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The Emergence of Triadic Play in Mother-Infant Interactions: Play Context and Nonverbal Communicative Behaviors

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ABSTRACT

The Emergence of Triadic Play in Mother-Infant Interactions:
Play Context and Nonverbal Communicative Behaviors

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As infants become more interested in their nonsocial surroundings, triadic play, where a toy is added to infants' play with their caregivers, becomes an increasingly frequent play context. Yet, little is known about the emergence of triadic play within the first year of life. Identifying the play contexts in which infants participate is integral to understanding the processes by which infants develop into increasingly competent social beings. The present research consisted of two studies. In Study 1, the Relational Play Category Coding Scheme was developed to delineate characteristic bouts of triadic play occurring between mothers and their infants aged 4 to 7 months. Five different triadic play categories were identified. The coding scheme was applied to a sample of mothers and their infants in Study 1 who participated in a longitudinal study of free play when their infants were 4, 5 ½, and 7 months of age. The Relational Play Category Coding Scheme was then applied to a cross-sectional (Study 2a) and a longitudinal sample (Study 2b) of mothers and their infants at 4 and 7 months within the face-to-face play context. Play context was further explored by including type of toy (social or functional) as a variable in Study 2. In addition, infants' gazing and smiling behaviors during dyadic and triadic play were examined. Results from the application of the Relational Play Category Coding Scheme from both studies converged to suggest the mutual influence of mother and infant on the context of early play interactions, whereby the content of play was

modified with infants' development. Infants were more autonomous in toy play with age; mothers provided fewer demonstrations of the toys and used fewer physical interventions with older infants. In addition, results from Study 2 indicated the powerful influence of play context on infants' communicative development. Infants' nonverbal communicative behavior did not differ as a function of infant age during dyadic play, but it did differ during triadic play. Seven-month-olds were found to gaze more toward their mothers' faces and displayed higher levels of smiling than the 4-month-olds when the social and social/functional toys were used. It was during the periods that the social and social/functional toys were used that the highest levels of Social play were also found to occur. Thus, at 7 months, it appears that infants were more responsive to triadic play with certain toys and engaged with their mothers to a greater degree as measured by infant gazing and smiling. The different triadic play contexts within which mothers and infants engaged, as well as the communicative contexts promoted by the use of different toys, underscores the diverse learning opportunities available to infants during triadic play. Implications for the development of communication and play in infancy are discussed.

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CHAPTER 1: Introduction

Parent-infant play is an integral component of infants' cognitive, socioemotional, and motor development, and encompasses many of the major developmental tasks of the infancy period (Beeghly, 1993; Tamis-LeMonda & Bornstein, 1993). For centuries it has been known that children acquire knowledge most easily in a playful manner (Papoušek, Papoušek & Harris, 1987). While children of all ages spend many of their waking hours in play, play interactions in the first year of life are especially important as they are a primary context within which infants develop an understanding of the process of communication during social interchange (Rubin, Fein, & Vandenberg, 1983; Tronick, 1989). Infants' developmental gains in their ability to communicate during the first year of life are remarkable. By the end of the first year, infants use gestures such as pointing to recruit the attention of their caregivers, and many infants have acquired their first words (e.g., Butterworth & Grover, 1990; Trevarthen & Hubley, 1979). However, even prior to the development of language, infants have salient means of communicating in the nonverbal domain such as through gazing and smiling.

In order to understand the setting within which infants' social and communicative development takes place, the play contexts in which infants participate must be identified. Infants' communicative skills are stimulated and encouraged primarily within two play contexts during the first year of life. In the first five months of life, infants' exposure to the process of communication occurs largely within a dyadic context where caregivers and infants play together without toys (Cohen & Beckwith, 1976; Trevarthen, 1977). Dyadic play remains common in the latter half of the first year of life, but gradually

declines as infants become more interested in their nonsocial environment, making triadic play an increasingly frequent context for social interchange (Papoušek & Bornstein, 1992). The term triadic play is used in the present dissertation to describe an interaction that includes a caregiver, an infant, and a toy.

There has been a proliferation of research investigating infants' social abilities during dyadic play. Results have revealed that infants are active participants in social interchange and are sensitive to the communicative signals of their social partners (e.g., Cohn & Tronick, 1988; Hains & Muir, 1996; Kaye & Fogel, 1980; Messinger, Fogel, & Dickson, 1999). In addition, studies have demonstrated that many of the basic organizing principles of communication (e.g., coordination, timing, and synchrony) are integral components of early interactions (e.g., Feldstein et al., 1993; Fogel, 1988; Tronick & Cohn, 1989). Dyadic play provides infants with the opportunity to acquire an understanding of the organization of social behavior and has been considered the origin of communicative dialogue (Kaye, 1982).

The transition from dyadic to triadic play is an area of communicative development that has received relatively little attention in the literature. Most research investigating the inclusion of objects in mother-infant play has involved infants 6 months of age and older, despite the fact that infants first begin to display sustained interest in objects around 4 months of age (e.g., Bakeman, Adamson, Konner, & Barr, 1990). The paucity of research addressing triadic play is striking given previous studies suggesting that triadic play provides learning opportunities that may have long term implications for the development of infants' language and attention skills, as well as exploratory

competence (Baldwin, 1991; Landry & Chapieski, 1989; Lawson et al., 1992; Pêcheux, Findji, & Ruel, 1992; Tomasello & Farrar, 1986). For example, caregivers' inclusion of objects in play provides one of the earliest referential contexts which serves to make language meaningful (Bruner, 1987). Furthermore, joint attention towards an object during mother-infant play has been linked to infants' language development. The amount of time spent in joint attention episodes with a caregiver is positively related to the infant's vocabulary (Tomasello & Todd, 1983). Similarly, joint attention episodes elicited longer and more frequent "conversations" between mothers and infants compared to episodes when there was no joint focus of attention (Tomasello & Farrar, 1986). Likewise, novel word learning in 16- to 19-month-olds was greatly facilitated by involvement with an adult in joint attention toward an object (Baldwin, 1991). Given the many learning opportunities provided in the context of toy play, studies focusing on the early months of the first year of life have the potential to make an important contribution to understanding the emergence of triadic play in infant development.

While there is a dearth of literature investigating the emergence of triadic play, there is a large literature on the developmental trajectory of infant solitary play. Observing the level of infants' play has been considered one means of assessing cognitive competence, resulting in attempts to categorize developmental changes in play (Beeghly, 1993). Increasingly sophisticated levels of infant independent play have been documented in previous research (Belsky & Most, 1981; Doehring, Benaroya, Klaimain, Steinbach, & Wayland, 1997; Zelazo & Kearsley, 1980). Infants' contact with toys initially consists primarily of indiscriminate mouthing, which gradually becomes more

tailored to the specific features of toys, such that they explore both the properties of toys and their functions. Pretend play characterizes the more sophisticated levels of play emerging around 12 months of age. Infants' growing representational competence and capacity for symbolic thought are evident in pretend play bouts, where they create new meanings or uses for objects (Fein, 1987; O'Reilly & Bornstein, 1993). While infants progress through developmentally more advanced levels of play, their adult partners are not constrained in the same manner and can incorporate toys into play in a variety of ways at any given time.

Further research is needed to categorize the different types of caregiver-infant interactions that occur early in development. This is particularly true in the realm of toy play where caregivers play a primary role in introducing the toys prior to the advent of infants' own abilities to reach for and grasp toys. As a result, caregivers have the opportunity to create play contexts depending on their activity and the function of the toy. The present studies were designed to contribute to research on triadic play through the use of a coding scheme that delineated categories of triadic play that were apparent in dyads between the ages of 4 and 7 months, a transitional period where toy play becomes increasingly frequent. Time spent in the different categories of play was evaluated in longitudinal samples of infants who engaged in free play with their mothers, allowing for an examination of changes in the structure and organization of play across developmental time. Furthermore, the effect of the type of toy included in the play on the content of the play was examined in relation to particular toys. The function of different communicative behaviors are best understood by examining them within the contexts within which they

are embedded. Thus, infants' gazing and smiling behaviors were examined across the play contexts elicited by the different play categories and types of toys used in play.

In order to provide a framework within which the present work is integrated, the pertinent literature will be reviewed beginning with current theoretical approaches on infant development and communication. The discussion of theory will be followed by a review of research underscoring infants' inherent social attunement, as well as findings of infants' communicative abilities from the realm of dyadic play in order to highlight current knowledge of infants' social competencies. A review of the research on triadic play will follow, leading into a description of the present studies, with an emphasis on aspects of infant communicative development that remain to be elucidated. The majority of past investigations of both dyadic and triadic play have studied mothers and their infants as opposed to fathers. The preponderance of mothers in studies is undoubtedly due, in part, to their greater availability and accessibility as they are most often the primary caregivers in infants' early months. Thus, most of the research reviewed reflects findings from mother-infant play, although fathers are increasingly being included in studies of infant development (e.g., Dickson, Walker, & Fogel, 1997; Lamb, 1997; Power, 1985).

Infant Development and Communication: Theoretical Approaches

Prior to the 1960s, infant development was regarded as a one-way process with the caregiver playing the key role. The infant was viewed as a passive recipient of external stimulation with immature capacities for partaking in the social world. This view of the passive infant resulted from the popularity of psychoanalytic and learning theories,

which placed an emphasis on the primary role of the caregiver in infants' early development (Fogel, 1997). A shift to cognitive theories of development, such as information processing theories and Piaget's constructivist approach, resulted in the recognition of infants' active roles in acquiring knowledge through their own actions on the environment. Piaget's infant-centered approach gave infants credit for their abilities to interact with their environment (Piaget, 1952). Yet, while psychoanalytic and learning theories over-emphasized the role of the caregiver, cognitive views have been criticized for understating the role of infants' caregivers in fostering and guiding development (Fogel, 1997).

Infant psychiatrist Louis Sander was influential in inciting changes in conceptualizations of the early mother-infant relationship from what was viewed as a one-way process, to theorizing that the mother-infant relationship was one of reciprocal mutual influences (Sander, 1962). This view of development is represented in transactional models and systems theories, which provide a more accurate depiction of the complexity of the process, with their emphasis on the mutual influences that impinge on infant development (e.g., Belsky, 1981; Fogel & Thelen, 1987; Gottleib, 1983; Sameroff & Chandler, 1975). Systems theories hold as a main tenet that development is non-linear, with interrelatedness between constructs by definition (e.g., genetics, physical and social environment, and culture). Systems theories more accurately represent the complexity of human interaction than previous theories that predominantly emphasized the infant's or the caregiver's role in development without acknowledging the mutual influence inherent in relationships.

Vygotsky's work embodied the reciprocal influence of the caregiver and infant. He emphasized the importance of parental involvement in fostering development in relation to the infant's own developing skills. Parents provide a supportive structure from which the infant can discover and explore the world (e.g., Rome-Flanders, Cronk & Gourde, 1995). Vygotsky considered parental guidance and support essential in fostering the development of new skills, and he believed that all higher mental functions originated in the social plane before they were internalized. Vygotsky placed particular emphasis on the timing of parental support in play. In order to have the greatest impact on learning, he advocated that parents needed to tailor their support to their infants' capabilities. In his view, parents should encourage skills that are slightly above that which the infant has already mastered, but also be available to provide support when needed. Vygotsky termed this the zone of proximal development, where maximal learning opportunities are available (Vygotsky, 1962; 1978).

For example, in the context of parent-infant games, parents initially take responsibility for instigating the games and providing the structure. The context of play during parent-infant games is a time during which the infant is alert and primed to participate and gradually learns the turn-taking nature and sequencing of the game. Adults then guide the infant into taking greater responsibility and playing an increasingly active role in the game with age (Gustafson, Green, & West, 1979; Rome-Flanders et al., 1995). Thus, the mutual influence of the parent and infant are apparent in that their behaviors in relation to one another during social interchange are modified with development and experience.

Systems models of development are incompatible with traditional models of communication. In traditional models, communication is conceptualized as a linear process where a discrete signal is sent and received, thus emphasizing the role of each individual partner (Fogel, 1993). In such an approach, the complexity of human interaction is reduced to discrete units that are looked at in isolation from the system in which they are embedded. Fogel and Thelen (1987), in applying the dynamic systems model to their research on infant development, underscore that communication between mother and infant cannot be reduced to the sum of its individual parts. Communication is a continuous process, where each partner is continuously active and can modify his or her own actions at any time without waiting for a discrete signal from the other (Fogel, 1993). Communication is viewed as a relational entity that is continuously coordinated, creative, and mutually generated.

Taken together, theoretical approaches to infant development have shifted considerably over the last four decades. Systems theories underscore that it is not the mother or the infant individually, but their relationship, that is the backdrop which frames the developmental change that occurs in infants' communicative abilities throughout the first year of life (Fogel, Walker, & Dodd, 1997). Moreover, this relationship is itself embedded in a broader cultural context which also influences the experiences and approaches to caregiving to which the infant is exposed. Systems theories highlight the necessity of longitudinal research with the recognition that infant development is embedded in the context of the developing caregiver-infant relationship. In order to study developmental change, examining the same dyad over developmental time allows the

study of emerging social behaviors as embedded in infants' motor and cognitive development, and within the dynamic infant-caregiver relationship.

Play is play because of its inherent creativity that would not be present if a set of rules prescribed in advance governed each play encounter (Fogel, Nwokah, & Karns, 1993). By its very nature, research on play must be open to capturing the interplay between each partner's participation in the interaction. Systems theories are amenable to the study of play given that play emerges over time and is influenced by multiple factors such as cognitive and affective components, as well as some not so obvious factors such as postural positioning and motor coordination (Fogel et al., 1993). The studies conducted for this dissertation integrated aspects of systems theories of development and communication into infant research by taking a relational approach to the study of play. In addition, components of infants' development such as their developing cognitive and motor capacities were acknowledged as contributing factors to the changes in play that emerged across developmental time. Finally, given the importance of studying development within the context of the developing mother-infant relationship, some samples of infants were studied longitudinally in the present research.

Infants as social beings

Evidence from a variety of studies in both the perceptual and social realms suggests that infants possess a precocious attunement to their social environment from birth. For example, research from the perceptual realm suggests that infants may possess an innate mechanism that orients them towards faces, thus serving to promote their interaction with their social world (Johnson & Morton, 1991). Newborns were found to

gaze at and track a human face-like pattern for a greater duration of time as compared to a face without any features present and a face where facial features were scrambled (Goren, Sarty & Wu, 1975; Johnson & Morton, 1991). In addition, infants can differentiate their mother's face from that of a female stranger's face within hours of birth (Bushnell, Sai, & Mullin, 1989; Field, Cohen, Garcia, & Greenber, 1984; Walton, Bower, & Bower, 1992), and show a preference for the sound and smell of their mother over that of another woman (DeCasper & Fifer, 1980).

The visual system appears to be sufficiently well developed from birth to engage in face-to-face contact with the caregiver, making the face a salient aspect of the infant's early social environment. Newborn infants can focus on objects eight inches away, the approximate distance of an infant from his/her mother's face during feeding (Stern, 1977). Given that the human face embodies information about emotional state and the direction of attention, the face plays a key role in communication. The information that the face conveys about emotional state eventually becomes explicit as infants' developing cognitive abilities enable them not only to detect changes in facial expressions, but also to subsequently attach meaning to these expressions.

Infants' abilities to differentiate their social from their nonsocial world from the first months of life also underscore their sensitivity to human contact and relationships. Communication takes place between people, and, as a result, person-object differentiation is a prerequisite for social behavior. Infants appear to reserve communicative signals, such as smiling, for people. Between 5 and 9 weeks of age infants smile and vocalize positively toward people but not toward a doll, and as young as 9 weeks of age, infants

respond with differentially organized face, hand, and arm behaviors to social and nonsocial stimuli (Legerstee, Corter, & Kienapple, 1990; Legerstee, Pomerleau, Malcuit, & Feider, 1987). Likewise, Ellsworth, Muir and Hains (1993) found that 3- and 6-month-olds smile at people but rarely at objects, and this is so even when the objects have similar features to a human face. Infants also produce hand actions that appear to be systematically organized in relation to affective states, gaze, and vocalizations when interacting with people (Fogel & Hannan, 1985). Infants' abilities to differentiate their social from their nonsocial surroundings undoubtedly facilitates the formation of attachments to, and communication with, significant others in their lives. Evidence that infants are active social beings from birth has contributed to the interest in and proliferation of research examining their role in social interchange from the earliest months of life.

Communication during dyadic play

The face-to-face paradigm, where mother and infant are seated facing each other at eye level during a series of brief interaction periods, has frequently been used in the study of social interchange in the first year of life. Studies employing the face-to-face procedure have provided evidence documenting the mutual sensitivity and responsiveness of mother and infant during dyadic play, and demonstrated the importance of interactional reciprocity. Further, face-to-face play studies have highlighted the roles of different maternal channels of communication in social interaction such as the role of touch, and underscored infants' capabilities of perceiving and responding to the presence or lack of contingency during social engagement (Brazelton, Koslowski, & Main, 1974; Cohn &

Tronick, 1988; Kaye & Fogel, 1980; Lamb, Morrison, & Malkin, 1987; Lepage, 1998; Lepage & Stack, 1997; Muir & Hains, 1993; Stack & Muir, 1990; Stack & Muir, 1992; Toda & Fogel, 1993).

Studies of dyadic play during face-to-face interaction have measured infants' nonverbal communicative behaviors as indices of infants' social expectancies, understanding, and level of engagement in face-to-face play. Gaze behavior is the only behavior over which young infants have considerable control as a means of receiving and rejecting communicative bids from social partners. Thus, examining infants' patterns of gazing provides an important window into their roles and participation in social interchange. Gazing involves sight, the motor act of moving the eyes, and head movement. By the end of the third month of life, infants' control over their gaze direction has matured such that they virtually have complete control over what they see (Stern, 1974; 1977).

Infants' patterns of gaze serve an important interpersonal role in their play interactions. From the first months of life, infants are sensitive to eye contact from their social partners. For example, Lasky and Klein (1979) found that infants gazed longer at an adult when the adult made eye contact. Dyadic play in a face-to-face context in the early months of life is characterized by bouts of mutual gaze between mother and infant, indicating that when infants gaze at their mothers, their mothers are likely to be looking at them (Fogel et al., 1997a). Between the ages of 3 to 6 months, infants spend approximately one third to one half of their total time in a face-to-face play bout gazing at their mother's faces (Fogel, Dedo, & McEwen, 1992; Stack & Arnold, 1998; Stack &

Colburne, 1996; Stack & Lepage, 1996; van Beek, Hopkins, & Hoeksma, 1994). The amount of infants' gazing toward mothers' faces during dyadic play has been found to decline with age, a decline that may be related to the development of reaching and grasping that results in infants becoming more oriented towards objects and their nonsocial surroundings (van Beek et al., 1994). For example, infants between 3 and 6 months of age who were not yet able to engage in visually guided reaching looked longer at their mothers' faces during face-to-face play than infants who were able to reach (Fogel et al., 1992). The ability to reach provides opportunities for infants to explore their surroundings, thus increasing the likelihood of gazing away from their mothers' faces.

Smiling is also a highly salient nonverbal communicative behavior that serves to potentiate communication (Fogel et al., 1997a). Infant smiles are most often followed by another positive parental social behavior such as touch or vocalization accompanied by positive affect (Rogers & Puchalski, 1986). While infant smiles have been found to increase in overall duration with age, the meaning of the smile changes with development (Fogel et al., 1997a). Smiling within the first month of life seems to be an involuntary product of fluctuations to internal states (Sroufe & Waters, 1976). These endogenous smiles occur almost exclusively during REM sleep, a period that is characterized by low levels of cortical activity. The earliest smiles while the infant is awake are elicited by low-level tactile and kinesthetic stimulation such as light touches on the skin (Emde & Koenig, 1969). Social smiles begin to emerge around 6 weeks of age, and one of the most successful elicitors of the infant's social smile is the human face (Fantz, 1961).

Moreover, different types of smiles have been found to be elicited in different contexts of parent-infant play (Dickson, Walker, & Fogel, 1997; Messinger, et al., 1999).

The occurrence of infants' smiles has been found to be related to their partners' behaviors during face-to-face play. Hains and Muir (1996) found that 3- to 6-month-old infants decreased their smiling whenever adults looked away. Moran, Krupka, Tutton and Symons (1987) established that 13- to 16-week-old infants were more likely to begin smiling and gazing at their mothers when their mothers had already begun smiling and gazing. In addition, a developmental progression has been noted in infants' responsiveness to their mothers' initiations during face-to-face play (Kaye & Fogel, 1980). Infants responded to their mothers' smiles, vocalizations, and facial expressions with corresponding smiles and vocalizations 20 percent of the time at 6 weeks of age, 35 percent of the time at 13 weeks of age, and by 26 weeks of age, infants were just as likely to initiate 'greetings' as they were to respond to their mothers' initiations.

As outlined previously, systems theories underscore the interrelationship and thus complexity between different components that impinge on infant development. In line with this perspective, there is a growing recognition that behavioral indices in isolation such as infant gaze or affect, in and of themselves, provide an over-simplified view of the ongoing interaction (Symons & Moran, 1987). Consequently, studies have investigated co-occurrences between infants' communicative behaviors. Infant smiling has been found to increase in frequency when infants are gazing at their mothers' faces (Kaye & Fogel, 1980; van wulfften Palthe & Hopkins, 1984). Likewise, infants produce hand actions that appear to be systematically organized in relation to affective states, gaze, and

vocalizations when interacting with people (Fogel & Hannan, 1985). Furthermore, positive associations between expressive behaviors such as infant smiling and gazing toward mothers' faces are sensitive to changes in context during face-to-face play, and have been found to differ during periods where mothers' interactions are modified by experimental instruction (e.g., still-face with touch periods; Stack & Arnold, 1998).

Weinberg and Tronick (1994) examined infants' communicative behaviors in a search for characteristic configurations of facial expressions, vocalizations, and body movements. They found that there were clusters of communicative behaviors that were more likely to co-occur in certain states of engagement. For example, social engagement was characterized by facial expressions of joy, looks at the mother, neutral/positive vocalizations, and mouthing body parts. Findings such as these have led researchers to imbue infants' nonverbal behaviors like smiling and gazing with communicative significance, given that they appear to have a socially-directed character. Object engagement was characterized by facial expressions of interest, sustained looking at objects, and mouthing objects. Examining the co-occurrences of infants' communicative behaviors enables a richer understanding of the meaning of these behaviors as they unfold in mother-infant dyadic play.

Taken together, research on dyadic play has revealed that infants are active participants in the process of social interchange. Infants are sensitive to the behavior of their social partners, as evidenced by differential patterns of infants' gaze and affective responses in relation to the activities of their caregivers. Less is known, however, about

the nature of communication between mother and infant in the presence of toys at early ages.

