pregnancy. Maternal health and demographics also impact gestation period.

Multiple birth rates

In 2006, the data for twin birth rates remained stable relative to the 2005 rates (32.1 twins per 1,000 births) and the rates for triplet births decreased by 5% (153.3 per 100,000 births) relative to 2005 rates (Martin et al., 2009). It is important to note, however, that between 1980 and 2004 the rate of multiple birth pregnancies jumped 70% (Martin et al., 2009). The multiple birth rate in 1980 was 18.9 per 1,000 births (Martin et al., 2009). Of the more than 4.2 million births in 2006, 137,085 were twins, 6,118 were triplets, and 355 were quadruplets; these numbers represent 3.37% of all the births in the United States during 2006. There were 4,121,930 singleton births in the United States in 2006 (Martin et al., 2009). Multiple birth deliveries by women aged 30-39 represented more than half the total multiple birth deliveries, (i.e. 3,983 of 6,540 births). The rate of women over age 30 delivering multiple births has risen continually since 1980 (Martin et al., 2009). The rise in multiple birth deliveries in older women may

be attributed to the use of assistive reproductive technology (American Society for Reproductive Medicine, 2006; Templeton & Morris, 1998).

It is unsurprising that rates for LBW births, premature births, and multiple births have risen together. Keith et al. (1998) found that low birth weight and preterm delivery were two of the most common risk factors for twins and triplets born in 2005. The CDC released data in 1999 regarding trends in twin and triplet births from 1980-1997. The trends reveal that although the rate of singleton low birth weight increased by 2%, the rate of twin and triplet sets increased by 10% (Martin et al., 1999). Statistics regarding trends in triplet births from 1971 to 1994 was also investigated by the CDC. The data indicated that in the early 1990's triplets had an average birth weight of 1,698 grams (3 pounds, 12 ounces) which is half of the average birth weight for singleton births (3,358 grams or 7 pounds, 6 ounces) (Martin et al., 1997). The report also indicated that the gestational period for triplets averaged 32 weeks, which is 7 weeks shorter than the average gestational period for singleton gestational periods (Martin et al., 1997). Of the 143,558 multiple births in 2006, more than half involved pre-term and LBW infants (Martin et al., 2009).

Impact of Premature Birth, Multiple Birth, and Low Birth Weight Rates

As a result of the increasing rates of premature, LBW and multiple birth infants, parents, caregivers, pediatricians, and pediatric healthcare professionals who work with these populations are likely to encounter developmental delays and/or learning deficits (National Institute of Child Health and Human Development, 2002). Researchers have found that LBW and prematurity are risk factors for speech and language delays (Delgado & Vigi, 2004; Zubrick et al., 2007). For example, Delgado and Vigi (2004) conducted a study with preschool-aged children to identify early risk factors for

language impairment. They found that both LBW and prematurity were risk factors in the development of specific language impairment among preschoolers. Results from the study also indicated that LBW and prematurity are risk factors for speech impairment with a co-occurring language impairment (Delgado & Vigi, 2004). In a more recent study, Zubrick et al. (2007) found that an infant's gestational age was a predictor of late language emergence. In their study, a questionnaire was sent to the parents of 1,766 two-year-old children. Of the 1,766 toddlers, 1,528 had normal language development and 238 had late language emergence. Within the group of 238 late talking toddlers, 10.7% had a medical history significant for premature birth (Zubrick et al., 2007).

Bishop and Bishop (1998) did an extensive study of the occurrence of language impairment among twins. They conducted a retrospective study in which they asked parents of school-age twins about various facets of their twins' early language development. Based on parent report, the researchers found a higher presence of language impairment in twins, particularly among twin sets in which the children demonstrated idiosyncratic phonological development. This idiosyncratic development resulted in the impression of the twins having created their own language (Bishop & Bishop, 1998.) This idiosyncratic language involved use of what the investigators termed *jargon*. Parents of these children described the twins' spoken language as unintelligible and accompanied by strings of babbling, gibberish and other noises. In the Bishop and Bishop study, twins who used jargon had a higher occurrence of language impairment at school age.

These studies underscore the potential impact of risk factors such as LBW, gestational age, and multiple birth status on speech and language development. With the importance of early intervention to eliminate or reduce speech and language delays or deficits, it is important for researchers to understand the impact these factors have on development. Studies such as these provide information that may help to ensure that parents and professionals working with pediatrics are properly educated on what to expect.

Prelinguistic Development of Typical Infants

Before discussing delayed or deviant prelinguistic development it is necessary to understand typical development. The time frame from birth to a child's first word is considered the prelinguistic phase of communication development. Most children begin to produce true words about 12 months after their birth. During the prelinguistic stage, however, infants have yet to develop a "true" language (Watt et al., 2006). During this phase, it is expected that infants will follow a predictable developmental pattern and that they will attain several "goals" on their way to their first words. These "goals" are referred to as milestones. Although individual infants will develop at slightly different rates, the milestones typically are attained in a predictable, sequential manner.

Speech Development

Following birth, infants immediately begin making sounds and reacting to their environment. As an infant develops, his or her vocal and gestural behaviors become progressively more intentional and communicative in nature. Researchers have studied patterns of infant speech development extensively during the first year of life and have found strong evidence that infants follow a sequential order of vocal development (Stoel-Gammon & Otomo, 1986; Stark, 1980). With regard to vocalizations, the major

periods that infants progress through during the first 12 months of life are as follows: vegetative/reflexive responses, cooing, marginal babbling, canonical babbling and finally, first words (Oller, 1980; Stark, 1980). Refer to Table 1-1 for a summary of these periods.

Vegetative/reflexive responses

During the first month of life infants will typically produce tongue clicks, burps, coughs and cries. These sounds are referred to as *vegetative/reflexive responses*. Stark (1980) reported on the characteristics infants demonstrate during this period. The *vegetative/reflexive* sounds are considered to be simple physiological responses that an infant produces in response to external or internal stimuli. They are often produced in conjunction with physiological states such as hunger, pain or pleasure (Stark, 1980). The sounds are vowel-like approximations. Such sounds are not considered to be produced intentionally. Thus, at this very early point of development, an infant is not yet able to assign any meaning to specific sounds or noises, nor can he or she control motor movements sufficiently in order to produce meaningful speech. The *vegetative/reflexive* stage will typically last until approximately 4 weeks of age.

Cooing

Stark (1980) also reported on the characteristics infants demonstrate while in the *cooing* period. From around one month of age to four months of age, infants will produce vowel-like utterances in addition to the *vegetative/reflexive* responses already noted. These utterances are known as *cooing* and often are produced during social interaction with a caregiver or some communicative partner (Stark, 1980). *Cooing* includes more vowel-like approximations that are sometimes combined with consonant-

like approximations, including velar sounds (Oller, 1980). As with *vegetative/reflexive* responses, *cooing* is not considered to be communicative in nature.

Marginal babbling

Following *cooing*, parents can expect to hear their infants produce vocalizations that may include consonant like sounds either before or after a vowel. This behavior, beginning around four months, is known as *marginal babbling*. Oller (1980) found that the most common forms for *marginal babbling* are those that contain consonant-vowel (CV, e.g. “bah”), and vowel-consonant (VC, e.g. “ub”) syllables; however, these syllables still are not consistent and do not include smooth vowel to consonant or consonant to vowel transitions. The only similarity between mature adult speech and *marginal babbling* is that infants’ productions consist of both vowels and consonants. Infants’ syllables have yet to include the prosody found in mature adult speech. Consonants typically heard during *marginal babbling* include [p, b, d, k, g].

Canonical babbling

As the infant nears 6 or 7 months of age, he or she will begin to produce patterned babbling (Oller, 1980). Stark refers to this period as *canonical babbling*. This stage consists of consonant-vowel vocalizations that are more sophisticated and precise than those found in *marginal babbling* (Oller, 1980). Parents can expect to hear their infant produce sequences of the same syllable (*reduplicated babbling*), such as “dee dee dee” or “bah bah bah.” Infants’ consonant and vowel productions now resemble more mature adult speech with regards to the timing characteristics of syllable production (Oller, 1980). Even though these vocalizations resemble mature adult speech, they do not yet carry any communicative intent.

Variegated babbling

After *canonical babbling*, the infant will enter the *variegated babbling* (or *nonreduplicated babbling*) stage. This usually occurs between 10 or 11 months (Stoel-Gamon & Otomo, 1986). Oller (1980) found that during this stage, infants produce longer consonant-vowel vocalizations with more varied sounds in the syllables. For example, a parent may hear their infant babble “gaba”. In this stage, the infants’ intonation patterns sound much more mature, as well (Oller, 1980).

Transition to first words

Infants typically make the transition from the prelinguistic phase to the linguistic phase at around 12 months of age (Stark, 1980). This transition is characterized by the infant’s first true words. This attainment is highly significant as it demonstrates that the infant has the capability of linking standardized spoken patterns with meaning in order to communicate intentionally.

To be considered a “true” word the infant must use the word consistently in a specific context and the word must also resemble the adult form of the word (Oller, 1980). Most first words include the following consonants within consonant-vowel, vowel consonant, and/or consonant-vowel-consonant-vowel syllables: [p, b, t, d, m, n]. In most cases, nouns make up the majority of an infant’s growing lexicon during the second year of life (McLaughlin, 2006).

Communication Development.

As was mentioned earlier this chapter, when an infant enters the one word stage around their first birthday, their speech begins to carry communicative intent and meaning. Just as with speech development, infants will follow a sequenced order of communication development. Austin (1962) identified 3 stages of communication

development: (a) the *perlocutionary stage*; (b) the *illocutionary stage*; and (c) the *locutionary stage*.

From birth through around 8 months of age, infants enter the *perlocutionary stage*. During this stage, infants have yet to assign meaning to their speech and they have yet to communicate intentionally. Thus, parents and caregivers step in to fill this void by providing interpretation of what they think their infants are trying to communicate. In other words, parents and caregivers infer their infant's communicative intents. For example, a 4-month-old infant who smiles at his or her caregiver does not intentionally produce this smile to represent any specific communicative intent; however, the infant's parent may interpret the smile as an active attempt by the infant to "tell" the parent that he or she is satisfied.

