Exploring the Relationship between Imitation and Social Communication in Infants

by

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B.A., University of Victoria, 1989
M.A., University of Western Washington, 1994

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Supervisory Committee

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Abstract

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This study examined the relationship between emergent imitation skills and social communication skills in 15 to 18 month old infants, using a quantitative correlational research design. Imitation skills are an index of later social cognition and language development, and a critical mechanism in language learning for typically developing children. Social communication skills in this age predict later language skills. The relationship between imitation and social communication is poorly understood in infants. This study looked at the relationship between imitation and social communication at their emergence.

This study included 30 typically developing infants, whose participation was volunteered by their parents. They were recruited through posters and word-of-mouth in communities in the Pacific Northwest. Infants' imitation behaviors were measured using the Motor Imitation Scale (Stone, Ousley, & Littleford, 1997), and their social communication skills were measured using the Communication and Symbolic Behavior Scales- Developmental Profile (Wetherby & Prizant, 2002). This study used a naturalistic observation model so the one-hour play sessions took place in the infants' homes. Sessions were digitally recorded for later scoring and analysis.

This study demonstrated a concurrent and predictive relationship between imitation and language understanding in this age group. The study suggests that imitation is an important variable in early language acquisition that needs further study, and needs to be addressed when assessing prelinguistic child development. The study suggests that imitation skills should be fostered early on and provides evidence-based methods for facilitating imitation and language development.

KEY WORDS: imitation; social communication; naturalistic observation; typically developing infants; language development

Table of Contents

List of Tables

List of Figures

Acknowledgments

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Dedication

I would like to dedicate this paper to the parents and caregivers of young children everywhere. There is no greater treasure for a child than a loving caregiver and time spent together. *"When we learn to see life through the eyes of a child, that is when we become truly wise"* - Mother Theresa.

Chapter 1: Introduction

Overview

In the field of child development, imitation appears to have an essential, but poorly understood relationship to the successive unfolding of language skills and social cognition. Social communication skills (i.e., joint attention, affect sharing, and gestures) have also been shown to relate to later language and social development. The relationship between imitation and social communication has not yet been fully researched or documented in young children. Nevertheless, some correlations between imitation and social communication skills have been documented in older children and in atypical populations, such as children with Autism Spectrum Disorders (Girardot, de Marino, Rey, & Poinso, 2009; Marton, 2009; Stone, Ousley, & Littleford, 1997; Thurm, Lord, Lee, & Newschaffer, 2007).

Imitation

Miller and Dollard (1941) defined imitation as "a process by which "matched," or similar, acts are evoked in two people and connected to appropriate cues" (p. 10). Imitation has been described as an innate and inherited skill-set (Meltzoff & Moore, 1977), a tool for social learning (Kiraly, 2009; Meltzoff & Decety, 2003; Want & Harris, 2002) and an index of cognitive, social, and language development (Girardot, de Marino, Rey, & Poinso, 2009). A sequential developmental pattern of acquiring imitative skills has been established (Girardot et al., 2009; Jones, 2007; Meltzoff & Moore, 1977; Meltzoff & Moore, 1989; Piaget, 1962; Want & Harris, 2002), with individual differences stabilizing between 9 and 14 months (Heimann & Meltzoff, 1996). The

importance of imitation as a critical mechanism in supporting later language and social development is well-documented (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter, Tomasello, & Striano, 2005; Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000; Girardot, et al., 2009; MacDuffie, Yoder & Stone, 2005; Masur, 2000).

Want and Harris (2002) and Meltzoff and Prinz (2002) suggested that while imitation has an "obvious utility" in language learning, little research has looked at *how* imitation might contribute to social learning. "The developmental literature has largely been concerned with the question of when social learning arises and not by which mechanism it operates" (Want & Harris, 2002, p. 11). Numerous studies have documented the acquisition timelines of imitation skills such as imitating tool use, what behaviors are imitated, and under what conditions behaviors are imitated (Jones, 2007; Learmonth, Lamberth, & Rovee-Collier, 2005; Meltzoff & Moore, 1977; Meltzoff & Prinz, 2002; Miller & Dollard, 1941; Uzgiris, 1981). Prinz and Meltzoff (2002) refer to this type of imitation research as the "*What-research"* (p. 2).

Still other researchers have investigated the role of imitation in the development of self- and other-awareness and self-regulation. "The power of imitation reverberates into the social domain" (Kinsbourne, 2002, p. 325). Researchers have observed that young children use imitation of caregivers and later, of peers, to learn social rules, to develop self-control of behaviors ("effortful control") and to learn how to influence the behaviors of others (Bronson, 2000; Dalton, Chartrand, & Finkel, 2010; Eisenberg, 2005).

Meltzoff (2007) explains how infants show preferential attention and imitation to those acting "like me." Understanding that other people are "like me" is considered to be a foundation of later social cognition (Tomasello, 1999). Using primarily measures of emulation imitation, researchers have investigated infants' understanding of the intentions of others (Kiraly, 2009; Rakoczy, Tomasello, & Striano, 2004; Tomasello & Carpenter, 2005; Want & Harris, 2002; Zelazo, Astington, & Olson, 1999).

Researchers have also looked at the relationship between imitation and responsiveness to social modelling (Bryan, 1971; Forman & Kochanska, 2001), and how the transition from emulating-modeled behaviors to spontaneous self-control of those behaviors is facilitated (Boyer, 2009). Research has also examined the relationship between mimicry imitation and attachment, and later in development, the selective demonstration of friendship, affiliation, and social conformity as a way of creating reciprocal relationships, and developing an understanding of inter-subjectivity and interpersonal regulation (Dalton, Chartrand, & Finkel, 2010; Nadel, Guerini, Peze, & Rivet, 1999; Rączaszek-Leonardi, Nomikou, & Rohlfing, 2013; Trevarthan, 2005; Trevarthan & Aitken, 2001; Trevarthan, Kokkinaki, & Fiamenghi, 1999).

Social Communication

Wetherby and Prizant (2003) described the development of social communication as "a complex interplay of emerging abilities in social, affective, cognitive, and linguistic domains" (p. 6). Social communication skills encompass both communicative functions (e.g., protests or requests for help) and communicative acts (e.g., use of words or gestures to express oneself). Communicative acts may be gestural, vocal, or verbal. Social

communication also involves developing and maintaining reciprocal interactions (e.g., initiating joint attention, turn taking, and responding to others' bids for attention) and using social-affective signaling (e.g., facial expression, eye gaze, and tone of voice). Social communication relies on a certain degree of symbolic understanding (e.g., comprehension of language, constructive play, and complexity of routines) to support these reciprocal interactions.

Several authors have shown that social communication skills of young children have a hierarchical developmental pattern of acquisition (Carpenter, Nagell, & Tomasello, 1998; Striano, Stahl, & Cleveland, 2009). Individual differences in the acquisition of social communication skills have been well documented (Mundy, Block, Delgado, Pomares, Van Hecke, & Parlade, 2007; Striano, Stahl, & Cleveland, 2009), and these individual differences stabilize between 9 and 12 months (Mundy et al., 2007). Research has also demonstrated that emergent social communication skills are an index that strongly predicts later language and social cognitive skills (Carpenter, Nagell, & Tomasello, 1998; Mundy et al., 2007; Striano, Stahl, & Cleveland, 2009; Watt, Wetherby, & Shumway, 2006).

Several models have been suggested to explain the important role of social communication in child development. Bates, Benigni, Bretherton, Camaioni, and Volterra (1979) proposed a "universal cognitive model," which suggests that the development of joint attention and social communication is an expression of overall cognitive development. According to the "social cognitive model" (Tomasello, 1995), joint attention and social communication development reflect the development of specific components of a general social cognition (i.e., awareness that others have intentions).

Furthermore, Mundy et al. (2007) proposed a "multiple process model" that suggests that the multiple facets of social communication and the development of social cognition reflect the development of different executive processes.

Correlations between Imitation and Social Communication

Many researchers have documented correlations between poor, or disordered, development of imitation skills and impaired communication and social skills in older children with developmental disorders such as Autism Spectrum Disorder (Carpenter, Pennington, & Rogers, 2002; Charman, Baron-Cohen, Swettenham, Baird, Drew, & Cox, 2003; Girardot, et al., 2009; Heimann & Ullstadius, 1999; MacDuffie, Turner, Stone, Yoder, Wolery, & Ulman, 2007; MacDuffie, Yoder, & Stone, 2005; Rogers & Pennington, 1991; Stone, Ousley, & Littleford, 1997; Thurm, Lord, Lee, & Newschaffer, 2007; Toth, Munson, Meltzoff, & Dawson, 2006; Zwaigenbaum, Bryson, Rogers, Roberts, Brian, & Szatmari, 2005). Most of this research suggests a strong interdependency between social communication and imitation skills with this population. Butterworth (1999) suggested, "An innate capacity for imitation serves not only learning, but also communication" (p. 82). While some evidence suggests that imitation and social communication are related, little research has dealt with the relationship between these emergent skills in typically developing infants.

Social Constructivist Theory

Constructivist theorists appear to have neglected the fact that, by definition, imitation and social communication are not acquired in a vacuum. The acquisition of these skills require the child to work *in concert with* a communicative partner, typically

the primary caregiver. "Parents and peers lead children to perform novel acts and gain self understanding that is not possible through independent discovery in social isolation" (Meltzoff, 2002, p. 36). Research indicates that the ability, or motivation, to demonstrate imitation acts is constrained by the social context more than by the physical acts themselves (Kiraly, 2009; Learmonth, Lamberth, & Rovee-Collier, 2004; Meltzoff, 2007).

Social constructivist theorists argue that, primarily through reciprocal interactions, social learning takes place. "The development of the child's imagination and future learning are dependent on the ability to exchange points of view and imitated ideas with a companion" (Trevarthen, 2005, p. 98).

Bandura (1986, as cited in Olson & Hergenhahn, 2009) and Santrock (2006) theorized that four processes are essential for social learning: attention, retention, behavioral reproduction, and motivation. He suggested that, for social learning to take place, the infant must first *attend* to the model. This attending is mediated by the salience and prevalence of the target behavior and by the infant's perceptual capabilities and arousal state, which develop and change over time. The infant must then *retain* a mental representation of the target behavior. The process is constrained by the level of symbolic coding, or the complexity, of the target behavior and by the infant's cognitive skills, which again develop over time. Attempts to *reproduce* the target behavior are constrained by the developing physical abilities of the infant, as well as by the cognitive representation of the target behavior the infant has developed (i.e., the memory of what steps were involved) and the feedback the infant receives. The final process involves the infant's *motivation* to reproduce the target behavior. Bandura (1986) suggested that this

is constrained by external and internal incentives (e.g., tangible rewards, social context, and preferences). Masur (2000) described learning through imitation as a "complex interplay between ability and motivation" (p. 33).

The interplay of influence between the child, his behavior, and the environment is referred to as "reciprocal determinism," where "none of the three components can be understood in isolation from the others as a determiner of human behavior" (Olson & Hergenhahn, 2009, p. 336). In the case of infant learning of social communication, the 'environment' is a priori the social context of reciprocal interaction with the caregiver. "Children learn first, and learn best from their parents… people need people to learn" (Meltzoff, 2010). The abilities of establishing and maintaining joint attention, retaining information, reproducing behaviors (imitation), and maintaining the motivation to interact, are the essential social learning processes.

Statement of the Problem

This study asks the research question: What is the relationship between emergent imitation behaviors and the development of social communication skills in typically developing 15 to 18-month-old infants?

Hypothesis

The hypothesis of this study is that a positive correlation would be demonstrated between emergent imitation behaviors and social communication skills in infants who are between 15 and 18 months of age.

Purpose of the Study

The purpose of this study was to examine the relationship between emergent imitation behaviors and the development of social communication skills in typically developing 15 to 18-month-old infants. The first half of the second year of life has been identified as a dynamic and critical pre-symbolic period of development for social awareness and language (Bates et al., 1979; Bee & Boyd, 2010). By developing a better understanding of the relationships between precursory social interaction skills that support early language development, this research may provide parents and early childhood educators with practical information to identify early difficulties and promote the development of competent communication skills in young children. This study contributes to educational research by providing valuable information about foundational learning skills in young children.

Definition of Terms

The following terms are used throughout this thesis.

Imitative acts: reproduction of "(relatively short-lived) body movements, instrumental, or communicative actions" (Prinz & Meltzoff, 2002, p. 2).

Deferred imitation: "reproduction of a behavior occurs in the absence of the model" (Butterworth, 1999, p. 74).

Emulation: "actions that reproduce the effect or outcome of another person's behavior" (Jones, 2007, p. 593).

Imitative learning: "the gradual build-up of (relatively long-lived) dispositions, like traits, attitudes, habits or skills" (Prinz & Meltzoff, 2002, p. 2).

Mimicry: "the reproduction of another person's specific muscle movements" (Jones, 2007, p. 593).

Social Communication: "communication, social-affective signalling, and symbolic abilities of children" (Wetherby & Prizant, 2002, p. 1).

Attention following: "to follow into the attention of others by following the direction of their visual gaze or manual pointing gesture to an outside object" (Carpenter, Nagell, & Tomasello, 1998, p. 8).

Communicative function: "Purposes served by communicative acts. Major functional categories include behavior regulation, social interaction, and joint attention" (Wetherby & Prizant, 2003, p. 99).

Communicative gestures: "a non-vocal behavior directed to another person that serves a communicative function" (Wetherby & Prizant, 2003, p. 33).

Communicative means: "Behaviors used to express communicative intentions. May include vocalizations, gestures, and /or words" (Wetherby & Prizant, 2003, p. 99).

Joint attention skills/behavior: "the ability to coordinate attention between people and objects for social purposes. This is typified in behaviors such as following the direction of an adult's gaze or point (responding to joint attention) and pointing or showing an object for the purpose of drawing another's attention to an object or event (initiating joint attention)" (Watt, Wetherby, & Shumway, 2006, p. 1225).

Joint engagement: "episodes… in which adult and infant share attention to an object of mutual interest over some measurable period of time" (Carpenter et al., 1998, p. 5).

Reciprocity: "Ability to fill one's turns in reciprocal interactions" (Wetherby & Prizant, 2003, p. 101).

Social-affective signalling: "Eye gaze and the expression of emotion" (Wetherby & Prizant, 2003, p. 38).

Symbolic behavior: "Language comprehension, symbolic play and constructive play" (Wetherby & Prizant, 2003, p. 102).

Referential language: "word used to make reference to external objects or activities" (Carpenter, Nagell, & Tomasello, 1998, p. 22).

Delimitations of the Study

This study was limited to measuring the emergent imitation acts and social communication skills of infants. Only typically developing infants who were between 15 and 18 months of age, whose parents agreed to their participation, would be considered. The participants were infants living in the Pacific Northwest.

Cultural affiliation would be included in the demographics to ensure that the sample reasonably reflected the general population (Gall, Gall, & Borg, 2010) but would not be included as a variable in the data analysis. All variables, conditions, and populations not so specified are beyond the scope of this study.

Assumptions

The following assumptions presided throughout this study:

- The strong positive correlations seen between imitation behaviors and social communication skills in older children (i.e., Girardot, De Marino, Rey, & Poinso, 2009) could be observed and measured in infants at the emergence of these skills.
- The naturalistic behavior sample methods for the imitation and social communication measures would provide an accurate reflection of the infants' abilities, and encourage spontaneous behavior (Wetherby & Prizant, 2003, p. 2).

- The imitation and social communication behaviors being measured would have emerged, and individual differences in performance would have stabilized, in infants between 15 and 18 months of age (Carpenter, Nagell, & Tomasello, 1998; Heimann & Meltzoff, 1996; Jones, 2007; Mundy et al., 2007).

Summary

Current research has demonstrated that both imitation and social communication skills emerge early in infancy, with a sequential developmental pattern of skill acquisition. Social communication skills have been shown to predict later language and social cognition skills, and imitation has been identified as an essential skill for the development of social cognition and language skills. The relationship between imitation and social communication in infancy has not been well examined. This research study examined the correlations between emergent imitation and social communication skills in infants.

The following chapter presents a review of the current research on imitation and social communication skills in infancy. In addition, a review will be presented of the correlational research that examines the relationship between imitation and social communication skills in infants.

Chapter 2: Literature Review

Overview

In this chapter, the pertinent research on imitation and social communication skills in infants is reviewed in separate sections. In a subsequent section, research findings are reviewed on the correlations between imitation and social communication in infants. The sections include: *Imitation in Infants, The Social Context of Imitation, Social Communication in Infants*, and *Correlations between Imitation and Social Communication in Infants*.

Imitation in Infants

One of the most often cited and influential works on infant imitation is by Meltzoff and Moore (1977) on newborn imitation. The research has historical significance because the authors were attempting to determine if imitation exists in neonates as an innate ability rather than as a learned behavior. They used a quantitative experimental design, and presented two phases of research in one article. In the first study, the participants were six infants (three male and three female) between 12 and 17 days old. No other demographic information was provided. The experimenters modeled four different facial and hand gestures: lip protrusion, tongue protrusion, mouth opening, and sequential finger movements. The infant responses were videotaped for later coding. The target gesture was modeled four times, with up to three presentation sets allowed. Two groups of six coders, who were blind to which target gesture was being modeled, ranked the infant behaviors as one of the four possible modeled behaviors; one group coded facial gestures and one group coded hand gestures. The two highest and the two

lowest ranking gestures were collapsed together, creating a “yes”/”no” dichotomous score. They then used a Cochran Q test to determine if the behavior of the infants significantly matched the target gesture.

Meltzoff and Moore (1977) found that the infants matched the target gesture more frequently than the other gestures [lip protrusion matched 27 times ($p < .01$); mouth opening matched 26 times ($p < .02$); tongue protrusion matched 30 times ($p < .05$); finger movement matched 27 times ($p < .001$)]. The authors reported that the infants produced many gestures during the modeling phase. Besides the very small sample size ($n = 6$), the study had a major limitation in that the experimenter might have incorrectly judged that the infant was not attending if the infant was producing a different gesture, and continued modeling the target behavior until the infant began matching the target behavior. This limitation prompted the authors to develop a second study.

In Study 2 (Meltzoff & Moore, 1977), the participants were 12 infants (six male and six female), who were between 16 and 21 days old. Again, no further demographic information was provided. The infants were given a soother to suck while the experimenter modeled two facial gestures (mouth opening or tongue protrusion) in a counter-balanced order. This was done to try to control for the random mouthing behaviors seen during modeling in the first study. Then, while the experimenter maintained a neutral face, the soother was removed. The infants’ behaviors were digitally recorded on video and coded by a single coder who tallied the target behaviors seen on the tape. The results were then analyzed using Wilcoxon matched-pairs signed-ranks tests. The experimenters observed a significant increase in the frequency of the

target behavior over the frequency of baseline movements or other facial behaviors ($p <$ .005). The authors do not mention any limitations to the second study.

Since the infants were able to reproduce four different movement patterns, two of which they could not see themselves performing, the authors concluded that imitation must be an innate ability. The authors suggested that imitating facial gestures requires an intersensory coordination between visual perception and oral-facial proprioception to reproduce the action successfully. They suggested that future developmental research needs to consider the perspective that imitation is present at the start of child development and is not the end product of skill development.

The two experiments reported in the study were the first with evidence of an innate ability in newborn infants to attend to and mimic an adult model, using matched-pairs analysis to demonstrate that the infants were more frequently reproducing the target behavior than any other gesture. Previously, imitation in infants was considered a skill learned over time through behavioral reinforcement. This research opened the provocative possibility that very young infants may be using imitation for learning, instead of learning to imitate. The limitations of this research were the very small sample sizes (n = 6 and 12), methodological limitations of repeated presentations of target behaviors until the infants responded, and the generous coding of approximations of gestures.