When Two Become Three: Triadic Play in Infancy

There is little systematic observational or experimental data concerning the development of triadic play in early infancy. As a result, the different contexts of triadic play that are apparent in mother-infant interaction between 4 and 7 months have yet to be delineated. Describing the triadic play contexts to which infants are exposed is particularly important in studying the development of infants' communication, given that communication cannot be studied apart from the context in which it is embedded. In particular, in the realm of triadic play, there are two contextual factors that have not been fully explored that were examined in the present set of studies. First, it is probable that the manner in which a toy is incorporated into play has an effect on infants' nonverbal communication. Yet, categories of play, as defined by the different ways in which toys are incorporated into play, have yet to be described. Second, the effect of the type of toy in fostering communicative interchange between mother and infant has not been examined. Research relating to both categories of play and types of toys included in play will be reviewed in the following sections, followed by a review of studies that have examined infants' nonverbal communicative behaviors during triadic play.

Play context: Activities with toys. Only recently have attempts been made to examine different contexts of caregiver-infant interaction in order to understand how they impinge on infant development. Bornstein (1989) sought to identify the most predominant categories of caregiver-infant interaction in order to study how different

modes of caregiving might influence infants' development. Two modes of interaction that commonly occur between caregivers and their infants were identified. The first mode of caregiving was social caregiving, defined as interpersonal exchanges during play, including behaviors such as kissing, smiling, physical comforting, and engaging in playful face-to-face contact. Bornstein's definition of social caregiving appears to refer to dyadic play, as he does not mention the inclusion of objects within these playful interchanges. The second type of commonly utilized caregiver interaction was didactic interaction which occurs when caregivers facilitate infants' interactions with the nonsocial world, thus encompassing the realm of triadic play. Caregivers' behaviors that are subsumed within didactic interactions are teaching, demonstrating, focusing of attention, labeling, and providing opportunities for infants to observe and learn. The social mode of interaction focuses on the dyad, while didactic interactions broaden the focus beyond the dyad to include the nonsocial world (Bornstein, 1989). The classifications of social and didactic caregiver modes of interaction may be a useful guideline for distinguishing some of the caregiver's activities with toys. However, this distinction between social and didactic play has yet to be applied systematically to observational studies of mother-infant play.

Most studies that have categorized the different types of interactions that unfold during play have determined the categories a priori, rather than deriving the categories based on the play itself. For example, Bakeman and Adamson (1984) defined six mutually exclusive categories of engagement. The Unengaged category was used when the infant was not involved with a specific person, object or activity. Onlooking occurred

when the infant was observing another's activity without taking part. Person engagement occurred when the infant was engaged with another person. Object engagement defined segments of play when the infant was playing independently with objects. Passive joint engagement occurred when the infant and the mother were actively involved with the same object, but the infant showed little awareness of his or her mother's presence. Finally, coordinated joint attention encompassed periods of play where there was a joint focus of attention between mother and infant, but the infant also coordinated his or her attention between the mother and the object. At the core of the definition of these engagement states is the direction of infant attention. However, for the purposes of the present set of studies, the categories including objects are general in their definitions and the manner in which the toys were incorporated into play was not included in the Bakeman and Adamson coding scheme.

Dickson, Walker, and Fogel (1997) investigated the relationship between smile type and play type during 10 minutes of free play between 12-month-olds and caregivers videotaped in their own homes. Play contexts included not only different types of play, but also partner, whereby free play was examined with both the father and the mother separately. The play-types coded in this study consisted of object play, defined as when the partners were playing with an object in a social manner, when the partners were using a toy together, or when one partner was playing with an object and the other partner was watching. Physical play was coded when members of the dyad were in physical contact such as in "I'm gonna get you" games. Vocal play consisted of games such as singing. Book reading was coded when the infant and caregiver were looking at a book together.

Finally, nonengaged was coded when one of the partners was not involved with the other. Two of these four play categories included objects; the object play category and book reading. Dickson et al.'s object play category was general, encompassing multiple variations of object play. For example, social object play and independent object play while the mother looks on, are in the same category. In addition, object play included when the mother was teaching the infant about the function of the toy, or when the partners were using the toy together, and embodied both social and didactic interchanges. In order to investigate the organization and structure of triadic play based on the ways in which toys are used, play categories are required that account for this diversity of object play and at the same time are specific enough to enable comparisons across development.

Research by Fogel and his colleagues has served to elucidate developmental changes in triadic play within the first year of life through the identification of four different frames, or recognizable segments of social communication in which partners can be mutually engaged (Fogel et al., 1997a, Pantoja, 1996). Frames help to elucidate the communicative process by providing a broad guideline as to the topic which is co-created between partners. At the same time, Fogel describes frames as defying exact description due to the creativity and spontaneity that are inherent in social interchange, thus making the content within each frame attainable only through a written narrative unique to each dyad. A social frame occurs when there are no objects involved, and mother and infant are mutually oriented toward each other. Guided-object frames occur when there is mutual orientation toward an object held by the mother or the infant where the mother is actively taking part in the infant's action. A non-guided-object frame is when there is

mutual orientation toward an object but the mother is not taking part in the infant's action. Finally, a social/object mixed frame occurs when there is mutual orientation toward each other mediated by an object, such as when both partners are engaged in social and physical-motor play involving objects.

Identifying frames of play allows for comparisons of different communicative behaviors across the different contexts as defined by the frames. The frames identified are general categories that are defined broadly by attention and action (e.g., guided-object frame) and describe the different contexts within which communication in play can take place. A detailed description of the content of each frame would be available through the use of written narratives, which have been used as a means of discovering the process of developmental change within individual dyads across time (e.g., Taylor, 1997; Pantoja, 1996; 1997). However, if one wants to look beyond individuals and draw conclusions across dyads of different ages in terms of the development of play, creating categories of play that include the different ways in which toys are incorporated is one means to systematically examine play. Future research is warranted in order to further describe the content of these early play interactions where toys are included. Given that the context of play has a fundamental role in the learning opportunities afforded to infants, further elucidating the nature of triadic play contexts has the potential to make an important contribution to present knowledge of infant development.

Play context: Type of toy. Another factor occurring during play which has the potential to affect both the category of toy play engaged in, as well as the communication patterns between partners, is the type of toy that is included in play. Remarkably, while

type of toy included in play is likely to have an effect on the communication that emerges during mother-infant play, few studies have included type of toy as a variable. Based on observations by this author, the types of toys that are included in play in early infancy can be classified within two main categories. The first category is social toys, which are toys that have faces such as stuffed animals or dolls. These toys are considered social because caregivers often personify or animate them when including them in play with their infants. For example, in a pilot study of mother-infant face-to-face play conducted by the present author, mothers were given a stuffed terry cloth bunny to use in free play for brief interaction periods. Infants ranged in age from 4 to 9 months. The focus of this study was on comparing Normal with Still-face interactive periods and not on categorizing different types of play. However, observations of the play indicated that the bunny was frequently used in a looming game where mothers would move the bunny inward toward their infants, culminating with tickling the infant with the bunny. In addition, mothers played peek-a-boo games with the bunny, and made the bunny kiss their infants' cheeks, and talk and dance on their infants' bodies. Mothers in this study often chose to personify the stuffed bunny and made it interact in a social manner.

The second category of toys that are often included in mother-infant play are functional toys. Functional toys are constructed in such a way that they are conducive to a certain activity. For instance, rattles that spin and shake with a variety of colors are functional toys. Functional toys are toys where "things happen" and where caregivers can facilitate play by demonstrating how a toy works (e.g., stacking brightly colored rings on a post). When functional toys are used in play, the toy itself is most often the focus of

the play. In contrast, social toys may often be used as mediators of the social play between mother and infant, where the interaction between the mother and infant, not the toy per se is the focus. As a result, it is probable that social and functional toys elicit different patterns of communication between mothers and their infants. However, the effects of type of toy on play have not been examined.

When type of toy has been a consideration in research studies, it has typically been with the purpose of investigating gender differences when children engage in play with sex-stereotyped toys (e.g., O'Brien & Huston, 1985). For example, Malone and Langone (1998) investigated the variability in play in relation to different toy sets in a sample of preschool children between 2 and 5 years of age with cognitive delays. They chose a vehicle, doll, and mixed toy set in order to investigate social stereotypes in children's play. Their study was based on observing infants' independent play with the toy sets, and did not include play with infants' caregivers. Five categorical play variables (non-play, exploration, functional, constructive, and pretend play) were operationalized and compared across toy sets. Different toy sets did elicit differences in type of play which were mediated by the child's gender. For instance, boys engaged in more exploration when playing with either the mixed or doll toy sets than when playing with the vehicle toy set. Girls explored the mixed toy set more than the doll toy set. Both boys and girls engaged in more pretend play while playing with the doll toy set than either the mixed or vehicle toy set, in addition to engaging in more sophisticated play with the doll toy set than the other two sets. Thus it appears that different types of toys can effect the type of play. However, the Malone and Langone findings pertain to independent

infant toy play in a preschool sample rather than play within a social context during infancy.

Other studies of triadic play have included a broad and standard array of toys. However, even with a broader array of toys, results are reported regarding toy play in general, without comparing infant responses when they are engaged with different types of toys. For example, in Bakeman and Adamson's (1984) investigation of triadic play, the toy sets were a toy telephone, a picture book, a four piece wooden puzzle, a set of colorful nesting cups, a doll, a rattle with movable parts, and a soft plastic toy with wheels. The doll was the only social toy included in their sample. It is unclear if there were any criteria underlying the choice of toys in this study. Given that their study included infants as old as 18 months of age, it is probable that they included a variety of toys that were conducive to symbolic play, such as the toy telephone.

Likewise, Bornstein and Tamis-LeMonda (1990) used a book, ball, blocks, nesting set, teapot and cover, cups and saucers, spoons, toy telephone, toy vehicle, and a clown doll in their studies of toy play with infants between 5 and 21 months of age. Power (1985) conducted a study to assess potential differences between mother- and father-infant play as well as infant solitary play. Toys were chosen specifically for the different parent-infant play modes that the toys might foster: visual exploration; individual object manual inspection; pretend play; relational play; turn-taking; and play involving the production of visual and auditory effects. However, consistent with the previous studies reviewed, findings were not reported based on type of toy, but rather were reported for toy play in general.

The aforementioned sets of toys appear to be characteristic of toys incorporated in other studies investigating triadic play with infants around similar ages. While it is clear that infants and their caregivers have had access to a wide variety of toys in studies of triadic play, the effect of type of toy has not been examined in most studies as a contributing factor to the context of play that unfolds. In particular, social toys likely promote different types of communicative interchange than functional toys, where the focus would most likely be on discovering the use of the toy. Including the type of toy as a factor when investigating mother-infant communication has the potential to make a significant and unique contribution to research on triadic play.

Communication during mother-infant toy play

Prior to the development of language, infants' nonverbal communicative behaviors provide a window into the development of the integration of social, affective, and cognitive skills in infancy. There have been many investigations of infants' communicative behaviors such as gazing and smiling during dyadic play, however, less is known about the occurrence and function of these behaviors during triadic play.

Infants' gazing behavior plays both instrumental and interpersonal roles in relation to their environments. Infants' gaze at objects is an important means of gaining information about their surroundings. Young infants are not yet able to exert well-controlled physical actions on objects or comprehend caregivers' verbal descriptions, but they can assimilate information about objects through visual attention (Pêcheux et al., 1992). Triadic play provides a context where caregivers can facilitate infants' developing attentional capacities by encouraging them to focus on and maintain their attention to

objects. While infants acquire information about objects independently through their gaze, this process can be facilitated by the adult who stimulates a variety of developmental processes in the first year of life (Vygotsky, 1978). Studies of infant gaze behaviors during triadic play have focused largely on the roles that mothers can play in facilitating infant attention. In addition, there have been studies investigating changes in infant gazing from a dyadic to triadic play context. To date, there have not been investigations examining patterns of infant gaze as they pertain to the use of the toy in play, or to the type of toy included in play.

Pêcheux, Findji, and Ruel (1992) discovered that the amount of time infants focused their attention on objects at 5 months correlated with the amount of maternal encouragement to attend to objects that infants received. In addition, 8-month-olds who focused their attention on objects for long durations had mothers who had frequently encouraged them to do so at 5 months of age, underscoring the instrumental role of caregivers in toy play. Furthermore, mothers and their infants were videotaped in their homes at 5 and 8 months of play for approximately one hour as they engaged in their regular activities. Sessions were then categorized into four exclusive and exhaustive categories: child care (e.g., feeding, diapering); interactions involving objects; direct interactions where no object was included; and infant alone play where the mother's attention was not focused on the infant (Findji, Pêcheux, & Ruel, 1993). Results indicated that the four different activities did not promote the same opportunities for mothers to focus their infants' attention on objects. Mothers mobilized their infants' attention to objects mainly during play with objects as compared to the child care

interactions such as feeding. The results imply that different contexts of interaction promote different learning opportunities, and that patterns of infant gaze are likely to vary across contexts.

The interpersonal aspects of gaze are dramatically altered in the context of triadic play where infants divide their attention between the toy and their social partner, compared to dyadic play where no toy is present. Of studies that have measured gaze behavior during toy play, it is clear that the toy captures most of infants' gaze, with a decline in gaze toward the mother. More specifically, in a face-to-face play context, Stack and Colburne (1996) found that infants gazed at their mothers' faces three times less during play interactions when a toy was present as compared to play without a toy. Likewise, McCollum and Stayton (1988) found that infants between the ages of 5 to 16 months focused most of their gaze towards the toy, with an average of 5 percent towards their mothers.

While infants' gaze at their mothers' faces is reduced during triadic play, there is a developmental progression in their ability to coordinate their attention between the toy and their social partner. During triadic play in the first half year of life, infants become engaged with the toy or their caregiver, but are not able to coordinate their attention between people and objects (Bakeman & Adamson, 1984). Bakeman and Adamson (1984) have called this engagement state passive joint engagement because while the caregiver and infant are both focused on the same toy, infants evidence little awareness of their caregivers' presence. However, beginning around 9 months of age, infants reference their caregivers' faces frequently during triadic play, as if to share their experience with

their caregiver. Gestures such as pointing, and infants' alternation of gaze between objects and adults during play, signal their attempts to establish joint attention with caregivers. Social referencing, where infants glance at their caregivers' faces in order to obtain information about their surroundings or new situations, also emerges near the end of the first year of life (Feinman, 1982; Sorce, Emde, Campos, & Klinnert, 1985).

In a longitudinal study examining infants' patterns of gaze during triadic play, Adamson and Bakeman (1984) found that person engagement declined with age, while coordinated joint engagement around an object increased with age. Coordinated joint engagement was defined as when the infant was actively involved with and coordinated his or her attention to another person and the object with which they were both involved. For example, an infant might have pushed a truck the mother had been pushing, and then looked back and forth between the mother's face and the truck. There was no increase in coordinated joint attention between 6 and 12 months of age, however, between 12 and 18 months there was a steady increase from a mean percent of 3.6 percent of the session at 12 months, to 26.6 percent at 18 months. Results indicate that as infants become older, they become more likely to coordinate their attention between people and objects.

Taken together, these findings underscore how the communicative context is altered when a toy is added during mother-infant play. An enriched social interaction is possible when infants and caregivers can share their understanding about aspects of their nonsocial worlds. However, prior to 9 months of age, little is known about the contexts in which young infants look at their caregivers during triadic play interactions. While gaze toward mothers' faces is lower during toy play, it still occurs, and examining the

contexts of play in which gaze toward mothers' faces occurs was considered instrumental in understanding the meaning of these gazes in relation to infants' experience and cognitive growth.

While the social context created by the caregiver during dyadic interaction serves to promote affective interchange, so also does mothers' involvement in infants' toy play. The context of the interaction (dyadic or triadic), and the social action in which the smile is embedded are important components in understanding the development of infant smiling. Previous studies have found that infants display more positive affect in dyadic play with people than when playing independently with a toy. However, when an object or toy is embedded within a social context where both the caregiver and infant are present, higher levels of smiling occur compared to infant solitary toy play. Studies investigating mother-infant toy play in infants aged six months and older have found that infants show more frequent displays of positive affect when playing jointly with a caregiver, as compared to independent play when infants interact with toys on their own (Adamson & Bakeman, 1985; Garner & Landry, 1992). In addition, infants displayed significantly more positive affect during triadic play with their mothers than with same-aged peers (Adamson & Bakeman, 1985).

Infants smile more during toy play with caregivers than during independent toy play, however, few studies have investigated what activities elicit infant smiles during triadic play. Dickson, Walker, & Fogel (1997) examined the relationship between smile type and play type during play in general, not specifically pertaining to toy play. Distinct patterns of smiles were identified as occurring with particular types of play. For example,

duplay smiles, smiles including a lip corner raise, jaw drop, and cheek raise, occurred more often during physical play. Basic smiles, smiles that involve a lip corner raise but no cheek raises, occurred during book reading and other forms of object play, of which the content was not specified. While not particular to toy play, these findings contribute a greater level of specificity over previous research, indicating that different types of smiles are elicited by different contexts of play.

One study which did examine infant affect in relation to mothers' activities with toys was the study by Adamson and Bakeman (1985) which investigated the relationship between toy play and infant smiling in infants 6 to 18 months of age. Two maternal activities during toy play were compared. Repetitive acts with an object were defined as the same act on an object three or more times with a brief pause between repetitions. Conventionalized rituals were play sequences where the object was involved in a shared social routine (e.g., talking on a toy phone). Results indicated that at least until 12 months of age, positive affect was most likely during periods of joint engagement when the mothers moved objects in a repetitive manner. Conventionalized actions with objects increased with infant age, and these conventionalized actions were the most common context for positive affect expressions for the older infants (15 to 18 months of age). It is likely that mothers may have had several different ways of incorporating the toy in a repetitive manner, and it is unclear from the findings exactly how the toy was used. For example, was the repetitive act with an object an act to the object itself without physical contact with the infant, or could it include when the object was used in a looming game where it was made to tickle the infant? The content of these actions was not elucidated.

How displays of infant affect vary depending on the type of toy included in play is also an area for investigation. Colburne, Switkin and Stack (1997) compared smiling of 5.5-month-old infants across dyadic and triadic play contexts. Durations of infant smiling were slightly lower during triadic play with a social toy, a stuffed bunny, than during dyadic play, but nevertheless remained at high levels compared to previous studies of infant independent toy play. However, in this study the toy was fastened to the infant seat, thus restricting the mobility of the toy and mothers' use of the toy. In addition, only a social toy was used in this study, and different types of toys were not compared in their ability to potentiate positive affect. Further studies are warranted where mothers are free to use the toys as they normally would at home. Studying what toys may be more effective at promoting positive affect is a worthwhile endeavor, as the inclusion of these types of toys in triadic play creates a context within which affective sharing eventually takes place.

Taken together, research on infants' nonverbal communicative behavior has made important contributions to describing how infant gaze and smiling differ between dyadic and triadic play. When a toy is added to the interaction, infants' gaze shifts to the toy, and occurs less frequently towards their mothers' faces. High levels of gaze at the toy provides the opportunity to obtain new information about the toy's functions and properties. Past research also reveals that infant smiling varies in both duration and type across different contexts of play. However, what activities with toys elicit infant smiles, what types of toys promote positive affect, and where infant smiles are directed during toy play are areas requiring further investigation. Understanding how infants' nonverbal

communication is modified when toys are included in play is limited in early infancy, thus further studies are warranted.

Summary

Play interactions within the first year of life are a primary context within which infants learn about their social and nonsocial worlds. The addition of toys into infants' play with their caregivers provides opportunities for referential learning, problem solving, exploration, and attention skills that are not as salient during dyadic play. Yet, the emergence of triadic play is not well understood. In particular, studies are warranted that investigate how toys are incorporated into play during the time frame when infants first experience triadic play with their caregivers. In addition, it is highly probable that different types of toys (i.e., social, functional) have different effects on the type of play that unfolds. Surprisingly, these contextual factors have not been investigated in systematic observational studies. Moreover, much remains to be elucidated regarding infants' patterns of gazing and smiling as they occur embedded in the context of triadic play. It is likely that infants' communicative development is a continuous rather than a stage-like process such that old communicative skills are neither lost, nor irrelevant, as new forms of communication emerge (Adamson & Chance, 1998). Thus, infants' early experiences in toy play with their caregivers undoubtedly play a role in what eventually develops into infants' explicit communicative intentions around objects through gestures such as pointing and social referencing. The present set of studies sought to further elucidate the development of triadic play between the ages of 4 and 7 months by delineating the ways that toys are incorporated into play (i.e., play categories), examining

the effect of type of toy included in play, and by investigating how infants' nonverbal communicative behavior may vary across play context.

The Present Research: Rationale and General Objectives

Two studies were designed to examine the emergence of triadic play between mothers and infants aged 4 to 7 months. These studies were designed to address the paucity of research examining caregivers' activities with toys during triadic play in infancy. Likewise, the influence of type of toy in determining the play activities engaged in has not been investigated. In addition, there are few studies that have examined infant nonverbal communication during toy play at young ages, and how these communicative behaviors might vary depending on the type of toy employed. Two general objectives formed the basis for the present set of studies. Specific objectives that apply to each study will be outlined in each of the introductions to the studies located in their respective chapters. The first general objective pertains to the context of infant play, while the second objective is related to infants' nonverbal communicative behavior during play.

Infants' development takes place within the context of the activities that occur in their everyday lives. Given that play is a primary context where infants learn and develop, delineating the different contexts of play that emerge during infancy is integral to understanding the learning opportunities prevalent during this rich stage of development (Tamis-LeMonda & Bornstein, 1993). The first objective of the studies was to delineate the play contexts that emerge between mothers and infants from 4 to 7 months of age. The different contexts of play were examined in both of the present studies. The primary goal of Study 1 was the development of the Relational Play

Category Coding Scheme which consisted of dyadic and triadic play categories occurring between mothers and infants aged 4 to 7 months. Development of the scheme provided a description of the shifting contexts of play as they occur in early infancy. Study 1 consisted of a longitudinal sample of mothers and their infants who participated in free play sessions when their infants were 4, 5 ½, and 7 months of age. The free play context of Study 1 allowed mothers and infants the freedom to play without toys, or to choose any or several of the five toys available during the play period. Categories of mother-infant play were derived through multiple viewings of the videotapes. Recurring types of play were identified and definitions for each of the play categories were operationalized and refined in a systematic manner. Dyadic play, play without toys, as well as triadic play with the toys available during the session, were coded. Subcategories of triadic play were developed to provide an account of the content of triadic play interactions in early infancy, thus providing additional information about play contexts than previously attained.

After developing the Relational Play Category Coding Scheme, the scheme was applied to the play sessions from dyads in Study 1. Changes in play context with age were examined by comparing overall durations of time spent in dyadic and triadic play with age. Further, durations of time spent in the subcategories of triadic play were compared across the three ages in order to determine whether the toy play changed in its organization and content across developmental time.

In Study 2, the Relational Play Category Coding Scheme was applied to a different play context, that of face-to-face play, where infants were seated across from

their mothers in an infant seat. Study 2 included a cross-sectional sample of 4- and 7-month-olds as well as a longitudinal component of the study; a subsample of 4-month-olds who returned at 7 months. While Study 1 was a free play context where mothers could play with or without toys, and choose the toys they wished to include, dyads in Study 2 participated in a standard set of interaction periods. Dyads engaged in an initial face-to-face play period without toys, and then engaged in three brief play periods with toys. Context of play was investigated in Study 2 by comparing durations of time spent in the subcategories of triadic play with age.