Around 11 months of age, infants usually begin to produce behaviors that represent emergent communicative intent. This stage is referred to as the *illocutionary stage* (Bates, 1976). During this period, children begin to realize that they can use their gestures and/or vocalizations to influence the behaviors of others. In other words, the infants develop intentional communication. Many times, infants will pair a vocalization with a gesture. For example, an infant may learn that when he or she cries, the parent or caregiver will give them attention. Although infants are producing vocalizations during this stage, these vocalizations are not yet consistent with adult forms of speech. During the late *illocutionary stage*, infants' begin to use vocalizations along with gestures to signal a range of communicative intentions. During this stage, infants will begin to demonstrate what Bates (1976) calls *proto-imperatives* and *proto-declaratives*. When infants make requests, demands or commands, they are demonstrating *proto-*

imperatives. In other words, the infants are somehow, such as with a gesture plus a vocalization, signaling to his or her parent that they need or want some particular object (Bates, 1976). A *proto-declarative* is a behavior that attempts to gain the attention of a parent or other communicative partner (Bates, 1976). The object of reference is not desired by the infant with a *proto-declarative*; instead, the parent's attention is desired.

At around 12 months of age, infants begin to intentionally link consistent phonetic forms with specific meanings to form their first words. The phonetic forms they use resemble those that adults use to express the same meanings. When children are able to produce true words, they are said to have entered the *locutionary stage* (Bates, 1976). For example, a 13-month-old child may look at a dog and say "doggy."

Classification of Prelinguistic Behaviors

Prelinguistic behaviors have been defined by researchers in many different ways. Three types of prelinguistic behaviors, *joint attention*, *eye gaze*, and *gestures*, have been frequently discussed in relation to communicative and linguistic development. Each of these behaviors is discussed in detail in this section.

Joint attention

According to Mundy and Newell (2007), infants demonstrate two types of joint attention. The first, *responding to joint attention*, refers to the manner in which infants respond to others' communicative behaviors (Mundy & Newell, 2007). An example of *responding to joint attention* is when an infant follows another's eye gaze or gesture. The second type of joint attention is *initiating joint attention*. With this type of joint attention the infant will spontaneously and independently initiate a communicative act via his or her own eye gaze or use of gestures (Mundy & Newell, 2007).

Joint attention is a social communication skill that is considered to be a building block for linguistic development (Mundy & Newell, 2007). *Joint attention* emerges within the *illocutionary stage*, as defined in the previous section. Infants use this skill not only to communicate and participate in a shared experience but also to demonstrate affection and learn about their environment (Miller, 2006). For instance, an infant may look at a juice cup that is sitting out of reach, and then look at the parent in order to alert a parent or caregiver that he or she wants it. The parent then looks at the object as well (shared experience), labels it for the infant (“cup”), and then gives the infant the cup (reinforcement for the infant’s communicative intention of getting the cup). This type of event involves the coordination of object orientation and person orientation. *Joint attention* is also an important prerequisite for linguistic development, as it provides a foundation for developing “Theory of Mind,” that is the ability to understand other’s emotions, intentions, and thoughts (Miller, 2006).

Eye gaze

Before infants have developed language skills, they rely on other developing skills to communicate with their caregivers (Shumway & Wetherby, 2009). One means of prelinguistic social communication involves *eye gaze*. Infants utilize *eye gaze* to engage in social interaction, initiate or engage in joint attention, and to regulate their own behavior (Wetherby & Prizant, 2002). Gaze behavior emerges during the *illocutionary stage* of communication development. Developmental specialists usually identify 2 types of gaze as significant in prelinguistic development. These are (a) *gaze point follow* and (b) *three point eye gaze*.

The *gaze point follow* (Wetherby & Prizant, 2002) involves the infant’s ability to follow the gaze of his or her communicative partner and engage in joint attention. This

communicative behavior is important because it lets the infant join in a shared experience with a communicative partner.

When an infant looks at an object, then looks at their communication partner, and then back at the object, it is called the *three point gaze* (Wetherby & Prizant, 2002). The *three point gaze* enables the infant to communicate a message to their communication partner. For example, the infant may look at the juice cup on the table, look at their parent, and then look back at the cup to indicate a need (i.e. a request) for the juice cup. The *three point eye gaze* can also be completed by looking at the communication partner first, then the object of reference, and then back at the communication partner.

Gesture development

When an infant uses his or her index finger to point at a juice cup, the gesture communicates an intention such as “I want my juice” or “I am thirsty.” *Gestures* are another means, aside from spoken language, through which infants can communicate intentionally (Crais et al., 2004; Thal & Tobias, 1994). As with speech and social communication development, infants will progress through a developmental sequence of gesture growth (Crais et al., 2004).

Iverson and Thal (1998) identified two stages of infant gesture development: *deictic* and *representational gestures*. *Deictic gestures*, which emerge around 7 to 9 months of age, are used by infants to refer to or call attention to some object (Iverson & Thal, 1998). Examples of *deictic gestures* are *pointing* and *showing*. *Deictic gestures* emerge during the *illocutionary stage* of communication development. *Representational gestures* have two functions. The first is to indicate reference and the second is to assign semantic or symbolic meaning (Iverson & Thal, 1998). Examples of

representational gestures include waving hello or bringing a hand to the mouth as if eating from a spoon. *Representational gestures* typically emerge following the development of a few *deictic gestures* (Crais et al., 2004).

Reaching, showing, giving, and pointing are considered *deictic gestures* and have been studied extensively (Crais et al., 2004). *Reaching* is the first *deictic gesture* to emerge in infants and it develops around the age of 8 or 9 months. An infant will demonstrate the reach gesture with either an open hand reach or by taking their parent's hand and placing it on the object of reference. Following the development of *reaching*, an infant will next demonstrate *showing* and then *giving*. These gestures will develop between 9 and 13 months of age, with *showing* emerging first followed by *giving*. The *pointing* gesture is a little more complex as the object's distance from the infant as well as the infant's intentions for pointing are involved in defining it (Crais et al., 2004) Therefore, pointing development includes two stages. The first is *proximal pointing*, which emerges around 9 or 10 months of age. With *proximal pointing*, the infant will point to an object of reference that is nearby. The second, called *distal pointing*, emerges around 13 or 14 months of age, and involves the infant pointing to some object further away from their body.

Importance of Pragmatic Development during the Prelinguistic Period

Researchers have found that the development of nonverbal communication skills, including joint attention, eye gaze, and use of gestures, during the prelinguistic period can be indicative of later language skills (Watt et al., 2006; Crais et al., 2009; Capone & McGregor, 2004; Shumway et al., 2009). In 2006, Watt et al. investigated the prelinguistic skills, including eye gaze, gestures and joint attention, of infants under 24 months of age. Watt et al. administered the *Communication Symbolic Behavior Scales*

Developmental Profile Behavior Sample, which targets eye gaze, joint attention and gestures, amongst other abilities, to typically developing children during their second and third years of life in order to determine any correlations between prelinguistic abilities and later language development. Results indicated that joint attention and gesture development in the second year of life were linked to later receptive language ability in the third year of life. The study also found that joint attention skills correlated to later expressive language ability.

Shumway & Wetherby (2009) investigated communicative acts in relation to children with autism spectrum disorder. The investigators administered the *Communication Symbolic Behavior Scales Developmental Profile Behavior Sample* to 18 to 24 month-old children with and without autism spectrum disorder. Communicative acts, according to the investigators, had to include the coordination of eye gaze, joint attention and gestures. The results indicated that children on the autism spectrum had a lower rate of communicative acts (1.23 per minute) as compared to the typically developing group (2.40 acts per minute). Shumway et al. also found that the group with autism spectrum disorder demonstrated significantly lower rates of joint attention, with just over 15% of their total acts including joint attention, as compared to the typically developing group with 38%

Rationale for a Longitudinal Case Study of a Set of Quadruplets

Since the early 1950s, researchers have been exploring the development of speech and language in infants, toddlers, and children. Consequently, parents and pediatric professionals have resources at their disposal to educate them on prelinguistic development. However, what types of resources do parents and pediatric professionals reference when investigating the prelinguistic development of special infant populations,

such as those with multiple birth status? Researchers, such as Bishop and Bishop, have investigated the speech and language of twins, however higher order multiples, such as triplets and quadruplets, have yet to be investigated extensively. Parents and professionals working with pediatric populations may benefit from research aimed at describing the prelinguistic development of higher order multiple birth infants.

One way to begin research investigating the prelinguistic development of multiple birth, LBW and premature infants is to conduct basic observational research. The case study approach can be designed by an investigator to allow for the documentation of individual children and their development within the first year of life. Such observations can then be used in the future to develop more sophisticated psychometric assessment tools. Such observations can also provide a good source of materials for developing informational resources that parents can use. By video recording infants in the natural environment, collecting parental reports, and other behavioral samples, a researcher can develop informational booklets, videos, and other resources that can assist parents

Studying the prelinguistic development of a set of LBW and premature quadruplets via a longitudinal case study will also provide insight into how this population attains prelinguistic milestones and should begin to answer questions pediatric professionals and parents may have regarding this population's development. Of particular interest will be how a set of multiple birth infants performs on two widely used standardized tests that target speech development, gesture development, and social communication development. The results will be used to monitor and determine changes in prelinguistic development over the period the participants are investigated.

The three primary research questions to be addressed in this case study are the following: (1) Do any of the infants in the quadruplet set show evidence of developmental delay? (2) Do any of the infants have a delay at an early stage of development and eventually test within normal limits at a later age of development? (3) Do the infants exhibit idiosyncratic communication skills of the sort described for twins by Bishop and Bishop (1998)? Answering such questions should help provide preliminary data regarding this unique subject. The testing will also provide information regarding any similarities and differences in prelinguistic development within the set of quadruplets as well as how their pattern of development relates at early and later stages of development.

Table 1-1. Speech Development

Stage	Age (in months)	Description
Vegetative/Reflexive	Birth to 1	Physiological responses, such as burps and cries
Cooing	1 to 4	Vowel-like, such as "oo" or "uh"
Marginal Babbling	4 to 6	Vowel plus consonant, such as "bah" or "ub"
Canonical Babbling	6 to 10	Vowel plus consonant, such as "mama" or "aga"
Variegated Babbling	10 to 12	Vowel plus varied consonants, such as "gaba"
First Words	12	Adult-like form of a word used consistently

CHAPTER 2 METHODS

Participants

The participants in the case study were one set of quadruplets. They were recruited for the present case study based on their birth weight, length of gestation and multiple birth status. The participants were born on July 31st, 2008. For the purposes of the case study, each of the participants was assigned a unique identifier, i.e. a letter.

Baby A is female and her birth weight was 2 pounds, 4 ounces. Baby B is male and his birth weight was 2 pounds, 9 ounces. Baby C is male and his birth weight was 2 pounds, 13 ounces. Baby D is male and his birth weight was 2 pounds, 14 ounces. These weights classify each participant as low birth weight according to the WHO, who categorizes infants as LBW when born with a weight below 5 pounds, 8 ounces (World Health Organization ICD-10, 2007).