Other researchers (e.g., Abravanel & Sigafoos, 1984) questioned the idea that imitative ability is innate in infants when they could not reproduce the results of Meltzoff and Moore (1979). They suggested instead that the behavior patterns noted were more likely "random movements," with some partially accurate matching of the model that

could be a "social reflex" or "fixed action pattern" released by the stimulation of frequent modeling that becomes suppressed with maturation, as it is for other early reflexive movements. Abravanel and Sigafoos (1984) also influenced the methodology of imitation research with infants, encouraging other researchers to be precise in their operational definition of imitation and careful in their procedures.

In 1989, Meltzoff and Moore proposed a new model for explaining the process of imitation that involves *active intermodal mapping* (AIM) between visual perception and motor production. They suggested that the infant "actively uses the adult's act as a model or guide against which to fashion motor output" (p. 961). They had observed that newborn infants were able to mimic movements, such as head-turning behavior in the opposite direction to the model, and tongue protrusions in the absence of any visual representation of their own face or mouth. This would require that the infants have some volitional control over these motor patterns and some perceptual and motor understanding of how to reproduce the target gesture. This suggests that something more deliberate is happening with infant imitation than purely reflexive motor patterns.

Another major theme in imitation research has been the delineation of timelines for the acquisition of imitation skills. Jones (2007) examined in detail the developmental acquisition of gestural and vocal imitation in young children, in a quantitative descriptive cross-sectional study of the mimicry behaviors of 162 infants, between 6 and 20 months of age. The participants were divided into successive two-month age groupings of approximately 20 (10 males and 10 females) infants per age group. The parents of the infants were recruited from county birth records in Indiana, and were from middle and lower SES groups of European American descent. In a lab setting, the parents of the

infants were shown a video model of a set of four of eight possible target behaviors (tap table; clap hands; wave bye-bye; sequential finger movements; vocalizing the early developing vowel sounds "ahh" or "eh-eh"; tongue protrusion; or placing hand on head), which they then modeled to their own infant. The infant responses were videotaped and two independent coders, blinded to the target behavior, judged which of the eight behaviors was being modeled to the infant by the parent. The author reported inter-rater reliability of .94 to 1.0.

Jones' (2007) research revealed a consistent sequential developmental pattern to the acquisition of mimicry. At six months, no clear evidence of mimicry was observed; that is, while 60% of the 6-month-olds matched tapping the table, and 40% matched tongue protrusion, these behaviors were seen with the same frequency spontaneously. By 8 months, more than 50% of the infants were able to imitate "aah" more frequently than spontaneous productions ($\chi^2 = 6.56$, $p < .01$). At 12 months, the infants were able to tap the table ($\chi^2 = 4.9$, $p < .03$), wave bye-bye ($\chi^2 = 4.63$, $p < .03$), clap hands ($\chi^2 = 5.27$, $p < .02$), and say "eh-eh" ($\chi^2 = 4.51$, $p < .04$) more frequently in imitation than in spontaneous productions. At 16 months, they were able to demonstrate imitation of sequential finger movements ($\chi^2 = 9.81$, $p < .01$) and hand on head gestures ($\chi^2 = 4.63$, $p < .03$). Lastly, at 18 months, the infants were able to mimic tongue protrusion more frequently in imitation than spontaneously ($\chi^2 = 6.24$, $p < .02$).

Jones (2007) suggested that mimicry might have been present at six months but that the behavior may be masked by other movement patterns over-riding the reproduction of the target movement. She also noted a pattern to the perceptual attributes of the target behaviors that the infants were able to imitate. The first actions imitated

were visible and audible to the infant when they were performing them, the next were only visible but not audible to the infant, and finally, the actions were invisible and inaudible to the infant who was not able to hear or see her or himself reproducing the target behavior (i.e., tongue protrusion). This suggested that imitation might be constrained by perceptual and motor development.

The author does not mention limitations to the study. She concluded that the developmental pattern of mimicry reflects "changes in infants' knowledge of their own body parts and the behavioral potentials of those parts, and also changes in the infants' social knowledge and motivations" (p. 598). As a suggestion for further research Jones (2007) noted that "the origins of imitation (the mechanisms that account for the development of this category of behaviors) and the nature of imitation (the mechanisms producing moment-to-moment mimicry, emulation, and other forms of behavior matching) are almost entirely unknown, and waiting to be described and explained" (p. 598).

With this study, Jones (2007) demonstrated a developmental progression in infants' ability to mimic actions and sounds between 8 and 18 months that appears to be constrained by their perceptual and motor development. The constraint of physical and perceptual development could explain some of the discrepancies and similarities between the research findings of Meltzoff and Moore (1989) and other researchers such as Abravanel and Sigafoos (1984). Both of these studies looked at infants under 5 months. Meltzoff and Moore (1989) used the motorically and perceptually simple actions of tongue protrusion and head turning, while Abravanel and Sigafoos (1984) included the more complex actions of hand opening, chin tapping, and chest tapping. The infants in

Jones' (2007) study were not able to perform tapping/clapping actions until at least 12 months, and were not able to perform hand gestures or head touching until 16 months. The most successful behavior reproduction in Abravanel and Sigafoos' (1984) study was simple tongue protrusion, which is consistent with Meltzoff and Moore's (1989) findings. All of the research on the emergence of imitation suggests that the perceptual and motor developmental changes between birth and 18 months, significantly affect the production of motor imitation.

Jones' (2007) findings also support Meltzoff and Moore's (1989) model of *active intermodal mapping* between perception and motor production in imitation. The implication for future research is that researchers need to consider the developmental appropriateness of the perceptual and motor complexity of imitation tasks, which they ask infants to reproduce.

The Social Context of Imitation

Learmonth, Lamberth, and Rovee-Collier (2005) noted that in their deferred imitation research some infants failed to produce deferred imitation when new experimenters entered the testing room. They developed a quantitative experimental research project to determine if the social context of the task influenced the performance of the infants who were being tested; the infants were between 6 and 18 months of age. A second research question asked in these studies was does immediate imitation practice improve deferred imitation production the following day? The authors presented the results of four complete studies in their paper, identified as Study 1a, 1b, 2, and 3.

For their first study (1a), they recruited 18 six-month-olds; 10 were Caucasian, 4 were Asian, and 4were from other ethnic backgrounds, and all were from high SES backgrounds. The task in the study was to imitate the three-step behavior of pulling a mitten off a puppet, shaking the mitten to hear the bell inside, and replacing the mitten. This behavior was modeled by an experimenter in the infant's home with half of the infants being allowed to practice this behavior. Then, 24 hours later, an experimenter returned to the home to test the infant's deferred imitation of the task, and the infant's responses were videotaped for later counting of imitative responses. For half of the groups, the experimenter on the second day was novel – the infant had never seen the experimenter before. For the other half of the groups, the experimenter who came to the home on the second day either had modeled the behavior on the previous day or had been in the room during the behavior modeling. The results were analyzed using a one-way analysis of variance (ANOVA).

The researchers found that if the experimenter on the second day had been present during, or had performed, the original modeling, then the infant was able to produce the deferred imitation. If, 24 hours later, the experimenter was novel to the infant, they appeared to be unable to produce the deferred imitation the next day, even if they had practiced the behavior (immediate imitation) following the demonstration (F [3, 20] = 3.74, $p < .05$). The authors concluded that this finding supported their anecdotal observations that the presence of a novel experimenter suppressed the 6-month-old infants' ability to retain and reproduce the behavior on the following day.

This study demonstrated that the ability of 6-month-old infants to produce deferred imitation of behavior is sensitive to the social context in which the behavior is

learned. The infants were not able to generalize their imitation behavior to a new social context (e.g., when a new person was present), suggesting that a strong social component is present in the act of imitation, both immediate and deferred.

The second part (Study 1b) replicated these results (Learmonth, Lamberth, & Rovee-Collier, 2005). In Study 1b, each possible combination of experimenter exposure (present during demonstration; present immediately before but not during demonstration; present the day before demonstration; never seen before) was sampled, and all of the groups were allowed to immediately imitate (practice) the behavior. The participants in this study were 24 six-month-olds (14 boys and 10 girls) from mostly Caucasian (n = 11), but also African-American (n = 1), Asian (n =8), Hispanic (n = 3), and Mixed-race descent (n = 1). Again, the authors found that the presence of a novel experimenter impaired the infants' ability to reproduce the modeled behavior from the day before (t (10) = 2.71, $p < .01$). This study again demonstrated that 6-month-old infants were sensitive to the presence of the experimenters in the social context *during* the behavior demonstration. They selectively reproduced the behavior in deferred imitation only when the experimenter had been present during the demonstration, regardless of whether or not they had been seen the day before.

To determine whether or not the effect of the social context applies to other age groups, Learmonth, Lamberth, and Rovee-Collier (2005) repeated this experiment in Study 2 and Study 3. The participants in Study 2 were 9-month-olds (n = 24) and 12-month-olds (n= 24), and the participants in Study 3 were 15-month-olds (n =18) and 18-month-olds (n = 18). Each of the age groups was divided evenly into the same four presentation condition groups as before.

The researchers found that the 9 to 18-month-old infants were able to consistently produce the deferred imitation if the experimenter was not novel or if they had the opportunity to practice the behavior (F [3, 40] = 4.24, $p < .01$). The authors do not mention any limitations to the studies. They concluded that for the 9 to 18-month-olds, deferred imitation is constrained by two conditions: either social context or practice. The authors suggested that in social groups, such as humans, learning takes place as an exchange of ideas from one group member to another. The infants' "heightened attention to the actor, as well as the event, may be critical to the development of early cognition" (p. 312).

The research of Learmonth, Lamberth, and Rovee-Collier (2005) has significant implications for the study of imitation in infants. The authors encouraged researchers to consider that, while deferred imitation in 6-month-olds appears to be rigidly constrained by social context, the ability to practice a new behavior ameliorates this effect in older infants. This suggests that the nature of infant learning through imitation changes as a factor of age. This research would also suggest that the study of imitation in infants requires a naturalistic and familiar social context for young infants to demonstrate their abilities. Additionally, it suggests that these social context constraints relax over time, as the infants grow older. The observations that the infants' sensitivity to the actors and their familiarity with the task influenced their ability to perform deferred imitation supports Bandura's theory that attention and motivation, in conjunction with imitation, are key processes for learning.

Kiraly (2009) attempted to evaluate this influence of social context on the social learning of novel tool use (using a ball as a tool) in infants, with a quantitative

experimental design. His participants were 85 14-month-olds (44 male and 41 female). No other demographic information was provided. The participants were distributed into four presentation condition groups: (1) hand unsuccessful-tool successful with model present at post-test (n =14); (2) hand unsuccessful-tool successful with model absent at post-test (n = 17); (3) tool successful with model present (n = 13); (4) tool successful with model absent (n = 18); and a control condition group (n = 22). In the "hand unsuccessful-tool successful" presentation condition (1 and 2), the infants watched as the experimenter attempted to remove a box embedded in a larger box by hand. The experimenter made the goal and the failure with this method obvious. Then the experimenter modeled how to use the novel tool (a ball) to achieve the goal (removing the box). In the other presentation condition, "tool successful" (3 and 4), the experimenter simply modeled the successful removal of the box using the novel tool. A control group was used to control for the variable of additional manual handling of the materials in the hand unsuccessful group. These children saw neutral handling of the materials prior to the successful tool use. The post-test of deferred imitation was one week following the initial modeling session for each presentation condition. The test condition was that the experimenter at the post-test was either a novel person, or the modeling experimenter.

When the three presentation conditions were analyzed, using a factorial analysis of variance (ANOVA), the infants in the hand unsuccessful-tool successful condition were more likely than the infants in the other presentation conditions to use the ball as a tool immediately rather than try to manipulate the boxes with their hands first (Wald χ^2 = 17.125, df = 2, p < .001). No significant differences were found between the tool successful and the hand-manipulation control conditions.

The pair-wise comparisons of the test conditions (modeling experimenter present/absent), revealed that the presence of the modeling experimenter at the post-test significantly increased the frequency of successful tool use imitation (Wald $\chi^2 = 6.072$, $df = 1$, $p = .014$), thus reinforcing Learmonth, Lamberth, and Rovee-Collier's (2005) findings of contextual sensitivity of imitation.

Kiraly (2009) concluded that the 14-month-olds were demonstrating selective imitation. That is, they did not always blindly mimic all of the behaviors of the experimenter, but emulated their performance, skipping the unsuccessful parts. The author suggested that this may have been related to the virtual transparency of the intended goal in the hand unsuccessful-tool successful condition, and that more trial and error or mimicry behaviors may have been seen with a less transparent goal. He stated that this research demonstrates "the importance of selective interpretation behind imitative learning" (p. 23) and was "proof of sensitivity to communicative relevance in imitation" (p. 24).

The only limitation he mentioned was that the action of using the ball as a tool appeared to be physically difficult for many of the infants, with only a 5-28% success rate of using the ball to retrieve the object. Again, this is consistent with Jones' (2007) suggestion of motor and perceptual development influencing imitation.

Kiraly's (2009) findings encourage speculation that a developmental shift from mimicry to emulation imitation may occur as early as 14-months of age. This study showed that by 14-months of age, infants appear to be able to learn from the unsuccessful actions of a model, and avoid making the same mistakes when attempting to reproduce the outcome. They appear to be able to differentiate between non-purposeful random

actions and purposeful, goal-oriented actions. The infants also demonstrated a sensitivity of the social familiarity of their partner in the interaction. As in Learmonth, Lamberth, and Rovee-Collier's (2005) study, the infants reproduced the target behavior more frequently when the modeling experimenter was present. Interplay between social communicative functions and infant imitation performance seems to be present, which is not yet fully understood.

Even though developmental changes between birth and 18-months are apparent with imitative behaviors, and the social and physical variables that influence imitation production are being discovered, the nature and functions of early imitation are still largely unknown. Further research evidence for the nature and function of social communication in infants will be presented in the next section.

Social Communication in Infants

The aim of most social communication research involving infants has been to identify social-cognitive and behavioral predictors of later language abilities. Consequently, most of the research has looked at correlations between social communication skills and later language outcomes.

Carpenter, Nagell, and Tomasello (1998) carefully documented the developmental emergence of multiple social-cognitive and communicative skills in infants between 9 and 15-months of age, in a quantitative descriptive study. The purpose of the research was to longitudinally document the emergence of social-cognitive skills, and second, to analyse the intercorrelations between them (Study 1). Third, they evaluated whether or not joint engagement and maternal language use predicted the infants' communication

skills (Study 2). For the purposes of this paper, I mainly consider their first two objectives in Study 1. The participants were 24 infant/mother dyads (12 male and 12 female infants) who were from primarily Caucasian (n = 22) and African-American descent (n = 2). The parents were recruited from a volunteer database at the Emory University's Psychology department. The infants were assessed monthly in a lab playroom setting between the ages of 9 and 15-months. Each of the seven play sessions was administered by one experimenter, and live-coded by a second experimenter. The sessions were videotaped for later reference and coding. In each session, eight social-cognitive measures were used: (1) joint engagement, (2) gaze following, (3) point following, imitative learning of both (4) instrumental actions, (5) arbitrary actions, directing attention with, (6) declarative (statement) gestures or (7) imperative (questioning) communicative gestures, and (8) referential language.

The gaze-following (2) and point-following (3) tasks were elicited by the experimenter by establishing eye contact with the infant, and then directing the infant's attention to a target object with an exclamation and either eye gaze or finger point. This task was passed if the infant correctly localized the object in the room, as judged by the second experimenter. The experimenter elicited the imitative learning tasks by demonstrating either an instrumental action (4) (e.g., opening a hinge or pressing a spring), or an arbitrary action (5) (e.g., putting their forehead down on a specially designed box). The result of each action (e.g., a light going on) was delayed for a second to provide an opportunity for an indication of expectancy from the infant. If the infant performed the task in imitation and looked expectantly for the response, they passed the measure. The infants' use of declarative (6) gestures was elicited by the experimenter

who caused a toy in the room to suddenly move. Imperative gestures (7) were elicited by the experimenter who gave the infant a desired toy in a clear but locked container, or by activating a windup toy and then handing it to the infant. The number and length of joint engagement (1) episodes and referential language use (8) were measured from the videotapes.

The infants were also presented with a physical and a social obstacle task, to differentiate between physical and social problem solving. For the physical obstacle task, an interesting toy was placed under a clear box near the infant. If the infant removed the box within one minute, they passed this task. For the social obstacle task, the experimenter first "blocked" the infant's play with a toy by covering the infant's hands with their own for five seconds. Then the experimenter performed a "teasing" action by taking away a toy the infant was playing with, and holding it out of reach for five seconds. These tasks were considered passed if the infant looked at the experimenter's face rather than the object in question.

In addition, the infants were presented with two non-social, object-related tasks: demonstrating understanding of object permanence and spatial relations. Object permanence was demonstrated if the infant was able to find an object hidden under an opaque screen on two trials. Understanding of spatial relations was measured by giving the infant wooden blocks and a large plastic cup. The task required the infant to place two or more blocks in the cup, and remove two or more blocks from the cup.

For Study 2, the researchers also measured the total time the mother and infant spent in joint engagement during each free-play session, and the number of joint engagement episodes. The researchers use the term "joint engagement" to refer to

"extended periods of shared attention… characterized mainly by the infant's gaze alternation between object and adult" (p. 5). An episode of joint engagement, for example, would be an infant and mother both attending to a toy and gaze shifting between each other and the toy. In addition, the mother's language was coded as utterances that either *followed* the infant's attention focus (i.e., "you like playing with that car"), *lead* the infant's attention (i.e., "look at this book") or *other* (i.e., "I'll put that away").

The age of emergence (AOE) was identified for each social-cognitive skill across the seven-month period. The AOE was defined as "the age at which an infant was first able to successfully perform a particular task or skill (regardless of performance in subsequent months)" (p. 39). The mean AOE for maintaining joint engagement (1) was at nine months (all the infants met emergence criteria immediately). For attention following, the mean AOE of point following (3) was 11 months, and 13 months for gaze following (2). For communicative gestures (6 & 7), the mean AOE was 10.7 months for showing, 12.1 months for giving, and 12.3 months for pointing. The mean AOE for both forms of imitative learning (4 & 5) was 11.9 months and for referential language (8) was 15.2 months. For passing the physical obstacle, the mean AOE was 9.2 months, and passing the social obstacle was 10.5 months. The mean AOE for spatial relations was 11.8 months and for object permanence was 12.3 months.

The most common order of emergence of the five major social-cognitive skills the researchers identified was determined to be joint engagement, communicative gestures, attention following, imitative learning, and then, referential language. These findings concur with observations that before infants can effectively use communicative gestures

or follow another person's attention, they must be able to achieve joint attention (Bates et al., 1979). Likewise, before they can imitate, they must be able to follow and understand the model's attention focus and gestures (Kiraly, 2009). The object-related skills did not fit consistently into any prerequisite pairs pattern, but instead, emerged independently among infants, between the emergence of joint engagement or communicative gestures and referential language.

Using an "ordering-theoretic method" to identify prerequisite relations between pairs of these skills ("i.e., pairs of skills that always emerge in the same order," p. 66), the authors consistently found the same ordering relationship. For example, communicative gestures always emerged after joint engagement had emerged, and always appeared before referential language. Only attention following and imitative learning did not have a prerequisite relationship with each other, but both emerged only after joint engagement and communicative gestures had appeared, and before referential language emerged. They appeared within the same period (between 11 and 15 months) in independent order within this hierarchy. Therefore, when the alternative order of emergence was added (joint engagement, communicative gestures, *imitative learning, attention following,* referential language), then 83% of the infants were accounted for. The remaining four infants varied only in their order of acquisition of the middle three skills: communicative gestures, imitative learning, and attention following. For these infants, communicative gestures appeared at the same time as, or immediately after, imitative learning or attention following.