Study 2 extended the investigation of play context by enabling an investigation of how type of toy included in play might influence the play categories that emerged. This was achieved by choosing specific toys for inclusion in play based on their functional and/or social properties. Dyads were given each toy to include in play for a set period of time. Durations of time spent in the different play categories with the social, functional, and social/functional toys were compared to determine how play contexts differ when different toys are included.

The second general objective addressed in the present research was to examine infants' nonverbal communication during play. One context where infants' burgeoning communicative abilities are fostered is during their play with toys. The face-to-face context of Study 2, where infants were positioned in the infant seat, enabled a clear view of infants' eye gaze and facial expressions. As a result, an examination of infants' gazing and smiling behaviors was possible. Previous research has indicated that infants' gazing toward their mothers' faces declines in a triadic compared to a dyadic play context. In

addition, infants' smiling occurs for longer durations during toy play with their caregivers than during solitary toy play. However, it has yet to be established how these communicative behaviors might vary as a function of the type of toy used in play.

An examination of developmental change was common to both of the present studies. How the play context was modified with infants' development and how infants' communicative behaviors changed over time was examined through longitudinal samples. Including the same infants at different ages enabled an investigation of the developmental progression of play interactions as they occur embedded in the mother-infant relationship.

Summary. The present set of studies contributed significantly and uniquely to research on communication and play in the first year of life. In particular, these studies focused on infants between the ages of 4 to 7 months, allowing an examination of triadic play commencing from the time when toys begin to be included in play. A Relational Play Category Coding Scheme was developed in Study 1 that represents the different play contexts that emerged in free play between mothers and their 4- to 7-month-old infants. The play categories in the coding scheme were developed in a relational manner, to take into account the infants' and mothers' relationship to each other and to the toys. As a result, the dyads' focus of attention, as well as their physical involvement with the toy and with each other, was embodied in the play category definitions. Thus, knowledge of which categories of play the dyads were engaged in revealed not only play context in terms of dyadic and triadic play, but also included information regarding dyads' communicative stance in relation to one another and the toys.

In Study 2, the Relational Play Category Coding Scheme was applied to both a cross sectional and longitudinal sample of infants in a new play context, that of face-to-face play with caregivers. Thus, through the application of the coding scheme to a new play context, examination of potential changes in the organization and structure of the play within a different play context than the floor play context of Study 1 was possible. There are multiple play contexts within which caregivers engage in play, and examining more than one context was therefore important in reflecting this diversity. In addition, as in Study 1, an examination of potential changes in play categories engaged in across time was enabled. Moreover, Study 2 provided a controlled comparison of potential differences in the content of play based on the inclusion of different types of toys. Finally, Study 2 was unique to the present set of studies in its inclusion of the behavioral indices of infants' gazing and smiling. These are nonverbal communication behaviors that are salient and influential in early mother-infant social interchanges.

Taken together, the present studies delineated the play contexts prevalent in mother-infant play between 4 and 7 months. In addition, changes in infants' nonverbal communicative behaviors as they occur embedded in these play contexts were examined, thus extending previous knowledge of the emergence of play in the first year of life. The longitudinal components of the studies enabled the investigation of the development of triadic play across developmental time when infants' cognitive and motor abilities were progressing, along with the relational history of the dyad. The examination of changes in play context between 4 and 7 months provided a window into infants' learning opportunities regarding their social and nonsocial worlds in the first year of life.

CHAPTER 2: Study 1

Both past and present researchers studying development purport that cognitive growth occurs within the context of interpersonal exchanges in natural interaction between infants with their caregivers (e.g., Bornstein, 1989; Fogel et al., 1997a; Vygotsky, 1962). As a result, examining play interactions in infancy is essential to gaining an understanding of the contexts within which infants learn and develop during their first year of life. Dyadic play is the primary play context until infants are around 4 to 5 months of age, after which triadic play becomes increasingly predominant (e.g., Fogel et al., 1992; Pantoja, 1997). In the context of triadic play, infants learn about their nonsocial environments, eventually sharing their attention and affect regarding experiences with toys with their caregivers. Triadic play interactions play a crucial role in the development of infants' attention skills, exploratory competence, and language development (e.g., Pêcheux et al., 1992; Tomasello & Farrar, 1986).

Despite the importance of triadic play in infants' early development, there remains much to be elucidated regarding the nature of infants' first interactions with their caregivers when toys are involved. Studies which have investigated the context of triadic play have done so by grouping play into broad categories (e.g., object versus social play), without specifying categories of play that adequately describe the variety of play contexts to which infants are exposed. In addition, studies of triadic play have sought to determine the frequency and types of maternal scaffolding behaviors occurring with toys, and how these may vary with development. For example, mothers' attention-directing and attention maintaining strategies have been explored in free play contexts where toys were

available (e.g., Findji et al., 1993; Landry, Garner, Swank, & Baldwin, 1996; Pêcheux et al., 1992). Other studies have dictated the use of toys in the session as part of the experimental manipulation such that dyads were instructed to engage in ball games, stack and topple games, or turn-taking games (e.g., Hodapp, Goldfield, & Boyatzis, 1984; Ross & Lollis, 1987). However, what is lacking in the literature are studies that have focused on the type of play that evolves based on how toys are used in early play interactions. Thus, it remains to be determined how toys are incorporated into play commencing at 4 months of age when infants first display sustained interest to objects (Bakeman, Adamson, Konner, & Barr, 1990). Likewise, it remains to be elucidated how the manner in which toys are incorporated into play might change between the ages of 4 and 7 months, when infants' motor and cognitive abilities are developing.

Research on infants' development has often been domain specific in investigating infants' understanding of objects, people, or self, without the integration of these three domains. Yet, development in infancy takes place within a context where all three domains are present and changing over time. In the present study, it was considered important to take into account that infants' development is embedded within the social context of their relationships with their caregivers. Thus, the emergence of triadic play can best be examined when dyads are studied longitudinally. A longitudinal approach to research on the development of triadic play provided the opportunity to observe changes in the structure and organization of play within the same dyads over time when they are gaining more experience in toy play, and when obvious changes in motor development are also impinging on the play environment.

Study 1 addressed three research objectives pertaining to the theme of context of infant play during the time frame when play is shifting from predominantly dyadic to triadic play. The primary objective of Study 1 was to identify and describe characteristic bouts of dyadic and triadic play occurring between mothers and infants from 4 to 7 months. The first objective of delineating and describing triadic play was addressed through the creation of the Relational Play Category Coding Scheme. The scheme was developed through multiple observations of dyads who were videotaped on each of their three visits when infants were 4, 5 ½ and 7 months of age. Mothers were instructed to play with their infants as they normally would at home, thus allowing them to engage in dyadic and triadic play as they wished. Play categories were defined in a relational manner such that categories accounted for the action of both partners at a given time. Categories provided information about the play and communicative context through their embodiment of information regarding each participant's focus of attention, as well as physical involvement with the toy. Identifying characteristic bouts of play contributed toward a better understanding of infants' earliest learning opportunities available during play interactions, and provided a window into the content of triadic play that eventually leads to coordinated person-object attention at the end of the first year of life.

Once the Relational Play Category Coding Scheme was developed, it was applied to the dyads who participated in Study 1. The second objective of Study 1 was to examine the period of transition between dyadic and triadic play across the dyads' three visits. Given the longitudinal sample and the age range employed in the present study, the potential existed to track the developmental transition of play between these two

contexts. Most research has either focused on dyadic or triadic play, whereas the actual transition from dyadic to triadic play can only be studied within contexts where dyads have the option to include toys if they wish. Within the free play context of Study 1, potential shifts in the organization of play in terms of percent durations of time devoted to dyadic or triadic play could be examined. With the exception of studies by Fogel and his colleagues (e.g., Pantoja, 1996), few studies have examined this transition within the same dyads across the time period where this developmental transition is thought to take place. It was expected that in the free play context where toys were available for dyads to use as they wished, dyadic play would decrease and triadic play would increase between 4 to 7 months, thus corroborating previous research.

The third and final objective of the present study was to determine if there were developmental changes in the organization and structure of triadic play. Investigating how play changed over time provided a description of the shifting contexts in which infants learn about their social and nonsocial worlds. The hypotheses for Objective 3 will be outlined after a section which describes the Relational Play Category Coding Scheme in order to first familiarize the reader with the different categories of play that were coded. The chapter concludes with a general discussion where the implications of the findings of the three objectives of Study 1 are addressed.

The Relational Play Category Coding Scheme

The primary objective of Study 1 was to delineate the contexts of play to which infants are exposed between the ages of 4 to 7 months. This was achieved by developing the Relational Play Category Coding Scheme, which served to elucidate the contexts of

play in which infants are introduced to communicative exchanges around toys. Mothers' and infants' relationships to the toys were embodied in the coding scheme in terms of whether one or both members of the dyad were physically involved with a toy. Likewise, their communicative stance in terms of direction of attention was inherent in the play category definitions. Furthermore, dyads' involvement with each other was captured by having different categories for when they were both engaged in the same activity, or when they were engaged in different activities.

The first step in determining how mother-infant play was organized involved a process where characteristic bouts of play were identified. The process took place over several months where categories of play were determined by repeatedly viewing the play sessions for dyads at all three ages in real time and at various speeds in order to develop mutually exclusive categories. By creating play categories based on viewing the videotapes rather than developing categories a priori, preconceived notions as to what comprises play were less likely to present a bias. This approach has been used in previous longitudinal studies on mother-infant play to investigate how play styles develop and change over time (e.g., Fogel et al., 1997b; Pantoja, 1996; Taylor, 1997). Existing categories of caregiving and play such as social and didactic caregiving (Bornstein, 1989), as well as the concept of social, guided-object frames and non-guided-object frames (Pantoja, 1996) served as guidelines in identifying play categories. However, as previously reviewed, the play categories in these past studies were global, and the present scheme was designed to segment triadic play into more precise categories.

A preliminary coding sheet was drafted and underwent numerous revisions as the scheme was developed. Two experienced coders who were reliable with one another in the coding of the scale, made decisions regarding play category definitions. The coding scheme was developed systematically until the number of play categories required to comprehensively describe the play was determined, and the definitions of the categories of play were operationalized. At that time, a sample of 10 pilot infants representing the three different ages was selected from Study 1. Onset and offset times were obtained for each of the play categories and reduced to obtain the overall durations of time spent in the play categories at different ages. Final decisions regarding the coding scheme were made based on the coding of the pilot infants.

The type of play derived for the coding scheme consisted of two main categories: Dyadic play (i.e., play with one another without toys), and Triadic play (i.e., play with one another with toys). Triadic play was further divided into subcategories of play which elucidated and more fully described the nature of the ongoing play. There was also a third category, Unengaged, that was used to describe segments of the session where mother and infant were simultaneously engaged in different activities. The code of Unengaged has been used in previous research on mother-infant play to signify either when the infant is uninvolved with any particular activity, or when the mother and infant are engaged in different activities (Bakeman & Adamson, 1984; Dickson, Walker, & Fogel, 1997). Play categories were defined and operationalized in the manner described below.

I. Dyadic play category

Dyadic play was play involving the mother and her infant without toys. Dyadic play consisted of bouts of active social play (e.g., singing, tickling games, physical games), as well as bouts of less active play where mother and infant were engaged with one another but may not have been involved in a game-like activity. A toy might have been present during these bouts but was ignored or peripheral to the play. For example, the infant might have been mouthing the toy, but was not focused on the toy or exploring the toy, but rather was gazing at his/her mother and responding to the interaction.

II. Triadic play categories

Triadic play was play involving the mother, her infant, and a toy or toys and consisted of five main categories: (1) Functional play, (2) Social play, (3) Developmental play, (4) Supported play, and (5) Mother onlooking. These categories were defined based on the action of the mother and infant in relation to each other and to the toy. These five play categories are defined in more detail below. A summary of the Triadic play category definitions can be found in Appendix A.

1) *Functional Play.* Functional play was coded when the mother demonstrated a function of the toy such as shaking a rattle, exploring the physical characteristics or properties of a toy with the infant such as texture, or labelling any part of the toy (e.g., eyes, nose, etc.) while pointing it out to her infant. The following three subcategories of Functional play were mutually exclusive and further divided the category of Functional play for descriptive purposes in terms of mothers' and infants' level of involvement with the toy.

a) *Mother-Facilitated Action.* Mother-facilitated action was coded when the mother guided her infant's physical action on the toy to discover the function of the toy. This occurred in one of two ways: 1) when the mother moved her infant's hands/arms directly in order to have them perform some action on the toy (e.g., held her infant's arms to make his/her hands play the piano keys); 2) when the mother moved the toy to facilitate her infant's exploration of the toy. In this instance, instead of physically moving the infants hands or arms on a toy, the mother moved the toy into the infant's arms and hands (e.g., mother moved the piano back and forth to hit the infant's hands).

b) *Joint-Action Instrumental.* Joint-action instrumental was coded when mother and infant were physically involved with a toy at the same time. For example, the infant's hands might have been on the top of the piano while the mother played the keys, or the infant's hands might have held a toy, while the mother also performed a functional action on the toy such as shaking, spinning, or pressing keys.

c) *Infant Onlooking.* Infant onlooking was coded when the mother demonstrated the function of the toy (e.g., shaking the rattle) to which she and the infant were mutually oriented. The infant was attending to the toy play but not physically involved with the toy.

2) *Social Play.* Social play was coded when the mother used the toy in a social manner while playing with her infant such as engaging in a social game. Examples of Social play were when a mother used a rattle to tickle her infant, played peek-a-boo by hiding behind a toy, played hide-and-seek with a toy by making it appear and disappear, or played 'tug-of-war' with a toy.

3) *Developmental Play.* While all play can be considered developmental in one form or another given that infants learn about their social and nonsocial worlds during play, the Developmental play category was reserved for bouts of play where mothers attempted to elicit behavior from their infants such as grasping/holding, reaching, rolling over, crawling, or visual tracking. Developmental bouts of play were often characterized by some "stage setting" behavior on behalf of the mother. For example, she might have placed a rattle just out of reach of her infant and encouraged her infant to reach for it. As in all play categories, the infant had to be attending to the activity.

There were two subcategories of Developmental play.

a) *Independent Developmental play.* Independent developmental play was reserved for bouts of play where the mother encouraged a developmental behavior from her infant, but the infant attempted the behavior independently, without any physical help from his or her mother. For example, a mother might have encouraged her infant to crawl to a toy, but did not help by pushing her infant's feet.

b) *Mother-Facilitated Developmental play.* Mother-facilitated developmental play was coded for bouts of play where the mother facilitated her infant's play. For example, mothers might have aided their infants' grasping of the rattle by helping them wrap their hand around the rattle, or by pushing their infants to help them roll over. The behavior represented in each bout of Developmental play was recorded in order to keep a record of the different types of developmental behavior that mothers encouraged.

4) *Supported Play.* Supported play was recorded when mothers played a supportive role by holding toys for infants to gaze at or explore manually, retrieving toys

that had rolled away, or repositioning toys that had fallen over. Mothers' hands or some part of her body were always on the toy during Supported play bouts, while infants' hands may or may not have also been on the toy.

5) *Mother Onlooking*. This code was reserved for bouts of play taking place within the triadic context where mothers and their infants were mutually oriented towards a toy with which the infant was involved. The Mother onlooking play category consisted of two subcategories.

a) *Mother onlooking - physical* characterized bouts of play where mothers observed their infants who were physically involved with the toys (e.g., holding and manipulating or mouthing a toy).

b) *Mother onlooking - gaze* signified bouts of play where mothers observed their infants who were involved with the toys through their gaze only.

III. Unengaged.

The definitions for the play categories involved segments of play where the mother and infant were both focused on the same activity. The Unengaged category was created for segments of the session where mother and infant were not engaged in the same activity. For example, the mother might have attempted to engage her infant in dyadic social play, while her infant did not attend to her and played with a toy. Alternatively, the mother may have played with the piano, while the infant was playing with a rattle. To be coded as Unengaged, the mother and infant had to be engaged in different activities for 3 seconds or longer in order to exclude brief fluctuations of attention. When the Unengaged code was used, the activities that the mother and infant

were engaged in were also recorded. However, the code Unengaged excluded any time that the infant and mother were engaged in different activities due to the mother turning away from her infant to reach for another toy or to perform some utilitarian function such as retrieving a tissue.

Measurement of the Play Categories

The recording of stop and start times to the second was chosen as a means of coding play in the development of the Relational Play Category Coding Scheme. Obtaining exact time durations in each play category provided a more comprehensive view of the development of play compared to methods such as frequency counts or time sampling procedures which have most often been used in studies of infant play (e.g., Hodapp et al., 1984; Landry et al., 1996; Rome-Flanders et al., 1995; Zelazo & Kearsley, 1980). Developmental changes can be masked when the occurrences of an event are recorded, given that the same number of behaviors may occur at two different ages, but the durations of the behaviors could vary substantially. The more precise the measure used, the greater the probability of capturing subtle developmental changes that occur over time.

Details regarding the process of determining the length of the time code to be used for the play categories and rules of application can be found in Appendix B. In brief, two seconds was chosen as the minimum length of time that dyads had to be engaged in a play category for it to be coded. A two second time criteria was also used as the time criterion for the relational coding scheme of interpersonal communication designed by Fogel, Walker, and Dodd (1997).

The goal in developing the Relational Play Category Coding Scheme was to categorize bouts of play occurring between 4 and 7 months. As a result, categories were created that encompassed the main bouts of play. The total mean percent durations of play coded for the pilot infants were calculated in order to ensure that the play categories that were created captured a significant proportion of the play. Results revealed that a mean percent duration of greater than eighty percent of the 8 minute play session was captured for each dyad. Play within the 8 minutes that was not captured included activities such as posture changes (e.g., mother repositions her infant from her stomach to back), utilitarian functions such as wiping up saliva, and transitional segments between different play bouts. Thus, the Relational Play Category Coding Scheme provided a comprehensive account of the play bouts occurring during the transition from dyadic to triadic play, from 4 to 7 months of age.

Objectives and Hypotheses

Objective 1 of the present study, to delineate contexts of play emerging in mother-infant play between the ages of 4 to 7 months, was achieved through the development of the Relational Play Category Coding Scheme. Once developed, the Relational Play Category Coding Scheme was applied to a longitudinal sample of mothers and infants in Study 1 in order to examine developmental changes in durations of time spent in the different play categories. The second objective of Study 1 was to examine the period of transition between dyadic and triadic play. As previously outlined, it was expected that in the free play context where toys were available for dyads to use as they wished, dyadic

play would decrease and triadic play would increase between 4 to 7 months, thus corroborating previous research.

Objective 3 was to examine developmental changes in the organization and structure of triadic play. Hypotheses regarding developmental change for each of the five triadic play categories (i.e., Functional, Social, Developmental, Supported, and Mother onlooking play) will be outlined in turn. Where previous literature supported a prediction of developmental change based on age, a specific hypothesis was proposed. The play categories outlined in the present scheme had not yet been applied and examined developmentally. As a result, no prediction was made regarding the direction of developmental change for some of the play categories.

Caregivers play a role in providing learning opportunities during play, which are maximally effective in relation to the infant's current abilities (Vygotsky, 1967). Thus, as infants' cognitive and motor abilities develop such that they are more adept in their participation in toy play, the structure of the play can be expected to change. Maternal scaffolding, where mothers provide support to their infants' play, decreases as their infants' growing capacities enable them to interact with toys more independently (e.g., Dedo, 1995; Pêcheux et al., 1992). In addition, major motor milestones such as visually guided reaching and unsupported sitting are achieved when infants are between 4 and 7 months. The ability to reach and attain toys without the support of the caregiver inevitably facilitates infants' interactions with toys. Given that the toys included in the present study were age appropriate, it was expected that mothers would spend less time

demonstrating the function of the toys as infants developed. Thus, Functional play, where the mothers demonstrate the functions of the toys, was predicted to decline with age.

In terms of the Social play category, previous research has revealed that infant smiling increases with age (Messinger et al., 1999). In addition, research has indicated that infants respond more to their mothers' smiles, vocalizations and facial expressions with corresponding smiles and vocalizations with age (Kaye & Fogel, 1980). In Kaye and Fogel's study, by 26 weeks of age, infants were just as likely to initiate 'greetings' as they were to respond to their mothers' initiations. With higher levels of smiling and more active participation in social interchange as infants develop, it was expected that mothers might engage in more Social play when their infants were 5 ½ and 7 months old as compared to 4 months.

Predictions based on age were difficult to make for Developmental play. It was expected that the content of Developmental play would be modified with age as a result of the interrelatedness of infants' motor and cognitive development in relation to the unfolding play. Once one behavior was mastered (e.g., holding the toy), it was predicted that mothers would encourage another more challenging behavior. For instance, given that most infants cannot sit at 4 months, it was unlikely that mothers would encourage crawling at this age. However, as infants gained better motor control, the encouragement of crawling was considered more likely. Given that there are developmental behaviors that can be encouraged at all ages, no clear prediction was made in terms of whether overall levels of Developmental play would vary with age.

Supported play, where mothers hold a toy for infants to gaze at or explore manually, or support a toy that would otherwise fall or roll away, was expected to decline with age. Consistent with the maternal scaffolding literature, it was predicted that infants would require less support from their mothers in interacting with the toys as they became better able to attain toys themselves, as well as handle the toys on their own.

The final play category occurring within a triadic play context was Mother onlooking, which was expected to increase with infant age. With infants' increasing motor competence and cognitive growth, mothers would likely provide longer bouts of play where infants could explore toys independently while they actively observed, offering support and demonstrations of toys when needed. The toys selected in the present study for the infants between 4 and 7 months were age appropriate, and it was considered probable that as they were exposed to the toys over the three sessions, they would interact with the toys more independently.

These hypotheses were examined by applying the Relational Play Category Coding Scheme to a sample of mothers and their infants who participated in free play on three different occasions, when infants were 4, 5 ½, and 7 months of age.

Method

Participants

The names of potential subjects were obtained from the birth records of a community teaching hospital in the Montreal area. Parents were contacted by telephone and informed of the general purposes of the study and asked for their voluntary participation. The age groups of 4, 5 ½, and 7 months of age were included in the study.

At four months of age, infants have acquired some experience in interacting with their nonsocial world, however, dyadic interaction with their caregivers is still the predominant form of play (Trevarthen, 1977). By 5 ½ months of age, infants' interest and exploration of the nonsocial world is increasing along with their ability to engage in directed, visually guided reaching. Seven-month-old infants were the oldest age group in the present studies. Many infants can sit alone by 7 months, the grasping reflex has declined enough at this age for infants to voluntarily pick up and let go of objects, and attentional capabilities are more fine-tuned. Moreover, due in part to their burgeoning motor abilities, 7-month-old infants are becoming more adept at exploring and playing with toys.