All four newborns had Apgar scores above 8, which are considered within normal limits. The term Apgar is an acronym which stands for *activity, pulse, grimace, appearance, and respiration* (Apgar, 1953). Each of these variables is assessed at birth and assigned a rating. The overall score is the average of all five areas.

Babies A, C, and D both received continuous positive airway pressure (CPAP) for approximately 1 week following delivery. Baby B required a ventilator. Baby D had a small hole in his lung that resolved itself during his stay in the neonatal intensive care unit.

Babies A, C, and D had no cardiac abnormalities. Baby B, however, had a heart valve that took longer than normal to close. It too resolved without any formal medical intervention.

Babies A, B, and D had no frank neurological abnormalities and no evidence of structural differences in their brains based on neuroimaging results. Baby C had an enlarged ventricle in the brain that was ruled out as evidence of hydrocephalus. Baby C also had 2 cysts in his brain that resolved without causing any long term brain damage.

At 2.5 weeks after delivery, Babies B, C, and D were receiving full feedings (about 26 milliliters) of breast milk through a gastric tube spread out over the course of the 24 hour day. Two days later breast feeding began. Baby A remained on IV support due to a staph infection she acquired shortly after delivery. Consequently, Baby A did not begin breast feeding until 3.5 weeks after delivery.

Although some respiratory conditions, cardiac abnormalities and neurological abnormalities had to be addressed, the participants overall were considered healthy given their premature birth and low birth weights. All four infants were released from the neonatal intensive care unit within two months of delivery. Baby D came home first, followed, in order, by Baby C, Baby B and Baby A.

Chronological age versus adjusted age. The participants were born two months and three days premature. Therefore, whenever possible, their chronological age and adjusted age were both used when scoring any assessments. The goal of scoring their adjusted age was to see whether or not their scores would change if their prematurity was taken into consideration. This also allowed the investigator to make further comparisons of their prelinguistic development. In general, clinicians and other pediatric professionals are not in agreement as to when to stop assessing premature infants using their adjusted age. Some professionals suggest to stop using adjusted age and begin using chronological age at 12 months; others suggest at 24 months. For

the purposes of this study, adjusted age will be used whenever possible (e.g. if norms are provided for the participants' chronological age and adjusted age, then both will be used.)

Data Collection

Two standardized assessment tools that are commonly used with infants and toddlers were administered to all four participants: the *MacArthur-Bates Communication Development Inventory: Words and Gestures* (Fenson et al., 2006) and the *Communication and Symbolic Behavior Scales Developmental Profile* (Wetherby et al., 2002). Each of these assessment tools is explained in more detail below. Refer to Table 2-1 for a summary of the participants' ages when the formal tests were completed.

MacArthur-Bates Communication Development Inventory: *CDI*

The *CDI* is in questionnaire format and it is administered to an infant's primary caregiver in order to gather information regarding the child's prelinguistic development. There are two versions of the test, *Words and Gestures* and *Words and Sentences*. The *Words and Sentences* format is most appropriate for infants over the age of 18 months. Because the participants in the present study are under the age of 18 months, the *Words and Gestures* format was used. The target communicative behaviors in *CDI* are emergent receptive and expressive abilities as well as gesture development. The test is standardized on infants who range in age from 8 to 18 months. The questionnaire is divided into two parts and each part divided further into subsections.

Part I of the *CDI* covers early word development. The subsections of Part I include the following categories: *First Signs of Understanding*, *Phrases*, *Starting to Talk*, and a vocabulary checklist. Parents are to indicate whether or not their infant

understands or produces the various target words and behaviors that are listed on the form.

Part II of the *CDI* covers actions and gestures. The subsections of Part II include the following categories: *First Communicative Gestures*, *Games and Routines*, *Actions with Objects*, *Pretending to be a Parent*, and *Imitating Adult Actions*. Parents are asked to indicate whether or not their infant has demonstrated the target actions/gestures yet.

Scoring is reported on the *Child Report Form* by summing the different responses within Parts I and II. The infant's raw scores are then converted to a percentile rank which allows for comparison to other children of their age range. Percentile ranks are provided in the following categories for Part I: *Phrases Understood*, *Vocabulary Comprehension*, and *Vocabulary Production*. The percentile ranks for Part II are *Early Gestures*, *Later Gestures*, and *Total Gestures*. Percentile rankings below the 16th percentile are considered deviant, according to the *CDI* technical manual (Fenson et al., 2006).

The participants' caregivers were asked to complete the *CDI* two times during the course of the case study. The first completion occurred when the infants were 10 months of age and the second completion occurred when the infants were 14 months of age (this is the infants' chronological age, not their adjusted age). The investigator gave the caregivers a folder which was labeled by date. The investigator asked the participants' mother to fill out the *CDI* questionnaire on the specific dates indicated which corresponded to the infants' chronological age. After the participants' mother completed the *CDI*, she mailed the forms back to the investigator for scoring.

Communication and Symbolic Behavior Scales Developmental Profile

The second formal test that the participants completed was the *Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP)*. The *CSBS DP* includes three components: the *Infant-Toddler Checklist*, the *Caregiver Questionnaire* and the *Behavior Sample*. The *CSBS DP* (Wetherby and Prizant, 2002) was developed to assess the communicative and symbolic behaviors of infants aged 6 months to 24 months. The assessment has three main purposes: (1) to identify children who are at risk for communication delays; (2) to evaluate the extent of any delays that a child might have; and (3) to document changes in a child's communicative behavior over time (Wetherby & Prizant, 2002). A child's expressive language, symbolic play, and social communication functioning are addressed on the scales.

The *CSBS DP - Infant-Toddler Checklist* is a one page screener that is used to determine if an infant needs to be referred for a comprehensive communication evaluation. The screener has been standardized on typically developing infants as young as 6 months, however if an infant is born prematurely, the evaluator must decide whether to interpret the results using either the infant's corrected age or the chronological age.

The Infant-Toddler Checklist is divided into three scales: *Social*, *Speech* and *Symbolic*. Within the *Social Scale* are the subsections *Emotion and Eye Gaze*, *Communication* and *Gestures*. Within the *Speech Scale* are the subsections *Sounds* and *Words*. Within the *Symbolic Scale* are the subsections *Understanding* and *Object Use*.

Each subscale item is given a point value and scoring is done by adding the points to yield a raw score. The raw score is then converted to a standard score and/or

percentile rank that can be used to compare the child's performance to the appropriate norms. If the infant's scores suggest that he or she is at risk for a delay then the evaluator is instructed to make a recommendation for a more comprehensive evaluation. All scores at or below the 10th percentile are considered a concern (Wetherby et al., 2002).

The participants' caregivers were instructed to complete the *CSBS-DP Infant-Toddler Checklist* when the participants were six months of age. The mother was given a folder labeled by date and instructed to fill out the *Infant-Toddler Checklist* when the date instructed. Once completed, the forms were mailed back to the investigator.

The second section of the *CSBS DP* is the *Caregiver Questionnaire*. It is a four page questionnaire that covers speech, language, and play milestones. The questionnaire has been standardized on typically developing infants; however, if an infant is born prematurely, the evaluator can choose to norm it based on either the infant's corrected age or the chronological age.

The *CSBS-DP Caregiver Questionnaire* is divided into three scales: *Social*, *Speech* and *Symbolic*. Within the *Social Scale* are the subsections *Emotion and Eye Gaze*, *Communication* and *Gestures*. Within the *Speech Scale* are the subsections *Sounds* and *Words*. Within the *Symbolic Scale* are the subsections *Understanding* and *Object Use*.

Each item in the various subsections is given a point value and scoring is done by adding the points to yield a raw score. The raw score is then converted to a standard score and percentile rank that are compared to the appropriate norms. Composite and

total scores at or below the 10th percentile are considered a concern (Wetherby et al., 2002).

The participants' mother was instructed to complete the *Caregiver Questionnaire* when the participants were 12 months and 14 months of chronological age. The mother was given a folder labeled by date and instructed to fill out the *Caregiver Questionnaire* when the date instructed. Once completed, the mother mailed the forms back to the investigator.

The investigator also assessed the participants using the *CSBS DP -Behavior Sample* when the participants were 12 months, and 14 months of chronological age. One caregiver was present during each session. The samples were video recorded then saved by recording date. The goal of *the Behavior Sample* is to assess the infant's communicative and play behaviors during interaction with the caregiver. The *Behavior Sample* has been standardized on typically developing infants as young as 12 months of age and accounts for prematurity.

Just like with the *CSBS DP - Infant-Toddler Checklist* and the *Caregiver Questionnaire*, the *Behavior Sample* is divided into three scales: *Social*, *Speech* and *Symbolic*. Within the *Social Scale* are the subsections *Emotion and Eye Gaze*, *Communication* and *Gestures*. Within the *Speech Scale* are the subsections *Sounds* and *Words*. Within the *Symbolic Scale* are the subsections *Understanding* and *Object Use*. Each scale includes target behaviors that are to be elicited during communicative acts (refer to Table 2-2 for definitions of the *CSBS DP Behavior Sample* measures). Wetherby and Prizant (2002) define communicative acts as interactions that involve the

use of a gesture, a vocalization, or a verbalization directed at an adult. The act must serve a communicative function.

The *Behavior Sample* is administered in six parts: a warm-up, communicative temptations, book sharing, symbolic play probe, language comprehension probe, and constructive play probe. During the warm-up the investigator provides the infant with a bag of toys and initiates interaction in order to allow the infant to become comfortable with the setting. Because the participants were already familiar with the investigator, this warm-up section was omitted if possible (i.e., if the participant was resisting the first sampling opportunity, as described in the next paragraph, the warm-up portion was introduced to familiarize the infant to the toys and setting.) Next, the investigator went through each of the six sampling opportunities, which include the use of wind-up toys, a balloon, bubbles, a jar with food in it, a book, a stuffed animal, and blocks. Each sampling opportunity provided the infants with a chance to demonstrate the target behaviors.

The investigator video recorded each assessment in order to refer back to each session for scoring. There were a total of 8 recorded assessments, four for each participant at 12 months, and 14 months of age. The recordings were stored according to recording date.

Each item in the subsections of the *Behavior Sample* is given a point value and scoring is done by adding the points to yield a raw score. The raw score is then converted to a standard score and percentile rank that will be compared to the appropriate norms. Composite and total scores at or below the 10th percentile are considered a concern (Wetherby et al., 2002).

Data Collection from Video Recorded Observations

A primary goal of this longitudinal study was to assess the participants in their natural environment. Therefore, video observations were performed in the participants' home with caregivers and siblings present. The recordings were collected over an eight month period beginning when the participants were six months old and ending when the participants were fourteen months old (January 31st, 2009 until October 1st, 2009.)