The correlations between the five primary social-cognitive skills were then evaluated. The AOE of gestures significantly and positively correlated with both

attention following and referential language ($r = .46$, $p < .05$). Attention following was also significantly correlated with referential language ($r = .36$, $p < .05$). The remaining correlations did not reach significance.

The authors of this study demonstrated a definitive pattern of early development for individual social-cognitive skills between 9 and 15-months of age. They concluded that these results support the view that "the period from 9 to 12-months of age represents a crucially important age in the emergence of infant's skills of social cognition" (p. 77). The prerequisite relationships identified between skills support the idea that a hierarchical order is involved with the acquisition of early social communication skills, some of which depend on the acquisition of imitation. Interestingly, the social-cognitive skills did not correlate to any of the non-social object-related tasks that measured non-verbal cognitive skills, suggesting that different learning processes are being used between these skill-sets. This finding would support Mundy et al.'s (2007) multiple process model of social cognition.

The infants' mean number of gestures, words produced, and words comprehended increased between 9 and 15-months. The infants' use of communicative gestures increased from an average of two at 9-months, to more than eight at 15-months, indicating a significant age effect (F [6, 23] = 74.99, $p < .001$). The infants' production of words increased significantly with age (F [6, 23] =11.02, $p < .001$) as did their comprehension of words (F [6, 23] = 47.13, $p < .001$). All of this evidence confirms that the infants were rapidly acquiring more social communication skills between the ages of 9 and 15-months. The authors also noted significant individual differences in the

acquisition of these skills. For example, the number of words comprehended at 15-months ranged between 6 and 281 for individual infants.

A significant positive correlation was found between joint-engagement and gestures produced at the earlier ages (r = .46 and .45, $p < .05$), but not at the later ages once language had emerged. This would be expected since pre-verbal infants would be relying on more non-verbal or gestural means to establish and maintain joint-engagement, compared to older, more verbal infants (Bee & Boyd, 2010). By 15-months, joint engagement correlated only to gesture production at 11 and 12-months (r = .45 and .42, $p < .05$). No other significant correlations were found between joint engagement and gesture skills.

When the results from Study 1 were correlated with the results of Study 2 ("joint engagement and communication"), the AOE for communicative gestures was found to be significantly negatively correlated to word production between 12 and 24 months (r = -.34 to -.43). This indicated that "the earlier the infants displayed attention following and communicative gesture skills (the smaller the AOE), the more words they produced from 12 through 24 months" (p. 110). When maternal language lead the infant's attention (e.g., "look at the train"), no significant correlations to comprehension were found, but maternal language that followed the infant's attention (e.g., "you got it open") at 12 months correlated strongly and positively to word comprehension between 11 and 14 months (r = .56, .60, .53, and .51, $p < .01$). A strong correlation was found between joint engagement at 14 months and word productions at 13 and 14 months (r = .41, .43, $p < .05$) and even stronger correlations were noted with word productions at 15, 18, and 24 months (r =.52, .63, and .56, respectively, $p < .01$). When considered together, joint

engagement and maternal use of language (e.g., leading or following) accounted for approximately 50% of the variance in the infants' early language skills.

The authors concluded that social communication development "requires both specific social-cognitive skills on the part of the child and specific types of social interaction" (p. 130). The authors did not mention any limitations to these studies; however, for future research they indicated the need to study the relationship between joint engagement and language in a variety of social context settings, "as this relationship appears to be highly sensitive to situational demands" (p. 114). This echoes the findings of Learmonth et al. (2005) and Kiraly (2009) on infant imitation.

Carpenter et al. (1998) demonstrated the relationship between the gradual acquisition of communication skills in infants and the prerequisite social-cognitive skills. They also identified the types of social interactions needed to facilitate the acquisition. They also demonstrated the wide range of inter- and intra-individual differences in the time frames of the skill acquisition. Infants who developed the most language use and comprehension at later ages were: (a) the first to acquire joint engagement and gestural communication, and (b) the ones who spent the most time in joint social engagement with a parent who used language that followed the infant's focus of attention. The authors hypothesized that before infants can initially acquire language, they must first understand that other people are "intentional agents" and they may require adults to "scaffold the process by following into their already-established attentional focus" (p. 130). This is similar to Kiraly's (2009) conclusion that before infants can emulate behavior they need to understand the intended goal for the behavior. Later in development, the infants appear to be increasingly able to decontextualize or independently discern the referents

for the new language the adults are using, and their dependency on adult scaffolding decreases (Bates et al., 1979). This research underscores the important role of the social interaction context in the acquisition of pre-linguistic and linguistic communication skills.

The contribution of prelinguistic social communication skills in predicting later language functioning was investigated by Watt, Wetherby, and Shumway, in 2006. Their quantitative correlational study looked at the predictive relationship between scores on the Communicative and Symbolic Behavior Scales-Developmental Profile (CSBS-DP) for behavior samples and the Mullen Scales of Early Learning (MSEL) receptive and expressive language scores.

The 160 participants (57% male [*n* =91]) were criterion sampled from a larger sample of 1,000 typically developing infants between 6 and 24 months, living in Tallahassee, Florida, who were taking part in a large-scale longitudinal study. The demographic information was presented and compared to the region, which the authors suggested was an over-representation of Caucasians (80% Caucasian [*n* = 128], 7.5% African-American [*n* = 12], 5.6% Hispanic [*n* = 9], 3.8% Asian [*n* = 6], 3.1% other [*n* = 5]). The participants met the criteria of having completed CSBS-DP behavior samples between 12-16 months of age ("early"), and again between 18-22 months ("later"), and having completed a MSEL developmental assessment by 36 months ("language outcome").

The authors reported an internal consistency reliability of .86 to .89 for the Composite scores of the CSBS-DP behavior sample. They also reported a high inter-rater reliability (*g* coefficient) of between .82 and .99 across the subtest measures of the CSBS-DP. Individual items from the CSBS-DP "that have been found to be associated with

language outcome" (p. 1227) were used for the analysis. No other discussion of validity was reported.

The MSEL is reported to have an internal consistency between .76 and .86 for the Receptive Language Scale and between .88 and .91 for the Expressive Language Scale. The inter-rater reliability is reported as .95 for the Receptive Language Scale and .98 for the Expressive Language Scale. Regarding validity, the authors reported that the MSEL "has been shown to demonstrate good psychometric properties for the children in the age range of this study" (p. 1229).

The authors found a continuity of development of social communication skills through the pre-linguistic period and into the linguistic period, and that some of these skills "make significant unique contributions to language outcome" (p. 1233). They found that early acts for joint attention (e.g., showing a toy) and the inventory of gestures (e.g., pointing) correlated to comprehension outcome at 3 years (r = .31 and .33, respectively, $p < .001$). Early acts for joint attention, inventory of gestures, and inventory of sounds (i.e., speech sounds produced during play) all correlated significantly to expressive language outcomes (r = .37, .28, and .33, respectively, $p < .001$). These results correspond with those of Carpenter et al. (1998). Lastly, they found that early measures of comprehension moderately correlated to later expressive language (r = .38, $p < .001$) and receptive language skills (r =.41, $p < .001$).

A hierarchical regression analysis revealed that the early (12-16 months) social communication skills of joint attention acts and inventory of gestures, along with the symbolic skills of language comprehension and symbolic play each contributed discretely to the receptive language outcomes at 3 years (R^2 = .24, $p < .001$). Later predictors (19-

22 months) of receptive language outcomes were inventory of words and language comprehension ($R^2 = .31$, $p < .001$). The early predictors of expressive language at 3 years were the social communication skills of acts for joint attention (e.g., showing) and inventory of gestures (e.g., pointing), and the inventory of speech sounds and symbolic comprehension (e.g., number of words understood), which all contributed discretely ($R^2 = .23$, $p < .001$). The later predictors of expressive language were inventory of words (e.g., number of words spoken during sample) and comprehension (e.g., number of words understood) ($R^2 = .31$, $p < .001$). Both early and later comprehension skills (e.g., number of words understood) contributed significantly to both expressive ($R^2 = .26$, $p < .01$ and .52, $p < .001$, respectively) and receptive language ($R^2 = .30$, $p < .01$ and .51, $p < .001$, respectively) outcomes at 3 years.

Watt et al. (2006) concluded that the two most important social communication skills early in the second year of life are acts for joint attention and conventional gestures, because they encourage and maintain joint attention interactions where caregivers can model language and build language comprehension. They did not mention any limitations to their study, but suggested that future research should look at patterns of social communication functioning for children with atypical development.

This study by Watt et al. (2006) reinforced the importance of the early social communication skills for building language comprehension early in the second year of life. Specifically, the authors demonstrated that the social communication skills of early comprehension (e.g., words understood), joint attention acts (e.g., showing toys), and communicative gestures (e.g., pointing) significantly predict both receptive and expressive language skills by age 3.

Correlations between Imitation and Social Communication in Infants

Quantitative correlation research that looks at the relationship between imitation and social communication skills has largely focussed on the relative deficits of both of these skill-sets in older, atypical populations such as school-aged children with Autism Spectrum Disorders (Girardot et al., 2009; Marton, 2009). In this research, deficits in imitation and joint attention are assumed to contribute to the social communication and language deficits that are the hallmarks of these disorders (Nadel et al., 1999).

A few studies have involved typically developing infants between 12 and 18 months. Slaughter and McConnell (2003) conducted a quantitative cross-sectional correlation analysis of the relationships between gaze following, social referencing, object-directed imitation, and vocabulary development. The participants in their study were 60 infants (26 boys and 34 girls) between 8 and 14 months, whose parents were recruited through newspaper ads and word of mouth. The infants were mostly of Caucasian descent (90%). No other demographic information was provided. The infants participated in a 30-minute play session in a lab setting. Before the session, the caregivers were interviewed using the MacArthur Communication Development Inventory (MCDI) to measure the infants' language production. Tasks were presented in a counter-balanced order and the infants' behaviors were videotaped for later scoring.

The infants were presented with two trials of a gaze-following task (the experimenter turned his or her own head to fixate gaze on an object) and two trials of a social-referencing task (the caregiver was trained to either express pleasure or disgust to a novel object/toy using facial expression and tone of voice). The infant received one point for each head turn away from mid-line for the gaze-following task, and one point for each

time they touched or played with the "pleasure" object over the "disgust" object. Two imitation tasks were also presented to the infants who were then allowed to attempt the task. These tasks involved actions on objects: a plastic dumbbell that could be pulled apart and a short chain that could be dropped into a wicker jug. Any attempt by the infant to imitate the experimenter's action within 30 seconds, received one point.

The tasks were scored by a single naïve coder, with a second coder scoring 20% of the samples; the inter-rater reliability was reported to be between 92% and 100% for the various tasks. The authors reported that "continuous scores" were collected for each task (e.g. a score of zero or one for each trial, for a total possible sum of two for any of the three tasks). This actually appears to be a repeated pass/fail measure. The narrow range of scores limited the variability of the scores. In addition, partial or approximate attempts at imitation were scored as pass (or one point).

Slaughter and McConnell (2003) found only one significant positive correlation, between vocabulary and the gaze following task ($r = .269$, $p < .05$). That is, the infants who had the higher scores for gaze following had larger vocabularies. This corresponds to the findings of Carpenter et al. (1998), and Watt et al. (2006), for older children. An ANOVA of the age differences between infants who passed one, two, or all three of the items in the joint attention tasks revealed an age effect indicating development of more joint attention skills with age (F [7,48] = 2.21, $p < .05$). The authors suggested that the limitations to their study were the limited number of trials for the tasks due to the young ages of the infants, and the restricted range in scores that resulted in limited variability.

The researchers concluded that, while they did not see the correlations seen in other studies, their results seemed to support the developmental sequence of skill

acquisition proposed by Carpenter et al. (1998): "the infants who passed the social-referencing task were significantly younger than those who passed the imitation task" (p. 67). They also suggested that their results for the correlations between gaze-following and vocabulary supported Carpenter et al.'s (1998) correlations between joint engagement, attention following, and word production. For future research, they suggested that longitudinal studies should be conducted on the continued development of joint attention between 12 and 18 months.

Slaughter and McConnell (2003) called into question the assumed relationships between joint attention, imitation, and language development. Nevertheless, in their study, a significant limitation was the actual performance of the infants on the three presented imitation tasks. The number of infants who demonstrated successful performance on any individual task ranged from 7 to 14, out of 60. Only 3 to 5 infants succeeded in performing any two tasks, and only one infant successfully performed all three tasks. Given the research precedence (Carpenter et al., 1998; Heimann & Meltzoff, 1996) that these tasks are developmentally appropriate and achievable for these age groups, and given the generous scoring procedures, one must question why this particular group of participants were unable to achieve them. These results may speak to the social context sensitivity of social communication and the imitation performance of infants and underscore the importance of considering social context when designing research that involves infants.

Carpenter, Tomasello, and Striano (2005) published the results of several quantitative correlational studies investigating whether or not infants in the second year of life could perform role-reversals in their imitative behaviors, and whether or not a

relationship exists between this cognitive ability and language development. In the first study (Study 1), the authors observed 48 typically developing 12 and 18 month-olds performing imitation tasks involving body actions and actions on objects. There were 24 infants were in each age group (12 of each sex), recruited from a research volunteers database. No other demographic information was provided. The tasks modeled for the infants involved either self-to-self role-reversals (e.g., roll toy car on own arm; tap own nose) or other-to-other role-reversals (e.g., roll toy car on other person's arm; tap the other person's nose), with the infants' responses being videotaped. The infants' responses were live coded by one experimenter, and recoded from the videotapes by a second experimenter. The authors reported the inter-observer reliability with Cohen's kappa scores of .91 for the 12 month-olds and .97 for the 18 month-olds. The infants' language comprehension, language production, and pronoun production were measured using the MacArthur Communication Development Inventory (MCDI). No reliability or validity information was provided regarding this measure.

Both age groups demonstrated limited imitation attempts (22% of trials for the 12-month-olds and 30% of trials for the 18-month-olds). The researchers found a strong positive correlation between the ability to do other-to-other role-reversals and pronoun comprehension ($r = .61$, $p = .005$) and pronoun use ($r = .47$, $p = .029$) in the 18 month old group. No significant correlations were found between self-to-self role-reversals and language in the 18-month-olds, or between any role-reversals and language in the 12-month-old group. The authors suggested that a limitation in their study was the 18-month-olds who were "shy" about acting on the experimenter's body, which was demonstrated by their hesitation to perform other-to-other role-reversals. They suggested

that the emergent symbolic language used by 12-month-olds does not require much understanding of role-reversal, while the pronoun use demonstrated by the 18-month-olds (e.g., “me” versus “you”) requires a certain amount of understanding of contextual perspective.

Study 1 by Carpenter et al. (2005) demonstrated a developmental change in the ability to perform role-reversal imitation with age, corresponding to the development of formal symbolic language understanding and use. Most of the younger infants were not able to demonstrate an understanding of the perspective reversals required to perform the role-reversal imitation or pronoun use, such as “that is your shirt, this is mine”. By 18 months of age, both of these skills were evident.

In Study 2a, the same group of infants were presented with a triadic object-mediated role-reversal game (hiding an object under a cloth for the other person to find) to test if the infants could perform this type of role-reversal. The task required the infant to use an object to interact collaboratively with another person. One experimenter demonstrated the game and then handed the objects to the infant. A second experimenter scored whether or not the infant looked at the face of the experimenter or the caregiver when they imitated the hiding game. The infants’ responses were videotaped for later coding. Inter-observer reliability of the coding was reported as a Cohen’s kappa of 1.0 for the 12-month-olds and .71 for the 18-month-olds. The scores were then correlated to the previous language scores from the first study.

The authors found significant age differences in the number of infants who imitated the game with a look to an adult’s face, with more 18-month-olds looking at the experimenter (χ^2 [1, N = 44] = 10.96, p = .0005). Again, for the 12-month-olds, no

significant correlations were found between the role-reversal imitation and language, but an "almost significant" positive correlation was found for the 18-month-olds (r = .33, p = .078).

Again, Carpenter et al. (2005) demonstrated developmental changes in how infants performed role-reversal imitation between 12 and 18 months, with a modest relationship to developing language abilities. This study specifically demonstrated a significant difference between the 12 and 18-month-olds' use of eye gaze as a social communication skill *during* imitation. The social use of eye gaze during the role-reversal imitation task turns the task into a collaborative joint activity and a communicative act, rather than simple mimicry. It also clearly demonstrates a qualitative shift in the coordinated use of imitation and social communication between 12 and 18 months of age (Wetherby & Prizant, 2002).

In Study 2b, an "Offering" role-reversal task, involving two distinct 'roles' of "the offerer" and responder, was presented to infants to see if they could switch between both roles in a simultaneous interaction. The participants were 52 infants (31 boys and 21 girls), recruited from a volunteer database in a middle-sized German city. Half were 12 months old, and half were 18 months old. No other demographic information was provided. Each infant was presented with four trials of paired objects that fit together: one 'actor' object and one 'base' (e.g., a tiger figure that went on a plate; a Lego brick that went into a cup). The experimenter twice modeled how to put the actor onto the base and then gave the infant the actor and "offered" the base. This was repeated until the infant could place the actor on the base. The experimenter then gave the infant the base and held out the actor. The infant was expected to reverse their previous role and "offer"

the base to the experimenter. The infants' responses were videotaped for later coding. Inter-observer reliability was reported as a Cohen's kappa of 1.0 for offering, 1.0 for spontaneity, and .65 for looking at the experimenter.

The researchers found that more 12-month-olds could complete this role-reversal than in previous studies, with no significant differences between the groups in offering or using eye gaze with the offer (χ^2 [1, N = 52] = .43, p = .26). This suggests that this role-reversal task was more communicatively transparent or obvious, and therefore, easier for the 12-month-olds to understand and perform (Kiraly, 2009).

From these studies, the authors concluded that infants are "beginning to be able to engage in role-reversals at an age when they are beginning to engage in productive language" and some relationship exists "between role-reversal imitation and language" (p. 268). For future research, they suggested looking at the complex relationships between both types of role-reversal imitation and symbolic communication development in both typically developing children and children with autism.

These studies by Carpenter et al. (2005) demonstrated that the *nature* of the role-reversal imitation tasks influenced the infants' ability to successfully perform role-reversal imitation, again underscoring the importance of the developmental appropriateness and social context of imitation tasks with infants. This research also demonstrated that the ability to understand and perform role-reversals improves with age between 12 and 18 months, and has some relationship to developing language, especially in the acquisition of pronoun use and understanding. Pronoun understanding and use appears to require infants to understand the reversal of perspective (e.g., "you" versus "me"), which can also be demonstrated through their ability to reverse roles in imitation

tasks (Carpenter et al., 2005). This supports the findings of Carpenter et al. (1998) that the emergence of referential language depended on the prior emergence of imitation. When individual infants were able to perform the role-reversal imitation, they were able to coordinate it with social eye gaze, and at 18 months, they were able to demonstrate pronoun understanding and use.