Subjects were recruited at 4 months of age. After the session at 4 months, the experimenter asked mothers if they would be willing to continue their participation when their infants were 5 ½ and 7 months of age. Mothers who consented to the longitudinal component of the study were contacted again when their infants were 5 ½ and 7 months of age. Twenty-three mothers and their infants participated in the study at 4 months of age. Of these mothers, all but one completed all three sessions of the longitudinal study. One mother was unable to complete the sessions because she moved out of the country prior to her infant turning 5 ½ months of age. Consequently, the final sample consisted of twenty-two infants (10 female, 12 male) who completed the study at all three ages (mean age = 4 months, 4.68 days , sd = 2.34 days; mean age = 5 months, 17.95 days, sd = 3.72 days; mean age = 7 months, 6.59 days, sd = 4.85 days). All participants were healthy

full-term infants. The mean age of mothers who participated in the final sample was 32 years (sd = 4.54 years).

The majority of the participants were Non-Hispanic White (86%). The remaining infants were products of bi-racial marriages (i.e., African American and White). All mothers spoke and understood English. Twenty of the mothers spoke English to their infants at home during play and during the experimental sessions. The remaining two mothers spoke French to their infants both at home and during the experimental sessions. All mothers were from intact two-parent families. In terms of educational attainment, families were classified as 5% with high-school but without college education, 32% had some college education, and 64% had degrees from programs requiring 4 years of college or more. In terms of occupational status, the families were classified in the domains of Executive/Administrators/Managerial (18%), Professional Specialty (41%), Sales (14%), Administration/Support/Clerical (5%), and Service Workers not in private households (18%; categories based on US Bureau of the Census, 1996). In addition, there was one family who was unemployed at the time of the study (5%).

Apparatus

The testing area was a large play room with a cushioned black vinyl mat (121 cm long x 183 cm wide) situated on the floor near the center of the room on which mothers and infants played. All sessions were video recorded by one of three cameras. One camera provided a side view of the play area and was situated 200 cm in front of the mat. This camera was mounted on a tripod 54 cm from the ground and concealed behind a black curtain. A second camera was mounted in the ceiling above the camera on the

tripod, providing an overhead view of the play area. A third camera was mounted in the corner of the ceiling behind the black mat in the opposite corner of the room to the other overhead camera providing a different angle of the dyad. The VCR and control panel were located in the control room, and received inputs from all three cameras. The control panel allowed the experimenter to alternate views between the three cameras while video recording, to obtain the view that provided the clearest picture of the facial expressions and body movements of the mother and infant. The experimenter set a digital timer in the control room which rang at the end of the 8 minute play session, indicating that the session was over. A Sony editing machine was used to code the play sessions.

Brightly colored toys were selected that were multimodal and thus likely to sustain infant attention. In addition, toys were chosen to be appropriate for infants from 4 through to 7 months of age. Five toys were used in this study: a Fisher Price Rock - a - Stack; a Discovery Toy rattle with a revolving ball in the middle containing colored beads; a plastic squeaky book with colorful pictures of animals; a soft Winnie-the-Pooh rattle; and a Little Tykes piano. All toys were non-toxic and were washed after each session. Toys were presented in a standardized array at the front of the mat and in the same location for all participants at all ages.

Experimental Instructions and Procedure

Upon arrival, mothers and infants were escorted into the waiting room. The experimenter reviewed the purposes and procedural details of the study, and mothers were given an informed consent form to read and sign (Appendix C). Mothers and infants were then escorted into the playroom and asked to situate themselves on the black

mat for the play session. Mothers were reminded that there would be video cameras recording the interaction and the three cameras operating in the room were pointed out to them. Mothers were asked to remain on the black mat with their infants during their play. Because the cameras provided either a side or an overhead view, the interaction could be clearly recorded regardless of whether mothers chose to place their infants lying on their backs, stomachs, or in a seated position. While mothers were given a few minutes to situate themselves and their infants on the mat, the experimenter turned on the video equipment and checked to ensure all cameras were clearly focused on the dyad. The experimenter was seated in an adjoining control room during the play sessions.

The play session lasted for a total of 8 minutes. The five toys were situated in a row beside the mat. The same toys were used in all three sessions at each of 4, 5 ½ and 7 months of age, and positioned in the same manner. Before commencing the first period, mothers were instructed to: "Play with your baby as you normally would at home. You may include the toys if you wish." All mothers were given identical instructions, and the instructions were the same at all three ages. Following the completion of the testing session, the mother and her infant were escorted to the waiting room where the experimenter asked the mother standardized questions regarding general demographic information and her infant's medical history (Appendix D). Given the longitudinal nature of the study, these standardized questions were administered in the first session only. In addition, in the first session, mothers were asked if they had any of the toys that were used in the study. Of the five toys, the Fisher Price Rock-a-Stack was reported to be owned by two of the families involved in the study.

Mothers were informed in the waiting room that they could stop the session at any time and for any reason, and that a break in the play session could be taken if at any point they felt it was required. Because sessions were brief and involved free play with no perturbations, and because it was mothers who selected the time of their visits in accordance with their infants' sleeping and eating schedules, few infants required a break during the sessions. Of the 66 sessions, 2 infants required a break in the 4 month sessions only. One infant required a break for feeding, and the other spat up during the session which required cleaning of the mat and wiping up the infant. After the break, play resumed for the remaining duration of the session.

Mothers and infants in the 4-month-old age group received a certificate of merit ("Infant Scientist Award") as a token of appreciation for their participation in the study. In addition, those mothers and infants who participated at all three ages received a VHS video cassette of their sessions to keep as a memento of their participation. Mothers were also informed that when the study was completed, they would receive a written summary of the general results by mail.

Coding and data reduction

All of the infants were coded from Study 1 for the play categories making up the Relational Play Category Coding Scheme described previously. Each mother-infant play session had a time line edited onto the 8 mm video tape. The time line that was edited onto the videotapes recorded minutes, seconds, and frames per second. The minutes and second of the start and stop time for each play category were recorded. Data were reduced to obtain total durations of time in each of the play categories across the 8 minute

play session. Examples of Functional and Social play for each of the five toys that served as a guideline for coding are listed in Appendix E (Table E1 and E2 respectively).

An observer who was blind to the hypotheses of the study was trained on the Relational Play Category Coding Scheme. Sessions randomly selected from one of the three time visits for 14 of 22 infants in the sample (21% of the total sessions) were coded in order to assess inter-rater reliability. Intraclass correlation coefficients (Shrout & Fleiss, 1979) conducted on the play categories were all above $\underline{r} = .99$. Cohen's kappa coefficient (Cohen, 1968; Hunter & Koopman, 1990), which corrects for chance agreement, was calculated to assess the reliability of onset and offset times for each play category. These values were also high, ranging from $\underline{r}_k = .78$ (Developmental and Supported play) to $\underline{r}_k = .86$ (Social play).

Results

Descriptive statistics were conducted on each dependent variable to determine if significant non-normality and/or outliers were present. All variables were normally distributed and no transformations were conducted. Where outliers were present, their influence was reduced by assigning the outlier a value that was one unit larger or smaller than the next most extreme score in the distribution (Tabachnick & Fidell, 1996). Following the descriptive analyses to screen the data set, split-plot ANOVA's were conducted for each type of play with Sex (male, female) as the between-subjects variable and Age (4, 5 ½ and 7 months) as the within-subject variable. Where Sex was significant, results will be reported. Where there were no significant sex differences, analyses were re-run collapsed across this variable. Tukey post hoc tests were used to

isolate significant differences for main effects involving age, and simple effects analyses were used to isolate the source of significance for 2-way interactions. For all analyses, a critical alpha level of .05 was selected as the criterion for statistical significance, with the more conservative Greenhouse-Geisser Adjusted F score being used to assess significance for within-subject effects.

The first section of results addresses the second objective of Study 1, which was to examine the period of transition between dyadic and triadic play across dyads' three visits. Thus, results are reported for the play categories in total, across all of the subcategories. The second section of results addresses Objective 3, which was to determine if there were developmental changes in the organization and structure of triadic play. ANOVA tables and Tukey tables for the Dyadic and total Triadic play categories are found in Appendix F and G respectively.

Dyadic Play. Proportions of dyadic play were obtained by calculating the time spent in dyadic play out of the total duration of the session. A main effect was found for Sex, $\underline{F}(1, 20) = 4.92$, $\underline{p} < .05$, with mother-daughter dyads engaging in more dyadic play ($\underline{M} = 21.44\%$) than mother-son dyads ($\underline{M} = 11.72\%$). In addition, there was a main effect for Age, $\underline{F}(2.00, 39.94) = 6.89$, $\underline{p} < .01$ (Table F1). Tukey HSD comparisons (Table F2) on the main effect of Age revealed that when infants were 4 months of age, dyads engaged in significantly more dyadic play than when infants were 5 ½ and 7 months of age ($\underline{M} = 23.63\%$ at 4 mos, $\underline{M} = 14.14\%$ at 5 ½ mos, and $\underline{M} = 10.64\%$ at 7 mos).

Triadic Play. Proportions of triadic play were obtained by calculating the time spent in triadic play out of the total duration of the session. Results revealed a main

effect for Age $F(1.99, 41.78) = 8.68$, $p < .001$ (Table G1). Tukey HSD comparisons (Table G2) revealed that on their 4-month-old visit, dyads engaged in significantly less triadic play ($M = 66.82\%$) than on their 5 ½ ($M = 79.50\%$) and 7-month-old visits ($M = 84.67\%$) with no significant difference in amount of triadic play between the 5 ½ and the 7-month-old visits. Complementing the finding of more dyadic play in mother-daughter dyads, there was a trend toward more triadic play in mother-son dyads, $F(1, 20) = 3.04$, $p = .097$. Mother-son dyads engaged in a mean percent duration of 81.51% of triadic play compared to 71.57% for the mother-daughter dyads.

Objective 3, the examination of developmental changes in the organization and structure of triadic play, was examined by calculating the proportion of time spent in each of the triadic play subcategories out of the total amount of time spent in triadic play. The findings for each triadic play category are reported in turn. ANOVA summary tables, Tukey tables, and mean tables for the Triadic play categories are found in Appendix H.

Functional play. The proportion of time each dyad engaged in Functional play was calculated out of the total time spent in triadic play. There was a main effect for Sex, $F(1, 20) = 7.59$, $p < .05$, with the mother-son dyads engaging in significantly more Functional play ($M = 31.39\%$) than mother-daughter dyads ($M = 20.74\%$). In addition, there was a main effect for Age, $F(1.86, 37.30) = 9.01$, $p < .001$ (Table H1). Tukey comparisons (Table H2) revealed that the 4-month-olds and their mothers engaged in significantly more Functional play ($M = 36.47\%$) than the 5.5-month-olds ($M = 21.56\%$) or the 7-month-olds ($M = 21.61\%$).

In order to further describe the nature of the Functional play, the proportions of time that infants spent in the three subcategories of Functional play out of the total time spent in Functional play were determined. Overall, dyads spent the most amount of time in Infant onlooking ($\underline{M}$ = 61.75%), where infants looked on while their mothers demonstrated the function of a toy. Joint-action instrumental, where mothers demonstrated the function of the toy while infants' hands were also on the toy, occurred for the second largest amount of time ($\underline{M}$ = 20.48%). Mother-facilitated play, where mothers physically intervened by helping their infants interact with the toy in a hand-over-hand fashion occurred for the least amount of time ($\underline{M}$ = 12.53%). An ANOVA was conducted on each of the Functional play subcategories in order to determine if there were significant differences in durations of time spent in the subcategories with age. Of the three subcategories of Functional play, a main effect for Age was found only for the Mother-facilitated play category $\underline{F}(1.84, 38.61) = 6.98$, $\underline{p} < .01$ (Table H3). Tukey comparisons for the main effect for age for the Mother-facilitated play category (Table H4) revealed that the significant differences were between the 4 and 7 month, and 5 ½ and 7 month visits ($\underline{M}$ = 18.12% at 4 months, $\underline{M}$ = 16.19% at 5 ½ months, $\underline{M}$ = 3.17% at 7 months). It is apparent that while Mother-facilitated play occurred the least amount of time out of the three subcategories of Functional play across all ages ($\underline{M}$ = 12.53%), it nonetheless occurred more than four times the duration at 4 and 5 ½ months than at 7 months, signifying that mothers offered less physical assistance in manipulating toys at older ages. ANOVA tables for the Joint-action instrumental and Infant onlooking Functional play subcategories can be found in Tables H5 and H6.

Social play. Social play occurred at low levels across all three age groups (M = 5.78% at 4 mos, 4.46% at 5 ½ mos, 3.02% at 7 mos) and analyses yielded no significant results. The ANOVA summary table can be found in Table H7.

Developmental play. Results revealed a main effect for Age, $F(1.65, 34.60) = 4.00$, $p < .05$ (Table H8). Subsequent Tukey comparisons (Table H9) revealed significantly more Developmental play with toys at 4 months (M = 11.86%) than at 5 ½ (M = 6.38%). While the magnitude of the difference is similar, the comparison between the 4 month and 7 month visits (M = 6.71%) did not reach significance.

For descriptive purposes, the mean proportions of time spent in the two subcategories of Developmental play, Independent developmental play and Mother-facilitated developmental play, were obtained for each dyad out of their total time spent in Developmental play. Means were calculated out of the total number of infants who engaged in Developmental play at a given age. Independent developmental play increased with age, from a mean percent duration of 53.85% at 4 months of age, to 88.28% at 5 ½ months, and finally to 92.41% at 7 months. Thus, infants were steadily allowed to take a more independent role in attempting developmental behaviors that their mothers encouraged. A complementary and opposite pattern was evident for Mother-facilitated developmental play, which decreased with age from a mean percent duration of 41.86% at 4 months, to 11.72% at 5 ½ months, to 7.59% at 7 months.

To further explore the content of Developmental play, the task which was the focus of each developmental bout was recorded for each infant, enabling a description of Developmental play by age. Seven behaviors were encouraged by mothers through their

utilization of the toy: holding, reaching, rolling over, crawling, walking to the toy, visual tracking, and infant giving of the toy. Holding, reaching, and crawling, the three most commonly encouraged behaviors, showed notable changes with age. The number of dyads where mothers encouraged these behaviors at a minimum of at least once were obtained for descriptive purposes. At 4 months, 91% of the mothers (n = 20) encouraged holding of the toy, whereas 41% of the mothers (n = 9) did so when their infants were 5.5-months-old, and only 5% (n = 1) did so at 7 months. Encouragement of reaching occurred in 9% of the dyads (n = 2) at 4 months, whereas at 5 ½ months, reaching was encouraged for 50% of the dyads (n = 11), and 5% of the dyads (n = 1) did so at 7 months. Finally, encouragement of crawling increased with age. Nine percent of mothers encouraged crawling at 4 months (n = 2), 18% of mothers at 5 ½ months (n = 4), and 68% of mothers (n = 15) did so at 7 months. The proportion of time out of total Developmental play spent encouraging each behavior was also calculated across each age group. At 4 months, the three behaviors encouraged for the greatest proportion of time were holding the toy (M = 65.76%), rolling to the toy (M = 15.76%) and crawling (M = 10.51%). At 5 ½ months, encouragement of reaching occurred for the greatest proportion of time (M = 36.99%) followed by rolling to the toy (M = 23.87%) and holding the toy (M = 23.15%). On the 7 month visit, crawling was encouraged the majority of the time (M = 92.61%) followed by giving the toy (M = 4.98%), and reaching for the toy (M = 1.89%).

Supported play. Results revealed a main effect for Age, $F(1.46, 30.65) = 16.27$, $p < .001$ (Table H10). Tukey HSD comparison's (Table H11) revealed that there were

significant differences at all three ages. Proportions of time spent in Supported play at 4 months (M = 20.20%) were significantly greater than at 5 ½ months (M = 11.34%) and 7 months (M = 4.64%). Likewise, there was a significant difference between dyads when infants were 5 ½ and 7 months.

Mother onlooking. Two separate analyses were conducted for the physical and gaze only subcategories of Mother onlooking. For the Mother onlooking - physical category, results revealed a main effect for Age, $F(1.77, 37.25) = 31.49$, $p < .001$ (Table H12). Tukey HSD comparisons (Table H13) revealed a significant difference in proportion of time spent in Mother onlooking when infants were 4 months of age (M = 19.85%) compared to when infants were both 5 ½ (M = 47.11%) and 7 months of age (M = 54.87%). The Mother onlooking - gaze subcategory occurred for low durations across the three ages (M = 6.12% at 4 months; M = 7.52% at 5 ½ months, M = 7.15% at 7 months), and no significant results were found (Table H14).

Summary. Taken together, results indicate that mean percent durations of time spent in different triadic play categories varied with age, as was evident for all but the Social play category, which occurred infrequently. The overall proportion of time spent in each of the triadic play categories calculated out of the total time spent in triadic play are presented for each of the three visits in Figure 1. Triadic play categories that were further divided into subcategories (e.g., Mother onlooking - physical and Mother onlooking - gaze) were combined for presentation in the figure. The figure clearly indicates that the content of dyad's free play changed with development.

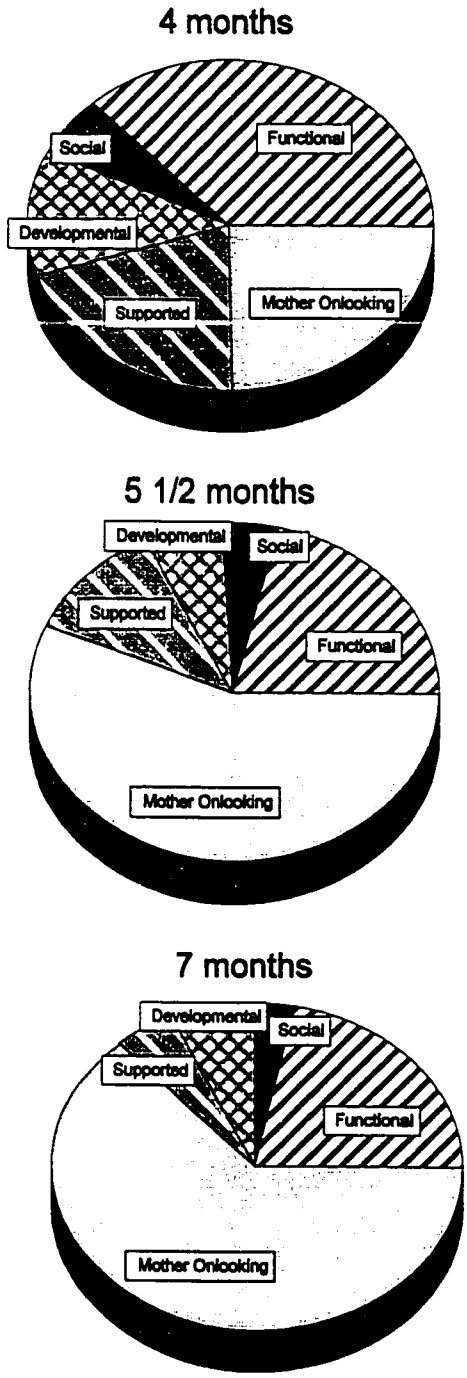


Figure 1. Mean percent duration spent in the triadic play categories out of total time spent in triadic play as a Function of Age.

Unengaged. Appendix I contains the summary tables for the Unengaged category. Mothers and infants spent little time engaged simultaneously in different activities. Results revealed a main effect for Age, $F(1.59, 33.47) = 4.34$, $p < .05$ (Table I1). Subsequent Tukey comparisons (Table I2) revealed that the significant differences by age were between the 4 month ($M = 8.63\%$) and 7-month-old visits ($M = 3.72\%$) but not with the 5.5-month-old visit ($M = 6.36\%$). In addition to obtaining mean durations of time when dyads were Unengaged, the different activities that mothers and infants were engaged in were also recorded. Thus, an examination of what activities dyads were participating in when they were not engaged in the same activity was possible. Results indicated that out of the total amount of time spent in the Unengaged category, the majority of the time at 4 months ($M = 77.57\%$) and at 5 ½ months ($M = 70.48\%$) was the result of mothers who were attempting to engage their infants in dyadic play, but whose infants were not responding to their attempts. At 7 months, mothers spent a mean of 30.84% of the time trying to engage their infants in dyadic play, with the majority of time in the Unengaged category spent where mother and infant were engaged with 2 different toys ($M = 52.40\%$).

Discussion

Given that previous researchers have not sought to categorize triadic play in early infancy, the development of the Relational Play Category Coding Scheme was a significant contribution to delineating the play contexts to which infants are exposed as they become increasingly adept at interacting with their nonsocial surroundings. The approach of deriving the scheme from the behaviors of the dyads themselves, rather than

developing play categories a priori, made it possible to accurately and comprehensively represent the diversity of play which is present between 4 and 7 months. Furthermore, infants' exposure to both their social and nonsocial worlds takes place primarily within the context of their relationships with caregivers. Thus, developing a scheme that embodied simultaneously the activities of both members of the dyad was important in obtaining an understanding of the play contexts prevalent between 4 and 7 months.

Once developed, the coding scheme was applied to the dyads from Study 1 who participated when infants were 4, 5 ½, and 7 months of age. It was hypothesized that within the free play format of Study 1 where toys were available for use, the proportion of time spent in dyadic play would decrease and time spent in triadic play would increase across the three ages. Results confirmed this hypothesis. For both dyadic and triadic play, the significant difference in proportions of time were between the 4 month compared to both the 5 ½ and 7-month-old visits. Although the raw figures showed that dyads engaged in more triadic play and less dyadic play at 7 months as compared to 5 ½ months, this difference was not significant. This likely reflects the fact that the peak time of dyadic play occurs between 4 and 5 months of age (Trevarthen, 1977), after which it declines as infants become more interested in their nonsocial surroundings. In addition, infants at 5 ½ months should have developed the ability to hold toys independently (Frankenburg et al., 1975). The ability to hold toys which was prevalent at both 5 ½ and 7 months may have been a factor which resulted in the similar and high proportions of triadic play on both of these visits. As a result, it is not surprising that the significant differences occurred between the 4 month as compared to the 5 ½ and 7 month visits.

Results from the Unengaged category, where mothers and infants were not engaged in the same activity, can also be interpreted in relation to the shift from dyadic to triadic play. Minimal durations of Unengaged occurred across all three visits, but the content of mothers' and infants' play when they were engaged in different activities is revealing. On the 4-month-old visit, the majority of time that dyads were coded as Unengaged was accounted for by mothers' attempts to have their infants' respond to dyadic play. By 7 months the majority of time that Unengaged was coded was accounted for by the fact that each member of the dyad was engaged with a different toy. The results from the Unengaged category reflect a decrease in mothers' attempts to elicit dyadic play as their infants became engaged with toys.

An unexpected finding was a gender difference in amount of time mothers and infants spent in dyadic play. Mother-daughter dyads spent almost twice as much time in dyadic play than mother-son dyads. In addition, there was a trend toward mother-son dyads spending more time in triadic play than mother-daughter dyads. While there is no previous research that relates directly to the present results, past studies investigating differential treatment of infants based on gender have found that girls were given more interpersonal and social stimulation than boys (e.g., Bell & Carver, 1980; Condry & Condry, 1976). Perhaps the finding of greater proportions of time in dyadic play reflects this difference as dyadic play could be considered more interpersonal than triadic play given that the focus is on each member of the dyad and not shared with the toy. At the same time, these gender differences could be a characteristic of this particular sample and are speculative without further replication.