The investigator gave the caregivers a video camera and instructed them on how to conduct the video recording observations. Recordings were to be done a minimum of two times per week for 20 minutes per day. The recordings did not have to be continuous. After the clips were recorded, they were stored according to recording date on a computer hard drive.

The participants were recorded in isolation in order to observe individual development. The participants' parents were instructed to record spontaneously during various activities including, but not limited to, feeding time, changing time, play time, bath time, and night time. They were also recorded as a set in order to observe potential interactions among them. Again, the participants' caregivers were instructed to record spontaneously during various activities including, but not limited to, feeding time, changing time, play time, bath time, and night time.

Data Analysis

Data from formal testing was scored according to the standardized tests' instructions. The description for scoring the two formal tests was described above within the data collection section. Data from video recordings within the participants' natural environment was reviewed and classified according to communication development.

Table 2-1. Participants' Ages when Standardized Tests Were Completed

Standardized Test	Chronological Age in Months									
	6	7	8	9	10	11	12	13	14	
<i>CDI</i>					X					X
<i>CSBS DP Infant Toddler Checklist</i>	X									
<i>CSBS DP Caregiver Questionnaire</i>							X			X
<i>CSBS DP Behavior Sample</i>							X			X

Table 2-2. Definition of *CSBS DP* scales measured during the *CSBS DP Behavior Sample* (Wetherby & Prizant, 2002)

CSBS DP Behavior	Definition
Gaze shift	Alternating eye gaze between a person and an object and back.
Shared positive affect	Clear facial expression of pleasure or excitement directed toward another with eye gaze
Gaze/point follow	Responding to another's gaze/point by turning head or following with eye gaze
Rate of communicating	Frequency of communicative acts displayed per sampling opportunity
Behavior regulation	Use of communication to attract attention to self
Social interaction	Use of communication to attract attention to self
Joint attention	Use of communication to direct another's attention to an object or event
Conventional gestures	Giving, showing, pushing/pulling away, reaching, pointing, waving, nodding head, shaking head
Distal gestures	Gestures in which the child's hand does not touch a person or object (i.e. pointing at a distance, waving)
Syllables with consonants	Vocal communicative acts that include vowel plus consonant combinations
Inventory of consonants	The variety of consonants produced during communicative acts
Words	Use of words during a communicative act
Inventory of words	Sample of different words used
Word combinations	Use of multiword combinations in communicative acts
Inventory of word combinations	Use of multiword combinations in communicative acts
Language comprehension	Comprehension of object names, person names, and body parts

CHAPTER 3 RESULTS

Results of the *CDI* and all 3 sections of the *CSBS DP* standardized assessments are presented below. Percentile ranks are provided per baby and per standardized assessment in Tables 3-1 to 3-12, following the sections. Figures 3-1 to 3-4 include the percentile ranks from both *CSBS DP Behavior Samples* for all four participants.

Baby A

CDI Results

The first administration of the *CDI* was performed on May 1, 2009. The assessment was completed by the participant's mother. At this time, Baby A's chronological age was 10 months and her adjusted age was 8 months. When scoring the *CDI* using Baby A's chronological age (10 months), her results across all subsections of the *CDI* fell within normal limits, as shown in Table 3-1, with the exception of *Later Gestures* and *Total Gestures*. When the *CDI* was scored using Baby A's adjusted age of 8 months, *Later Gestures* and *Total Gestures* fell within normal limits, along with all other subsections. According to the *CDI* results, Baby A understood 7 out of the 28 phrases targeted in the *CDI*, such as "Daddy's/Mommy's home," and "Look here." She also understood one or more words from the following categories: *sound effects/animal sounds*, such as "yum yum" and "meow," *animal names*, such as "doggy," *toys*, *food/drink*, *body parts*, *rooms*, *small household items*, *outside things/places to go*, *people*, *games/routines*, such as "night night" and "Hi," *action words*, including "drink" and "sleep," *descriptive words*, and *quantifiers*. Baby A's mother reported that, at the time of test administration, Baby A demonstrated gestures, including *reaching*, *pointing*, and *showing*.

The second assessment using the *CDI* was completed by the participant's mother on October 5, 2009. The percentile ranks for this *CDI* assessment are also provided in Table 3-1. At this time, Baby A's chronological age was 14 months, with an adjusted age of 12 months. Baby A's scores across all subsections of the *CDI* fell within normal limits when scoring using her chronological age. Thus, when scoring using Baby A's adjusted age, scores remained within normal limits. According to the *CDI* results, Baby A continued to demonstrate the prelinguistic skills reported during the first *CDI* assessment. The second *CDI* assessment showed that Baby A understood 21 of the 28 phrases targeted by the *CDI*. Baby A expanded on the amount of vocabulary she understood, as well. That is, in addition to the words Baby A understood at 12 months chronological age, she understood one or more words from the following categories at 14 months chronological age: *vehicles, clothing, and pronouns*, including "mine" and "you." According to Baby A's mother, Baby A had sometimes imitated words produced by adults and labeled objects. Baby A had also produced some words independently, including one or more words from the following categories: *sound effects/animal sounds, animals, vehicles, toys, food/drink, clothing, body parts, small household items, people, and games/routines*. *CDI* results also showed that Baby A had increased gesture use. Baby A's mother reported that Baby A demonstrated new gestures, such as *shaking head "yes" and "no" and blowing kisses*. Baby A also engaged in games, such as *peekaboo and patty cake* and combined actions with objects.

CSBS DP Results

Additional information about Baby A's development was collected using all 3 sections of the *CSBS DP*. The *Infant-Toddler Checklist* was completed on January 31, 2009 by Baby A's mother. Baby A's chronological age was 6 months. Baby A's results

across all 3 scales of the *Infant-Toddler Checklist (Social Composite, Speech Composite, Symbolic Composite, and Total Score)* fell below the 10th percentile.

On August 1, 2009, Baby A's mother completed the *CSBS DP Caregiver Questionnaire*. At this time, Baby A's chronological age was 12 months and her adjusted age was 10 months. Based on her mother's report, Baby A's results across all scales of the *Caregiver Questionnaire* fell within normal limits, as shown by the Baby A's percentile ranks provided in Table 3-2. According to the *Caregiver Questionnaire* results, Baby A demonstrated several behaviors in the *Emotion and Eye Gaze* subsection, including *smiling while looking at her caregiver* and *gaze shifts*. Baby A's mother reported that Baby A has demonstrated communication behaviors, such as *letting her caregiver know she needs help, greeting her caregiver when enter/leave a room, and attempting to get caregiver's attention*. Results also showed that Baby A demonstrated the following gestures: *showing, pushing, reaching with an open hand and pointing to something out of reach*. Baby A's mother reported that, at 12 months chronological age, Baby A used sounds, such as [m, n, d, g] to engage in vocal play; however, her mother indicated that Baby A had yet to use intelligible words or word approximations to communicate. Baby A understood 16 of the 36 target words included in the *Caregiver Questionnaire*. Baby A's mother reported that Baby A combined actions with objects, such as *drinking with a cup* and *rolling a ball* and also *turns the pages of books* and *looks/points at pictures in the book*.

The second assessment using the *CSBS DP Caregiver Questionnaire* was completed by Baby A's mother on October 5, 2009. Percentile rank results of the *Caregiver Questionnaire* are provided in Table 3-2. Baby A's chronological age was 14

months and her adjusted age was 12 months. Results across all subsections of the *Caregiver Questionnaire* as reported by the participant's mother fell within normal limits. According to the *Caregiver Questionnaire*, Baby A continued to demonstrate all the behaviors as reported by her mother in the first *Caregiver Questionnaire* assessment. Results show that Baby A now demonstrates new gestures, such as *giving*, *waving "hi" and "bye,"* and *shaking head "yes" and "no."* Baby A also produced more sounds, including [w, l, y]. Baby A's mother reported that Baby A could now communicate using word approximations, including "mommy," "daddy," "all gone," "and "ball." Baby A understands 21 of the 36 target words in the *Caregiver Questionnaire*. Results show that Baby A could combine more actions with people or stuffed animals, such as *combing hair* and *hugging*.

A *CSBS DP Behavior Sample* was taken on August 1, 2009, when Baby A was 12 months, chronologically. However, video recordings of the assessment were damaged and therefore were unable to be analyzed.

The second *CSBS DP Behavior Sample* was completed on October 5, 2009. Baby A's chronological age was 14 months and her adjusted age was 12 months. Results of this *Behavior Sample* are provided in Table 3-9. Baby A demonstrated scores within normal limits on all *composite scores* and the *Total Score*. During the *Behavior Sample*, Baby A demonstrated the following behaviors: *gaze shift*, *gaze follow*, *shared positive affect*, *behavior regulation*, *social interaction*, and *joint attention* (refer to Table 2.2 for definitions of these behaviors.) She demonstrated several gestures, including *giving*, *showing*, *reaching* and *pointing to distal objects*. Baby A produced [d,

t, g, k] during the sample. She demonstrated action plus object use by *putting objects in* and *drinking with a bottle*.

Baby B

CDI Results

The first administration of the *CDI* was completed by Baby B's mother on May 1, 2009. Baby B's chronological age was 10 months and his adjusted age was 8 months. When scoring the *CDI* using Baby B's chronological age (10 months), his results across all subsections of the *CDI* fell within normal limits, as shown by the percentile ranks provided in Table 3-3, with the exception of *Vocabulary Production*, *Early Gestures*, *Later Gestures* and *Total Gestures*. When scoring using Baby B's adjusted age (8 months), *Vocabulary Production*, *Early Gestures*, and *Total Gestures* fell within normal limits; however, *Later Gestures* remained below the 16th percentile. According to the *CDI* results, Baby B understood 5 of the 28 phrases targeted in the *CDI*, such as "Open your mouth," and "Look here." He also understood one or more words from the following categories: *sound effects/animal sounds*, such as "ouch" and "meow," *animal names*, such as "doggy," *vehicles*, *toys*, such as "ball" and "book," *food/drink*, *clothing*, *furniture*, *small household items*, *outside things/places to go*, *people*, *games/routines*, *action words*, *descriptive words* and *prepositions/locations*. Baby B's mother reported that Baby B had demonstrated gestures, including *reaching*, *pointing*, and *showing*.

The second assessment of the *CDI* was completed by the Baby B's mother on October 5, 2009. Baby B's chronological age was 14 months and his adjusted age was 12 months. Baby B's scores across all subsections of the *CDI* fell within normal limits when scoring using his chronological age, as shown in Table 3-3. Thus, when scoring using Baby B's adjusted age, scores remained within normal limits. According to the

CDI results, Baby B continued to demonstrate the prelinguistic skills reported during the first *CDI* assessment. The second *CDI* assessment showed that Baby B understood 21 of the 28 phrases targeted by the *CDI*, such as “Stop it,” “Clap your hands,” and “Come here.” Baby B had expanded on the amount of vocabulary understood. In addition to the words Baby B understood at 12 months chronological age, he understood one or more words from the following categories at 14 months chronological age: *body parts, pronouns, question words, prepositions*, including “off” and “on,” and *quantifiers*.