Heimann, Strid, Smith, Tjus, Ulvund, and Meltzoff (2006) conducted a study of the predictive relationships between early imitation skills, social communication skills, memory, and later language outcomes in typical infants. This quantitative correlational study examined the interrelationships between deferred imitation (DI), visual recognition memory (VRM), and the social communication skills of joint attention (JA) and turn taking. The authors argued that, while deferred imitation (e.g., remembering and reproducing a motor action once the model is gone) and visual recognition memory (e.g., remembering a previously seen stimulus) are both memory tasks, they appear to represent different memory processes. The authors state, "VRM in early infancy (6-12 months) appears to be an especially good predictor of receptive language skills" (p. 235), while "the contribution of DI prior to 18 months was too recently discovered" to have such a relationship well established. The purpose of the study was to look at the unique predictive relationships between deferred imitation and visual recognition memory, and infants' gestural communication and language comprehension abilities at 14 months. The participants in this study were 30 healthy, full-term infants (17 female, 13 male) recruited in Sweden. No other demographic information was presented. The infants were longitudinally observed at 6, 9, and 14 months in a lab setting.

The deferred imitation (DI) tasks presented at 9 and 14 months were actions on objects, based on tasks from Heimann and Meltzoff (1996). The reliability and validity of these tasks was not indicated. The experimenter demonstrated actions on three different toys, three times (e.g., pushing a button mounted in a box; shaking a plastic egg; and lowering a string of plastic beads into a cup), and the materials were then handed to the infant, following an 8-10 minute delay (12 minutes for the 14-month-olds). The infants' responses were videotaped and scored by two scorers as a yes/no dichotomous score, with 'yes' indicating the target action was achieved. The inter-rater reliability was reported as a Cohen's kappa of .85 for the 9-month-olds, and .89 for the 14-month-olds.

The visual recognition memory (VRM) measure was completed at 6 and 9 months using the computerized version of the Fagan Test of Infant Intelligence (FTII; Fagan & Shepherd, 1987). The FTII is a measure of visual novelty preference, where infants are presented with comparison pairs of visual images and their visual fixations are measured. Novelty preference is assumed to provide a measure of infant visual memory since the infants would have to remember the previous image to notice a novel one. The reliability and validity of this tool was not mentioned. In 10 trials, the infants were presented with a computer image for familiarization (e.g., a facial pattern), and the image was then paired with a novel image (e.g., a different facial pattern). The measure is the number of visual fixations on the novel image, which indicates that the other image is remembered.

At 14 months, the infants' social communication skills were measured using the Early Social Communication Scales. This tool measures three skill-sets: Joint Attention (Initiating and Responding to Joint Attention – IJA and RJA); Requesting (Initiating Object Requesting and Responding to Requesting – IOR and RR); and Social Interaction

(Initiating Social Interaction and Responding to Social Interaction – ISI and RSI, which are measures of turn taking and interaction maintenance). The validity of this tool was not mentioned. For this measure, the experimenter presented the infant with a set of toys, picture books, social games, and posters mounted on the walls. The experimenter presented toys, pointed and looked at the wall posters, and made requests. A frequency count of the target behaviors was collected from a videotape of the session. The authors reported a videotape scoring agreement reliability of $r = 0.94$ for the Joint Attention scale, and $r = 0.75$ for the Social Interaction scale. In addition, the infants' language comprehension and gesture production skills were measured from parental reports, using a Swedish version of the MacArthur Communication Development Inventory, the Swedish Early Communicative Development Inventory (SECDI; Eriksson & Berglund, 1999). This tool is described as an "age-appropriate inventory... [of] words and gestures" (p. 240). No other information regarding validity or reliability was presented.

The researchers found that language comprehension at 14 months was significantly positively correlated only to DI at 14 months ($r = .57$, $p = .001$). Gestures produced at 14 months were correlated to VRM at 6 months ($r = .46$, $p = .03$), and to IJA ($r = .46$, $p = .02$) and turn taking at 14 months ($r = .47$, $p = .01$). A regression analysis revealed that, together, the three hypothesized predictor variables (VRM, DI, and turn-taking) accounted for more than 40% of the variance in gestures produced, and that DI at 9 months was the strongest predictor of gestures at 14 months ($\beta = .53$, $p < .01$). VRM and turn taking did not contribute significantly to gesture production. Only deferred imitation (DI) at 14 months predicted language comprehension at 14 months ($\beta = .55$, $p < .01$). Again, the contributions of VRM and turn taking were not significant. As a

limitation of the study, the researchers mentioned that the sample was relatively small (*n* = 22 for some tasks). Correlations between the social communication measures and deferred imitation were not examined.

Heimann et al. (2006) concluded that infant deferred imitation and social communication skills are significantly correlated to later language development. They also concluded that early DI appears to be a strong predictor of later language development.

The researchers added that, while two of the social communication measures, IJA and turn taking, were correlated to language development, they did not correlate with each other. Thus, "it is conceivable that these measures tap different communicative abilities or different aspects of the infant's early communicative competence" (p. 244). This would further support Mundy's (2007) multiple process model of social cognition. Each component of early social communication appears to be demonstrating a unique relationship to the development of later non-verbal (gestural) and verbal language skills.

This study highlighted the importance of early imitation skills as a contributor to later language development. The results suggest that social communication skills, such as initiating joint attention and turn-taking, are related to deferred imitation skills since they all contribute to non-verbal gestural communication and verbal language development. In any case, the relationship between the social communication and imitation predictor variables was not examined.

Summary

Research on infant imitation has demonstrated that the ability to imitate is innate, with a gradual acquisition of purposeful control and selectivity developing with age between birth and 18 months. The performance of deferred imitation in infants appears to be constrained by social context and rehearsal. By 14 months of age, infants demonstrate selective imitation, depending on the communicated goal, relevance of the action, and familiarity with the social context. The research suggests that developmental changes seen in imitation between birth and 18 months reflect the growing changes in infants' perception, motor skills, understanding, and social awareness of themselves and others. A social communicative influence seems to affect imitation performance in infants, in that, if the infant does not appear to understand the communicated aim of the task, they are less likely to attempt it.

Research on early social communication skills has demonstrated that the period between 9 and 12 months is an intense period of growth in social awareness, with many of the prerequisite joint attention skills typically being established by 9 months of age. A hierarchical developmental pattern can be seen in the emergence of social communication skills in typically developing infants, with the emergence of some social communication skills being dependent on the prior acquisition of imitation. The research has shown that formal language acquisition requires specific social-cognitive skills (gaze following, imitation, coordinated visual attention, and affect sharing) and specific types of social interactions (frequent and sustained joint attention interactions).

The correlational research between imitation and social communication in infants has largely focussed on the relationship of the variables to the later acquisition of

language. The research has demonstrated that role-reversal imitation emerges at the same time as expressive language, and by 18 months, the two are strongly related. Initiating joint attention and turn taking have also been shown to have a strong relationship with the later comprehension of language. The research shows that both early deferred imitation and social communication skills (joint attention and turn taking) have a strong predictive relationship to language development. The correlational research also indicates a relationship between imitation and early social communication skills – in that both appear to be discretely contributing to and predicting the acquisition of language – though the relationship between these two variables has not yet been examined.

This study attempts to address the lack of documented information on the relationship between early imitation and social communication abilities. The quantitative correlational research design is to carefully examine the relationship between emergent imitation skills and social communication skills in infants.

The study looked at the age range between 15 and 18 months, because the literature suggests that both imitation and social communication skills should have emerged (Carpenter et al., 1998; Jones, 2007; Meltzoff & Moore, 1989; Wetherby & Prizant, 2002) and individual differences in skills should be stabilized (Heimann & Meltzoff, 1996; Mundy et al., 2007). Infants in this age range would have some referential language skills (Bates et al., 1979; Carpenter et al., 1998), but would be expected to still demonstrate a greater reliance on non-verbal or gestural communication, rather than verbal language skills (Bates et al., 1979; Bee & Boyd, 2010).

In the next chapter, the research design, methods, procedures, and data analysis methods will be described.

Chapter 3: Methods

Introduction

This chapter describes the design of research methods for this study. The study used a quantitative correlational design to investigate the relationship between imitation behaviors and social communication skills in infants between 15 and 18 months of age. The research paradigm, research design, sampling, measures, procedures, and data analysis methods will be explained.

Quantitative Research Paradigm

Quantitative research assumes an objective social reality that stays constant across time or settings. Reality is represented objectively and numerically (Gall, Gall, & Borg, 2010). The steps involved in a quantitative study begin with identifying the research question(s), purpose, and hypotheses. The relevant literature is reviewed. The research design is specified and the population being studied and sampling procedures are described. The measures used and data collection and analysis methods are described. The data is usually analyzed with statistical methods. The results are presented and then discussed in relation to the literature review (Doehring, 1988; Gall, Gall, & Borg, 2010).

Quantitative studies can look at a whole population or a sample that represents the population (Doehring, 1988). Instruments used could be interviews, observations, standardized tests, performance measures, or scales. The data is collected through sampling of measurable phenomena. By choosing measures with established validity and reliability, researchers can establish the internal validity of the study. The review of literature can also support the external validity and standardized administration of

measures and scoring protocols can support the reliability of the results. If the methodology and study design is well described, other researchers should be able to replicate the study, thus supporting the reliability and validity of the results. Random sampling or group assignment, blind study designs, and control groups can control for experimenter bias (Doehring, 1988; Gall, Gall, & Borg, 2010).

An advantage of using quantitative research is that it allows researchers to study large populations through sampling methods (Gall, Gall, & Borg, 2010). This approach provides objective, numerical data that can be generalized to the sampled population through inferential statistics (Howell, 2008). Disadvantages of the quantitative research approach are that it does not always allow for an explanation of the results, and it cannot be used for phenomena that are not measurable.

Correlational Research Design

This study used a correlational design, as described by Gall, Gall, and Borg (2010), to determine relationships between the identified variables (Howell, 2008). Correlational research designs assume a social reality of interrelated cause-effect relationships, but they cannot definitively prove a causal relationship. Rather, this design is useful when trying to understand the direction of a relationship between the variables, to predict outcomes, particularly when evaluating the relationships of social behaviors between people (Doehring, 1988). Understanding the relationships between the variables in the sample population can provide predictions about the larger population and can support or refute theoretical assumptions about those relationships (Gall, Gall, & Borg, 2010).

The independent variable represents the predicted cause, and the dependent variable represents the predicted effect. A correlational design does not allow for the independent variable to be manipulated. Correlational research can demonstrate the strength of a relationship between variables, but it cannot explain the causal effect that one variable has on the other (Howell, 2008). For example, correlational research can demonstrate a strong correlation between the presence of an infant car seat in a car and the presence of a baby, but it cannot lead to the conclusion that car seats *cause* babies. A regression analysis allows researchers to explain how differences in one variable predict differences in another related variable (Howell, 2008).

In a correlational research design, the target population and the independent and dependent variables are first identified. A hypothesis is then generated about the predicted relationship between the variables being measured. A random sample of participants who represent the target population is selected and time-lines developed for the sample collection. Materials, tasks, and/or instruments are selected that are appropriate to the research question and the identified variables. Examples could be standardized tests, scales, questionnaires, interviews, or direct behavior observation. Data is then collected from each participant for each variable and the data is analyzed using descriptive and inferential statistical methods to quantify the relationship between the variables (Gall, Gall, & Borg, 2010; Howell, 2008).

The internal validity of correlational research studies can be supported by using a random sampling of participants who represent the target population, and standardized administration of the validated measures involved. Additionally, behavior observations can be videotaped, allowing for repeated scoring of behavior samples if needed to

strengthen the reliability of the results. The external validity of correlational research is supported by using measurement tools that have been validated to measure the behaviors or variables identified in the study and through a careful comparison with the methods and results published in previous studies on the same topic (Gall, Gall, & Borg, 2010, p. 136-143).

Experimenter bias can be controlled for in correlational research by clearly explaining the methods for accessing and recruiting participants, choosing unbiased measures, limiting the researchers' contact with participants to avoid influencing their behavior, and using unobtrusive measurement techniques (e.g., videotaping behaviors for later scoring versus scoring behaviors in front of participants). Experimenter bias in scoring can be controlled for by using a second trained rater, who is blinded to the target behaviors, and repeating some of the videotape scoring (Doehring, 1988).

Clear explanations of sampling methods, measures, and data collection methods can support the replication of correlational research. The analysis of data is designed to provide a prediction of the relationship between the variables in the sample participants, which can be generalized back to the general target population. The stronger the correlation between the identified variables, the stronger is the generalizability back to the target population. The generalizability of results is limited by incomplete data or small sample sizes (Gall, Gall, & Borg, 2010; Howell, 2008).

This research design was best suited to the research question posed in this study, because it allows objective, numerical behavioral data to be collected from a sample that is representative of a larger population. The data can be analyzed for statistically significant correlations and these correlations between the variables can be generalized

back to the target population using inferential statistics. Determining the nature of the relationship between the behavioral variables in the sample allows for predictions that are representative of the larger population.

Sampling

The target population of this study was typically developing infants who were between 15 and 18 months of age, living in the Pacific Northwest. A volunteer sample of this population was obtained and a total of 30 infants were included in the study to allow for better generalization, compared to a smaller sample, and for comparisons to previous research (Doehring, 1998). The volunteers Most of the correlational research involving this age population has reported using sample sizes between 21 and 30 (Carpenter, Nagell, & Tomasello, 1998; Carpenter, Pennington, & Rogers, 2002; Carpenter, Tomasello, & Striano, 2005; Heimann, Strid, Smith, Tjus, Ulvund, & Meltzoff, 2006). These authors describe their sample sizes as relatively small but significant in that they provide a unique contribution to the existing research and have been the "first preliminary results" (Heimann, Strid, Smith, Tjus, Ulvund, & Meltzoff, 2006, p. 246) that have "important theoretical and clinical implications" (Carpenter, Pennington, & Rogers, 2002, p. 104) that will drive future research.

Sample Size

To determine an appropriate sample size (*n*), the statistical "power" of the study, or the probability of correctly rejecting the null hypothesis, must be estimated (Howell, 2008). This can be done by first estimating the "effect size," which is defined as "the magnitude of the difference between two groups or ...the magnitude of the relationship

between two variables" (Gall, Gall, & Borg, 2010, p. 181). Effect size can be calculated using Cohen's *d*, where *d* equals the difference between the two anticipated means, divided by the pooled standard deviations of the measures (Howell, 2008). When the standard deviations are very different, as in this study, a common variance cannot be assumed, so the recommended denominator is the standard deviation of the independent measure only (Howell, 2008). When the predicted mean of the independent variable (15.2) is subtracted from the predicted mean of the dependent variable (100) and divided by the standard deviation of the independent variable (8.5), the resultant effect size is 9.97. The large difference in the estimated means of the two measures gives this study a large estimated effect size (Cohen's *d* of 9.97), where any value above .8 is considered a large effect size (Howell, 2008).

Knowing the effect size, Glass' delta (δ) can be used to determine the statistical power of the study for a particular value of *n*, given the effect size (*d*), using the formula $\delta = d\sqrt{n}$. For a power level of .80, or an 80% probability of correctly rejecting the null hypothesis, Glass' δ must be equal to 2.80 (Howell, 2008). Using these numbers to estimate a required sample size, we can use $n = (\delta/d)^2$, or *n* equals the square of δ (2.80) divided by *d* (9.97), which is .08. This suggests that the sample size could be very small (e.g., $n = 1$) and the study would still have significant power. Since a sample of less than 30 participants is considered to be a small sample (Goodwin & Leech, 2006), a minimum of 30 was required to reduce the sampling error (Gall, Gall, & Borg, 2010).

Selection Criterion

The inclusion criterion was age, calculated from the date of birth provided by the parent(s), and typical development. Children who were younger or older than the target group (less than 60 weeks or more than 72 weeks old), or who were born prematurely, were excluded. To ensure that the sample group was representative of the target population (Gall, Gall, & Borg, 2010, p. 280), children who were at-risk for, or born with, a pre-existing or acquired atypical developmental condition or diagnosis (e.g., Down Syndrome, Cerebral Palsy, encephalitis), were excluded through the screening questions asked to the parents during the consent process. In addition, if any of the infants scored below the 10^{th} percentile on the Communication and Symbolic Behaviour Scales-Developmental Profile (CSBS-DP), they were considered "at risk for communication and language delays" (Wetherby & Prizant, 2002, p. 113). The data collected from participants who scored below this cut-off were excluded from the data analysis, and the parents were contacted immediately by the researcher and given information about how to access further screening and support for early development in their home community.

The sample group of participant infants was recruited through advertisements at local parenting resources such as parenting magazines and children's retailers that asked parents to volunteer their infant's participation. They were also recruited through word-of-mouth from other parents.

The elicited behavior samples were collected through a single standardized play session between the primary investigator and the infant, done in the family home, with the parent(s) or caregiver(s) present. The sessions were digitally recorded on video. The

imitation behaviors and social communication behaviors were then scored from the digital video recording.

Methods of Data Collection

Measures

Demographics.

The infants' date of birth, sex, and family contact information were collected from the parent(s). The parent(s) were asked to self-identify any cultural affiliation(s) of the family. This information was used in the non-parametric statistics to describe the participants in relation to the general population. In addition, the parent(s) were asked screening questions to screen for atypical development. These questions were:

1. Was the pregnancy with this child full term? Was it a healthy pregnancy?
2. Were there any serious complications at delivery?
3. Has the infant been referred for any Early Intervention Therapies?
4. Does the infant have any medical diagnoses that you know of?
5. Has the infant had any serious illnesses or injuries?

An affirmative answer to questions 2-5, or a negative answer to question 1, resulted in exclusion of that participant.

Imitation.

In the absence of any commercially available comprehensive measure of imitation for infants, the Motor Imitation Scale (MIS), as described by Stone, Ousley, and Littleford (1997) was chosen for this study. This tool was developed for a research study

investigating the nature of motor imitation in young children with Autism Spectrum Disorders (ASD). The participants in that study were 54 children with typical development or diagnoses of ASD, or Developmental Delays, between 14 and 39 months of age.

Stone, Ousley, and Littleford (1997) reported that the inter-rater reliability between videotaped and live scoring of 20% of the sample was .80, using Cohen's kappa. Internal consistency was calculated for the total test score and for the scores obtained for body movement, object manipulation, and meaningful and non-meaningful actions. The alpha coefficient for the total MIS score for a sample of 54 scores was reported to be .87. Coefficients ranging between .54 and .88 for the other dimensions were reported. Test-retest reliability at two weeks was reported as .80.

The MIS consists of 16 elicited single-step motor imitation tasks and takes up to 20 minutes to administer. Half (8) of the tasks involve body movements (i.e., wiggling an index finger or waving bye-bye) and half (8) involve manipulation of objects. Four of the object items involve meaningful actions (i.e., "walking" a toy dog or pushing a toy car) and the other four are non-meaningful actions (i.e., "walking" a hairbrush or putting a block on your head). The experimenter, followed by a verbal prompt (e.g., "Do this"), demonstrated each item playfully. Three trials of each item are allowed with a minimum of three presentations by the experimenter. This measure was video-recorded for later scoring. Responses were scored on a three-point scale: 2 points for a complete imitation; 1 point for an "emerging" or incomplete response (i.e., holds up a finger but does not wiggle it), and 0 points for no or incorrect responses. Only immediate responses were scored; delayed imitation responses were not scored. The participant's best response for

each item was tallied, with a possible total score of 32. This Total imitation score was the independent variable.

Social communication.

The measure for the social communication skills of the infants was the Communication and Symbolic Behavior Scales Developmental Profile Behavior Sample (CSBS-DP; Wetherby & Prizant, 2002). This is a norm-referenced and standardized screening and assessment measure of social communication behaviors in children between 12 and 24 months. The norm sample for the behavior sample was collected from 337 typically developing children between 12 and 24 months of age, from Caucasian (*n* = 288), African-American (*n* = 30), Asian (*n* = 10), and Other (*n* = 3) descent, living in Tallahassee, Florida. The CSBS-DP provides 20 weighted raw scores summed into 7 Cluster scores (Emotion and Eye Gaze; Communication initiation; Gestures; Sounds; Words; Understanding; and Object Use). The seven Cluster scores were summed to create three Composite scores: Social (sum of Emotion and Eye Gaze, Communication initiation, and Gestures); Speech (sum of Sounds and Words); and Symbolic (sum of Understanding and Object Use). The CSBS-DP provides weighted raw scores, standard scores, and percentile ranks.