Taken together, results corroborate observations that social interactions involving the mother and infant broaden with age to include objects (Fogel et al., 1992; Pantoja, 1997). Infants develop motor skills between 4 and 7 months that enable them to handle toys (e.g., holding, visually guided reaching) which likely contribute to their increased involvement with toys. A strength of the present study was the longitudinal approach which, within the same dyads in a free play setting, was able to demonstrate a decrease in dyadic and an increase in triadic play with development. Thus, as infants move from the realm of dyadic to triadic play, the opportunity exists for them to merge their social and nonsocial environments where they can learn about objects within the context of mother-infant play.

The third objective of Study 1 was to examine developmental change in the triadic play subcategories. The results for each subcategory of triadic play will be discussed in turn. The hypothesis that Functional play would decrease with age was supported. When infants were 4 months of age, dyads engaged in significantly more Functional play than on their 5 ½ or 7-month-old visits. Observations of dyads at 4 months indicated that at this age, many infants were not able to securely hold the toys, and thus unable to explore them independently. Furthermore, 91% of the total Developmental play at 4 months involved mothers encouraging their infants to hold toys, indicating that holding toys was a developmental task that was being mastered at that age. This suggests that in order to discover how the toy worked, mothers would have had to show their infants, as infants' own ability to manipulate toys was not well developed. Moreover, infants at 4 months could not reach or independently locomote to the toys. Thus, infants' physical interaction

with toys was dependent on the mother first retrieving the toy and bringing it into the interaction. Because mothers' handling of the toys on the 4 month visit was a necessary prerequisite for the toys to be physically included in the play, this may have fostered more demonstrations of the toys. At 5 ½ and 7 months where some infants could sit unsupported, and the ability to hold toys and reach for toys was better developed, infants were less reliant on mothers' initial role at recruiting the toys and bringing them into the play.

No developmental difference in overall durations of time spent in Functional play was found between the 5 ½ and 7 month visits. Previous research on motor control, as well as an examination of the Developmental play results reveals that one commonality between 5 ½ and 7 months was that infants were likely able to hold the toys independently (Frankenburg et al., 1975). It may be that their ability to hold the toys was a significant factor in mothers playing less of a role in demonstrating the functions of the toys at both of the older ages. Likewise, with infants holding and reaching for toys becoming better developed at 5 ½ and 7 months, infants were more autonomous in their interaction with the toys. The finding that Mother onlooking, where infants played with a toy while their mothers observed, increased with infant age, supports the idea that infants had greater autonomy in toy play with age.

It can be argued that Functional play occurred for the longest durations at 4 months because this was also the infants' first exposure to the toys used in the study. It may have decreased on the 5 ½ and 7 month visits simply due to increased familiarity with the toys. Thus, mothers may have demonstrated the function of the toys on their first

visit when they were novel, and as a result were less compelled to do so on their subsequent two visits. However, this explanation of the developmental differences is unlikely, given that there was approximately a 6 week span between visits. During this duration of time there would be many changes in infants' development, and in the mother-infant relationship. As a result, while the toys were the same, each visit would be unique as mothers and infants brought their new abilities and way of relating to bear on the play.

An unexpected finding was a significant difference in durations of time spent in Functional play as a function of infant gender. Mothers of sons were found to spend greater proportions of time demonstrating the toys than mothers of daughters. While there is not a large body of literature pertaining to gender differences of caregivers actions during toy play, the present findings contradict what might be expected based on previous studies. Power (1985) examined the play techniques that parents used with their infants aged 7, 10 , or 13 months to influence their behavior during play. Play techniques included strategies such as manipulating objects, demonstrating the function of the toy, and physically assisting the infant. Mothers were found to spend less time directing the exploration of their boys with infant age, and more time directing the exploration of their girls. In addition, during problem-solving activities, mothers tend to use more directive and supportive language with daughters than with sons (Leaper, Anderson, & Sanders, 1998). While these studies are somewhat tangential to the present work, they do suggest that if any gender differences emerged, they should be more likely to reflect more Functional play in the mother-daughter dyads rather than the mother-son dyads as was the

case in the present study. Thus, the present gender effect may be particular to this sample, and overall gender differences in amounts of Functional play between 4 and 7 months remain speculative without further replication.

Social play occurred for minimal durations across all age groups. This low occurrence is likely due to the fact that only one toy was a social toy, the Winnie-the-pooh bear rattle, and this toy was used infrequently. Four of the five toys, the book, stacking rings, piano, and rattle could all be considered functional toys.

While results revealed that Developmental play occurred for low durations at all three ages, total durations of Developmental play decreased from 4 to 5 ½ months, while they remained at similar levels from 5 ½ to 7 months. As predicted, the content of Developmental play was modified across the three visits. At 4 months of age, the predominant form of Developmental play consisted of encouragement of holding toys. At 5 ½ months of age, encouragement of holding had given way to the encouragement of reaching for toys. At 7 months of age, encouragement of crawling by positioning a toy to crawl towards was the predominant form of Developmental play. An examination of proportion of time spent in Independent versus Mother-facilitated developmental play revealed that mothers provided more support towards infants' execution of the developmental tasks at younger ages, which was not as evident for the developmental behaviors encouraged at the older ages. Thus, mothers' sensitivity to the developmental abilities of their infants was underscored.

Results for Developmental play indicate that mothers may have intuitively built in success experiences to the play interactions. The present data do not provide a measure

of infants' success at engaging in the various developmental behaviors. Nonetheless, the dramatic change in mean durations of Developmental play devoted to encouraging different developmental behaviors with age likely indicates that infants were encouraged to engage in a behavior when it was just beyond their abilities, and were no longer encouraged once the behavior was mastered or reliably executed. As such, mothers were creating a zone of proximal development, as described by Vygtosky (1978), where they fostered and encouraged new developmental abilities in tandem with infants' own developmental readiness to participate in such activities.

Results from the category of Supported play confirmed the hypothesis that infants received less support in triadic play from their mothers with age. A change with development was noted, with mothers providing more support for play at 4 months than at both 5 ½ or 7 months of age. Results complement those from Developmental and Functional play, that mothers intervened less with infants' development. It was evident that Supported play most often took place where mothers were holding up a toy for infants to explore. As infants were able to hold the toys themselves, there would be less of a need for mothers to play this supportive role, which is reflected in the decline in Supported play across the three visits.

The hypothesis that dyads would engage in greater durations of Mother onlooking with age was also supported. In particular, this finding was for the subcategory of Mother onlooking - physical where mothers observed their infants who were physically involved with toys. Mother onlooking while infants were gazing at toys occurred for minimal durations across all three ages and no significant age differences were found. While it is

not possible to confirm this from the present data, it is likely that there were minimal durations of this latter play category because infants' gazing at toys often resulted in obtaining the toy. For instance, mothers likely interpreted their infants' gazing at the toy as a sign of interest and thus brought the toy towards their infant so that they could play with it. Likewise, if the toy of interest was positioned such that infants could attain it themselves, they would likely have done so. As a result, the Mother onlooking - gaze bouts of play would not have been prolonged. Out of the five triadic play subcategories, Mother onlooking was the predominant form of play at both 5 ½ and 7 months of age. These results indicate that infants increasingly acted on the toys independently and thus discovered and learned about their nonsocial worlds through direct contact. At the same time, during Mother onlooking play bouts, both mother and infant were mutually oriented towards the same toy, such that mothers could offer support and demonstrations of toys when needed (i.e., Supported and Functional play). Results are consistent with previous studies on maternal scaffolding where mothers have been found to decrease their interventions, such as attention directing and stage setting behaviors, during toy play with infant age (e.g., Hodapp et al., 1984; Pêcheux et al., 1992).

Taken together, results from the application of the Relational Play Category Coding Scheme confirmed the hypotheses pertaining to developmental change. The context of play was modified from 4 to 7 months of age as measured by the mean durations of time dyads engaged in the different play categories. The organization of play was found to shift from dyadic towards more triadic play across dyads' three visits. Results further indicated that infants were more independent in their interactions with

toys with age. At the same time, mothers were present to support infants in their play, to demonstrate the function of toys, and to encourage new behaviors such as reaching and crawling across the three visits. These results underscore the mutual influence of mother and infant on the context of early play interactions. Mothers were responsive to their infants' cognitive and motor abilities such that as infants became more adept in their participation in the toy play, the structure of the play was altered. Results support previous assertions that the social and cognitive domains are inextricably linked in infancy. Mothers' facilitation and support in play provides a context that serves to promote infants' competence in interacting with their environment in a manner beyond that which is possible during infant independent toy play (Roggman, Langois, & Hubbs-Tait, 1987).

In conclusion, the play categories developed through the Relational Play Category Coding Scheme provided insight into the different play contexts that are prevalent in mother-infant play between 4 and 7 months. At the same time, the play categories also revealed information regarding the communicative context of play, as categories were designed to embody information about the relationship of mother and infant to each other and the toy during free play. The Relational Play Category Coding Scheme was applied to a new sample and play context in Study 2, where communicative context was studied not only through the coding of the play categories, but also through coding behavioral indices of infants' nonverbal communicative behavior. Thus, Study 2 was designed to enable an analysis of the communicative context of play interchanges at a more micro-analytic level than that afforded in the free play context of Study 1. In addition, toys in

Study 2 were chosen specifically for their social and/or functional properties and were included for a set period of time across all dyads, allowing a systematic investigation of the influence of type of toy on the play categories that emerged.

CHAPTER 3: Studies 2a and 2b

Infants' communicative behaviors have been examined at the end of the first year of life, when infants' attempts to share their interest in objects through gestures such as pointing emerge (e.g., Butterworth & Grover, 1990; Trevarthen & Hubley, 1979). Passive joint engagement, where caregivers and infants are involved with the same toy but infants show little awareness of their caregivers' presence, eventually develops into coordinated joint attention, where infants' gaze alternates between caregivers and objects of interest. The ability to coordinate attention to people and objects is a major developmental milestone and has been the focus of investigations regarding infants' communicative development. However, coordinated attention does not appear consistently until the second year of life, several months after objects are first included in play (Bakeman & Adamson, 1994). Infants' previous experience with toys undoubtedly plays a role in the development of coordinated attention. In particular, infants' play with toys embedded within the social context of play with their caregivers creates a context whereby infants have the opportunity to develop the skills to communicate about objects of interest. The idea that new communicative forms first emerge embedded in a social context is central to developmental theories espoused by Vygotsky (1978), Bruner (1982) and Trevarthen (1977), among others.

Infants' nonverbal communicative behaviors such as gazing and smiling are imbued with meaning by their caregivers as attempts to communicate their impressions about aspects of their nonsocial world. One means of studying how infant gazing and smiling are used communicatively is to examine their occurrence across different contexts

of play. In Study 1, the different contexts of mother-infant play from 4 to 7 months of age were delineated through the development of the Relational Play Category Coding Scheme. Identifying the different contexts of play prevalent in early infancy provided a window into the learning opportunities to which infants are exposed as they acquire knowledge about their social and nonsocial worlds. In addition to revealing the type of play in which dyads were engaged, the coding scheme was designed in a relational manner in order to reflect infants' and mothers' communicative stance towards one another. Information regarding their direction of attention, as well as their level of involvement in the play, was embodied in the play category definitions. While play categories revealed where infants' attention was generally directed (i.e., to the toy or to the mother), they did not provide information regarding durations of gaze as can be achieved when coding gaze micro-analytically. Infant smiling is another salient nonverbal communicative behavior which could be obtained through the use of micro-analytic coding techniques.

Study 2 was designed, in part, to enrich and extend our present knowledge regarding the different contexts of play between 4 and 7 months by utilizing micro-analytic measures of infants' gazing and smiling which were coded across play with different types of toys. An examination of infant gazing and smiling was possible in Study 2 by employing the face-to-face play context which provided a consistent and close-up view of the infant's face. In order to obtain a broader understanding of infants as social partners, a more extensive examination of gazing and smiling patterns of infants during play was warranted. Previous studies have not investigated in what contexts

infants gaze at their mothers' faces and smile during triadic play in early infancy, yet an examination of context is essential to determine the communicative function of these behaviors. Further, the co-occurrences of infants' gazes at their mothers' faces while smiling were examined in order to assess how the occurrence of these socially-directed smiles might vary based on play context and infant age.

In addition to examining infants' nonverbal communication, Study 2 contributed to knowledge pertaining to the context of infant play. Unique to Study 2 was the examination of the effect of type of toy included in play on the contexts of play that emerged. In Study 1, the durations of time that mothers and infants played with toys and the number of toys used varied between dyads and across play sessions. As a result, the effect of type of toy on play categories was not studied. In contrast to the first study, the length of the play periods with each toy, as well as the type of toy included in play, were standardized in Study 2, allowing the effect of type of toy to be studied in a systematic manner. With the exception of studies designed to examine sex-stereotyped toy play, past studies have not included the type of toy as a variable for investigation. Context of play was further explored by comparing the durations of time dyads spent in the different play categories defined by the Relational Play Category Coding Scheme. Thus, as in Study 1, the application of the coding scheme afforded the opportunity to investigate whether there would be changes in the structure and organization in play with infants' development.

Study 2 addressed three research objectives pertaining to the goals of examining play context and infants' nonverbal communication. These research objectives were studied across two samples of infants. Study 2a consisted of a cross-sectional sample of

mothers and their infants aged 4 and 7 months, and Study 2b consisted of a longitudinal sample of dyads who participated at 4 months in Study 2a and returned at 7 months. Other than the different samples, the objectives and method for Studies 2a and 2b were identical. Objective 1, also investigated in Study 1, was to examine developmental change in the content and organization of play when dyads were 4 and 7 months through the application of the Relational Play Category Coding Scheme. In Study 1, mothers were instructed to include the toys if they wished, and play alternated between dyadic and triadic bouts. In contrast, mothers in Study 2 were given one toy at a time and told to include the toy in their play. As a result, only triadic play categories were coded for Study 2. Objective 1 was addressed in Study 2a by comparing durations of time spent in the triadic play categories across age within a cross-sectional sample of infants 4 and 7 months of age. The hypothesis for each triadic play category will be discussed in turn.

The hypothesis from Study 1 that Functional play would decrease with age was supported, and the same hypothesis was made for Study 2. With the increasing competencies of the infant, it was expected that mothers of the 7-month-old infants would spend less time demonstrating the functions of the toys. However, one explanation for the results from Study 1 was that mothers may have demonstrated the function of the toys on their first visit and therefore were less likely to do so on their subsequent two visits. Examining Functional play in a cross-sectional sample in Study 2 helped to determine whether this finding truly reflected a developmental change.

Social play was not adequately assessed in Study 1 as only one social toy was included, and Social play occurred for minimal durations. As discussed in Study 1, it was

considered possible that the higher levels of smiling and more active participation in social interchange with infant age (e.g., Kaye & Fogel, 1980; Messinger et al., 1999; Rome-Flanders et al., 1995) may be associated with longer bouts of Social play at 7 months as compared to 4 months.

Results from Study 1 indicated that overall durations of Developmental play decreased with age, and that mothers' physical assistance in helping infants with developmental tasks decreased with infant age. The same pattern was expected to emerge in the face-to-face play context of Study 2. It was predicted that mothers' encouragement of Developmental play would decline with age. Of the Developmental play that did occur, more Independent than Mother-facilitated developmental play was expected at 7 months than at 4 months, thus replicating the results from Study 1. In addition, the content of the Developmental play in Study 1 was found to vary across infants' three visits. If the developmental behaviors that were encouraged in Study 1 were a reflection of those typical of the age range studied, then it was expected that the same behaviors would be encouraged in Study 2. However, unlike Study 1, it would not be possible to encourage gross motor play such as crawling in Study 2 because the infant was seated in an infant seat.

Supported play in Study 1 decreased with infants' age. The same pattern was expected in Study 2. It was considered likely that mothers would provide less physical support with regards to the toy play (e.g., holding the toy while the infant explored) at 7 than at 4 months. Finally, based on the findings from Study 1, it was expected that bouts of Mother onlooking, where the infant was playing with the toy while the mother

observed, would increase with age. Thus, Mother onlooking was expected to occur for longer durations at 7 than at 4 months.

The second objective, unique to Study 2, was to examine how the play categories that emerged might vary depending on the type of toy included in play. A social toy, a functional toy, and a toy with both social and functional properties were given one at a time to mothers to include in their play. The hypotheses were formulated from observations that stuffed toys with faces are likely to elicit social games such as tickling and peek-a-boo and the speculation that functional toys such as books and rattles would result in play designed to explore the uses for which these toys were designed. Thus, it was expected that play might unfold in a different manner depending on the toy presented. The hypotheses relating to the effect of type of toy on play context were that the toy chosen for its social properties would elicit the most Social play (lion), the functional toy would elicit the most Functional play (rattle), and the toy with both social and functional properties (worm), would elicit both Social and Functional play activities.

The third objective of the present study, addressed exclusively in Study 2, was to examine infants' nonverbal communicative behavior as it occurs in the context of play. Gazing and smiling were used as behavioral indices of infants' social communication. Communication is inextricably linked to the context in which it occurs. The design of Study 2, where dyads had standardized periods of play, made it possible to conduct a systematic investigation of potential changes in infants' gazing and smiling between play contexts. All dyads in Study 2 began their play with a period of face-to-face interaction without toys, followed by three periods where each of the three different toys were

included in the play. A comparison of mean percent durations of infants' gazing toward mothers' faces and infant smiling was made between the dyadic play period as well as the three triadic play periods.

The first hypothesis regarding infants' communicative behaviors was that infants' gazing toward mothers' faces and smiling would decrease between the dyadic and triadic play contexts, confirming previous research (McCollum & Stayton, 1988; Stack & Colburne, 1996). In addition to the general finding that a different pattern of infant gazing and smiling would be evident in the dyadic compared to the triadic play periods, the type of toy included in play was considered to be a mediating variable in determining infants' patterns of nonverbal communication. Based on previous research, it was expected that across all triadic play periods, infants' gazing toward mothers' faces during toy play would occur at low levels (McCollum & Stayton, 1988). Nonetheless, different toys would likely be used in different play activities, and therefore it was considered likely that the type of toy included in play would influence levels of infants' gazing and smiling.

In face-to-face play without toys, mothers often play tickling games, peek-a-boo, or use their hands and upper body in looming games. Observations made by the author of play with a social toy revealed that play was often similar to the games prevalent in dyadic play. For example, the stuffed toy was used in tickling and looming games much like mothers used their hands to tickle their infants during dyadic play. In contrast, play with functional toys, if undertaken with the goal of discovering how a toy works, likely results in infants' attention focused on the toy. Based on these speculations, it was

predicted that there would be more infant gazing toward mothers' faces and smiling during bouts of play with the social and the social/functional toy as compared to the functional toy.

Age was also considered to be a mediating factor in infants' communicative behaviors during toy play. Previous studies have shown that infants become more active social participants in cooperative games, demonstrating greater initiative with age (Gustafson et al., 1979; Kaye & Fogel, 1980; Rome-Flanders et al., 1995). In addition, in the second half of the first year of life, infants increasingly solicit attention to the self which elicits reactions from others (e.g., teasing and clowning around), exemplifying their increasing social awareness (Reddy, 1991). Likewise, salient communicative behaviors such as infant smiling have been found to increase with infant age (Messinger et al., 1999). As a result, it was considered likely that the 7-month-old infants might be better able to regulate their interactions between their mothers and the toy, resulting in more gazing toward mothers' faces and infant smiling during toy play when compared to infants at 4 months.

As previously reviewed in Chapter 1, systems theories which underscore the complexity of the caregiver-infant interaction, are currently a prevailing theoretical framework in developmental research. Systems theories have been influential in the growing recognition that discrete behavioral indices such as gaze and affect, in and of themselves, do not represent the complexity of infants' communicative responses during social interaction (Symons & Moran, 1987). Rather, communicative behaviors occur simultaneously, embedded in the ongoing play. As a result, co-occurrence measures offer

the means to examine associations between different expressive behaviors. Several researchers have suggested that associations between expressive behaviors and gazing toward mothers' faces represent meaningful communicative content with a socially-directed character (Fogel & Thelen, 1987; Stack & Arnold, 1998; van Wulfften Palthe & Hopkins, 1984). As such, in addition to examining infant gazing and smiling individually as they occurred across the dyadic and triadic play contexts, an examination of the co-occurrences of infant gazing and infant smiling within the same play contexts was undertaken.

The co-occurrence measure consisted of the percent durations of infant smiles that occurred while gazing toward mothers' faces, out of total duration of infant smiling. It was expected that there would be more gazing toward mothers' faces while smiling during play with the social and social/functional toys. These toys likely elicit more gazing toward mothers' faces and smiling overall, increasing the likelihood that they would occur together. Moreover, because 7-month-olds have a longer history of social experience and increasing cognitive abilities, it was expected that infants would be more likely to direct smiles at their mothers' faces at 7 than at 4 months within the triadic play context.

In summary, three objectives were addressed in Study 2. The first two objectives pertained specifically to an examination of play context between 4 and 7 months, whereas the third objective examined infants' nonverbal communicative behaviors across these play contexts. While parents are undoubtedly the more competent play partners when paired with their infants, infants' attunement to the social world from their first months of

life and nonverbal means of responding to the play such as gazing and smiling are evidence of their developing social competencies. A study with a cross-sectional (Study 2a) and longitudinal (Study 2b) sample was designed to examine the play contexts within which these social interchanges take place. Tracking developmental changes in infants' communicative responses to the play served to extend our present knowledge of the nature of infants' earliest encounters where their social and nonsocial worlds merge in the form of triadic play.

Study 2a

Method

Participants

Subjects were recruited in the same manner as in Study 1. Two different age groups of infants participated in Study 2, 4- and 7-month-old infants, which parallel the youngest and oldest age groups from Study 1. The sample consisted of a total of 63 full-term healthy infants and their mothers. Five infants were subsequently excluded from the analysis. Infants were excluded if they engaged in greater than 20 consecutive seconds of fretting in any given period, and 2 infants were subsequently excluded based on this criterion. In addition, 2 infants were excluded because when they were placed in the infant seat, they became very distressed. Thus the sessions were terminated even before the play periods had commenced. One infant was excluded due to the infant spending most of the time looking around the room in all periods. The final sample consisted of 58 infants; 30 4-month-olds (16 female), with a mean age of 4 months, 9.03 days (sd = 4.77 days) and 28 7-month-olds (14 female) with a mean age of 7 months, 5.79 days (sd = 5.59 days). The mean age of the mothers of the 4-month-old infants was 31 years (sd = 4.58 years), and the mean age of the mothers of the 7-month-old infants was 33 years (sd = 4.82 years).

The majority of the families who participated in Study 2a were Non-Hispanic White (91 %). The remaining families were African American (5 %), Asian/Pacific Islander (2 %), and bi-racial (Asian and White; 2%). All mothers spoke and understood English. Of mothers who did not normally speak English to their infants in the home,

they were encouraged to speak to their infants in whatever language they would normally use. In terms of the language that mothers used to speak to their infants during the session, most mothers spoke English (88%), with the remaining mothers speaking French (7%), Greek (2%), Italian (2%), and Bulgarian (2%). Most mothers were from intact two-parent families (97%), with the remaining mothers being single mothers (3%).