According to Baby B’s mother, Baby B had sometimes labeled objects and produced some words independently. The words Baby B had produced, as reported by his mother, include one or more words from the following categories: *sound effects/animal sounds, animals, toys, food/drink, games/routines, and descriptive words*. *CDI* results also showed that Baby B had increased gesture use from the last *CDI* assessment. Baby B’s mother reported that at 14 months chronological age, Baby B demonstrated new gestures, such as *indicating “all gone”* and *gesturing “hush” by placing finger to lips*. Baby B also engaged in games, such as *peekaboo* and *patty cake*, combined actions with objects and plays with stuffed animals/dolls, such as *putting them to bed* or *pushing in a stroller*.

CSBS DP Results

Additional information about Baby B’s development was collected using all 3 components of the *CSBS DP*. The first *CSBS DP* standardized assessment completed by Baby B’s mother was the *Infant-Toddler Checklist*. It was completed on January 31, 2009, when Baby B’s chronological age was 6 months. Baby B’s results across all 3 subsections of the *Infant-Toddler Checklist* (*Social Composite, Speech Composite, Symbolic Composite, and Total Score*) fell below the 10th percentile.

On August 1, 2009, Baby B's mother completed the *CSBS DP Caregiver Questionnaire*. Baby B's chronological age was 12 months and his adjusted age was 10 months. Baby B's results across all scales of the *Caregiver Questionnaire*, as reported by Baby B's mother, fell within normal limits. Percentile rank results of the *Caregiver Questionnaire* are provided in Table 3-4. According to the *Caregiver Questionnaire* results, Baby B demonstrates several behaviors from the *Emotion and Eye Gaze* section, including *smiling while looking at his caregiver* and *gaze shifts*. Baby B's mother reported that Baby B had demonstrated communication behaviors such as *letting his caregiver know he needs help*, *greeting caregiver when enter/leave a room*, and *attempting to get caregiver's attention*. Results also showed that Baby B demonstrated the following gestures: *giving*, *showing*, *pushing*, *reaching with an open hand*, *pointing to something out of reach* and *shaking head "no."* Baby B's mother reported that Baby B used sounds, such as [m, n, b, d, g] to engage in vocal play and that Baby B had approximated words, including "mommy," "daddy," "no," and "night night." Baby B understands 17 of the 36 target words included in the *Caregiver Questionnaire*. Baby B's mother reports that Baby B had combined actions with objects, such as *drinking with cup* and *pushing a toy vehicle*. At Baby B's chronological age of 12 months, he had demonstrated *putting objects in containers* and *taking them out*, and also *turns the pages of books* and *looks/points at pictures in the book*.

The second assessment of the *CSBS DP Caregiver Questionnaire* was completed by the Baby B's mother on October 5, 2009. Baby B's chronological age was 14 months and his adjusted age was 12 months. Results across all subsections of the *Caregiver Questionnaire*, as reported by the Baby B's mother fell within normal limits, as shown in

Table 3-4. According to the *Caregiver Questionnaire*, Baby B continued to demonstrate all the behaviors as reported by his mother in the first *Caregiver Questionnaire* assessment. Results showed that Baby B demonstrated new gestures, such as waving “hi” and “bye,” and pushing an object away. Baby B’s mother reported that Baby B had not increased his consonant inventory since what was reported on the last *Caregiver Questionnaire*. Results showed that Baby B had not yet increased the amount of understandable word approximations he produced and he had not increased the amount of words he understood. At Baby B’s chronological age of 14 months, he combined more actions with people or stuffed animals, such as *feeding with a spoon* and *hugging/kissing*.

The first *CSBS DP Behavior Sample* was completed on August 1, 2009, when Baby B was 12 months, chronologically, with an adjusted age of 10 months. Percentile rank results of the *Behavior Sample* are provided in Table 3-10. Baby B’s results placed him below normal limits in the *Social* and *Symbolic Composites* as well as with the *Total Score*. However, Baby B had a *Speech Composite* within normal limits. During the *Behavior Sample*, Baby B demonstrated the following behaviors: *gaze shift*, *gaze follow*, *shared positive affect*, *behavior regulation*, *social interaction*, and *joint attention*. Baby B did not produce any words during the sample. He demonstrated one gesture, *reaching*. Baby B produced [b] and [p] during the sample. He demonstrated action plus object use one time, by *drinking with a bottle*.

The second *CSBS DP Behavior Sample* was taken on October 5, 2009. Baby B’s chronological age was 14 months and his adjusted age was 12 months. Baby B’s results across all 3 scales and the total score placed him within normal limits, as shown

in Table 3-10. During the *Behavior Sample*, Baby B continued to demonstrate the prelinguistic behaviors he demonstrated in the first sample. In addition to those behaviors, Baby B demonstrated the following gestures: *giving, pushing/pulling away, pointing to proximal and distal objects, and nodding head “yes.”* Baby B produced the sound [w.] He demonstrated increased action plus object use by *putting objects in a container and feeding with a utensil.*

Baby C

CDI Results

The first administration of the *CDI* was completed by Baby C’s mother on May 1, 2009. Baby C’s chronological age was 10 months and his adjusted age was 8 months. When scoring the *CDI* using Baby C’s chronological age (10 months), his results across all subsections of the *CDI* fell within normal limits, as shown in Table 3-5. Thus, when scoring using Baby C’s adjusted age (8 months), all scores increased and remained within normal limits. According to the *CDI* results, Baby C understood 7 of the 28 phrases targeted in the *CDI*. Examples of these phrases include “Time to go night night,” and “Look here.” He also understood one or more words from the following categories: *sound effects/animal sounds*, such as “ouch” and “moo,” *animal names*, such as “doggy,” *toys*, such as “ball,” *food/drink*, *body parts*, *furniture*, *small household items*, *outside things/places to go*, *people*, *games/routines*, such as “bye bye” and “night night,” *action words*, *descriptive words*, and *quantifiers*. Baby C’s mother reported that Baby C had demonstrated gestures, including *reaching, pointing, and showing and waving “bye bye.”*

The second assessment of the *CDI* was completed by Baby C’s mother on October 5, 2009. Baby C was 14 months chronological age with an adjusted age of 12

months. Percentile rank results of Baby C's *CDI* assessment are provided in Table 3-5. Baby C's scores across all subsections of the *CDI* fell within normal limits when scoring using his chronological age (14 months). Thus, when scoring using Baby C's adjusted age (12 months), scores remained within normal limits. According to the *CDI* results, Baby C continued to demonstrate the prelinguistic skills reported during the first *CDI* assessment. The second *CDI* assessment showed that Baby C understood 22 of the 28 phrases targeted by the *CDI*, such as "Don't do that," "Stop it," and "Come here." Baby C expanded on vocabulary understood. In addition to the words Baby C understood at 10 months chronological age, he understood one or more words from the following categories at 14 months chronological age: *vehicles, clothing, words about time, pronouns, question words*, such as "mine," and "I," and *prepositions*, including "off" and "on." According to Baby C's mother, Baby C had sometimes imitated words produced by adults and labeled objects. Baby C also produced some words independently, including one or more words from the following categories: *sound effects/animal sounds, animal names, vehicles, toys, food/drink, clothing, small household items, outside things/places to go, people, games/routines, action words, descriptive words, prepositions/locations, and quantifiers*. *CDI* results also showed that Baby C had increased gesture use from the last *CDI* assessment. Baby C's mother reported that Baby C demonstrated new gestures including *nodding head "yes"* and *smacking lips to indicate "yum yum."* Baby C also engaged in game playing, such as *peekaboo* and *patty cake*, combined actions with objects and plays with stuffed animals/dolls, such as *putting them to bed* or *pushing in a stroller*.

CSBS DP Results

Additional information about Baby C's development was collected using all 3 components of the *CSBS DP*. The first *CSBS DP* standardized assessment completed by Baby C's mother was the *Infant-Toddler Checklist*. It was completed on January 31, 2009, when Baby C's chronological age was 6 months. Baby C's results across all 3 subsections of the *Infant-Toddler Checklist* fell below the 10th percentile.

On August 1, 2009, Baby C's mother completed the *CSBS DP Caregiver Questionnaire*. Baby C's chronological age was 12 months and his adjusted age was 10 months. Results of the *Caregiver Questionnaire* are provided in Table 3-6. Baby C's results across all scales of the *Caregiver Questionnaire*, based on his mother's report, fell within normal limits. According to the *Caregiver Questionnaire* results, Baby C demonstrated several behaviors from the *Emotion* and *Eye Gaze* section, such as *smiling while looking at his caregiver* and *gaze shift*. Baby C's mother reported that Baby C had demonstrated communication behaviors including *letting his caregiver know he needs help*, *greeting caregiver when enter/leave a room*, and *attempting to get caregiver's attention*. Results also showed that Baby C demonstrated the following gestures: *giving*, *showing*, *pushing*, *reaching with an open hand*, *pointing to proximal and distal objects*, and *shaking head "no."* Baby C's mother reported that Baby C used sounds, such as [m, n, b, d, g] to engage in vocal play; however, his mother indicated that Baby C had yet to produce intelligible word approximations to communicate. Baby C understood 16 of the 18 target words included in the *Caregiver Questionnaire*. Baby C's mother reported that Baby C combined actions with objects, such as *drinking with cup* and *rolling a ball*. He also had demonstrated *putting objects in a container* and

taking them out as well as turning the pages of books and looking/pointing at pictures in a book.

The second assessment of the *CSBS DP Caregiver Questionnaire* was completed by the Baby C's mother on October 5, 2009. Baby C's chronological age was 14 months and his adjusted age was 12 months. Results across all scales of the *Caregiver Questionnaire* fell within normal limits, as shown in Table 3-6. According to the *Caregiver Questionnaire*, Baby C continued to demonstrate all the behaviors as reported by his mother in the first *Caregiver Questionnaire* assessment. Baby C's mother reported that Baby C produced more sounds in addition to those reported on the last *Caregiver Questionnaire*, such as [w, l, y.] Results showed that Baby C now produced understandable word approximations, such as "mommy," "daddy," and "baby." He had also increased the amount of words he understood, from 18 of 36 to 24 of 36. Results showed that Baby C combined more actions with people or stuffed animals, such as *covering with a blanket* and *hugging/kissing*.