The CSBS-DP was designed to provide early identification of social communication disorders, and to provide a profile of the social-affective, communicative, and symbolic understanding skills of infants. Thus, the CSBS-DP yields seven Cluster scores, which measure the seven prelinguistic skills considered to be the most significant for early identification of communication disorders, and three Composite scores. The

Composite scores group the Clusters into a social, speech, and symbolic understanding profile to help guide clinicians in assessment and intervention decision-making.

The CSBS-DP manual reports excellent construct validity for the Behavior Profile, as demonstrated through moderate correlations among the Cluster raw scores (r =.39 to .67, $p < .001$), lower correlations between Cluster raw scores (r = .19 to .47, $p <$ .05 to .001), and a principle component analysis that supported the seven Clusters and the three Composite scores.

The CSBS-DP manual reports an internal consistency reliability coefficient of r = .86 to .90, for the Behavior Profile. The t scores for test-retest (after 4 months) comparisons of raw scores in each Composite ranged from 3.01 to 8.65 ($p < .001$), with large effect sizes. The test-retest comparisons for the standard scores ranged from -0.35 to -1.40, which were not statistically significant. This indicates that the test is sensitive to changes in development over short periods (raw score differences) but stable in terms of standard scores since there were no significant changes to the standard scores. The inter-rater reliability for the Behavior Profile is reported as g coefficients, ranging from .88 to .97.

The elicited behavior sample takes up to 30 minutes to complete and consists of ten items (Wetherby & Prizant, 2002, p.3):

- Four Communicative Temptations (wind-up toys, bubbles, snack in a jar, toys in a bag) - with two gaze/point following probes (point to distant object with “look!”)
- Sharing books
- Symbolic play probes (feeding toys set)

- Language comprehension probes (object, person and body parts names)
- Constructive play probes (building blocks)

The CSBS-DP is administered with the parent in the room, and can be completed with the infant seated at a table, in the parent's lap, or on the floor. The experimenter presents the toy or activity to the infant, demonstrates it, and then observes the infant's responses, taking care not to frustrate or tease the infant with the object. For example, when presenting the snack sealed in a jar, the experimenter responds immediately to any communicative attempt by the infant, by opening the jar. Being an attentive and responsive partner involved having the adult not only acknowledge all of the infants' initiations but also to imitate the infant at times, for example to encourage their engagement. For the language comprehension probe, the infant is asked questions, like "Can you show me Big Bird's nose? Where is your head? or Where is Mommy?" The CSBS-DP can be scored simultaneously or from the video behavior sample. The seven Cluster scores were the dependent variables.

Procedures

This research study was approved by the supervisory committee, and by the University of Victoria Human Research Ethics Board (HREB) subcommittee. The parents who volunteered for the study provided written informed consent for the infants' participation and the videotaping of the session. The infants were asked for their assent to "play". If any parents chose to refuse or revoke consent, or if the infant refused to interact, the session was cancelled and none of the data from that participant was used.

The demographic information collection and screening questions were done with the parents during the consent process.

Participants took part in one play-based session in their home, with the primary investigator and the parent/caregiver present. The CSBS Behavior sample and then the MIS were administered and digitally recorded on High Definition video for later scoring. As a thank you at the end of each session, the parents were offered a free children's book and a handout on how to encourage social communication and imitation skills.

In this study, the external validity of the measures depended on choosing tools derived from, and validated in, previous research (Stone, Ousley, & Littleford, 1997; Watt, Wetherby, & Shumway, 2006; Wetherby & Prizant, 2002). The internal validity was achieved through rigorous adherence to the scoring protocols described above. Repeated scoring of 20% of the videos was done by a second trained rater, who was blinded to the target behaviors, to confirm the reliability of the scoring protocol for the imitation behavior measure (Gall, Gall, & Borg, 2010).

Scoring procedures

Each participant was presented with all of the items from the MIS (Motor Imitation Scale; Stone, Ousley, & Littleford, 1997) and the CSBS-DP (Communication and Symbolic Behavior Scales-Developmental Profile; Wetherby & Prizant, 2002), while the interaction was recorded digitally on video. Later, the investigator used the published scoring protocols from the MIS and the CSBS-DP to score each video. As training for accurate scoring, a scoring tutorial video provided with the CSBS-DP was completed prior to scoring the data samples. The second rater was trained to recognize the

behaviors being scored by using the scoring training video, which is part of the CSBS-DP, as well as selected sample videos from the study to practice scoring the MIS with the investigator.

Data analyses

Descriptive statistics were analyzed from the data, looking at the mean and median scores, the presence of any outliers, the variability of scores, and the standard deviation of scores, to test the assumption of a normal distribution of scores (Gall, Gall, & Borg, 2010; Howell, 2008).

The scores from each of the measures for each participant were entered into an SPSS database, and analyzed using a multivariate correlational analysis to determine if any statistically significant relationships existed between the imitation score and each of the social communication Cluster scores being measured. The null hypothesis was that the correlation between these variables is zero (Gall, Gall, & Borg, 2010). A Pearson product-moment correlation coefficient, or Pearson's *r*, was derived since both variables are continuous scores (Gall, Gall, & Borg, 2010). If any significant relationships were found from the correlation analysis, using a two-tailed test of significance, a linear regression analysis was run using SPSS, to examine the nature of the relationship between the correlated skills. A separate regression was run to determine the degree to which the independent variable predicts each of the correlated dependent variables. The hypothesized relationship was that the imitation score might strongly predict the correlated social communication score(s). A regression analysis was done to provide more information regarding the amount that the independent variable (the imitation score)

was contributing to the dependent variable(s) (the correlated social communication scores) (Howell, 2008).

Summary

A quantitative correlational research study was designed to examine the relationship between emergent imitation and social communication skills in typically developing infants between 15 and 18 months of age. Each infant participated in a home-based play session using the Motor Imitation Scale (MIS) and the Communication and Symbolic Behavior Scales- Developmental Profile (CSBS-DP), with their parent(s) and the primary investigator present. The sessions were digitally recorded on video for later scoring by a trained scorer and a portion of the videos was re-scored by a second trained scorer. The scores were entered into an SPSS database for analysis. The study examined the correlations between the infants' imitation score on the MIS with their social communication scores on the CSBS-DP. A regression analysis was run on the observed correlations to determine the predictive value of the imitation score to the correlated social communication score(s). In the following chapter, the results of are reported.

Chapter 4: Results

Introduction

This study examined the relationship between imitation and social communication in 15 to 18-month-old typically developing infants. Imitation data was collected using the Motor Imitation Scale (MIS) to score the video-recorded administration of 16 action imitation items. Social communication data was collected from the videotaped administration of the Communication and Symbolic Behavior Scale-Developmental Profile (CSBS-DP), which presents infants with six different activities designed to prompt social communicative interactions. Seven social communicative behaviors were measured from the video. In this chapter, the results of this study will be presented, including an explanation of the data collected, with tables and graphs that illustrate the findings. The results of the data analyses will be described.

Reliability

One-third (10) of the videos were re-scored by the investigator to check for intra-rater scoring reliability, revealing a correlation of $r = 0.99$ between scoring sessions, and indicating consistent scoring procedures. Subsequently, 20% of the videos were re-scored by a trained second scorer to establish the inter-rater reliability (IRR) of the data. These scores demonstrated strong correlations with the initial scores on the CSBS-DP ($r = .91$) and the MIS ($r = .97$), indicating excellent reliability in the scoring methods. The data was then entered into SPSS (v. 21) for analysis.

Descriptive Data

The participants for this study were 30, typically developing infants (17 females and 13 males), who were between 15 and 18 months of age. The distribution of ages and gender of the participants is shown in Table 1. Parents volunteered the participation of their infants and provided written consent for their participation and for the video recording of the session.

Table 1

Age and Gender of Participants

Age (in months)	Males	Females	Total
15	4	8	12
16	4	1	5
17	1	3	4
18	4	5	9
Total	13	17	30

The participants came from several different communities in the Pacific Northwest, and the assessment took place in their home or family daycare setting with a parent or familiar caregiver present. Each home visit lasted exactly one hour. Twenty-one of the families (70%) self-identified their cultural affiliation as "Canadian" or of "Anglo-Saxon/Caucasian/Canadian" descent (Figure 1). The remaining 30% of families identified themselves as coming from European (i.e., Spanish, Danish, or Slovakian), New Zealand, Asian (i.e., Chinese, or Japanese), or Jewish descent. This demonstrates a wide variety of cultural backgrounds and should give an adequate representation of the target

communities at large, which were urban and suburban communities in the Pacific Northwest.

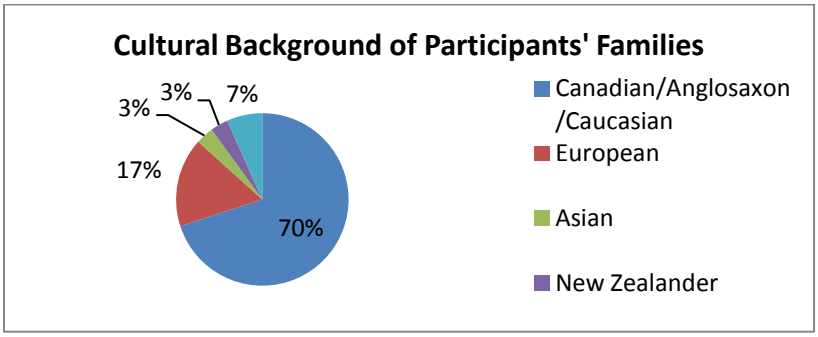


Figure 1. Cultural background of participants' families as identified by the parent(s).

All of the parents reported that their infant's first language was English. The family units were a cross-section of two-parent, same-sex parent, single parent, teen parent, and blended families. All of the participants passed the screening questions for typical development (i.e., full-term healthy pregnancy, no serious birth complications, no developmental concerns, and no serious illnesses/injuries).

Imitation Data

The scores that were achieved on the Motor Imitation Scale ranged from 5 to 30 out of a possible 32. All of the participants attempted some, if not all, of the items. After the presentation of the model, each response was scored as either "0"(no attempt, incorrect action),"1" (partially correct action) or "2" (correct action). The median score was 17.47 with a Standard Deviation (*SD*) of 6.3. The frequency count and histogram (Figure 2) both demonstrate a relatively normal distribution of scores with no significant outliers. This means that the variations in the data fit the assumption of probability that a

natural variability exists from one participant to another, with the main distribution of scores centering on the mean score (Howell, 2008). The absence of any significant outliers in the data indicates that none of the participants varied significantly from this expected distribution.

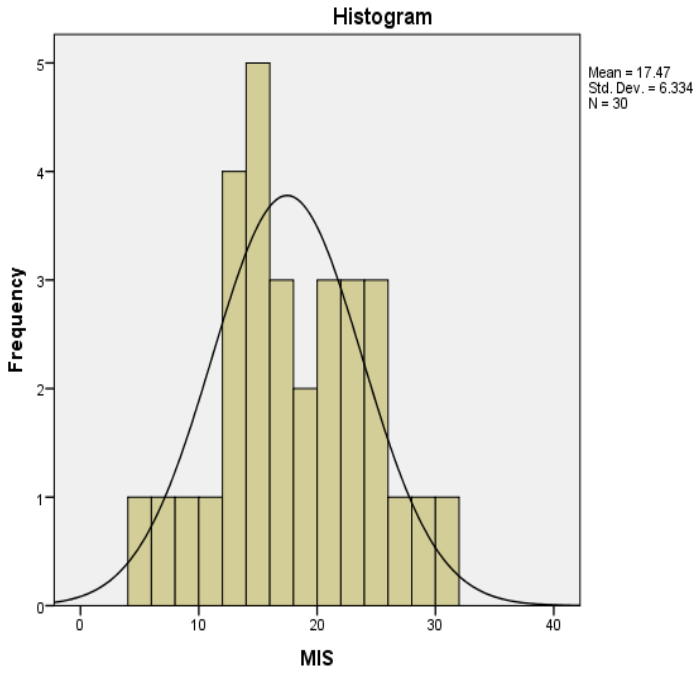


Figure 2. Frequency distribution histogram of MIS Scores.

A plot of the MIS scores by age in months (Figure 3) indicates that the MIS scores increased with age, with a range of approximately 2 *SD* in each age group. This indicates a gradual acquisition pattern of imitation skills with age, with a range of individual differences. The 15-month-old group demonstrated a range in scores from 5-21; the 16-month-old group had scores that ranged from 12-24; the scores for the 17-

month-old group ranged from 16-25; and the 18-month-old group had a range in scores from 14-30.

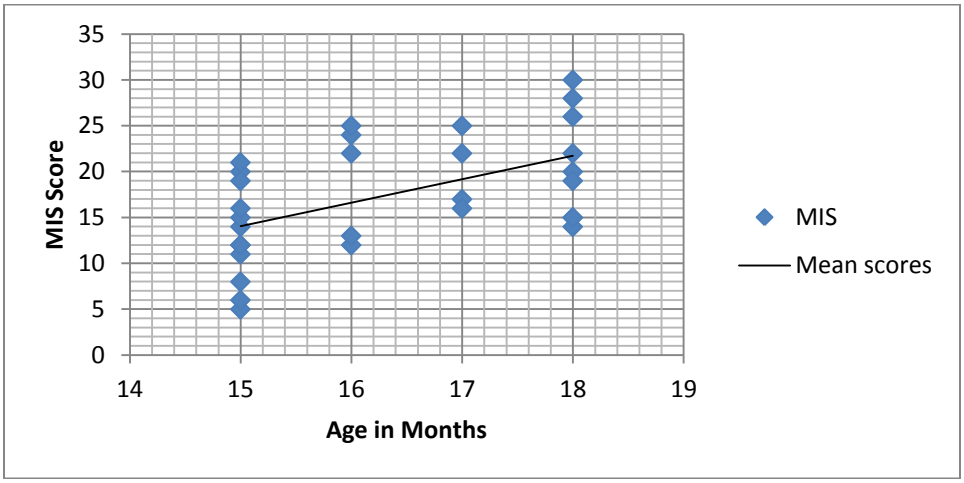


Figure 3. Plot of MIS Scores by Age in Months.

Social Communication Data

The Total Scores on the Communication and Symbolic Behavior Scales-DP ranged from Standard Scores of 81 to 134, with a median score of 105.73 and a Standard Deviation (*SD*) of 14.09. The frequency distribution and histogram for the Total Scores indicate a normal distribution of scores with no significant outliers (Figure 4). Again, this means that the data fit the assumption of probability: that the variability and distribution of the sample scores will center on the mean score.

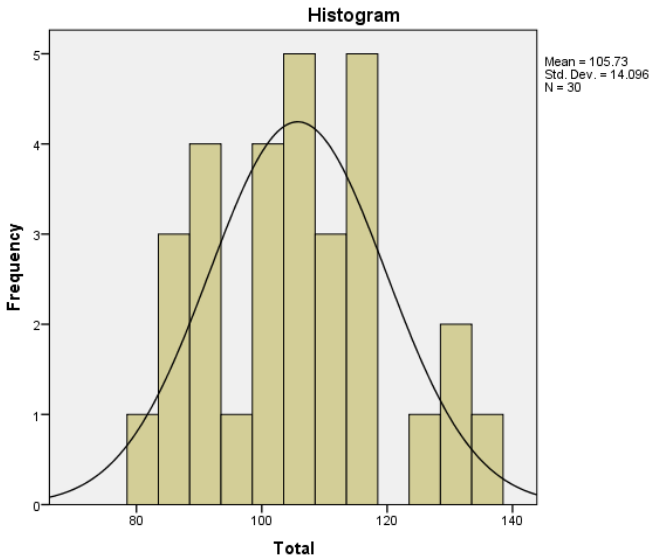


Figure 4. Frequency distribution histogram of CSBS-DP Total Score

The Composite Scores (Table 2) ranged from Standard Scores of 7-14 with a median of 10.66 and an *SD* of 1.98 for the Social Composite (Emotion and Eye Gaze, Communication, and Gestures Clusters), Standard Scores of 7-15 with a median of 11.8 and an *SD* of 2.32 for the Speech Composite (Sounds and Words Clusters), and Standard Scores of 7-17 with a median of 11 and an *SD* of 2.81 for the Symbolic Understanding Composite (Understanding and Object Use Clusters). Figure 5 shows the frequency count histograms for each Composite score, which indicate a normal distribution of scores with no significant outliers. While each Composite demonstrates a unique distribution pattern of scores, each distribution still fits the pattern of expected probability of sampling error, which is the degree of error expected when sample values are drawn from the larger unknown population values.

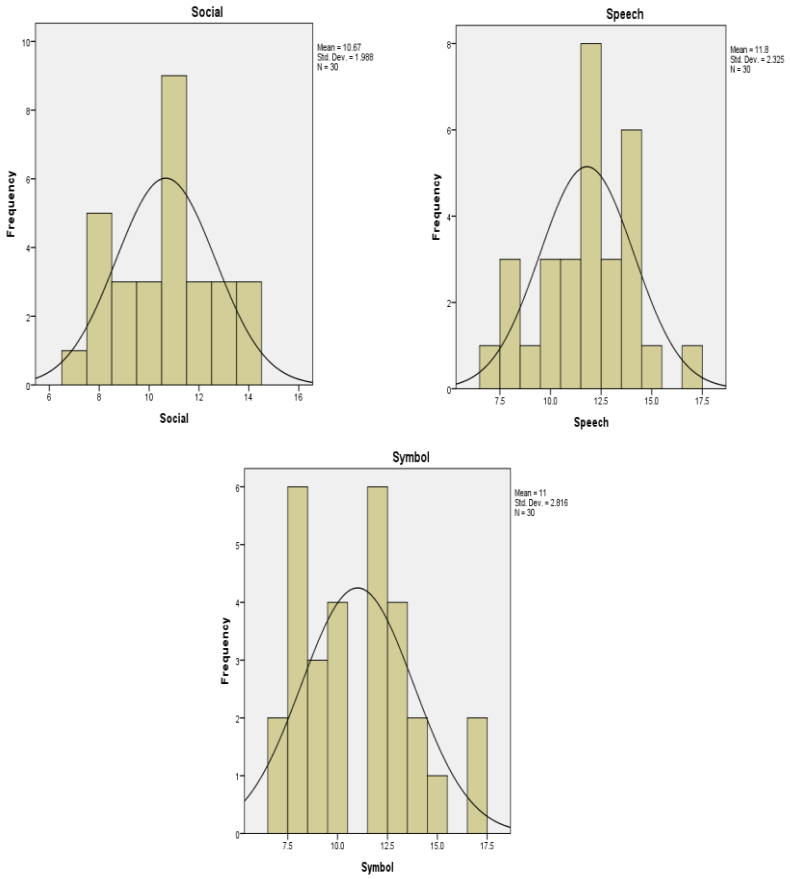


Figure 5. Frequency distribution histograms of Composite Scores of CSBS-DP.