In terms of education, families were classified as 5% with no high-school education, 9% with high-school but without college education, 34% had some college education, and 52% had degrees from programs requiring 4 years of college or more. In terms of occupational status, the families were classified in the domains of Professional Specialty (27%), Service workers not in Private households (20%), Executive/ Administrators/Managerial (17%), Sales (17%), Technical and Related Support (7%), Administration/Support/Clerical (3%), Transportation and Material Moving (2%), Handlers, Equipment Cleaners, Helpers, and Laborers (2%; categories based on US Bureau of the Census, 1996). The remainder of the families were students (3%) and unemployed workers (3%).

Apparatus

Infants were seated in an infant seat mounted and securely fastened to a custom-made wooden box (75 cm high x 46 cm wide x 51 cm long). Mothers were seated on an adjustable wooden stool at eye level, directly across from their infants. A view of the interaction was obtained using two cameras whose images were transmitted through a split screen generator and recorded on a Sony 8 mm video recorder located in an adjacent observation room. One camera (Hitachi Solid State Color Video Camera VK-C350) was

mounted on the wall and located behind and to the left of the mother, capturing a frontal view of the infant and the side of the mother. A second camera was located on a tripod 58 cm directly behind the infant seat, and captured a frontal view of the mother's face. A Video Timer (FOR.J VTG-22) was used to record a time line on each videotaped session in order to permit precise calculation of occurrences of each dependent measure in minutes and seconds.

Three toys were used in Study 2. All toys were brightly colored and made noise, and were appropriate for the age level of the infants who participated in the study. Toys were selected on the basis of their social or functional properties. A colorful stuffed lion (Battat Toys) was chosen as the social toy because it had a face, making it easy for mothers to animate in their play. A rattle (Discovery Toys) was chosen as the functional toy because it had various components to spin and move, which the mother and infant could discover together. Finally, there was a stuffed worm (Zoobit Toys) which was multi-functional, having both social and functional properties. It had the social features of eyes, nose, and feet, but also squeaked, rattled, crinkled, and had Velcro so that it could open and close.

Experimental Instructions and Procedure

Upon arrival, mothers were escorted into the waiting room. The experimenter reviewed the purpose and procedural details of the study, and mothers were given an informed consent form to read and sign (Appendix J). After signing the consent form, the mother was escorted with her infant to the testing room. The mother then secured her

infant in the infant seat while the experimenter turned on the video equipment situated in the adjacent observation room.

Each mother-infant dyad participated in four interaction periods. The experimenter gave the instructions at the beginning of each period, and then exited the room into the adjacent observation room. The experimenter knocked on the observation window both at the beginning and end of the period to indicate to the mother when to begin and end her play. There was a 20-second inter-trial interval between each period when the experimenter returned to the room and gave mothers the instructions for the next period.

All dyads engaged in an initial two minute period of face-to-face play without a toy where mothers were instructed to play with their infants as they normally would at home. Mothers were given a different toy at the beginning of each of the three remaining 90 second periods. They were instructed to play with their babies as they normally would at home, including the toy in their interaction. There were two orders of presentation of the toys as represented in Table 1. Each mother-infant dyad received one of the orders. In order 1, the first period of toy play (period 2) commenced with the lion, followed by the worm and ended with the rattle. In order 2, toy play commenced with the rattle, followed by the worm, and ended with the lion.

Mothers were informed that the session could be terminated at any time and for any reason, and that she could interrupt the session to give her infant a break if necessary (e.g., for a feeding). Two mothers of 4-month-old infants requested that the sessions be terminated prior to the start because their infants became distressed when placed in the

Table 1

Design Table for Study 2a

Order	Period 1	2	3	4
Order 1 (n = 29) (n = 16 at 4 months) (n = 13 at 7 months)	No toy	Lion	Worm	Rattle
Order 2 (n = 29) (n = 14 at 4 months) (n = 15 at 7 months)	No toy	Rattle	Worm	Lion

infant seat that was used for the study. One mother of a 4-month-old requested a break during testing for a diaper change.

Following the completion of the testing session, the mother and her infant were escorted to the waiting room where the experimenter asked the mother standardized questions regarding her infant's medical history as well as general demographic information (Appendix D). In addition, mothers were asked if they owned any of the toys that were used in the study. None of the mothers in Study 2 reported that they had any of the three toys used in the study at home. All participants received a certificate of merit ("Infant Scientist Award") as a token of appreciation for their participation in the study. In addition, mothers were informed that a report summarizing the general findings of the study would be sent to their home once the study was completed.

Behavioral Measures and Coding

The Relational Play Category Coding Scheme designed in Study 1 was applied to Study 2 for the three periods including toys. Examples of play behaviors that were defined as Functional and Social play based on each toy are found in Appendix K (Tables K1 & K2). In order to document infants' nonverbal communicative responses to different play contexts, infant gaze and affect were also coded. Infants' gaze was coded when they were looking at their mothers' faces, as well as away from the experimental situation (e.g., ceiling, walls) during the face-to-face play period without the toys, and at mothers' faces, the toy, and away from the experimental situation during the periods where toys were included. The measure of infant gaze at toy was coded whenever the infant looked at any part of the toy. Infant gaze away was coded when the infant gazed away from the

experimental situation. This included gaze at walls and ceiling, but excluded anything in the proximal vicinity of the play such as the infant chair, and the infant's own body. This measure of gaze away has been employed in previous research (e.g., Lepage, 1998; Toda & Fogel, 1993). Durations of infant smiling were also coded for each period. A smile was operationally defined as an upturned mouth, either open or closed. All measures in Study 2 were frame-by-frame coded in order to obtain durations of each infant behavior in a given period. Measures of infant gaze away, gaze at mothers' faces and infant smiling have all been reliably coded in the past using the same definitions and method (e.g., Lepage, 1998; Stack & Arnold, 1998; Stack & Muir, 1992).

Inter-rater reliability was assessed by blind observers for 21% of the records upon completion of the coding. Intraclass correlation coefficients conducted on the play category variables for Study 2a were all above $\underline{r} = .99$. Cohen's kappa coefficients conducted on the play category variables were also high, ranging from $\underline{r}_k = .85$ (Social play) to $\underline{r}_k = 1.00$ (Developmental play and Mother onlooking). Intraclass correlation coefficients were all above $\underline{r} = .99$ for the attention variables (infant gaze at mothers' faces, infant gaze at toy, and infant gaze away). Cohen's kappa coefficients for the attention variables were also high ($\underline{r}_k = .98$ for infant gaze at face; $\underline{r}_k = .94$ for infant gaze at toy; $\underline{r}_k = 1.00$ for infant gaze away). Finally, the intraclass correlation coefficient for smiling was $\underline{r} = .99$. Cohen's kappa coefficient for smiling was $\underline{r}_k = .76$.

Results

Descriptive statistics were conducted on each dependent variable to determine if significant non-normality and/or outliers were present. Where outliers were present, their

influence was reduced by assigning the outlier a value that was one unit larger or smaller than the next most extreme score in the distribution, a method advocated by Tabachnick and Fidell (1996). The few instances where a transformation was deemed appropriate will be indicated in the text. For ease of comprehension, when data were transformed, raw means are presented in the text and the transformed means are represented in the Appendices. However, when transformations were conducted, the F-scores and p-values cited in the text were taken from the analyses on the transformed data, as these are the values on which the interpretations are based. Following the screening analyses, split-plot ANOVA's were conducted for each period with Age (four, seven), Order (one, two), and Sex (male, female) as the between-subjects variables and period as the within-subject variable (no toy, lion, worm, rattle). When Order or Sex were significant they will be noted, otherwise the results reported were from analyses that were collapsed across Order and Sex. Tukey post hoc tests were used to isolate significant differences for main effects involving more than two levels, and simple effects analyses were used to isolate the source of significant interactions.

The first section of results focuses on context of play, and includes the findings of percent durations of time spent in the play categories from the Relational Play Category Coding Scheme, and how these changed across age. Embedded in this first section are the results pertaining to Objective 2, how the type of toy influenced the play categories in which dyads engaged. The second section of results focuses on the findings from the examination of infants' nonverbal communicative behavior during play, thus addressing the third and final objective of the present study. Infant gazing and smiling are addressed

in turn, followed by a section where results from the co-occurrence of infant gaze and smiling are reported.

I. Play Context.

ANOVA summary tables, Post-Hoc comparisons, and mean tables for the results of the Relational Play Category Coding Scheme are found in Appendix L.

Functional play. Consistent with Study 1, the total proportion of time dyads spent in Functional play was found to differ by age, $F(1, 54) = 15.00$, $p < .001$ (Table L1). Mothers and infants at 4 months spent significantly greater proportions of time in Functional play ($M = 35.38\%$) than mothers and infants at 7 months ($M = 24.53\%$). There was also a difference in amount of time spent in Functional play as a function of Toy, $F(1.95, 105.11) = 124.04$, $p < .001$. Dyads spent the greatest proportions of time in Functional play with the rattle ($M = 48.47\%$), followed by the worm ($M = 32.46\%$), and the lion ($M = 9.50\%$). These main effects were qualified by a three-way interaction between Toy, Age, and Order, $F(1.95, 105.11) = 3.53$, $p < .05$. A simple effects analysis was conducted evaluating Age while holding Toy and Order constant in order to isolate the source of significant differences. The results are illustrated in Figure 2, and revealed that the source of significant differences was in the worm and rattle periods. When the play bout with the worm was preceded by the lion (Order 1), more time was spent in Functional play at 4 months than at 7 months, but this difference was not significantly different ($M = 33.75\%$ at 4 mos; $M = 31.21\%$ at 7 mos). In contrast, when the rattle preceded the worm period (Order 2), there was significantly more Functional play at 4 months than at 7 months, $F(1, 54) = 11.12$, $p < .01$ ($M = 42.80\%$ at 4 mos; $M = 22.53\%$ at

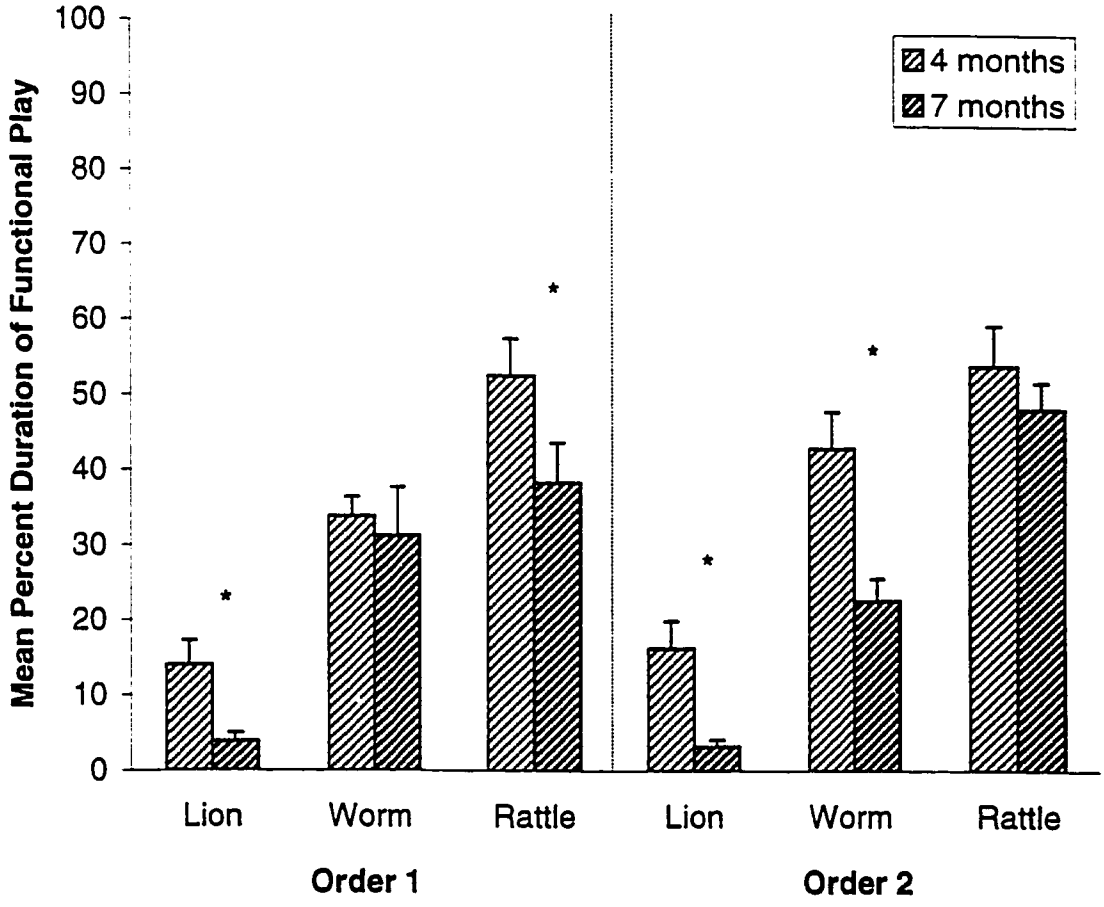


Figure 2. Mean percent duration dyads spent engaged in Functional play as a function of Age, Toy, and Order. Standard errors are shown by vertical bars.

7 mos). When the toy play periods ended with the rattle after play periods preceded by the lion and worm respectively (Order 1), a significant difference was apparent by age, with dyads at 4 months engaging in greater durations of Functional play $F(1, 54) = 4.33$, $p < .05$, ($M = 52.54\%$ at 4 mos; $M = 38.27\%$ at 7 mos). However, when the play period commenced with the rattle (Order 2), there was more Functional play at 4 months than at 7, but the degree of difference was not significant ($M = 53.75\%$ at 4 mos; $M = 48.03\%$ at 7 mos). Figure 2 also illustrates that there were significant differences by Age in the lion period, with more Functional play occurring at 4 months than 7 months, but this difference was consistent across both Order 1 and Order 2. Taken together, results reveal that in all instances more Functional play occurred at 4 months than at 7 months, but the degree of these differences varied based on the order of presentation of toys.

As in Study 1, three subcategories of Functional play make up the total Functional play category. To further describe the nature of the Functional play, the means for the proportion of time spent in each subcategory of Functional play out of the total amount of Functional play for each infant were obtained. T-tests with age as the grouping factor conducted on each of the three subcategories of triadic play revealed no significant differences with age. At both ages, it was evident that mother-infant dyads spent the least amount of time in Mother-facilitated functional play ($M = 4.86\%$), followed by Infant onlooking ($M = 36.26\%$), with the greatest proportion of time spent in Joint-action instrumental ($M = 58.86\%$).

Social play. The data for Social play were moderately positively skewed and thus a square root transformation was performed on this measure. Analyses revealed an Age

main effect, F (1, 56) = 5.33, $p < .05$ (Table L2). Seven-month-old infants and their mothers spent more time engaged in Social play (M = 27.10%) than 4-month-old infants and their mothers (M = 19.65%). There was also a significant main effect for Toy, F(1.92, 107.31) = 178.11, $p < .001$. Subsequent Tukey comparisons (Table L3) on the transformed means revealed that dyads spent more time engaged in Social play with the lion (M = 44.93%), than with the worm (M = 21.98%) or the rattle (M = 2.81%). Likewise, the amount of time spent in Social play with the worm was significantly greater than with the rattle. Transformed means by infant age are found in Table L4 and transformed means by type of toy are in Table L5.

Developmental play. Confirming the findings from Study 1, a decrease in Developmental play with age was found. Because of the low occurrence of Developmental play at 7 months, an ANOVA was not conducted to statistically evaluate age differences. There were a large number of zero values making the distribution unsuitable for statistical analyses. However, the means were calculated for descriptive purposes. As a group, the 4-month-olds and their mothers engaged in a mean proportion of 22.92% of Developmental play, whereas the dyads at 7 months engaged in only 2.51% of Developmental play.

As in Study 1, the mean proportion of time spent in the subcategories of Developmental play were also explored. Time spent in Independent developmental play and Mother-facilitated developmental play was calculated out of the total time dyads engaged in Developmental play. An increase in Independent developmental play occurred with age. Of the dyads that engaged in Developmental play, 41.42% of their

time was spent in Independent developmental play at 4 months of age as compared to 100% of their time at 7 months of age. Mother-facilitated developmental play decreased with age from a mean percent duration of 44.22% at 4 months to 0% at 7 months. In addition, some dyads at 4 months of age engaged in visual tracking, which occurred for a mean proportion of 14.67% of the total Developmental play.

To further explore the content of Developmental play, the developmental task which was the focus of each developmental bout was examined. When infants were 4 months of age, three different behaviors were encouraged by their mothers. Durations of time spent encouraging each of these developmental behaviors was calculated out of the total time spent in Developmental play across all 4-month-old infants. The greatest proportion of Developmental play was spent encouraging infant holding ($\underline{M}$ = 67.37%), followed by visual tracking ($\underline{M}$ = 24.33%), with the least amount of time spent encouraging infant reaching ($\underline{M}$ = 8.30%). The proportion of dyads who engaged in the different developmental behaviors was also calculated. Dyads that participated in more than one of the behaviors were counted for each behavior in which they engaged, thus the totals add up to greater than 100%. Eighty-percent of the infants ($\underline{n}$ = 24) were encouraged to hold the toy, 37% of the infants were encouraged to visually track the toy ($\underline{n}$ = 11), and 10% of the infants ($\underline{n}$ = 3) were encouraged to reach for the toy.

At 7 months of age, minimal durations of time were spent encouraging Developmental play ($\underline{M}$ = 2.51%), and as a result, the means provided below were derived out of a small proportion of the play. In fact, across all infants and all periods at 7 months, a total of only 63.26 seconds of Developmental play occurred. Of the total

time 7-month-olds spent engaged in Developmental play, 39.46% of time was spent encouraging holding the toy, 34.13% of the time was spent encouraging giving the toy, and 26.41% of the time pertained to reaching for the toy. The proportion of dyads who engaged in the different developmental behaviors was also calculated. Eleven percent of infants were encouraged to hold the toy ($n = 3$), 11% were encouraged to reach for the toy, and 7% of infants ($n = 2$) were encouraged to give the toy to their mothers. Visual tracking was not encouraged at 7 months. The low amounts of Developmental play can be attributed to the fact that infants were seated in the infant seat, and therefore gross motor behaviors such as crawling could not be encouraged as they were by mothers of infants at 7 months in Study 1.

Supported play. Descriptive statistics revealed moderate positive skewness, therefore a square root transformation was used. Results for the total amount of Supported play revealed a main effect for Order (Table L6). More Supported play occurred for dyads in Order 1 where dyads were presented with the lion, worm and rattle respectively $F(1, 50) = 4.72$, $p < .05$; ($M = 10.45\%$) than for dyads in Order 2 ($M = 6.75\%$) where the toys were presented in the reverse order. In addition, there was a main effect for Sex, $F(1, 50) = 7.81$, $p < .01$, where mother-daughter dyads engaged in more Supported play ($M = 10.98\%$) than mother-son dyads ($M = 6.04\%$). There was also a main effect for Toy, $F(1.98, 98.78) = 8.35$, $p < .001$, where dyads were found to engage in more Supported play with the rattle ($M = 12.16\%$) than the worm ($M = 6.12\%$) or the lion ($M = 7.50\%$). The main effect for Toy was qualified by a Toy by Age interaction, $F(1.98,$

98.78) = 5.05, $p < .01$. As illustrated in Figure 3, simple effects analyses revealed that the source of significant interaction was during the lion period, $F(1, 56) = 12.56$, $p < .001$, where mother-infant dyads at 4 months engaged in more Supported play with the lion (M =10.39%) than mother-infant dyads at 7 months (M = 4.41%). Transformed means for Supported play by Order, Sex and Age can be found in Tables L7, L8, and L9 respectively. There was also a trend towards a 3-way interaction between Toy, Age, and Sex, $F(1.98, 98.78) = 2.78$, $p = .068$. Given the nonsignificance, no simple effects analysis was conducted, however, an examination of the means revealed a large difference between the male and female infants at 7 months during the rattle period. For mother-son dyads, mothers provided support with the rattle for a mean duration of 6.33% whereas for mother-daughter dyads, mothers did so 22.43% of the time.

Mother onlooking. In contrast to Study 1, there were no bouts of Mother onlooking - gaze in the present study. This is likely the result of the change in play context. In the floor play context of Study 1, infants were far enough away from toys at times that they used only their gaze to interact with toys. Likewise, more than one toy was present, and toys were resting on the mat where infants could observe them. However, in Study 2 only one toy was used at a time and the toys were involved in the play within the close proximity of the face-to-face play context, resulting in no bouts of Mother onlooking - gaze. Thus results pertain to the Mother onlooking - physical category only. A main effect for Sex was evident, $F(1, 56) = 4.70$, $p < .05$, and revealed that mother-son dyads engaged in Mother onlooking for greater proportions of time (M = 23.74%) than mother-daughter dyads (M = 16.84%; Table L10). An interaction between

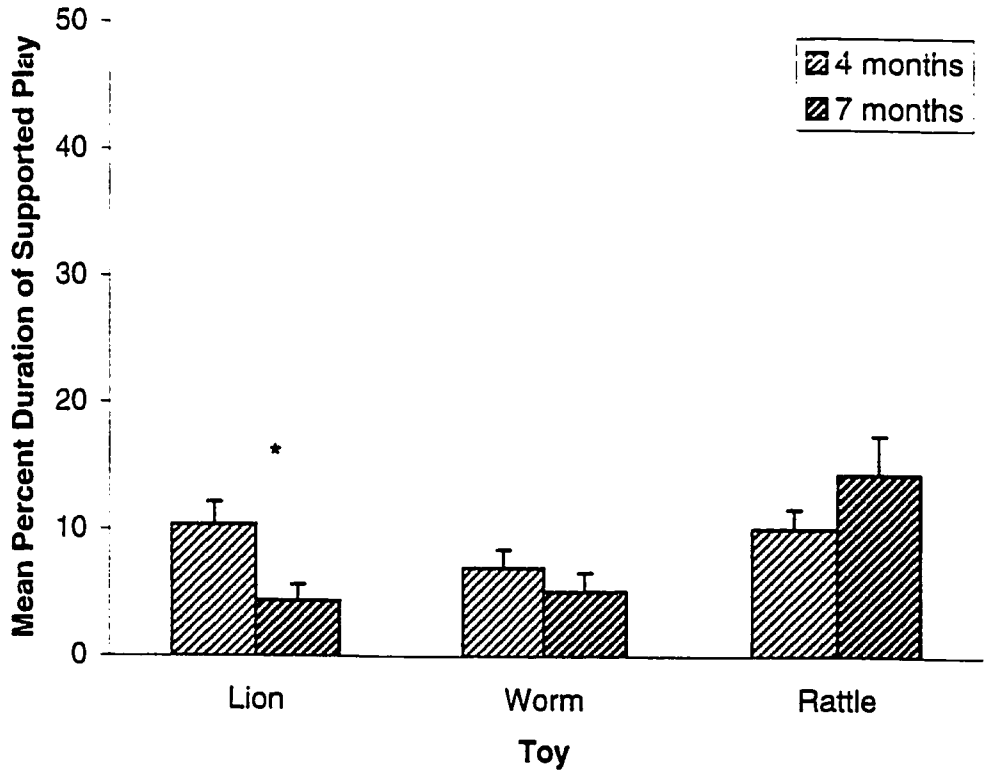
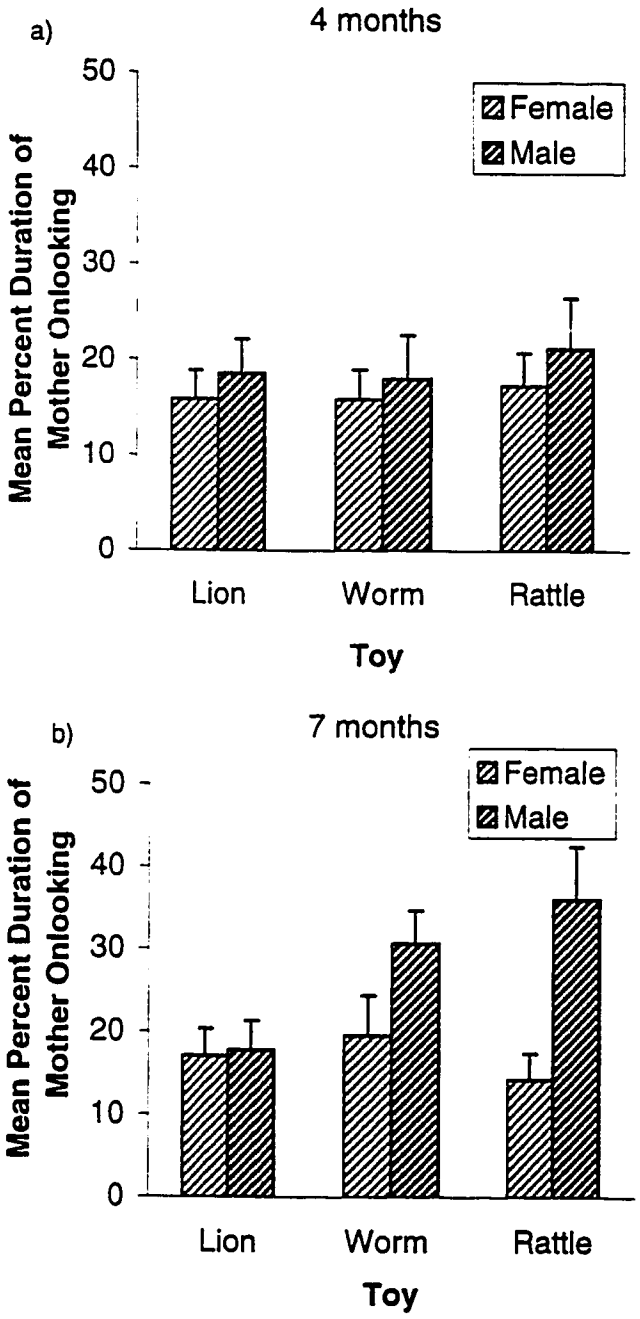


Figure 3. Mean percent duration dyads spent in Supported play as a function of Age and Toy. Standard errors are shown by vertical bars.