The first assessment of the *CSBS DP Behavior Sample* was completed on August 1, 2009, when Baby C was 12 months, chronologically, with an adjusted age of 10 months. Baby C's results fell below the norm in the *Social* and *Symbolic Composites* and in the *Total Composite*, as shown in Table 3-11. Baby C's *Speech Composite* result fell within normal limits. During the *Behavior Sample*, Baby C demonstrated the following behaviors: *gaze shift*, *gaze follow*, *shared positive affect*, *behavior regulation*, *social interaction*, and *joint attention*. He demonstrated one gesture, *reaching*. Baby C did not produce any sounds or word approximations during the sample. He

demonstrated action plus object use two times, by *drinking with a bottle* and *putting an object in a container*.

The second *CSBS DP Behavior Sample* was taken on October 5, 2009. Baby C's chronological age was 14 months, with an adjusted age of 12 months. Baby C's percentile rank results from the *Behavior Sample* are provided in Table 3-11. Baby C's results on all 3 scales and the total score fell within normal limits. During the *Behavior Sample*, Baby C continued to demonstrate the prelinguistic behaviors he demonstrated in the first sample. In addition to those behaviors, Baby C demonstrated new gestures, including *giving*, *showing*, *pushing/pulling away* and *pointing to proximal and distal objects*. Baby C did not produce any sound or words during the sample. He demonstrated increased action plus object use by *kissing a stuffed animal*, *feeding with a utensil*, and *scooping with a spoon*.

Baby D

CDI Results

The first administration of the *CDI* was completed by Baby D's mother on May 1, 2009. Baby D's chronological age was 10 months and his adjusted age was 8 months. When scoring the *CDI* using Baby D's chronological age (10 months), his results across all subsections of the *CDI* fell within normal limits, as shown in Table 3-7. Thus, when scoring using Baby D's adjusted age (8 months), all scores remained within normal limits. According to the *CDI* results, Baby D understood 7 of the 28 phrases targeted in the *CDI*, such as "Daddy's/Mommy's home," and "Look here." He also understood one or more words from the following categories: *sound effects/animal sounds*, such as "ouch" and "baa baa," *animal names*, such as "doggy," *toys*, such as "ball" and "book," *food/drink*, *furniture/rooms*, *small household items*, *outside things/places to go*, *people*,

games/routines, such as “bath” and “bye bye,” *action words*, *descriptive words*, and *quantifiers*. Baby D’s mother reported that Baby D had demonstrated gestures, such as *reaching*, *pointing*, *showing*, *waving* “bye bye,” and *shaking head* “no.” Baby D also combined a few actions with objects, as reported by his mother, such as *pushing a toy car* or *throwing a ball*.

The second assessment of the *CDI* was completed by the Baby D’s mother on October 5, 2009. Percentile rank results from the *CDI* are provided in Table 3-7. Baby D’s scores across all subsections of the *CDI* fell within normal limits when scoring using his chronological age (14 months). Thus, when scoring using Baby D’s adjusted age (12 months), scores remained within normal limits. According to the *CDI* results, Baby D continued to demonstrate the prelinguistic skills reported during the first *CDI* assessment. The second *CDI* assessment showed that Baby D understood 24 of the 28 phrases targeted by the *CDI*, such as “Don’t do that,” “Stop it,” and “Come here.” Baby D had expanded on vocabulary understood. In addition to the words Baby D understood at 10 months chronological age, he understood one or more words from the following categories at 14 months chronological age: *vehicles*, *clothing*, *body parts*, *words about time*, *pronouns*, such as “mine,” and “I,” *question words*, and *prepositions*, including “off” and “on.” According to Baby D’s mother, Baby D had sometimes imitated words produced by adults and labeled objects. Baby D also produced some words independently. As reported by his mother, Baby D produced one or more words in the following categories: *sound effects/animal sounds*, *animals*, *vehicles*, *toys*, *food/drink*, *clothing*, *furniture/rooms*, *outside things/places to go*, *people*, *games/routines*, *action words*, *descriptive words*, *prepositions/locations* and *quantifiers*. Baby D’s mother

reported that Baby D demonstrated new gestures including *nodding head “yes”* and *indicating “all gone.”* At Baby D’s chronological age of 4 months, he also engaged in games, such as *peekaboo* and *patty cake*, combined actions with objects and plays with stuffed animals/dolls, such as *putting them to bed* and *pushing in a stroller*.

CSBS DP Results

Additional information about Baby D’s development was collected using all 3 sections of the *CSBS DP*. The first *CSBS DP* standardized assessment completed by Baby D’s mother was the *Infant-Toddler Checklist*. It was completed on January 31, 2009 when Baby D’s chronological age was 6 months. Baby D’s results across all 3 subsections of the *Infant-Toddler Checklist* fell below the 10th percentile.

On August 1, 2009, Baby D’s mother completed the *CSBS DP Caregiver Questionnaire*. Baby D’s chronological age was 12 months and his adjusted age was 10 months. Baby D’s results across all scales of the *Caregiver Questionnaire* fell within normal limits, as shown in Table 3-8. According to the *Caregiver Questionnaire* results, Baby D demonstrated several behaviors from the *Emotion and Eye Gaze* section, including *smiling while looking at his caregiver* and *gaze shift*. Baby D’s mother reported that Baby D had demonstrated communication behaviors including *letting his caregiver know he needs help*, *greeting caregiver when enter/leave a room*, and *attempting to get caregiver’s attention*. Results also show that Baby D demonstrates the following gestures: *giving*, *showing*, *pushing*, *reaching with an open hand*, and *pointing to proximal and distal objects*. Baby D’s mother reported that Baby D used sounds, such as [m, n, b, d, g] to engage in vocal play. Baby D had not yet produced word approximations. Baby D understood 16 of the 36 target words included in the *Caregiver Questionnaire*. Baby D’s mother reported that Baby D combines dactions

with objects, such as *drinking with a cup* and *pushing a toy vehicle*. Baby D also had demonstrated *putting objects in containers and taking them out*, and also *turning the pages of books* and *looking/pointing at pictures in a book*.

The second assessment of the *CSBS DP Caregiver Questionnaire* was completed by Baby D's mother on October 5, 2009. Baby D's chronological age was 14 months and his adjusted age was 12 months. Baby D's percentile rank results from the *Caregiver Questionnaire* are provided in Table 3-8. Results across all scales of the *Caregiver Questionnaire*, as reported by Baby D's mother, fell within normal limits. According to the *Caregiver Questionnaire*, Baby D continued to demonstrate all the behaviors as reported by his mother in the first *Caregiver Questionnaire* assessment. Results showed that Baby D demonstrated new gestures, such as *waving "hi" and "bye,"* and *nodding head "yes."* Baby D's mother reported that in addition to the sounds reported on the last *Caregiver Questionnaire*, Baby D produced [w, l, y.] Results showed that Baby D produced understandable word approximations, such as "mommy," "daddy," and "baby." Baby D understood 20 of the 36 target words included in the *Caregiver Questionnaire*. According to Baby D's mother, Baby D combined more actions with people or stuffed animals, such as *drinking with a cup/bottle* and *hugging/kissing*.

The first *CSBS DP Behavior Sample* was completed on August 1, 2009, when Baby D was 12 months, chronologically, with an adjusted age of 10 months. Baby D's scores placed him below the norms in the *Social* and *Symbolic Composite Scores* and in the *Total Score*; however, his *Speech Composite Score* fell within normal limits, as shown in Table 3-12. During the *Behavior Sample*, Baby D demonstrated the following

behaviors: *gaze shift, gaze follow, shared positive affect, social interaction, and joint attention*. Baby D demonstrated the following gestures during the sample: *reaching* and *pointing to distal objects*. Baby D did not produce any sounds or words during the sample. He demonstrated action plus object use one time, by *drinking with a bottle*.

The second *CSBS DP Behavior Sample* was taken on October 5, 2009. Baby D's chronological age was 14 months and his adjusted age was 12 months. Results of the *Behavior Sample* are provided in Table 3-12. All of Baby D's results fell within normal limits. During the *Behavior Sample*, Baby D continued to demonstrate the prelinguistic behaviors he demonstrated in the first sample. In addition to those behaviors, Baby D demonstrated *behavior regulation*. He demonstrated new gestures, including *giving, showing, pushing/pulling away, pointing to proximal objects, and waving*. Baby D produced syllables with consonants and produced the sounds [d, t, g, k, w.] He did not use any words during the sample. He demonstrated increased action plus object use by *putting objects in* and *feeding with a utensil*.

Data Collection from Video Recordings

Video recordings of the infants were made in their natural environment during the 8-month period that the study lasted. The recordings captured the infants' behaviors from ages 6 months to 14 months. The intent of the recordings was to develop a video-based instructional guide on prelinguistic development for parents and caregivers of multiple birth infants. The general structure of the instructional guide is discussed under the section *Future Research and Direction* in Chapter IV. Video recordings were reviewed by the investigator and excerpts were classified according to the following behaviors: communication behaviors (including joint attention, eye gaze, and gestures), play development, and speech development.

Table 3-1. Baby A's *CDI* Percentile Rank Results

<i>CDI</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Phrases Understood	40	70	50	70
Vocabulary Comprehension	55	80	55	80
Vocabulary Production	60	90	70	90
Early Gestures	30	99	95	99
Later Gestures	5	95	75	95
Total Gestures	15	99	85	99

Note: CA = chronological age; AA = adjusted age

Table 3-2. Baby A's *CSBS DP Caregiver Questionnaire* Percentile Rank Results

<i>CSBS DP</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Social Composite	25	50	75	84
Speech Composite	50	63	91	95
Symbolic Composite	63	91	63	84
Total Score	40	68	83	93

Note: CA = chronological age; AA = adjusted age

Table 3-3. Baby B's *CDI* Percentile Rank Results

<i>CDI</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Phrases Understood	30	70	50	70
Vocabulary Comprehension	60	80	80	95
Vocabulary Production	5	90	55	85
Early Gestures	15	99	55	85
Later Gestures	5	95	35	75
Total Gestures	10	99	40	80

Note: CA = chronological age; AA = adjusted age

Table 3-4. Baby B's *CSBS DP Caregiver Questionnaire* Percentile Rank Results

<i>CSBS DP</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Social Composite	75	95	63	75
Speech Composite	37	63	16	25
Symbolic Composite	63	91	63	84
Total Score	50	83	42	75

Note: CA = chronological age; AA = adjusted age

Table 3-5. Baby C's *CDI* Percentile Rank Results

<i>CDI</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Phrases Understood	45	70	70	85
Vocabulary Comprehension	65	80	80	95
Vocabulary Production	75	90	90	99
Early Gestures	70	99	85	95
Later Gestures	45	95	60	90
Total Gestures	35	99	65	90