Table 2 shows the descriptive statistics for each of the Cluster Scores, the Composite Scores, and the Total Score on the CSBS-DP. Within the Social Composite Scores, the Eye Gaze Cluster demonstrated Standard Scores ranging from 7-17, with a median of 11.37 and an *SD* of 2.76, while the Communication Cluster Standard Scores ranged from 7-17, with a median of 11.23 and an *SD* of 3.12, and for Gesture, the Standard Scores ranged from 6-17, with a median of 9.5 and an *SD* of 2.17. Within the Speech Composite, the Sounds Cluster showed Standard Scores that ranged from 7-15, with a median of 11.10 and an *SD* of 2.48, and for Words, the Standard Scores ranged from 7-17, with a median of 11.83 and an *SD* of 2.73. Within the Symbolic

Understanding Composite, the Understanding Cluster showed Standard Scores that ranged from 7-17, with a median of 11.07 and an *SD* of 3.05; and the Object Use Standard Scores ranged from 5-15, with a median of 10.17 and an *SD* of 2.64. All of the Cluster Scores ranged within 2 *SD* of their respective median score, with the exception of the highest scores for Eye Gaze, Gestures, and Symbolic Understanding that were more than 2SD above the mean. The Speech Cluster demonstrated the widest range of scores, from more than 2SD above and below the mean.

Table 2

Descriptive Statistics for CSBS-DP

Measure	n	Minimum	Maximum	Mean	Std. Deviation
Eye Gaze	30	7	17	11.37	2.760
Communication	30	7	17	11.23	3.126
Gesture	30	6	14	9.50	2.177
Sounds	30	7	15	11.10	2.482
Words	30	7	17	11.83	2.730
Understanding	30	7	17	11.07	3.051
Object Use	30	5	15	10.17	2.640
Social	30	7	14	10.67	1.988
Speech	30	7	17	11.80	2.325
Symbolic	30	7	17	11.00	2.816
Total	30	81	134	105.73	14.096
MIS	30	5	30	17.47	6.334
Valid N (list-wise)	30				

Correlation Analysis

To investigate the question: What is the relationship between emergent imitation behaviors and the development of social communication skills in typically developing 15 to 18-month-old infants, a correlation analysis was run between the MIS scores and the Total CSBS-DP scores. The analysis (Table 3) indicates a positive and significant correlation between the MIS and the Total CSBS-DP scores (r =.471, p <.01). Figure 6 shows the scatter plot of the MIS and CSBS-DP Total scores, which shows that the relationship has a positive sloping regression line (r^2 = 0.222). The line shows a linear increase in imitation scores as the CSBS-DP Total score increases.

Table 3

Correlation matrix for MIS and CSBS-DP Total Score

Measure		1	2
1. MIS	Pearson Correlation	1	.471**
	Sig. (2-tailed)		.009
	N	30	30
2.CSBS Total	Pearson Correlation	.471**	1
	Sig. (2-tailed)	.009	
	N	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

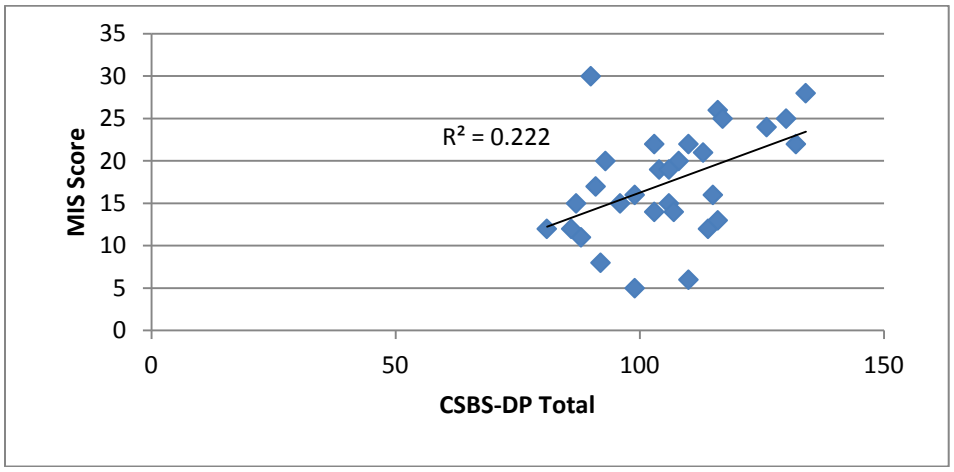


Figure 6. Scatter plot of MIS and CSBS-DP Total Scores.

Further investigation of the relationship between Imitation and Social Communication skills was performed by running a correlation analysis between the MIS score and each of the Composite and Cluster scores on the CSBS-DP. Tables 4 and 5 show these correlation analyses. At the Composite level (Table 4), one positive and significant correlation was found between the MIS and the CSBS-DP, with the Symbolic Understanding Composite, which is a combined score of Object Use and Understanding Cluster scores (r =.505, p < .01). Neither of the other two Composite scores demonstrated a significant correlation with the MIS. Within the CSBS-DP itself, significant correlations were seen between the Social Composite and the Speech Composite (r = .447, p <. 05) and the Symbolic Understanding Composite (r = .388, p < .05). The Speech Composite correlated significantly not only to the Social Composite but also to the Symbolic Understanding Composite (r = .637, p < .01).

Table 4

Correlation Matrix of MIS and CSBS-DP Composite Scores

	Measure	1	2	3	4
1.MIS	Pearson Correlation	1	.016	.234	.505**
	Sig. (2-tailed)		.935	.214	.004
	N	30	30	30	30
2.Social	Pearson Correlation	.016	1	.447*	.388*
	Sig. (2-tailed)	.935		.013	.034
	N	30	30	30	30
3.Speech	Pearson Correlation	.234	.447*	1	.637**
	Sig. (2-tailed)	.214	.013		.000
	N	30	30	30	30
4.Symbol	Pearson Correlation	.505**	.388*	.637**	1
	Sig. (2-tailed)	.004	.034	.000	
	N	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

This indicates that a significant positive relationship exists between all three Social Communication Composites.

At the Cluster level (Table 5), only one positive and significant correlation was found between the MIS and the CBSB-DP Understanding Cluster score ($r = .457$, $p < .05$). None of the other correlations between the two tests were statistically significant. One small negative correlation was noted between the MIS and the Gesture Cluster score ($r = -.215$, $p = .254$), but it was not statistically significant.

Table 5

Correlation Matrix of MIS and CSBS-DP Cluster Scores

Measure		1	2	3	4	5	6	7	8
1. MIS	Pearson Correlation	1	.217	.149	-.215	.157	.296	.457*	.280
	Sig. (2-tailed)		.250	.431	.254	.407	.113	.011	.134
	N	30	30	30	30	30	30	30	30
2. Eye Gaze	Pearson Correlation	.217	1	.210	-.083	-.006	.461*	.271	.176
	Sig. (2-tailed)	.250		.266	.662	.977	.010	.147	.353
	N	30	30	30	30	30	30	30	30
3. Communication	Pearson Correlation	.149	.210	1	.099	.348	.494**	.403	.296
	Sig. (2-tailed)	.431	.266		.604	.060	.006	.027	.112
	N	30	30	30	30	30	30	30	30
4. Gesture	Pearson Correlation	-.215	-.083	.099	1	-.073	.055	-.031	-.015
	Sig. (2-tailed)	.254	.662	.604		.700	.772	.870	.937
	N	30	30	30	30	30	30	30	30
5. Sounds	Pearson Correlation	.157	-.006	.348	-.073	1	.476**	.464	.176
	Sig. (2-tailed)	.407	.977	.060	.700		.008	.010	.352
	N	30	30	30	30	30	30	30	30
6. Words	Pearson Correlation	.296	.461*	.494**	.055	.476**	1	.780	.430*
	Sig. (2-tailed)	.113	.010	.006	.772	.008		.000	.018
	N	30	30	30	30	30	30	30	30
7. Understanding	Pearson Correlation	.457*	.271	.403*	-.031	.464**	.780**	1*	.324
	Sig. (2-tailed)	.011	.147	.027	.870	.010	.000		.081
	N	30	30	30	30	30	30	30	30
8. Object Use	Pearson Correlation	.280	.176	.296	-.015	.176	.430*	.324	1
	Sig. (2-tailed)	.134	.353	.112	.937	.352	.018	.081	
	N	30	30	30	30	30	30	30	30

** Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Within the CSBS-DP, statistically significant positive correlations were found between several of the subtests (Table 5). The Eye Gaze Cluster correlated significantly and positively with the Words Cluster ($r = .461$, $p < .05$); as did the Communication

Cluster (r =.494, $p < .01$); and the Sounds Cluster ($r = .467$, $p < .01$). The Words Cluster not only showed a positive significant correlation to the Eye Gaze Cluster, Communication Cluster, and Sounds Cluster, but also to the Understanding Cluster (r = .430, $p < .05$). This indicates that number of words spoken (Words Cluster) is positively related to Eye Gaze, Communication initiations, the Sounds inventory, and Understanding. The Understanding Cluster showed positive significant correlations to the Communication Cluster ($r = .403$, $p < .05$), the Sounds Cluster ($r = .464$, $p < .01$), and the Words Cluster ($r = .780$, $p < .01$). This means that the Understanding scores had a significant positive relationship to the number of Communication attempts, number of Sounds heard, and number of Words spoken. Lastly, the Object Use Cluster had a significant positive correlation to the Words Cluster ($r = .430$, $p < .05$).

Figure 7 shows the scatter plot of the MIS scores and the Symbolic Understanding Composite scores. The regression line clearly shows the positive relationship between the MIS scores and the Symbolic Understanding Composite scores. As the MIS scores increase, the Symbolic Understanding Composite scores also increase. Figure 8 shows the scatter plot of the MIS scores and the Understanding Cluster scores, with a similar pattern and regression line.

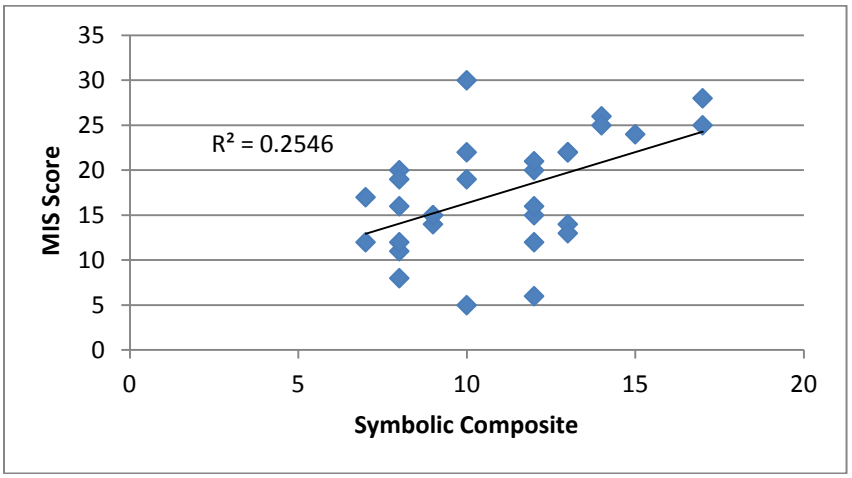


Figure 7. Scatter plot of MIS Score and Symbolic Understanding Composite Scores.

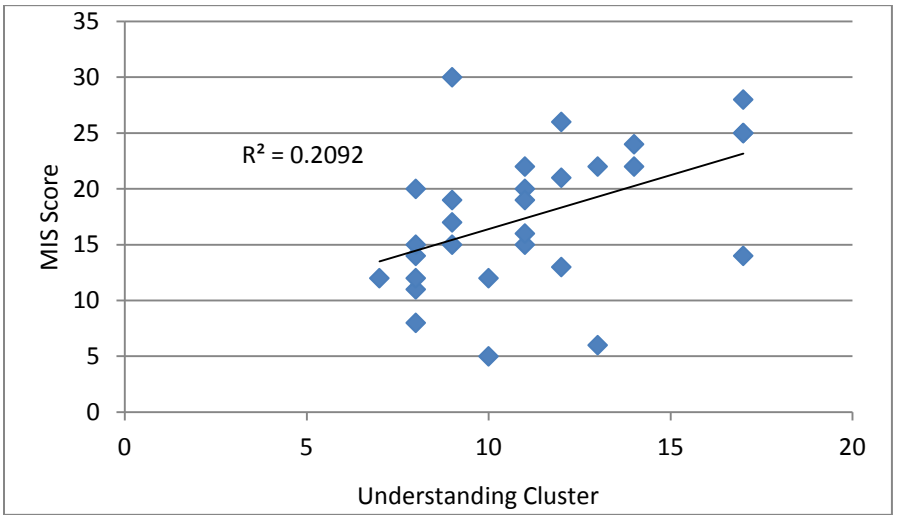


Figure 8. Scatter plot of MIS Score and Understanding Cluster Scores.

Regression Analysis

The hypothesis in Chapter 1 was that imitation and social communication skills would have a positive and significant correlation. This has been demonstrated by the correlation of many variables. The null hypothesis was that no relationship exists between

these variables beyond random chance. A regression analysis was run on each correlation to determine the degree to which imitation predicted the correlated social communication skills. The CSBS-DP is organized hierarchically with seven Cluster scores combined into three composite scores and then combined again into a total score. The regression analysis was run at each level and Tables 6 to 8 show the results of each analysis.

The initial regression analysis using the MIS score as the independent variable and the Total CSBS-DP score and the MIS score is shown in Table 6. The Total CSBS-DP score is an aggregate of all three Composite scores: Social, Speech, and Symbolic. As Table 6 shows, the analysis confirmed the correlation between the Total CSBS-DP score and the MIS score as $r = .471$. The squared correlation ($r^2 = .222$) was significant to $\alpha = 0.05$ ($F(1, 28) = 8.003$, $p = 0.009$), with a Standard Error (*SE)* of 12.651, which means that the probability of this degree of correlation shown between these two scores is sufficiently unlikely that the null hypothesis can be safely rejected (Howell, 2008). This indicates that the MIS score predicted approximately 22% of the Total Social Communication score. This equation has a coefficient = 1.04, ($t(28) = 2.829$, $p = 0.009$) and an intercept of 87.407. The minimum Total Social Communication score recorded was 81, but with a standard error of measurement of 6.877, this may explain the intercept at 87.

Table 6

Regression Analysis of Total CSBS-DP Score and MIS Score

Regression Statistics	
Multiple R	0.471
R Square	0.222
Adjusted R Square	0.195
Standard Error	12.651
Observations	30.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance p*
Regression	1.000	1280.819	1280.819	8.003	0.009
Residual	28.000	4481.048	160.037		
Total	29.000	5761.867			

	Coefficients	*Standard Error*	*t Stat*	*β*	*P-value*
Intercept	87.407	6.877	12.709		0.000
MIS	1.049	0.371	2.829	.471	0.009

Table 7 shows the regression analysis run at the level of the Symbolic Understanding Composite score. Again the correlation between the Symbolic Understanding Composite score and the MIS was confirmed (r =.505). The squared correlation was r^2 = .255, which indicates that over 25% of the variation in the Symbolic Understanding Composite score was predicted by the MIS score, with an *SE* of 2.475. The analysis of variance indicates that this correlation is significant to α=0.05 (F (1, 28) = 9.56, p=0.004), so again the null hypothesis can be rejected. This equation also has a positive slope = 0.224, (t (28) = 3.092, p=0.004). The intercept was again slightly above the minimum score of 7 at 7.082.

Table 7

Regression Analysis of Symbolic Understanding Composite Score and MIS Score

Regression Statistics	
Multiple R	0.505
R Square	0.255
Adjusted R Square	0.228
Standard Error	2.475
Observations	30.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance p*
Regression	1.000	58.550	58.550	9.562	0.004
Residual	28.000	171.450	6.123		
Total	29.000	230.000			

	Coefficients	*Standard Error*	*t Stat*	*β*	*P-value*
Intercept	7.082	1.345	5.264		0.000
MIS	0.224	0.073	3.092	.505	0.004

The final regression analysis was run at the level of the Understanding Cluster score as the dependent variable confirmed the correlation (r = 0.457) between this score and the MIS. This analysis is shown in Table 8. The squared correlation (r^2 =.208) indicates that over 20% of the variation in the Understanding Cluster score was predicted by the MIS score, with an *SE* of 2.761. This correlation is significant at α= 0.05 (F (1, 28) =7.391, p = 0.011), again allowing for the null hypothesis to be rejected. The regression equation has a positive slope =0.22 (t (28) = 2.718, p =0.011), which is consistent with the higher-level result, and an intercept at 7.222. This may be explained by the fact that the minimum score on the Understanding Cluster was 7.0.

Table 8

Regression Analysis of Understanding Cluster Score and MIS Score

Regression Statistics	
Multiple R	0.457
R Square	0.209
Adjusted R Square	0.181
Standard Error	2.761
Observations	30.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance p*
Regression	1.000	56.358	56.358	7.391	0.011
Residual	28.000	213.509	7.625		
Total	29.000	269.867			

	Coefficients	*Standard Error*	*t Stat*	*β*	*P-value*
Intercept	7.222	1.501	4.811		0.000
MIS	0.220	0.081	2.719	.457	0.011

The regression analysis, using the MIS score as the independent variable and the Understanding Cluster score as the dependent variable, confirmed the correlation (r = 0.457) between these two variables. This analysis is shown in Table 6. The squared correlation (r^2 = .208) indicates that over 20% of the variation in the Understanding Cluster score was predicted by the MIS score, with an *SE* of 2.761. This correlation is significant at $\alpha = 0.05$ ($F(1, 28) = 7.391$, $p = 0.011$), which means that the probability of this degree of correlation between these two scores is sufficiently unlikely that the null hypothesis can be safely rejected (Howell, 2008). The regression equation has a positive

slope = 0.22 (t (28) = 2.718, p = 0.011) and an intercept at 7.222. This can be explained by the fact that the minimum score on the Understanding Cluster was 7.0.

Summary

The data from this study, examining the relationship between imitation and social communication skills in typically developing 15-18-month-old infants, demonstrates a significant and positive correlational relationship between these two emerging skills. The Imitation scores significantly and positively correlated to the Total social communication scores, as well as the Symbolic Understanding Composite scores (Understanding and Object Use) and the Understanding Cluster scores. A regression analysis of these correlations revealed that the Imitation score predicted each of the correlated social communication skills by approximately 20-25%, with statistical significance to $\alpha = 0.05$. The relationship between the two variables in this study has been demonstrated to be positive and statistically significant. This allows us to safely reject the null hypothesis.

In the next chapter, these results will be discussed in relation to prior research and theory. The significance of these findings will be explained along with suggestions for future research directions. The implications of these findings will be discussed in terms of research and practice.

Chapter 5: Discussion

The purpose of this research study was to examine the relationship between emergent Imitation and Social Communication skills in typically developing infants. The literature review revealed that both imitation and early social communication skills predict later language and social development (Carpenter, Tomasello, & Striano, 2005; Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000; Girardot, et al., 2009; MacDuffie, Yoder, & Stone, 2005; Masur, 2000; Mundy et al., 2007; Striano, Stahl, & Cleveland, 2009; Watt, Wetherby, & Shumway, 2006). This is extremely important to parents and educators, because the later language skills can directly influence literacy and social outcomes at school (Poon, Watson, Baranek, & Poe, 2012; Van Agt, van der Stege, de Ridder-Sluiter, Verhoeven, & de Koning, 2007). Research has also demonstrated that non-verbal cognitive skills, such as imitation, may be able to partially mitigate the impact of language-based learning deficits (Bowyer-Crane, Duff, Hulme, & Snowling, 2011). Despite the importance of these early skill-sets, a paucity of research has examined the nature of the relationship between imitation and social communication when they are first emerging.

The present study sought to investigate the relationship between imitation and social communication in a naturalistic context, to provide new information to parents and early childhood educators about these important building blocks in early development. The research question asked in this study was: What is the relationship between imitation behaviors and the development of social communication skills in typically developing 15 to 18 month old infants when these skills are emerging?