Sex and Toy was marginally significant, $F(1.90, 106.54) = 3.00$, $p = .057$. An examination of means revealed that with all toys, mother-son dyads engaged in more Mother onlooking than mother-daughter dyads. However, this pattern was particularly prevalent when the rattle was used ($M = 28.64\%$ for mother-son dyads; $M = 15.92\%$ for mother-daughter dyads).

There was no age difference for the Mother onlooking play category as predicted. However, there was a trend toward a significant three-way interaction of Toy, Sex, and Age, $F(1.91, 102.90) = 2.58$, $p = .08$. Although not significant, the three way interaction is illustrated in Figure 4 for descriptive purposes. When infants were 4 months, the amount of Mother onlooking that occurred was similar across toys and gender. However, at 7 months, Mother onlooking occurred for greater durations in the mother-son dyads than the mother-daughter dyads for the worm period ($M = 19.56\%$ for female infants vs. $M = 30.61\%$ for male infants) and more than twice as much for the mother-son dyads when the rattle was used ($M = 14.26\%$ for female infants vs. $M = 36.06\%$ for male infants). Thus, while there was no age effect per se, the trend of the three-way interaction between Toy, Sex, and Age is informative in terms of changes in amount of Mother onlooking that occurred with age.

Unengaged. Unlike Study 1, where infants engaged in free play for an 8 minute period, in the present study, play occurred in brief periods of 90 seconds. Mothers were given specific instructions to include the toys in their play and as a result, low levels of Unengaged, where mothers and infants were engaged in different activities, were



Figures 4a and 4b. Mean Percent Duration of Mother onlooking as a function of Sex and Toy at 4 months (4a) and 7 months (4b).

expected. This was the case, and consequently no analyses were conducted on this measure (M = 0.19% at 4 mos.; M = 1.24% at 7 mos.).

II. Infants' Nonverbal Communicative Behaviors: Gazing and Smiling

Two dependent variables were analysed to address the question of infant gaze behaviors during dyadic and triadic play. These variables consisted of infant gaze: (a) at mothers' faces, (b) at the toy. Each dependent variable is discussed separately.

Infants' gaze at mothers' faces. ANOVA summary tables and transformed means can be found in Appendix M. Descriptive statistics revealed moderate positive skewness and significant outliers, thus a square root transformation was conducted on the infants' gaze at mothers' faces measure. An ANOVA on the transformed data (Table M1) revealed a significant main effect for Age, $F(1,56) = 5.80$, $p < .05$), where infants gazed more at their mothers' faces at 7 months (M = 20.00%) than at 4 months (M = 16.46%). There was also a significant main effect for Period, $F(2.80, 156.94) = 234.10$, $p < .001$), which indicated that infants gazed at their mothers' faces for the longest durations during dyadic play without any toys (M = 49.69%), followed by the lion period (M = 11.43%), the worm period (M = 6.61%), and the rattle period (M = 4.95%). These main effects were qualified by an Age by Period interaction, $F(2.80, 156.94) = 3.20$, $p < .05$, illustrated in Figure 5 (see Table M2 for transformed means). A simple effects analysis on the Age by Period interaction holding the Period factor constant revealed that the source of the significant differences occurred during the lion $F(1, 56) = 10.45$, $p < .01$), and the worm periods, $F(1, 56) = 5.90$, $p < .05$, where the 7-month-old infants gazed more at their

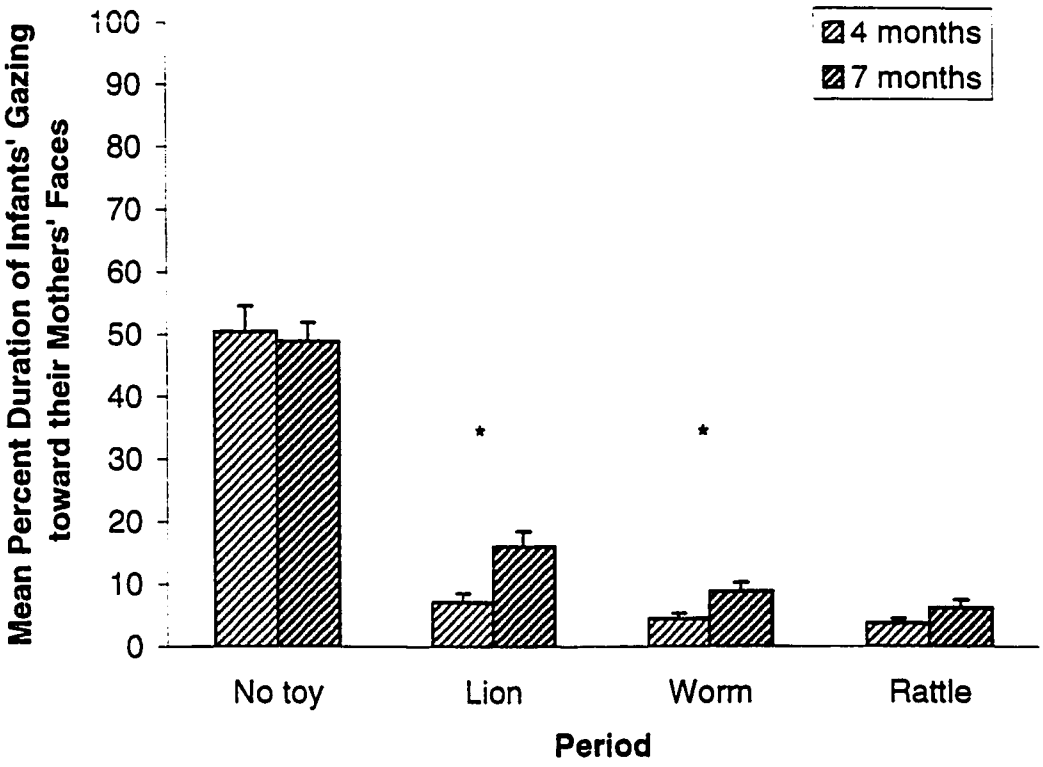


Figure 5. Mean percent duration of infants' gazing toward their mothers' faces as a function of Age and Period. Standard errors are shown by vertical bars.

mothers' face than the 4-month-olds (M = 16.05% at 7 months vs. M = 7.12% at 4 months for lion; M = 8.87% at 7 months vs. M = 4.50% at 4 months for worm). No significant difference by age emerged for the rattle period (M = 6.21% at 7 months; M = 3.78% at 4 months).

Infant gaze at toy. The ANOVA summary table for the infant gaze at toy measure can be found in Appendix N. Results revealed a main effect for Order, $F(1, 50) = 8.02$, $p < .05$. Infants in Order 1 where the order of presentation was the lion, worm, then rattle gazed for longer durations at the toy (M = 85.92%) than infants in Order 2 where toys were presented in the opposite order (M = 79.66%). The Order main effect was qualified by an Order by Toy interaction, $F(1.53, 76.68) = 4.19$, $p < .05$, as illustrated in Figure 6. A simple effects analysis, holding Toy constant, revealed the source of the significant difference was within the lion period, $F(1, 56) = 8.14$, $p < .01$. Infants gazed for longer durations when the lion was presented as the first toy (Order 1; M = 78.96%) as compared to when the lion was presented as the last toy (Order 2; M = 66.91%). There was also a main effect for Age, $F(1, 50) = 17.11$, $p < .001$ which revealed that 4-month-old infants gazed for longer durations at the toy (M = 86.86%) than 7-month-old infants (M = 78.66%). Also present was a main effect for Toy, $F(1.53, 76.68) = 57.55$, $p < .001$, where infants gazed for the longest duration at the rattle (M = 89.90%) followed by the worm (M = 85.66%) and the lion (M = 73.14%). These main effects were qualified by a Toy by Age interaction, $F(1.53, 76.68) = 11.24$, $p < .001$, as illustrated in Figure 7. A simple effects analysis, holding the levels of Toy constant, revealed a significant difference by Age during the lion period, $F(1, 56) = 16.83$, $p < .001$, where 4-month-olds looked at the

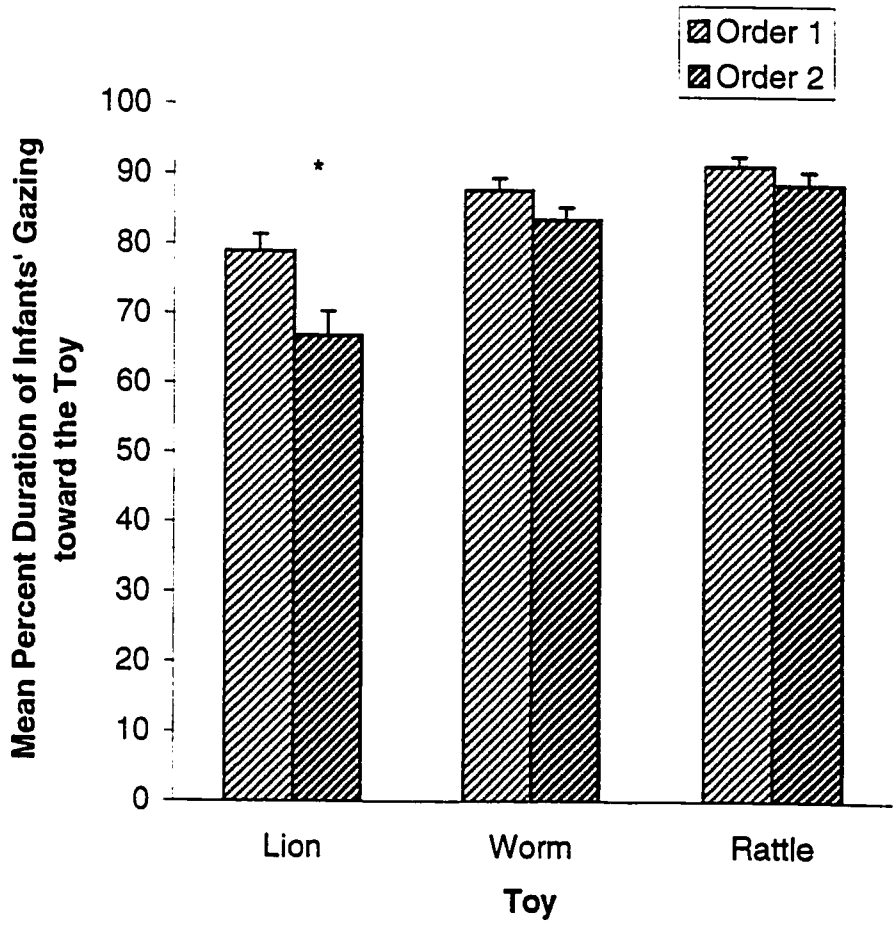


Figure 6. Mean percent duration of infants' gazing toward the toy as a function of Toy and Order. Standard errors are shown by vertical bars.

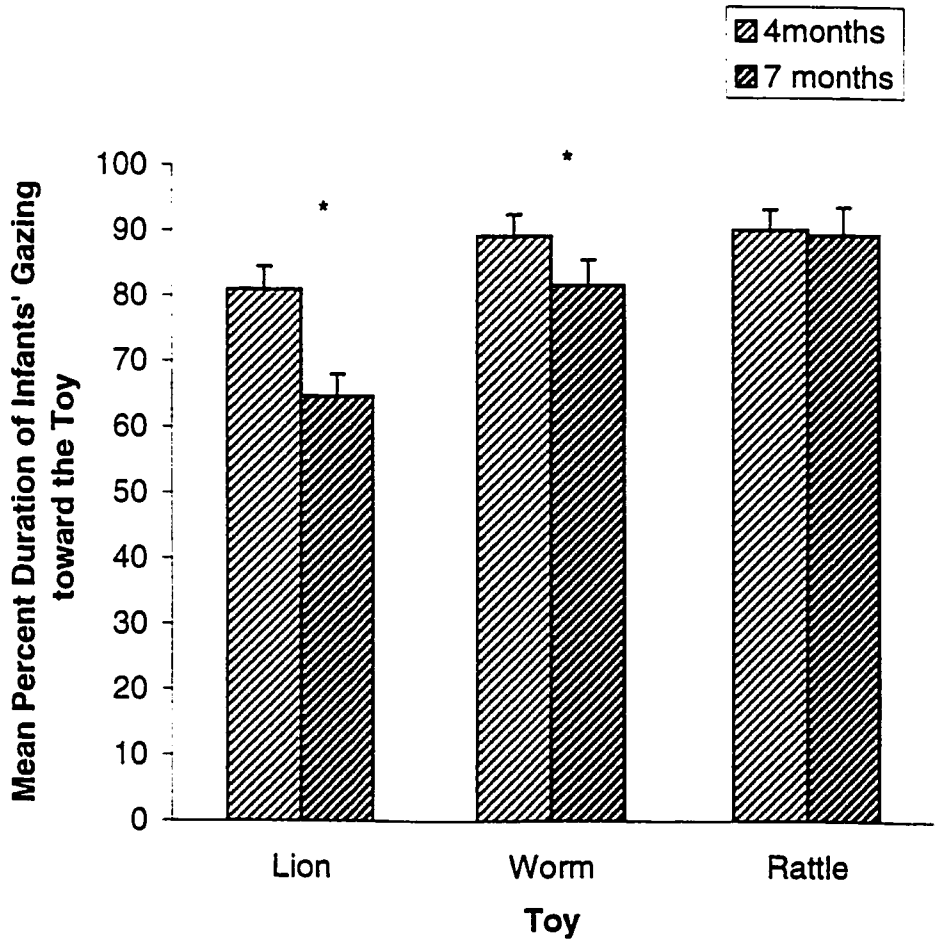


Figure 7. Mean percent duration of infants' gazing toward the toy as a function of Age and Toy. Standard errors are shown by vertical bars.

lion for longer durations (M = 80.99%) than the 7-month-olds (M = 64.73%). Likewise, there was a significant difference by Age during the worm period F (1, 56) = 10.28, p < .01, where the 4-month-olds looked at the worm for greater proportions of time (M = 89.30%) than the 7-month-olds (M = 81.75%), with no significant difference during the rattle period (M = 90.27% at 4 months; M = 89.50% at 7 months). There was also an Age by Sex interaction, F(1, 50) = 4.38, p < .05. A simple effects analysis holding the Age factor constant revealed no significant differences for Sex at either 4 or 7 months.

Infant smiling. Results revealed an Age main effect, F(1, 50) = 22.19, p < .001, which revealed that 7-month-old infants smiled for greater proportions of time (M = 46.09%) than 4-month-old infants (M = 30.47%). Also present was a Period main effect, F(2.87, 143.68) = 111.71, p < .001. Infants smiled for the greatest proportions of time in the dyadic play period where no toys were present (M = 62.35%), followed by the lion period (M = 44.26%), the worm period (M = 29.47%), and the rattle period (M = 15.96%). The main effects were qualified by a Period by Age interaction, F(2.87,143.68) = 12.71, p < .001 (see Appendix O; Figure 8). Simple effects analyses on the Period by Age interaction, holding the Period factor constant, revealed significant differences during play with the lion and worm. During the lion period, 7-month-olds smiled for a significantly larger proportion of the period (M = 60.81%) than the 4-month-olds (M = 28.82%) , F(1, 56) = 38.91, p < .001. Likewise, during the worm period, F(1, 56) = 13.51, p < .001, 7-month-olds smiled for longer durations (M = 39.54%), than the 4-month-olds (M = 20.08%). Also present was a Period by Order interaction, F(2.87,143.68) = 6.25, p < .001. Simple effects analyses holding the Period factor

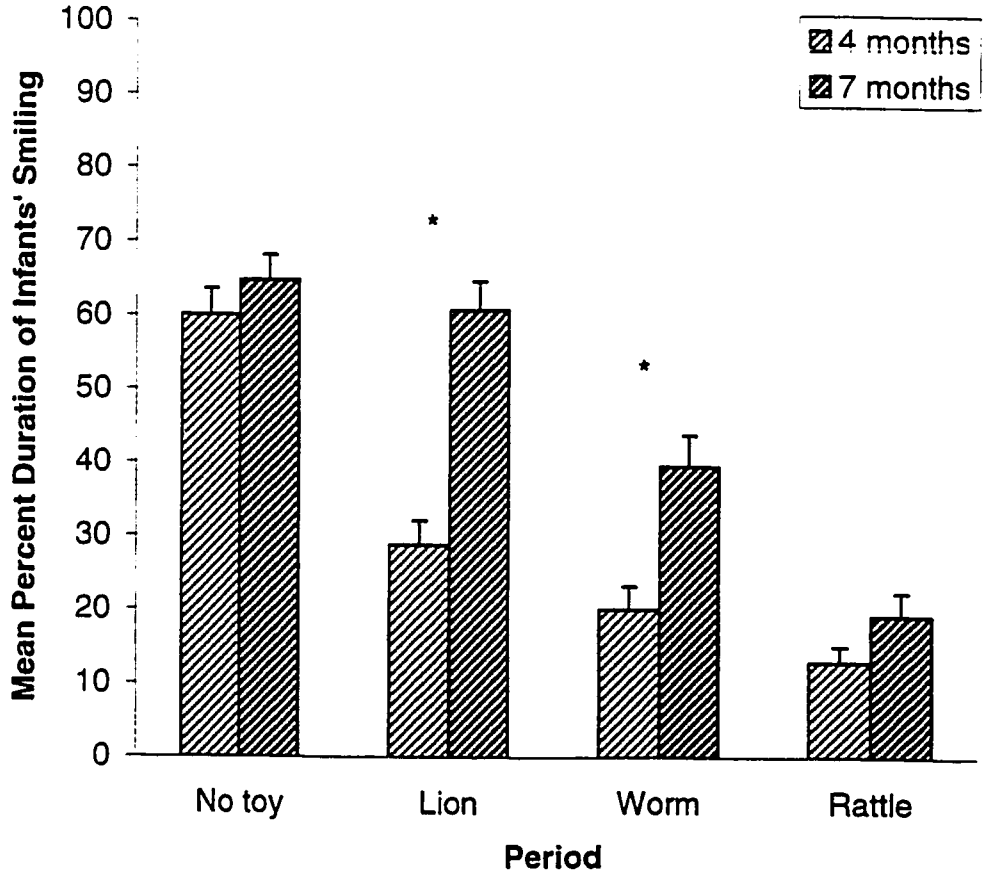


Figure 8. Mean percent duration of infants' smiling as a function of Age and Period. Standard errors are shown by vertical bars.

constant did not reveal any significant results, although the period of play with the lion was marginally significant $F(1, 56) = 3.99$, $p = .05$, with infants in Order 1 smiling for greater durations ($M = 50.70\%$) than infants in Order 2 ($M = 37.82\%$). Finally, there was an Order by Sex interaction, $F(1, 50) = 5.04$, $p < .05$. Simple effects analyses, holding the Order factor constant, did not reveal any significant differences by Sex.