Note: CA = chronological age; AA = adjusted age

Table 3-6. Baby C's *CSBS DP Caregiver Questionnaire* Percentile Rank Results

<i>CSBS DP</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Social Composite	50	84	50	63
Speech Composite	37	63	95	98
Symbolic Composite	63	91	75	84
Total Score	47	79	83	93

Note: CA = chronological age; AA = adjusted age

Table 3-7. Baby D's *CDI* Percentile Rank Results

<i>CDI</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Phrases Understood	45	70	80	95
Vocabulary Comprehension	65	80	80	95
Vocabulary Production	70	90	90	99
Early Gestures	75	99	85	95
Later Gestures	60	95	65	95
Total Gestures	70	99	75	95

Note: CA = chronological age; AA = adjusted age

Table 3-8. Baby D's *CSBS DP Caregiver Questionnaire* Percentile Rank Results

<i>CSBS DP</i> Section	Ages			
	CA 10	AA 8	CA 14	AA 12
Social Composite	75	95	91	95
Speech Composite	37	63	98	99
Symbolic Composite	50	84	63	84
Total Score	50	81	91	97

Note: CA = chronological age; AA = adjusted age

Table 3-9. Baby A *CSBS DP Behavior Sample Percentile Rank Results*

CSBS DP Section	Age	
	Sample 1 CA 12	Sample 2 CA 14
Social Composite	N/A	37
Speech Composite	N/A	37
Symbolic Composite	N/A	16
Total Score	N/A	21

Note: CA = chronological age

Table 3-10. Baby B *CSBS DP Behavior Sample Percentile Rank Results*

CSBS DP Section	Age	
	Sample 1 CA 12	Sample 2 CA 14
Social Composite	9	37
Speech Composite	25	25
Symbolic Composite	5	37
Total Score	8	25

Note: CA = chronological age

Table 3-11. Baby C *CSBS DP Behavior Sample Percentile Rank Results*

CSBS DP Section	Age	
	Sample 1 CA 12	Sample 2 CA 14
Social Composite	9	25
Speech Composite	16	16
Symbolic Composite	9	50
Total Score	5	16

Note: CA = chronological age

Table 3-12. Baby D *CSBS DP Behavior Sample Percentile Rank Results*

CSBS DP Section	Age	
	Sample 1 CA 12	Sample 2 CA 14
Social Composite	5	37
Speech Composite	16	50
Symbolic Composite	5	16
Total Score	5	27

Note: CA = chronological age

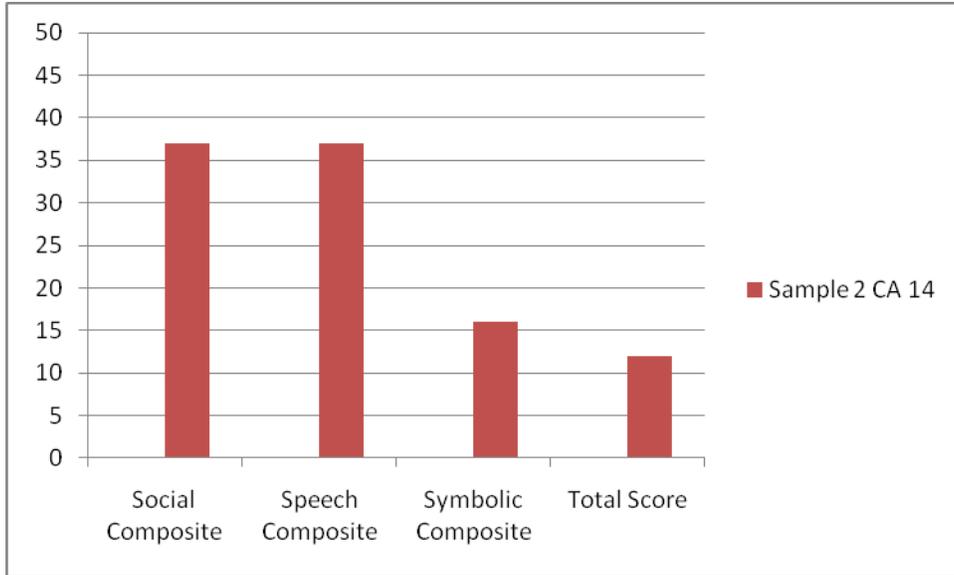


Figure 3-1. Baby A CSBS DP Behavior Sample Percentile Rank Results (CA = chronological age)

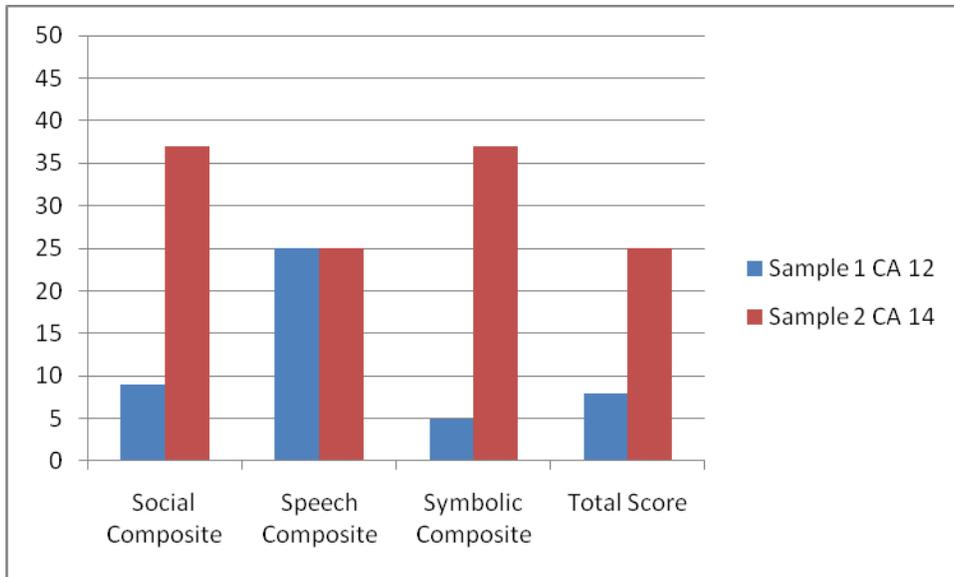


Figure 3-2. Baby B CSBS DP Behavior Sample Percentile Rank Results (CA = chronological age)

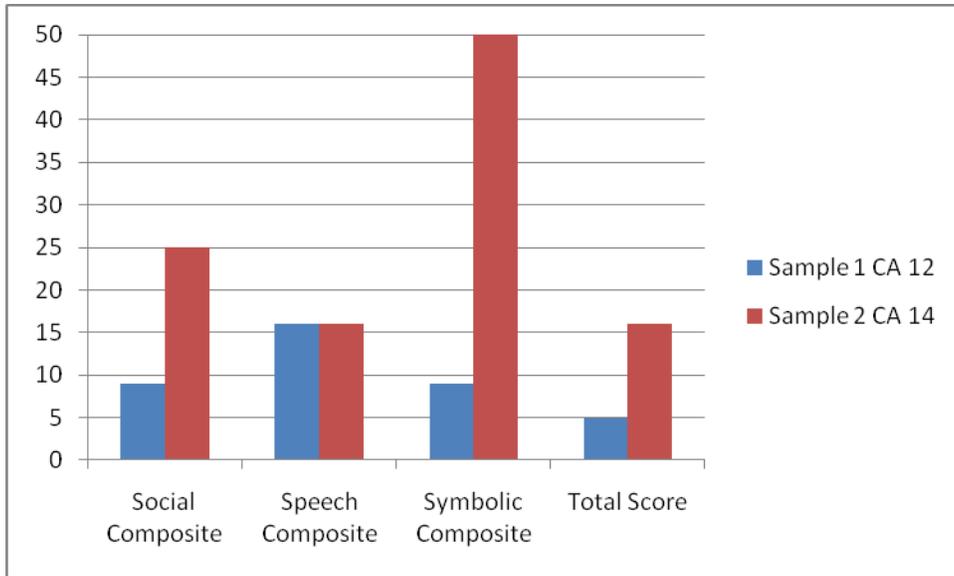


Figure 3-3. Baby C CSBS DP Behavior Sample Percentile Rank Results (CA = chronological age)

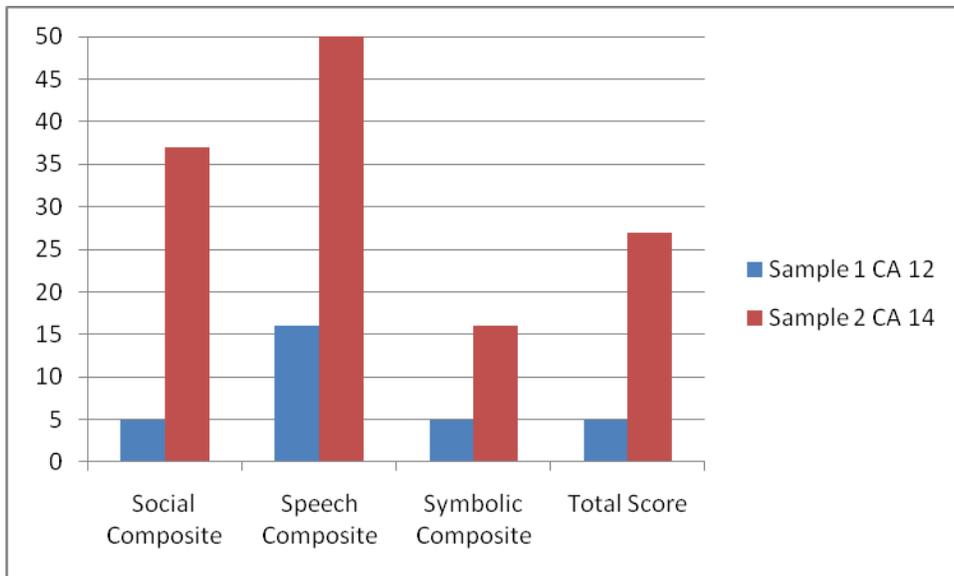


Figure 3-4. Baby D CSBS DP Behavior Sample Percentile Rank Results (CA = chronological age)

CHAPTER 4 DISCUSSION

Prelinguistic Development

Speech Production

Results from the *CSBS DP Caregiver Questionnaire Speech Scale* show that all four infants produced speech within normal limits at their chronological ages of 12 and 14 months. The *Speech Scale* reports scores on the infants' speech sound production, including a consonant inventory and syllable productions, as reported by the infants' mother. According to the *CSBS DP Caregiver Questionnaire*, by 12 months chronological age, each infant was producing the consonants [m, n, b, d]. Interestingly, Baby B was the only infant to not expand his consonant inventory by the age of 14 months when the second *CSBS DP Caregiver Questionnaire* was administered. Although the infants' scores on The *CSBS DP Behavior Sample Speech Scale* fell within normal limits at the infants' chronological ages of 12 and 14 months, the *Behavior Sample* scores revealed different results. The infants did not produce [m] or [n] during the samples. Baby A produced primarily alveolar and velar stops; Baby B produced bilabial stops; Baby C did not produce any speech sounds during either sample; and Baby D, who didn't produce any speech sounds during the sample taken when his chronological age was 12 months, produced alveolar and velar stops when the sample was taken at 14 months chronological age.