The strong relationship between these variables that is evident in older children with atypical development (Girardot, de Marino, Rey, & Poinso, 2009; Marton, 2009; Stone, Ousley, & Littleford, 1997; Thurm, Lord, Lee, & Newschaffer, 2007) was believed to be reflected in their relationship at emergence during typical development. Therefore, in this study, the hypothesis was that a significant positive correlation existed between emergent imitation behaviors and social communication skills in infants who are between 15 and 18 months of age.

This chapter discusses the results of this research study, starting with the results of the data analyses and following with an examination of the relationships between the two variables of imitation and social communication. The results are explained within the context of previous research and learning theory. The limitations of the present study are clarified, and directions for future research are proposed. The implications of the findings, with regards to present research and practice, will then be discussed, and finally, a summary of the study is presented.

Imitation

When the data from each measure used in this study are examined independently, the results are consistent with previous research using the measurement tools. This confirms the external validity of the results. Stone, Ousley, and Littleford (1997) developed the MIS for a study comparing children with ASD to typically developing children. The typically developing 14-27 month old participants in their study (n=18) achieved a median score of 15.2 (*SD* of 8.5). In the present study, the mean score for the MIS was 17.4 with an *SD* of 6.3. This indicates a slightly higher achievement of correct

responses overall, with a smaller variability in scores than in the previously mentioned study. A larger sample and a smaller age range could account for this in the present study (Howell, 2008).

The MIS data also demonstrated an increase in frequency of imitation with age, suggesting a developmental pattern of acquisition of skills consistent with Jones' (2007) research with typically developing 6-20-month-olds (n = 162). This finding is supported by Graf et al. (2014) who did a group comparison study of deferred imitation in 6-9-month-olds in both Germany and northwest Cameroon (n = 367). They found a significant increase in frequency of imitation between 6 and 9 months of age in both groups. In the present study, for example, a 15 month old might attempt eight of the actions (e.g., waving bye-bye, walking the toy dog), while the most proficient 18 month old successfully imitated 15 of the 16 actions.

Social Communication

Regarding the CSBS-DP scores achieved in this study, we can compare some of the scores to the CSBS-DP validation studies by Wetherby, Allen, Cleary, Kublin, and Goldstein (2002). The participants for their validation studies were 337 infants between 12-24 months, in four-month age groupings. When compared to their results for the 12-16 and 17-21 month-old groups at the Composite Score level, the present study found Standard Scores that were slightly higher than the validation sample, with a smaller variability in scores. The smaller range of variability in scores may reflect the smaller sample size in the present study (Howell, 2008). Within the CSBS-DP scores in this study, moderate correlations were found between all three Composite Scores, and

between several Cluster scores, which is consistent with the results of the standardization studies for the CSBS-DP (Wetherby & Prizant, 2002).

Relationship between Imitation and Social Communication

When the data was examined for correlations, a significant positive correlation was found between Imitation, as measured by the MIS, and Social Communication skills, as measured by the CSBS-DP (r =.471, p < .01); thus, confirming the hypothesis put forth by this study. This finding extends previous research down to the 15-18 month old stage, where verbal language is just emerging, and clearly demonstrates that these two skill-sets have a significant relationship during this developmental period.

Further analysis of the data, as discussed in Chapter 4, revealed that at the Composite skill level this relationship was specific only to the subset of Social Communication skills related to Symbolic Understanding (r = .505, p < .01), which are Object Play and Language Understanding. At the more precise Cluster level, this relationship was only demonstrated with the Language Understanding scale, which measures Language Comprehension (r = .457, p < .05). Imitation did not correlate to Object Play once Language Understanding was controlled for. No other significant correlations were found between the Imitation and Social Communication measures.

These results extend beyond previous correlational studies that demonstrated a relationship between imitation and language in typically developing infants. Carpenter et al. (2005), in a group comparison study of 12 and 18-month-olds (n = 48), found a correlation between role-reversal imitation and pronoun comprehension (r = .69, p < .005) and pronoun use (r = .47, p < .029) for their 18 month old group. Expressive

pronoun use was not specifically measured in the current study, so direct comparisons cannot be drawn for this variable. Nevertheless, Carpenter et al. argued that pronoun comprehension did not appear until the role-reversal concept was symbolically understood and demonstrated through imitation. This concurs with the relationship demonstrated between imitation and language comprehension in the present study.

Given that the MIS is a measure of motor imitation, a correlation might be expected to appear between the MIS and the non-verbal Social Communication Cluster scale scores of the CSBS-DP, such as the Emotion & Eye Gaze Cluster or the Gesture Cluster, which measures spontaneous communicative gestures. Instead, the relationship between Imitation and these skills was not significant, and in the case of Gesture, even slightly inversely related [negative correlation of r = -.215 (p = .254)]. Previous research on the role of non-verbal gesture and language development can explain this. Carpenter, Nagell, and Tomasello (1998) demonstrated an "ordering relationship" in the social communication skills of 9-15 month old infants. These authors found that imitative learning developed after joint attention and communicative gestures appeared, by around 10 months of age, and before referential language use began at around 15 months. Wetherby, Cain, Yonclas, and Walker (1988) demonstrated that typically developing infants shift from communicating primarily with gestures and sounds at 12 months, to a combination of gestures, sounds, and words at 18 months, until around 24 months, when they primarily use words and word combinations to communicate . Thus, as infants in the 15-18 month range acquire more language comprehension and expressive referential language, their dependence on gestural communication seems to diminish (Crais, Watson,

& Baranek, 2009). At the same time, imitation skills have been shown to develop in quality and frequency (Jones, 2007).

The inverse relationship between gestures and motor imitation seen in the current study suggests that imitation in 15-18-month-olds is not simply a motor resonance or a gestural "echo" of the communication partner. Instead it appears to be a deeper processing of the intent of the actions, a conceptual understanding of the act, and a purposeful and meaningful communication of that understanding (Thoermer, Woodward, Sodian, Perst, & Kristen, 2013). Moore (2013) states "Central to the requirements of imitation here are two abilities. First, the ability to grasp the goal with which an other's action has been performed; and second, the ability to recreate precisely that observed action in pursuit of that goal" (p 497). The significant positive correlation between imitation and comprehension found in this study provides valuable concrete evidence to support this theoretical viewpoint.

Predicting Language Understanding

A regression analysis of each of the correlations between the MIS scores and the CSBS-DP scores in the present study indicated that imitation was predicting approximately 22% of the Total CSBS-DP score. At the Composite level, imitation predicted the Symbolic Understanding scale score by over 25%. Within the Symbolic Understanding Composite, at the Cluster level, imitation predicted Language Understanding by over 20%. This indicates that imitation is predicting the language understanding score significantly, but also that the two variables being measured are not the same, or we would see the slope of the correlation line approaching 1.0 (Howell,

2008). Thus, imitation appears to be a discrete variable contributing specifically to language understanding (comprehension).

Significance of the Study

The results of this study provide new evidence that fits with existing theory and extends previous research regarding the role of imitation in language acquisition. Bates, Thal, Whitesell, Oakes, and Fenson (1989) studied the relationships between gestures and language in 12-16-month-olds (n =95). Using factor analysis, they found that imitation of routine gestures (i.e., waving) loaded on language production, while imitation of gestures using objects loaded on both language production and comprehension, contributing greater variation to comprehension. The authors concluded that imitation of actions with objects "reflect the child's understanding of the object world and his or her interest in communicating that understanding" (p. 1009). Heimann et al. (2006) also found a concurrent correlation between deferred imitation skills and comprehension (r = .57, $p < .001$) at 14 months of age. This was a longitudinal study between 6-14 months (n = 22), examining the relationship between three variables: deferred imitation, joint attention, and visual memory, and language outcomes at 14 months, as measured by the McArthur CDI. The authors also found that early deferred imitation at 9 months (r = .35, $p < .03$) and initiating joint attention at 14 months (r = .46, $p < .02$) predicted (pre-verbal) expressive gestures at 14 months, but neither predicted comprehension.

In the present study, we did not see a relationship between Imitation and the Object Use Cluster scale, once Language Understanding was controlled for. Within the CSBS-DP, however, the scores for Object Use were correlated to Words used, which is a

measure of expressive language vocabulary. This suggests, as in Bates et al. (1989), that a relationship exists between object play (e.g., constructing pretend play routines with dishes) and expressive language constructions in15-18 month old development, while imitation apparently relates to language understanding. This study has provided significant evidence that imitation may be one of a few select variables, along with object play and joint attention (Watt, Wetherby, & Shumway, 2006), contributing discretely to different facets of language acquisition at this important stage of development.

Limitations and Future Directions

The results and the generalizability of this research study may be limited due to the smaller sample size of 30, though the statistical power of the study was confirmed with a large effect size (Gall, Gall, & Borg, 2010; Howell, 2008). The administration of the two measures was not counter-balanced, so an order effect may have been present in the administering of the longer CSBS-DP and because of the longer time to develop rapport with each participant before administering the imitation tasks. The CSBS-DP administration; however, allows each participant a "warm-up" period of free-play with toys and the researcher before the behavior sampling begins. The higher scores on both measures, compared to those reported in previous research, may attest to the effective use of this methodology with this age group. The MIS as a measure was limited by the large variability of scores in the original study from which it was derived (Stone, Ousley, & Littleford, 1997).

The slightly elevated MIS and CSBS-DP scores in the present study may also reflect the anticipated positive effect of the more relaxed social context of home-based

interactions with infants instead of clinic-based interactions (as with the validation sampling by Wetherby et al., 2002). Previous research has shown that infants are very sensitive to the social context and more likely to demonstrate stronger performance in a familiar context (Kiraly, 2009; Learmonth, Lamberth, & Rovee-Collier, 2004; Meltzoff, 2007). While home-based naturalistic observation can be innately challenging and time-consuming, Rothbart (2005) argues that it allows for "coder objectivity and ecological validity" (p. 1). This is because the experimenter is not attempting to control or manipulate the environmental context and the infant is afforded the opportunity to overcome the approach-avoidance that is temperamentally typical of this age group (Rothbart, 2005). As Ray (2012) points out, critical skills are required for valid naturalistic observation: awareness of one's role in the context, unobtrusive and accurate data collection, and focussed attention to details. To avoid "reactive behavior," where the behavior of participants may be influenced by their awareness of being observed (Ray, 2012), this study employed a *participant-observer* model where the researcher actively engaged in social and play interactions with the infants while collecting the elicited behavior sample (Anderson & Arsenault, 1998). The researcher was a trained observer, fluent in the administration of both measures. The interactions were recorded using a four-inch digital video camera, which was set up discretely in a corner and then ignored. Using video recording allowed for objective observations and data collection outside of the interaction, while maximizing the opportunity to capture spontaneous social interactions in a natural context. The participants in the present study demonstrated relaxed social interactions by comfortably moving away from their caregiver and initiating spontaneous interactions with the researcher. In one example, a pre-verbal 15

month old took the toy cup, ran across the room to his play kitchen, pretended to fill the cup with “water” from the tap, and offered it, smiling, to the researcher to “drink”. In another example, during the book presentation probe, an 18-month-old girl nestled into the researcher’s lap to read the book.

The immediate recommendation from this study is that imitation, in all of its permutations (motor acts, concrete and arbitrary actions with objects, and vocal imitations) needs to be further researched in this age group. For example, vocal imitation (e.g., turn taking with babbling sounds) may have a different relationship to language development in this age group, in comparison to motor imitation. Differences may also exist in how imitation of motor acts (e.g., clapping hands), concrete object actions (e.g., pretending to drink from a cup), or arbitrary object actions (e.g., pretending a hairbrush is a phone) contribute to language understanding. This needs further study. In addition, exploration of what other factors may be contributing to the additional 75% variability in the Symbolic Understanding Composite score should be examined. This study has demonstrated that naturalistic observation is a valid and feasible method to pursue further research in this direction.

Replication of this research study with a larger sample may add evidence of, or disprove, the relationship between imitation and language understanding in infants. A larger sample would also better control for socio-economic and cultural influences (Gall, Gall, & Borg, 2010). The relationships between object play, joint attention, imitation, and how they each contribute to language acquisition merits further study.

Immediate work needs to be done to develop standardized measures of imitation skills at all ages to support further research into imitation. Standardized measures

presently exist to evaluate play skills and joint attention in this age group, but none is available for evaluating imitation. Most measurement tools currently available only record the presence or absence of imitative behaviours. In the absence of assessment tools, this variable appears to be largely overlooked as a measurable factor in assessing child development or for identifying early learning concerns.

Implications for Research and Practice

This study has contributed new evidence to the growing body of research demonstrating that imitation, as a distinct measure, is a strong predictor of early language comprehension acquisition and possibly later language outcomes (Carpenter, Tomasello, & Striano, 2005; Heimann, Strid, Smith, Tjus, Ulvund, & Meltzoff , 2006; Zambrana, Ystrom, Schjølberg, & Pons, 2013). The implications of this study for both research and practice are compelling. Presently, as mentioned in Chapter 2, joint attention and object play are considered two of the strongest prelinguistic predictors of later language outcomes (Watt, Wetherby, & Shumway, 2006). Imitation skills in this age group may also be an early predictor of later language outcomes, though this needs to be examined longitudinally. Possibly, techniques could be developed for improving early imitation skills, which could foster language acquisition. Research has yet to demonstrate exactly what role imitation plays in the acquisition of language across the span of typical development or how to intervene effectively. Researchers in this field need to examine the relationship between imitation and language across different ages and abilities. Efficacy studies are also needed to determine the best methods for encouraging the development of imitation skills.

Early childhood educators frequently rely on imitative performance as a teaching and evaluation method, but little information is available on how to remediate poor imitation skills. “Understanding how to teach imitation and how to facilitate its use in everyday contexts are important tasks” (Ledford & Wolery, 2011). Parents and educators need to know what it means, and what to do, when they say “*Do it like this*” and the child is unable to imitate.

Dunst et al. (2011) suggests that “Naturalistic intervention strategies are now generally considered methods of choice for promoting early communication and language development” (p. 8). Effective naturalistic methods to encourage language acquisition typically include following the child’s interest, establishing and maintaining joint attention with the child, and responding to the child’s initiations (Dunst, Raab, & Trivette, 2011). Parents and educators are encouraged to imitate the infant to demonstrate that they are attending (joint attention) and to extend the interaction time (Weitzman, Girolametto, & Greenberg, 2006). Recent research by Gill, Mehta, Fredenburg, and Bartlett (2011) suggests that adults producing intensive vocal and motor imitation (16-18 sessions of 50 minutes of constant imitation each) of 18-19-month-olds (n = 5) can significantly increase the infants’ spontaneous vocal imitation and speech sound production. Moreover, Olson and Masur (2012) demonstrated that when infants in the second year of life (n = 20) imitate their mothers during daily routines at home; the mothers are more likely to imitate the infant again, especially when the word is new to the child’s vocabulary. The authors suggested that this leads to increased frequency of exposure, and increased saliency of new words, which in turn, may lead to better comprehension.

Imitating infants at this age appears to encourage their imitation attempts, which in turn, may facilitate language acquisition. If we imagine the natural context of playing tea party with an infant in the home or childcare setting, we can see how this research may inform practice. When informed parents and educators spend time down on the floor playing with a child, they are not just having fun. They are following the child's interest and establishing joint attention (Weitzman, Girolametto, & Greenberg, 2006). By modeling new play ideas, they can extend the child's repertoire of object play (Jones & Reynolds, 1992). By being present and attentive they are demonstrating interest and affection to the child, in that "*I am here, I hear you, I understand, I care*" (Boyer, 2011, p. 38). Moreover, by actively imitating their infants' words, actions, and sounds, this study suggests that they may be fostering imitation skills and encouraging language understanding. This research study presents important information that might help parents and educators better understand the nature of imitation and the important role it plays in early child development.

This research study has made an important contribution to the existing body of research on typical child development by demonstrating that imitation has a concurrent and predictive relationship to language understanding. The study has demonstrated that imitation may be a very important variable to consider when assessing prelinguistic development. In addition, this study supports current intervention research regarding the important role of imitation as a tool for encouraging language development within natural play contexts. As parents and early childhood educators have intuited for generations, imitative learning may prove to be a keystone to unlocking language learning in infants.

Summary

In conclusion, this quantitative correlational study has found a significant positive correlation between imitation and the social communication variable of language understanding in typically developing 15-18-month-olds, confirming the hypothesis of the study. The study demonstrated that motor imitation can be measured reliably in infants between 15-18 months, and that a demonstrable increase in imitation skills occurs in this age group. The naturalistic home-based play context of the study provided robust reliable scores and ecological validity to the results. The results suggest that imitation in 15-18-month-olds has a unique relationship to social communication that is specific to language understanding, and separate from verbal expression or gesture. This study has demonstrated that imitation in infancy may be predictive of concurrent language understanding and later language outcomes.

References

Abravanel, E., & Sigafoos, A. (1984). Exploring the presence of imitation during early infancy. *Child Development , 55,* 381-392.

Anderson, G., & Arsenault, N. (1998). *Fundamentals of educational research* (2nd ed.). Philadelphia: PA: The Falmer Press, Taylor, & Francis.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.

Bates, E., Thal, D., Finlay, B.L., & Clancy, B. (2003). Early language development and its neural correlates. In F. Boller & J. Grafman (Series Eds.) & S.J. Segalowitz & I. Rapin (Vol. Eds.), *Handbook of neuropsychology, Vol. 8, Part II, Child neuropsychology*, (*2nd ed).*, 525–592. Amsterdam: Elsevier Science B.V.

Bates, E., Thal, D., Whitesell, K., Oakes, L., & Fenson, L. (1989). Integrating language and gesture in infancy. *Developmental Psychology*, *25*(6), 1004-1019.

Bee, H., & Boyd, D. (2010). *The developing child* (12th ed). Boston, MA: Pearson Education, Inc.

Bowyer-Crane, C., Duff, F., Hulme, C., & Snowling, M., (2011). Response to early intervention of children with specific and general language impairment. *Learning Disabilities: A Contemporary Journal 9*(2), 107-121.

Boyer, W. (2009). Crossing the glass wall: Using preschool educators' knowledge to enhance parental understanding of children's self-regulation and emotion regulation. *Journal of Early Childhood Education, 37*, 175–182. doi: 10.1007/s10643-009-0343-y

Boyer, W. (2011). Using child parent relationship therapy (CPRT) with our First Nations people. *International Journal of Play Therapy*, *20*(1), 38–49. doi: 10.1037/a0022650

Bronson, M. (2000). *Self-regulation in early childhood*. New York, NY: The Guildford Press.

Bryan, J. (1971). Model affect and children's imitative altruism. *Child Development, 42*, 2061-2065.

Butterworth, G. (1999). Neonatal imitation: existence, mechanisms, and motives. In J. Nadel, & G. Butterworth (Eds.), *Imitation in Infancy* (pp. 63-88). Cambridge, UK: Cambridge University Press.

Carpenter, M., Nagell,K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63*(4), 1-144.

Carpenter, M., Pennington, B., & Rogers, S. (2002). Intercorrelations among social-cognitive skills in young children with autism. *Journal of Autism and Developmental Disorders*, *32*(2), 91-106.

Carpenter, M., Tomasello, M., & Striano, T. (2005). Role reversal imitation and language in typically developing infants and children with autism. *Infancy*, *3*, 253-278.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2000). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development, 15*, 481-498.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Drew, A., & Cox, A. (2003). Predicting language outcome in infants with autism and pervasive development disorder. *International Journal of Language & Communication Disorders*, *38*(3), 265-285.

Crais, E., Watson, L., & Baranek, G. (2009). Use of gesture development in profiling children's prelinguistic communication skills. *American Journal of Speech-Language Pathology, 18*, 95-108.

Dalton, A., Chartrand, T., & Finkel, E. (2010). The schema-driven chameleon: How mimicry affects executive and self-regulatory resources. *Journal of Personality and Social Psychology*, *98*(4), 605–617. doi: 10.1037/a0017629

Doehring, D. (1998). *Research strategies in human communication disorders*. Boston, MA: College-Hill Press.

Dunst, C., Raab, M., & Trivette, C. (2011). Characteristics of naturalistic language intervention strategies. *Journal of Speech-Language Pathology and Applied Behavior Analysis, 5*(1–3), 8–16.

Eisenberg, N. (2005). Temperamental effortful control (self-regulation). In R.E. Tremblay, R. G. Barr, R. Peters (Eds.), *Encyclopedia on Early Childhood Development* [online]. Montreal, Quebec: Centre of Excellence for Early Childhood Development; 2005:1-5. Retrieved from http://www.child-encyclopedia.com/documents/EisenbergANGxp.pdf

Forman, D., & Kochanska, G. (2001). Viewing imitation as child responsiveness: A link between teaching and discipline domains of socialization. *Developmental Psychology, 37*(2), 198-206. doi: 10.1037//0012-1649.37.2.198

Gall,M., Gall, J., & Borg, W. (2010). *Applying education research: How to read, do, and use research to solve problems of practice* (6th ed.). Boston, MA: Pearson Education.

Gill, C., Mehta, J., Fredenburg, K., & Bartlett, K. (2011). Imitation therapy for non-verbal toddlers. *Child Language Teaching and Therapy, 27*(1), 97-108. doi: 10.1177/0265659010375179

Girardot, A., De Marino,S., Rey, V., & Poinso, F. (2009). Étude des relations entre l'imitation, l'interaction sociale et l'attention conjointe chez les enfants autistes. [Study of the relations between imitation, social interaction and joint attention in autistic children]. *Neuropsychiatrie de l'enfance et de l'adolescence*, *57*, 267-274.

Goodwin, L., & Leech, N. (2006). Understanding correlation: Factors that affect the size of *r*. *The Journal of Experimental Education, 74*(3), 251-266.

Graf, F., Borchert, S., Lamm, B., Goertz, C., Folling, T., Fassbender, I., Teubert, M., Vierhaus, M., Freitag, C., Spangler, S., Keller, H., Lohaus, A., Schwarzer, G., & Knopf, M. (2014). Imitative learning of Nso and German infants at 6 and 9 months of age: Evidence for a cross-cultural learning tool. *Journal of Cross-Cultural Psychology, 45*(1), 47-61.

Heimann, M. (2002). Notes on individual differences and the assumed elusiveness of neonatal imitation. In A. Meltzoff & W. Prinz (Eds.), *The imitative mind* (pp.74-84). Cambridge, UK: Cambridge University Press.

Heimann, M., & Meltzoff, A. (1996). Deferred imitation in 9-and 14-month-old infants: A longitudinal study of a Swedish sample. *The British journal of developmental psychology, 14*, 55-64.

Heimann, M., Strid, K., Smith, L., Tjus, T., Ulvund, S., & Meltzoff, A. (2006). Exploring the relation between memory, gestural communication, and the emergence of language in infancy: A longitudinal study. *Infant and Child Development, 15*, 233–249. doi: 10.1002/icd.462

Heimann, M., & Ullstadius, E. (1999). Neonatal imitation and imitation among children with autism and Down's syndrome. In J. Nadel & G. Butterworth (Eds.), *Imitation in Infancy* (pp.235-253). Cambridge, UK: Cambridge University Press.

Howell, D. (2008). Fundamental statistics for the behavioral sciences (6th ed.). Belmont, CA: Thomson Wadsworth.

Jones, E., & Reynolds, G. (1992). *The play's the thing: Teachers' roles in children's play.* New York, NY: Teacher's College Press.

Jones, S. (2007). Imitation in infancy: The development of mimicry. *Psychological Science , 18* (7), 593-599.

Kinsbourne, M. (2002). The role of imitation in body ownership and mental growth. In A. Meltzoff & W. Prinz (Eds.), *The imitative mind* (pp. 311-330). Cambridge, UK: Cambridge University Press.

Kiraly, I. (2009). The effect of the model's presence and of negative evidence on infants' selective attention. *Journal of Experimental Child Psychology , 102*, 14-25.

Learmonth, A., Lamberth, R., & Rovee-Collier,C. (2005). The social context of imitation in infancy. *Journal of Experimental Child Psychology , 91*, 297-314.

Ledford, J., & Wolery, M. (2011). Teaching imitation to young children with disabilities: A review of the literature. *Topics in Early Childhood Special Education, 30*, 245-255, first published online March 12, 2010. doi: 10.1177/0271121410363831

MacDuffie, A., Yoder, P., & Stone, W. (2005). Prelinguistic predictors of vocabulary in young children with autism spectrum disorders. *Journal of Speech, Language, and Hearing Research, 48*, 1080-1097.

McDuffie, A., Turner, L., Stone, W., Yoder, P., Wolery, M., & Ulman, T. (2007). Developmental correlates of different types of motor imitation in young children with autism spectrum disorders. *Journal of Autism & Developmental Disorders, 37*(3), 401-412. doi: 10.1007/s10803-006-0175-1

Marton, K. (2009). Imitation of body postures and hand movements in children with specific language impairment. *Journal of Experimental Child Psychology*, *102*(1), 1-13. doi:10.1016/j.jecp.2008.07.007

Masur, E. F. (2000). Infants' verbal imitation and their language development: Controversies, techniques, and consequences. In L. Menn & N.B. Ratner (Eds.), *Methods for studying language production* (pp. 27-44). Mahwah, NJ: Erlbaum.

Meltzoff, A. (2002). Elements of a developmental theory of imitation. In A. Meltzoff & W. Prinz (Eds.), *The Imitative Mind* (pp. 19-41). Cambridge, UK: Cambridge University Press.

Meltzoff, A. (2007). 'Like me': A foundation for social cognition. *Developmental Science 10*(1), 126–134. doi: 10.1111/j.1467-7687.2007.00574.x

Meltzoff, A. (2010). Interview with Dr. Meltzoff: KCTS 9 Connects, By Enrique Cerna, *KCTS9*, May 20, 2010. Retrieved from: http://video.kcts9.org/video/1500506897

Meltzoff, A., & Decety, J. (2003). What imitation tells us about social cognition:A rapproachment between developmental psychology and cognitive neuroscience. *Philosophical Transactions of the Royal Society , 358*, 492-500.

Meltzoff, A., & Moore, M. (1977). Imitation of facial and manual gestures by human neonates. *Science, 198* (4312), 75-78.

Meltzoff, A., & Moore, M. (1989). Imitation in newborn infants: Exploring the range of gestures imitated and the underlying mechanisms. *Developmental Psychology*, *25*(6), 954-962.

Meltzoff, A., & Prinz, W. (2002). *The imitative mind*. Cambridge, UK: Cambridge University Press.

Miller, N., & Dollard, J. (1941). *Social learning and imitation*. London, UK: Oxford University Press.

Moore, R. (2013). Imitation and conventional communication. *Biology & Philosophy*, *28*, 481-500. doi: 10.1007/s10539-012-9349-8

Mundy, P., Block, J., Delgado, C., Pomares, Y., Van Hecke, A., & Parlade, M. (2007). Individual differences and the development of joint attention in infancy. *Child Development*, *78*(3), 938 – 954.

Nadel, J., & Butterworth, G. (1999). *Imitation in infancy*. Cambridge, UK: Cambridge University Press.

Nadel, J., Guerini, C., Peze, A., & Rivet, C. (1999). The evolving nature of imitation as a format for communication. In J. Nadel & G. Butterworth (Eds.), *Imitation in Infancy* (pp. 209-234). Cambridge, UK: Cambridge University Press.

Olson, M., & Hergenhahn, B.R. (2009). *An introduction to theories of learning* (8th ed.). Upper Saddle River, NJ: Pearson Education.

Piaget, J. (1962). *Play, dreams and imitation in childhood*. (F. H. Gattegno, Trans.) W.W. Norton & Co.

Poon, K., Watson, L., Baranek, G., & Poe, M. (2012). To what extent do joint attention, imitation, and object play behaviors in infancy predict later communication and intellectual functioning in ASD? *Autism and Developmental Disorders, 42,* 1064-1074. doi: 10.1007/s10803-011-1349-z

Prinz, W., & Meltzoff, A. (2002). An introduction to the imitative mind and brain. In A. Meltzoff & W. Prinz. (2002). *The imitative mind*. Cambridge, UK: Cambridge University Press.

Raçzaszek-Leonardi, J., Nomikou, I., & Rohlfing, K. (2013). Young children's dialogical actions: The beginnings of purposeful intersubjectivity. *IEEE Transactions on Autonomous Mental Development*, *5*(3), 210-221. doi: 10.1109/TAMD.2013.2273258

Rakoczy, H., Tomasello, M., & Striano, T. (2004). Young children know that trying is not pretending: A test of the "behaving-as-if" construal of children's early concept of

pretence. *Developmental Psychology, 40*(3), 388–399. doi: 10.1037/0012-1649.40.3.388

Ray, W. (2012). *Methods towards a science of behavior and experience* (10th ed.). Belmont, CA: Wadsworth, Cengage Learning.

Rogers, S.J., & Pennington, B.F. (1991). A theoretical approach to the deficits in infantile autism. *Developmental Psychopathology, 3* (2), 137–162. doi: 10.1017/S0954579400000043

Rothbart, M. K. (2005). Early temperament and psychosocial development. In: R.E.Tremblay, R.G. Barr, & R. DeV. Peters (Eds.), *Encyclopedia on Early Childhood Development* [online]. Montreal, Quebec: Centre of Excellence for Early Childhood Development; 2005:1-6. Retrieved from http://www.child encyclopedia.com /documents/RothbartANGxp.pdf.

Santrock, J. (2006). *Educational psychology* (2nd ed.). New York, NY: McGraw-Hill.

Slaughter, V., & McConnell, D. (2003). Emergence of joint attention: Relationships between gaze following, social referencing, imitation, and naming in infancy. *Journal of Genetic Psychology, 164* (1), 54-71.

Stone, W., Ousley, O., & Littleford, C. (1997). Motor imitation in young children with autism: What's the object? *Journal of Abnormal Child Psychology, 25*(6), 475-485.

Striano, T., Stahl, D., & Cleveland, A. (2009). Taking a closer look at social and cognitive skills: A weekly longitudinal assessment between 7 and 10 months of age. *European Journal of Developmental Psychology, 6* (5), 567-591. doi: 10.1080/17405620701480642

Thoermer, C., Woodward, A., Sodian, B., Perst, H., & Kristen, S. (2013). To get the grasp: Seven-month-olds encode and selectively reproduce goal-directed grasping. *Journal of Experimental Child Psychology, 116,* 499-509.

Thurm, A., Lord, C., Lee, L., & Newschaffer, C. (2007). Predictors of language acquisition in preschool children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*, 1721–1734. doi: 10.1007/s10803-006-0300-1

Toth, K., Munson, J., Meltzoff, A., & Dawson, G. (2006). Early predictors of communication development in young children with autism spectrum disorder: Joint attention, imitation, and toy play. *Journal of Autism and Developmental Disorders, 36*, 993–1005. doi: 10.1007/s10803-006-0137-7

Tomasello, M. (1995). Joint attention as social cognition. In C. Moore & P. Dunham (Eds.),, *Joint attention: Its origin and role in development.* Hillsdale, NJ: Erlbaum.

Tomasello, M. (1999). Having intentions, understanding intentions, and understanding communicative intentions. In P. Zelazo, J. Astington, & D. Olson (Eds.), *Developing theories of intention: Social understanding and self-control* (pp. 63-76). Mahwah, NJ: Lawrence Erlbaum Associates.

Tomasello, M., & Carpenter, M. (2005). Intention reading and imitative learning. In S. Hurley & N. Chater (Eds.), *Perspectives on imitation: from neuroscience to social science* (Vol. *2*, pp. 133-148). Cambridge, MA: The MIT Press.

Trevarthan, C. (2005). First things first: Infants make good use of the sympathetic rhythm of imitation, without reason or language. *Journal of Child Psychotherapy , 31* (1), 91-113.

Trevarthan, C., & Aitken, K. (2001). Infant intersubjectivity: Research, theory, and clinical applications. *Journal of Child Psychology and Psychiat*ry, *42*(1), 3-48.

Trevarthan, C., Kokkinaki, T., & Fiamenghi, G. (1999). What infants' imitations communicate: with mothers, with fathers and with peers. In J. Nadel & G. Butterworth (Eds.), *Imitation in Infancy* (127-185). Cambridge, UK: Cambridge University Press.

Uzgiris, I. (1981). Two functions of imitation during infancy. *International Journal of Behavioral Development, 4*, 1-12.

Van Agt, H., van der Stege, H., de Ridder-Sluiter, H., Verhoeven, L.T.W., & de Koning, H. (2007). A cluster-randomized trial of screening for language delay in toddlers: Effects on school performance and language development at age 8. *Pediatrics, 120*, 1317-1325. doi: 10.1542/peds.2006.3145

Want, S., & Harris, P. (2002). How do children ape? Applying concepts from the study of non-human primates to the developmental study of 'imitation' in children. *Developmental Science , 5*(1), 1-41.

Watt, N., Wetherby, A., & Shumway, S. (2006). Prelinguistic predictors of language outcome at 3 years of age. *Journal of Speech, Language and Hearing Research, 49*, 1224-1237.

Wetherby, A., Allen, L., Cleary, J., Kublin, K., & Goldstein, H. (2002). Validity and reliability of the communication and symbolic behavior scales developmental profile with very young children. *Journal of Speech, Language, and Hearing Research, 45,* 1202-1218.

Wetherby, A., & Prizant, B. (2002). *CSBS-DP manual: Communication and symbolic behavior scales developmental profile*. Baltimore, MD: Brookes.

Wetherby, A., Cain, D. H., Yonclas, D. G., & Walker, V. G. (1988). Analysis of intentional communication of normal children from the prelinguistic to the multiword stage. *Journal of Speech and Hearing Research*, *31*, 240–252.

Weitzman, E., Girolametto, L., & Greenberg, J. (2006). Adult responsiveness as a critical intervention mechanism for emergent literacy: Strategies for preschool educators. In L. Justice (Ed.), *Clinical approaches to emergent literacy intervention* (pp. 127-178). San Diego, CA: Plural.

Zambrana, I.M., Ystrom, E., Schjølberg, S., & Pons, F. (2013). Action imitation at 1½ years is better than pointing gesture in predicting late development of language production at 3 years of age. *Child Development, 84*(2), 560-73. doi: 10.1111/j.1467-8624.2012.01872.x.

Zelazo, P., Astington, J., & Olson, D. (1999). *Developing theories of intention: Social understanding and self-control.* Mahwah, NJ: Lawrence Erlbaum.

Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience*, *23*,143–152. doi:10.1016/j.ijdevneu.2004.05.001

Appendix A
Demographic Information Questionnaire

file #_____

Child's Name _____

Date of birth _____ (Months)

Sex M F

Family contact information _____

Phone: _____

Address: _____

_____

Email: _____

Cultural background _____

1. Was the pregnancy with this child full term? Y/N

Was it a healthy pregnancy? Y/N _____

2. Were there any serious complications at delivery? Y/N

_____

3. Has the infant been referred for any Early Intervention Therapies? Y/N

_____

4. Does the infant have any medical diagnoses that you know of? Y/N

_____

5. Has the infant had any serious illnesses or injuries? Y/N

_____

An affirmative answer to questions 2-5, or a negative answer to question 1, will result in exclusion of the participant.

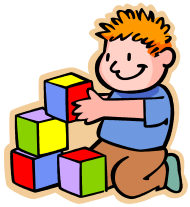
Appendix B
Motor Imitation Scale
(MIS; Stone, Ousley & Littleford, 1997)

(Min.3 models each- followed by prompt: "you do it")

1. Clap hands	0	1	2
2. Shake noisemaker	0	1	2
3. wave hand	0	1	2
4. bang spoon on table	0	1	2
5. bend index finger up and down	0	1	2
6. push toy car across table	0	1	2
7. scratch tabletop with fingers	0	1	2
8. walk toy dog across table	0	1	2
9. open and close fist	0	1	2
10. push teacup across table	0	1	2
11. drum hands on tabletop	0	1	2
12. walk hairbrush across table	0	1	2
13. pull on earlobe	0	1	2
14. hold string of pop-beads behind neck	0	1	2
15. pat cheek	0	1	2
16. place small block on head	0	1	2

(32)

Appendix C
Sample Parent Handout
Strategies to Promote Early Social Communication & Imitation



Share Attention

- Get down to his level, face to face
- Take turns with the same toys
- Imitate what she is doing
- Follow his lead- let him show you what he is playing, then join in
- Talk about what he is doing (e.g. "you made a big tower"), or what he is noticing (e.g. "you're watching Daddy cook").
- Bring toys up near your face to encourage eye gaze.

Encourage new words

- Use "Communication Temptations" to encourage comments and requests. For example:
  - Open a bottle of bubbles, blow a bubble, and put the lid back on very tightly. Hand her the bottle and wait for the request.
  - "Forget" an important part of the routine (i.e. water in the tub) or an important tool (i.e. a spoon for the soup) and wait for him to tell you.
  - Put his snack in a clear sealed container that is hard to open and wait for the request.
  - Roll a ball back and forth, then "surprise" her by rolling a rattle or a car instead.
- *Highlight* new words by repeat them often (e.g. "It's a *giraffe*. The *giraffe* has a long neck. What a tall *giraffe.*").
- Repeat back what she says plus "one" (add one word to it).
- Show what you mean ⇨through pointing, pictures, gestures.

Share Books

- Cuddle up so you can both see the book. Repeat often.
- Choose books about topics your child is interested in (e.g. trucks, animals, snow). Ask the local librarian for help.
- Take turns pointing out what you see, and naming pictures.
- Find books that have simple rhymes or stories.
- Use books to highlight new sounds: (e.g.*Jamberry* for "b"; Chicka *chicka boom boom* for "ch").
- Try using different voices for characters, or guessing: "what's next?", "where is he going?"

Imitation Station

- Monkey See Monkey Do: Pretend to be different animals, make noises, copy each other's actions (e.g. hopping, rolling, crawling).
- Use songs that have actions like: *Head & Shoulders, Knees & Toes; If you're happy and you know it; Wheels on the Bus.*
- Encourage her to watch your mouth making new sounds, and try it.
- Read *Mr. Brown can Moo can You?*
- Let him help you with chores- give him a little broom or dust cloth to copy what you do.

Play Time

- Pretend play is social play. Put on a hat and take a role in the game.
- Help your child act out daily routines: (e.g. going to the store; waking up; making dinner; catching a bus).
- Demonstrate a new idea of how to combine two toys in a new way.
  - Play with friends may be "parallel play" with toys (beside each other) - encourage them to trade toys occasionally to make it more social.
- Note: if you are doing dishes or watching TV at the same time- you are not in the game!

Adapted from:

1. Pepper, J. and Weitzman, E. (2004) *It Takes Two to Talk*. The Hanen Centre, Toronto.
2. Chesterman, M., Zeidler, D. and Gardner, A. (2011) *Partnerships in Communication*. Ministry for Children and Family Development.
3. First Nations of Quebec and Labrador Health and Social Services Commission (2007) *Preschool Calendar.* Canadian Council of Learning.