The *CDI Vocabulary Production* score reports results regarding the infants' word production. Based on the results from both ages (10 and 14 months chronologically) the infants demonstrated word production within normal limits. These results are

consistent with the results from the *CSBS Caregiver Questionnaire Speech Scale* which also reports on word production.

Language Comprehension

The *CDI Phrases Understood* and *Vocabulary Comprehension* scores report information on the infants' comprehension of phrases and single word vocabulary comprehension, respectively. All four infants' results for these two CDI sections fell within normal limits at both test administrations (10 and 14 months chronological age.) The results of the *CSBS DP Caregiver Questionnaire Symbolic Scale* are consistent with the *CDI Vocabulary Comprehension* results as this scale reports scores on single word understanding as well. Results from the *CSBS DP Behavior Sample Symbolic Scale*, which reports on comprehension of object names, person names, and body parts, are not consistent with either the *CDI Phrases Understood* and *Vocabulary Comprehension* scores or the *CSBS DP Caregiver Questionnaire* results.

Nonverbal Communication Skills

The CDI reports scores on *Early Gestures*, *Later Gestures* and *Total Gestures*. These sections include questions on gestures, games, actions and pretend play. Based on results at the infants' chronological age of 10 months, Baby A, Baby C, and Baby D all exhibited early gestures, such as reaching and pointing, and also game playing and combining actions with objects. Baby B, who had a percentile rank of 15, did not exhibit game playing and demonstrated limited combinations of actions plus objects. His score, however, increased to the 99th percentile when it was scored using his adjusted age (8 months.) By 14 months chronological age, all four infants had scores on the *CDI Early Gestures*, *Later Gestures*, and *Total Gestures* that fell within normal limits. The *CSBS DP Caregiver Questionnaire Social Scale* reports information on gestures. At the

infants' chronological age of 12, Baby A had the lowest *CSBS DP Caregiver Questionnaire Social Scale* (25th percentile); however, this score still fell within normal limits. At 14 months chronological age, all four infants' results on the *Social Scale* remained within normal limits, however, Baby B's score decreased from the 75th percentile at 12 months chronological age to the 63rd percentile at 14 months chronological age. Also, Baby C's score remained the same (50th percentile.) Both infants did not demonstrate any notable gesture development from 12 to 14 months of age based on their mother's report on the *CSBS DP Caregiver Questionnaire*.

Based on the *CSBS DP Behavior Sample Social Scale*, Baby B, Baby C, and Baby D demonstrated gesture inventories that fell below normal limits at their chronological age of 12 months. The infants only demonstrated the reaching gesture during the sample, with the exception of Baby D who also demonstrated a pointing gesture. However, the second *Behavior Sample*, which was taken at the infants' chronological age of 14 months, indicated that all four infants had gesture inventories that were within normal limits. At this age, they demonstrated a variety of gestures, including waving, shaking head, showing and pushing away.

The *CSBS DP Behavior Sample* allows for observation of other nonverbal communication skills, such as eye gaze and joint attention. On the first sample taken when the infants' chronological age was 12 months, Baby B, Baby C, and Baby D had *Social Composite* scores that fell below the norm. However, it is important to note that the infants all exhibited eye gaze and joint attention behaviors, including gaze shift, gaze follow, shared positive affect, behavior regulation, and social interaction. These behaviors were also demonstrated during the second *Behavior Sample* taken when the

infants' chronological age was 14 months. The *CSBS DP Caregiver Questionnaire* also indicated, based on the infants' mother's report, that all four infants demonstrated eye gaze and joint attention behaviors since the infants' chronological age was 12 months.

How the Participants' Performance Relates to Typical Development and what is Expected of Infants with LBW, Short Gestation, and Multiple Birth Status

Research by Bishop and Bishop (1998) indicates that it is not uncommon for twin siblings to develop idiosyncratic phonological rules which suggest use of "private language." Work by Zubrick et al. (2007) documents the extent to which premature infants can present with atypical and/or delayed speech and language development. Based on such findings, it was thought at the outset of the study that the infants who participated in the present study might be at risk for the same or similar types of developmental problems. These patterns, to date, have not been realized however. That is, the participants have yet to demonstrate any idiosyncratic prelinguistic patterns. Thus, the present findings underscore the concept of individual differences among multiple birth children. Although many such children exhibit marked differences in communication development when compared to singletons, not every child does.

The only delays noted in the present study occurred when the participants' speech and gesture development tasks were scored using norms based upon their chronological age. It is widely felt that such an approach penalizes children who are born prematurely, and indeed that seemed to be the case in the present study. All of the "delays" that were suggested through the use of chronological age norm references were no longer present when scores were referenced against the infants' adjusted age, with the exception of one score (Baby B's *Later Gesture* percentile rank on the *CDI*.)

Foundation for Research

Longitudinal case studies allow for extensive observation of a particular population. In this case, the longitudinal study allowed for an in-depth look at communication-related behaviors and general development within a set of LBW and premature quadruplets. Studies into the early communicative development of higher order multiples, such as triplets and quadruplets, is limited. In fact, to our knowledge, this is the first study in which these issues have been examined in a quadruplet set. Therefore, this study provides preliminary information regarding the prelinguistic development of this population using standardized testing and observation.

Limitations

One of the goals of this research was to observe a set of LBW and premature quadruplets in their natural environment in order to report data on prelinguistic development, including speech and gesture development, during the first year of life. The participants were video recorded within their home with caregivers, siblings and other volunteers present. Although this environment provides advantages to observing natural behavior; it also provides disadvantages.

One disadvantage concerns the logistic of conducting the video recordings with this population. In short, it is very difficult to execute high quality recordings of four siblings simultaneously. This became apparent as the investigator attempted to review and analyze recordings made in this study. Once the analysis commenced, it became apparent that background noise levels were loud enough to make it difficult to determine which infant was verbalizing at a particular time and what the infant was verbalizing. In future research, this issue might be resolved by fitting each infant with a microphone.

Such an approach would reduce the effect of background noise (i.e. from other infants and other family members) on the quality of the recordings.

One aspect of prelinguistic development the investigator wanted to analyze using the video recordings was babbling development. However, when the video recordings were reviewed it became apparent that not only was it difficult to determine who was babbling and what the sounds were. Also, also the frequency with which the infants were babbling during recording times made it difficult to collect useful samples.

It is also important to note that this type of longitudinal study requires time commitment and responsibility from the parents. Although the participants' parents were timely with filling out the required standardized tests and adhered quite closely to the basic procedures for recording and completing the parental reports, external factors, such as having to take care of the participants' older siblings, made it challenging for them to devote as much time and attention to the project as they may have otherwise been able to do. Thus, it would benefit future studies of this type to have a dedicated researcher or research assistant, such as a graduate student clinician, present to help deal with such factors.

Both the *CDI* and the *CSBS DP - Caregiver Questionnaire* rely on parental report. Although this is a practical way to gather information on an infant's developmental history, it also has some limitations as parents and caregivers may not remember accurately or understand the behaviors being assessed. With this longitudinal case study, the parents' of the participants had to complete questionnaires on all four of their infants which poses even further possibility for parental error when reporting on the development of each child.

Clinical Application

As pediatric professionals encounter infants with multiple birth status, it becomes necessary for them to have an adequate understanding of the infants' development across all systems, including speech and language development. Providing pediatric professionals, such as pediatricians, speech pathologists, neonatal nurses, and more, with information regarding prelinguistic development should educate them on important developmental differences, if any, they should expect. The results from this study begin to address these differences within one set of multiple birth infants.

Future Research and Direction

Data collection included weekly video recordings taken within the participants' natural environment. This video footage has potential to also be analyzed and classified according to communication and play behaviors. The results of coding the information in this way could benefit both pediatric professionals and parents as it could be used to create an educational tool defining the prelinguistic development of LBW, premature, and multiple birth infants. The video recordings provide actual examples of specific behaviors and when put together with an informational book may be a practical way to educate those involved with the prelinguistic development of not only LBW, premature, and multiple birth infants, but also typically developing infants.

Clinicians sometimes rely on parent report when evaluating infants. Parents are a reliable resource; however it would be interesting to know how reliable their reports are as compared to formal testing. Data for this study was collected from the standardized assessments in two ways; (a) caregiver questionnaires; and (b) formal testing completed by a graduate student clinician. This could allow for a future study to be done on the relationship between caregiver questionnaires and formal testing. It would

be interesting to see how the results of caregiver questionnaires relate to the results of formal testing (e.g. Are the results of both the caregiver questionnaires and formal testing completed by a professional similar? Does one report delay and the other report no delay?).

CHAPTER 5 CONCLUSION

When a family discovers they are expecting a child, several questions and concerns are raised. These questions and concerns take on a new, scary and exciting twist when parents discover they are expecting more than one child, when the child is delivered premature, and/or when the child is born at a low birth weight. Their search for education may include questions regarding the prelinguistic development of their infant(s) and what the significance of different behaviors mean. Given the lack of research regarding these populations it appears necessary to investigate further the prelinguistic development of multiple birth infants. This longitudinal case study of a set of premature, low birth weight quadruplets should provide the appropriate preliminary data regarding this important period of development. The results and future research expanding upon what was attained may benefit parents and pediatric professionals by providing education and information they both deserve regarding prelinguistic development of infants with multiple birth status.

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BIOGRAPHICAL SKETCH

Kristen M. Lewandowski received her Master of Arts from the Department of Communication Sciences and Disorders at the University of Florida in August of 2010. She received her Bachelor's Degree in Linguistics at Oakland University in Auburn Hills, Michigan. During that time she spent a semester studying French in Orléans, France and focused her undergraduate thesis in linguistics studies on French phonology. After receiving her bachelor's degree in 2007, she went on to post-bachelor's studies in Communication Sciences and Disorders at Wayne State University in Detroit, Michigan. In fall of 2008, she began graduate studies within the Department of Communication Sciences and Disorders at the University of Florida.