Co-occurrence of infants' gaze at their mothers' faces and infant smiling. The ANOVA summary table and transformed means can be found in Appendix P. A square root transformation was conducted on the data because the descriptive statistics revealed moderate positive skewness and significant outliers. Results revealed a significant main effect for Age, $F(1,54) = 8.54$, $p < .01$. Seven-month-old infants gazed at their mothers' faces while smiling ($M = 26.07\%$) for greater proportions of time than the 4-month-olds ($M = 21.41\%$). There was also a main effect for Period, $F(2.52, 136.09) = 151.04$, $p < .001$, which indicated that infants gazed at their mothers' faces while smiling for the greatest proportions of time in the dyadic play period without toys ($M = 61.68\%$), followed by the lion period ($M = 15.33\%$), the worm period ($M = 11.55\%$), and the rattle period ($M = 6.16\%$). These main effects were qualified by an Age by Period interaction, $F(2.52,136.09) = 3.67$, $p < .05$ (Table P1; Figure 9). Simple effects analyses on the Age by Period interaction, holding Period constant, indicated a significant difference by Age during the lion and worm periods, $F(1,56) = 9.95$, $p < .01$; $F(1,56) = 7.31$, $p < .01$, respectively. No difference was observed during the play period without toys, or during the play period with the rattle. For both the lion and the worm periods, the 7-month-olds showed a significantly higher percentage of co-occurrence between gaze at face and

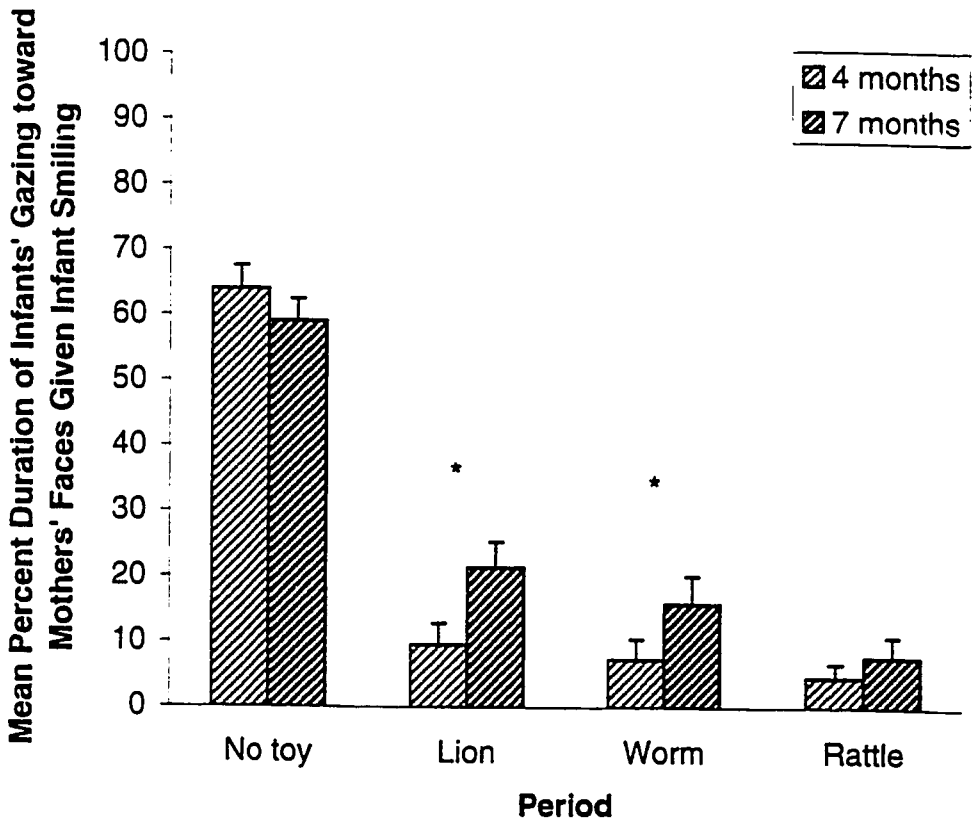


Figure 9. Mean percent duration of infants' gazing toward mothers' faces given infant smiling as a function of Age and Period. Standard errors are shown by vertical bars.

smiling than the 4- month-olds (M = 21.47% vs. M = 9.60% for lion; M = 15.88% vs. 7.35% for worm). Transformed means can be found in Table P2. In addition, there was amain effect for Order, $F(1,54) = 5.29$, $p < .05$. An examination of the means revealed that there was less co-occurrence of infant gaze at face and smiling in Order 1 where the toys were presented in the order of lion, worm, then rattle (M = 20.64%) than in Order 2 where the order of presentation was rattle, worm, followed by lion (M = 26.90%). Transformed means for co-occurrences by Order can be found in Table P3.

Co-occurrence of infants' nonverbal communicative behaviors with Social play. The findings from infants' gazing and smiling behaviors during triadic play revealed that 7-month-old infants gazed toward their mothers' faces and smiled more in the lion and worm periods. Results from the type of toy analysis indicated that it was during play with these two toys that the highest levels of Social play occurred at both 4 and 7 months. At the same time, a main effect for Social play was found, with more Social play occurring at 7 months (M = 27.10%) than at 4 months (M = 19.65%). While the difference in levels of Social play between dyads at 7 and 4 months was not large, it may be that the infant gazing and smiling results during triadic play, where 7-month-olds engaged in greater proportions of these behaviors during the lion and worm periods, reflect that there was more Social play at 7 months. Thus, the higher levels of gazing toward mothers' faces and smiling at 7 months may be indicative, in part, of a contextual difference in how the toys were used.

To explore this possibility, co-occurrences were calculated both for infant gazing toward their mothers' faces and infant smiling as they occurred during bouts of Social

play. Co-occurrences were calculated during the lion period, where the highest levels of Social play were found to occur. T-tests were conducted using Age as a grouping factor to compare the proportions of time that infants gazed toward their mothers' faces during Social play, and smiled during Social play at 4 and 7 months. Results revealed that the 7-month-olds gazed more toward their mothers' faces during Social play in the lion period ($\underline{M}$ = 16.70%) than the 4-month-olds ($\underline{M}$ = 6.14%; $\underline{t}(56) = -3.28$, $\underline{p} < .01$). Likewise, the 7-month-old infants smiled more during Social play in the lion period ($\underline{M}$ = 73.74%) than the 4-month-olds ($\underline{M}$ = 30.20%; $\underline{t}(56) = -8.26$, $\underline{p} < .001$).

Discussion

Results from Study 2a indicated that the content and structure of triadic play was modified with infant age within the face-to-face play context. In addition, infants' nonverbal communicative behaviors of gazing and smiling underwent developmental change, which was mediated by the type of toy included in play. In particular, the 7-month-old infants were found to gaze more toward their mothers' faces and display higher levels of smiling during play with the lion and the worm, the social and social/functional toys. In addition, co-occurrence measures revealed that at 7 months, infants gazed toward their mothers' faces while smiling during the lion and worm periods for greater proportions of time than the 4-month-old infants. Furthermore, infants smiled more during bouts of Social play at 7 months than at 4 months. Taken together, results from infants' nonverbal communicative behavior suggest that infants at 7 months were more socially responsive to the play as measured by gazing towards their mothers' faces and smiling. Results from Study 2a underscore the dynamic interaction between infants'

development and play context in determining both the type of play that unfolds, as well as the degree of infants' nonverbal communicative behaviors. The cross-sectional sample allowed for the comparison of different groups of infants at two different ages. Whenever cross-sectional samples are employed, it could be argued that age differences are simply an artifact due to some extraneous sampling factor. However, in Study 2a this was considered unlikely given that developmental changes were in the direction predicted based on the findings from the longitudinal sample from Study 1. Nonetheless, incorporating a longitudinal sample of infants into the same experimental procedure provided the opportunity to replicate and strengthen the results. This was achieved by having a number of infants who had participated at 4 months in Study 2a return at 7 months of age, thus creating the longitudinal subsample that resulted in Study 2b. Results for Study 2a will be discussed in full and integrated in a general discussion after the results of Study 2b are reported.

Study 2b

The importance of conducting longitudinal research is emphasized in systems theories of development where it is underscored that infants' development takes place embedded in their relationships with their caregivers. The inclusion of a longitudinal sample in the investigation of the development of triadic play is particularly important given variability in infants' achievement of milestones such as holding and reaching, as well as innate differences in attentional capacities that might influence infant gazing. Tracking developmental change within the same dyad provided a means to control for these variations, thus ensuring that change is due to development rather than to some extraneous sampling factor inherent in the cross-sectional sample. The objectives, experimental procedure, and dependent variables for this longitudinal subsample of Study 2 were the same as those for the cross-sectional sample, and will not be reiterated.

Participants

Of the 30 mothers and their 4-month-old infants who participated in Study 2, 22 were invited to return when their infants were 7-months-old. Of the 8 dyads that were not asked to return, one family was moving out of town, and the remaining seven infants turned 7-months-old during a time period where the experimenter was not available to test. Of the 22 mothers asked to return, 3 declined, resulting in a final sample of 19 full-term, healthy infants (mean age = 4 months, 9.21 days, sd = 5.18 days at 4 months; mean age = 7 months, 10 days, sd = 9.67 at 7 months). Ten of the 19 participants were female and 9 were male. The mean age of the mothers who participated in the longitudinal portion of Study 2 was 31 years (sd = 4.56 years). The majority of the participants in

Study 2b were Non-Hispanic White (89%). The remaining families were African American (5%) and Asian/Pacific Islander (5%). All dyads participated in the same order of presentation of toys as they had on their visit at 4 months. As a result, 11 dyads participated in Order 1, and 8 dyads participated in Order 2. All mothers spoke and understood English, and used English in speaking to their infants in the session. The majority of mothers were from intact two-parent families (95%), with one mother being a single mother (5%).

In terms of education, families who participated in the longitudinal portion of Study 2 were classified as 5% with no high-school education, 16% with high-school but without college education, 21% had some college education, and 58% had degrees from programs requiring 4 years of college or more. In terms of occupational status, the families were classified in the domains of Professional Specialty (37%), Service workers not in Private households (26%), Executive/Administrators/Managerial (16%), Sales (11%), Administration/Support/Clerical (5%; categories based on US Bureau of the Census, 1996). The remainder of the families were unemployed workers (5%).

Inter-rater reliability was assessed by blind observers for 21% of the records upon completion of the coding. Intraclass correlation coefficients conducted on the play category variables were all above $\underline{r} = .99$. Cohen's kappa coefficients conducted on the play category variables were also high, ranging from $\underline{r}_k = .81$ (Supported play) to $\underline{r}_k = 1.00$ (Developmental play and Mother onlooking). For the gaze variables, intraclass correlation coefficients were all above $\underline{r} = .99$ (i.e., gaze at mothers' faces, and gaze at toy). Cohen's kappa coefficients for the gaze variables were also high ($\underline{r}_k = .93$ for gaze

at face; r_k = 1.00 for gaze at toy). Finally, the intraclass correlation coefficient for smiling was r = .99. Cohen's kappa coefficient for smiling was r_k = .74.

Results

The approach to statistical analyses was identical to that conducted on the cross-sectional data for Study 2a except for the fact that age was now included as a within subjects variable rather than a between subjects variable. As for Study 2a, the results are reported in two sections. The first section contains the findings regarding play context. Results from the application of the Relational Play Category Coding Scheme as applied to this longitudinal sample are presented, as well as results pertaining to the effect of type of toy on the play categories that emerged. The second section contains the results from infants' nonverbal communicative behaviors of gazing, smiling and the co-occurrence between these two measures. In all instances, results replicated those of the cross-sectional sample in Study 2a. Where results did not reach significance, the means were obtained for comparison purposes, and were consistently in the same direction as the findings from Study 2a. Thus, results from Study 2b replicate and strengthen those from Study 2a. It is likely that the failure to find significance for some of the measures was due to the smaller sample size.

I. Play Context

ANOVA summary tables, Post-Hoc Comparisons, and mean tables for the triadic play categories can be found in Appendix Q.

Functional play. Results indicated a trend towards a difference in time spent in Functional play by age, $F(1, 18) = 3.33$, $p = .08$, with the mother-infant dyads at 4 months

engaging in more Functional play (M = 34.55%) than mother-infant dyads at 7 months (M = 30.05%). While the age difference was not significant as it was with the cross-sectional sample (Study 2a), the developmental change was in the same direction. In addition, the total proportion of time dyads spent in Functional play was found to differ by toy, $F(1.62, 29.17) = 52.67$, $p < .001$ (Table Q1). Tukey HSD comparisons revealed a significant difference in time spent in Functional play in the lion period (M = 10.20%) compared to both the worm (M = 36.67%) and rattle periods (M = 50.30%), as well as a significant difference between the worm and rattle periods (see Table Q2). Thus, results were consistent with the findings from the cross-sectional sample, that more Functional play occurs with the rattle than with the other two toys.

To further describe the nature of the Functional play, the means for the proportion of time spent in each subcategory of Functional play out of the total amount of Functional play for each infant were obtained. As in the cross-sectional sample, at both ages mother-infant dyads spent the least amount of time in Mother-facilitated functional play (M = 5.78%), followed by Infant onlooking (M = 41.04%), with the greatest proportion of time spent in Joint-action instrumental (M = 53.19%), where mothers demonstrated the function of the toys while their infants' hands were also on the toys.

Social play. As in Study 2a, mean percent durations of Social play varied based on the type of toy included in play, $F(1.73, 31.12) = 120.40$, $p < .001$ (Table Q3). Subsequent Tukey comparisons (Table Q4) revealed that significantly greater proportions of time were spent in Social play when dyads were playing with the lion (M = 46.97%) than with the worm (M = 23.30%) or the rattle (M = 3.53%). The time dyads spent in

Social play with the worm was also significantly greater than the time spent in Social play with the rattle. While there was no main effect for Age as found in the cross-sectional sample, the means were obtained for comparison purposes and were in the same direction. That is, dyads at 7 months spent more time in Social play (M = 26.28%) than dyads at 4 months (M = 22.92%).

Developmental play. Results for the Developmental play category were consistent with those from Study 2a. As with Study 2a, no formal analysis was conducted on the Developmental play category due to the large number of zero values, especially found at the 7 month visit. Rather, means were obtained for descriptive purposes. Developmental play was found to decrease with age from 26.18% at 4 months to 6.37% at 7 months. The mean proportion of time spent in the subcategories of Developmental play were also explored. Of the dyads at 4 months who engaged in Developmental play, the mean proportion of time spent in Independent Developmental play was 54.66%, in Mother-Facilitated developmental play was 31.61%, and 13.74% of the time was spent in visual tracking. At 7 months, of the dyads who engaged in Developmental play, the mean proportion of time spent in Independent developmental play was 71.88%, in Mother-facilitated developmental play was 18.18%, and 9.94% of the time was spent in visual tracking.

To further explore the content of Developmental play, the developmental task which was the focus of each developmental bout was examined. When infants were 4 months of age, three different behaviors were encouraged by their mothers. Eighty-four percent of the infants (n = 16) were encouraged to hold the toy, 42% of the infants were

encouraged to visually track the toy (n = 8), and 16% of the infants (n = 3) were encouraged to reach for the toy. Durations of time spent encouraging each of these behaviors was also calculated out of the total time spent in Developmental play across all infants. The greatest proportion of Developmental play was spent encouraging infant holding (M = 60.36%), followed by visual tracking (M = 27.84%), with the least amount of time spent encouraging infant reaching (M = 11.80%).

When dyads were 7 months of age, 42% of the infants (n = 8) were encouraged to hold the toy, 16% of the infants (n = 3) were encouraged to reach for the toy, and 11% of the infants were encouraged to visually track the toy (n = 2). The greatest proportion of Developmental play across all dyads was spent encouraging reaching (M = 49.67%), followed by holding (M = 40.87%), with the least amount of time spent encouraging visual tracking (M = 9.46%).

Supported play. Supported play was found to differ significantly by Toy, F(1.86, 33.40) = 7.63, p < .01 (see Table Q5). Subsequent Tukey HSD comparisons (Table Q6) revealed that there was a significant difference between proportion of time spent in Supported play between the worm and rattle periods. When dyads were playing with the rattle, more Supported play occurred (M = 10.85%), than when dyads were playing with the worm (M = 4.60%).

Mother onlooking. As apparent in the cross-sectional sample, no instances of Mother onlooking - gaze were recorded. Thus, results pertain to the Mother onlooking - physical subcategory only. Analyses revealed a main effect for Age, F(1, 18) = 10.25, p < .01, where mother-infant dyads at 7 months engaged in significantly more Mother

onlooking during toy play (M = 23.08%) than the dyads at 4 months (M = 15.13%). No other effects were found (Table Q7). In the cross-sectional sample of infants, there was also a marginal Toy by Sex interaction. While this interaction was not significant for the longitudinal data, the means were obtained for comparison purposes, and revealed a similar pattern of results.

Unengaged. The Unengaged category was designed to capture segments of the session where mother and infant were engaged simultaneously in different activities. As in Study 2a, percent durations of time where dyads were unengaged were negligible (M = 0.17% at 4 mos.; M = 0.13% at 7 mos.) and consequently no analyses were conducted.

II. Infants' Nonverbal Communicative Behaviors: Gazing and Smiling

Infants' gaze at mothers' faces. The ANOVA summary table and post-hoc comparisons for the infants' gaze at mothers' faces are located in Appendix R. ANOVA results revealed a Period main effect, $F(1.55, 27.87) = 169.82$, $p < .001$ (Table R1). Tukey HSD comparisons (Table R2) indicated that infants gazed for greater proportions of time at their mothers' faces in the face-to-face play period without toys (M = 50.67%), than in either of the lion (M = 10.93%), worm (M = 6.99%) or rattle periods (M = 5.49%). There was no significant Age by Period interaction for the longitudinal data, although an examination of the means revealed the same pattern of results as found for the cross-sectional data. At 7 months, infants gazed for longer durations at their mothers' faces during play with all three toys. More specifically, during play with the lion, the mean proportion of gaze at face was 14.08% at 7 months as compared to 7.78% at 4 months. Likewise, differences were also apparent for the worm and rattle periods (M = 10.42% at

7 months vs. 3.57% at 4 months for worm; M = 6.59% at 7 months vs. 4.39% at 4 months for rattle). For comparison and illustrative purposes, these means are plotted in Figure 1 of Appendix R, along with the accompanying figure for the Age by Period interaction found in Study 2a.

Infant gaze at toy. The ANOVA summary table and post-hoc comparisons for the infant gaze at toy measure are found in Appendix S. ANOVA results (Table S1) revealed a main effect for Order, $F(1,17) = 4.90$, $p < .05$, where infants in Order 1 gazed at the toys for longer durations ($M = 86.85\%$) than infants in Order 2 ($M = 81.00\%$). Also evident was an Age main effect, $F(1, 17) = 8.44$, $p < .01$, where the 4-month-olds looked at the toys for greater proportions of time ($M = 86.99\%$) than the 7-month-olds ($M = 79.94\%$). At the same time, the means indicate that there were high levels of gaze at toy for both the 4- and 7-month-olds. In addition, there was a Toy main effect, $F(1.46, 24.89) = 32.46$, $p < .001$. Tukey HSD comparisons (Table S2) revealed that infants gazed significantly longer at the rattle ($M = 89.40\%$) and the worm ($M = 86.33\%$) as compared to the lion ($M = 74.67\%$).

Infant Smiling. Consistent with Study 2a, ANOVA results revealed a main effect for Age, $F(1, 17) = 6.15$, $p < .05$, where 7-month-olds smiled for greater proportions of time ($M = 39.93\%$) than the 4-month-olds ($M = 31.92\%$). There was also a main effect for Period, $F(2.54, 43.22) = 113.44$, $p < .001$, where infants were found to smile for the longest durations during the dyadic play period without toys ($M = 62.42\%$), followed by the lion period ($M = 37.63\%$), the worm period ($M = 25.54\%$), with the least amount of smiling in the rattle period ($M = 18.11\%$). These main effects were qualified by an Age

by Period interaction, $F(2.13, 36.15) = 5.60$, $p < .01$ (Appendix T). Simple effects analyses on the Age by Period interaction (Figure 10) revealed that the source of significant differences were during the lion and rattle periods. During the lion period, the 7-month-olds smiled more ($M = 47.75\%$) than the 4-month-olds ($M = 27.50\%$), $F(1, 18) = 14.94$, $p < .01$. Likewise, during the rattle period, the 7-month-olds smiled more ($M = 21.55\%$) than the 4-month-olds ($M = 14.67\%$), $F(1, 18) = 5.01$, $p < .05$. ANOVA results further revealed a Period by Order interaction, $F(2.54, 43.22) = 7.64$, $p < .001$. Simple effects analyses holding the Period factor constant revealed that levels of Order differed significantly during the lion period, $F(1, 17) = 6.15$, $p < .05$. Infants smiled for longer total durations when the lion was the first toy to be presented (Order 1; $M = 47.42\%$) than when the lion was presented after the rattle and the worm (Order 2; $M = 30.51\%$). The Period by Order interaction is illustrated in Figure 11.

Co-occurrence of infants' gaze at their mothers' faces and infant smiling. ANOVA summary tables and post-hoc comparisons are found in Appendix U. Results of the ANOVA can be found in Table U1, and revealed a significant main effect for Age, $F(1,18) = 5.18$, $p < .05$, with infant smiling accompanied by gazing at mothers' faces occurring for greater proportions of the play period at 7 months ($M = 27.22\%$) than at 4 months ($M = 20.96\%$). In addition, there was a main effect for Period, $F(1.88, 33.80) = 89.30$, $p < .001$. Tukey HSD comparisons (Table U2) revealed that the significant difference in Period was present between the dyadic period where dyads engaged in face-to-face play without a toy as compared to each of the triadic play periods. Infants gazed for greater proportions of time at their mothers' faces in the face-to-face play period

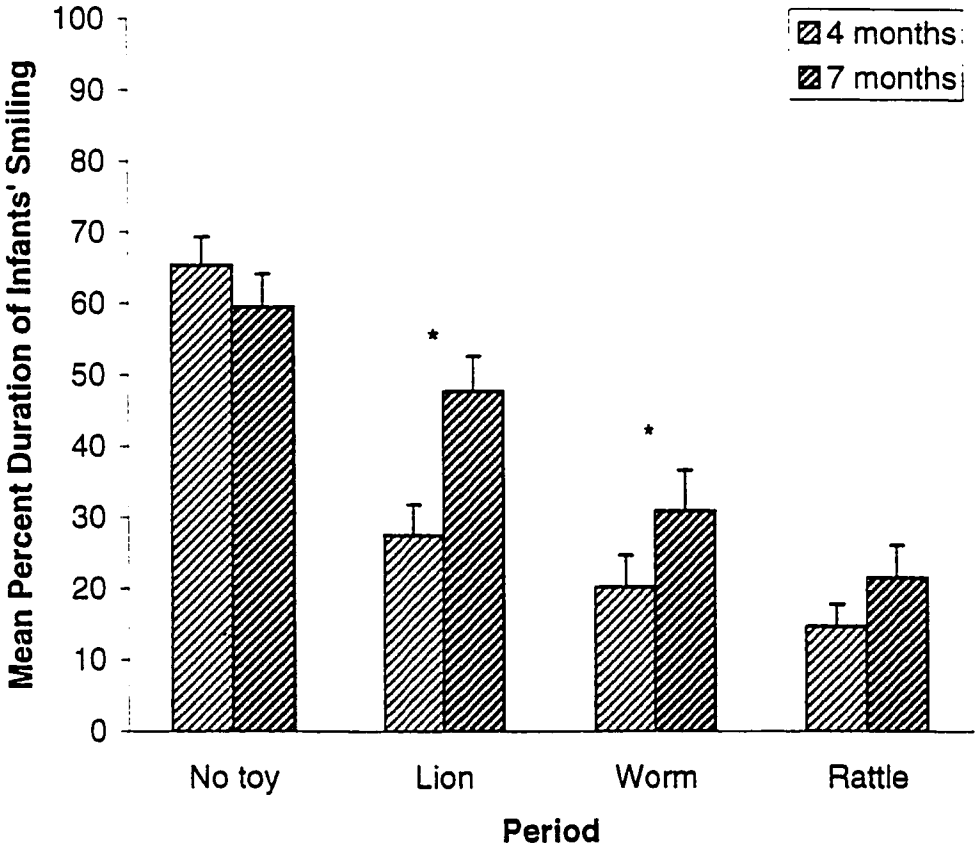


Figure 10. Mean percent duration of infants' smiling as a function of Age and Period. Standard errors are shown by vertical bars.

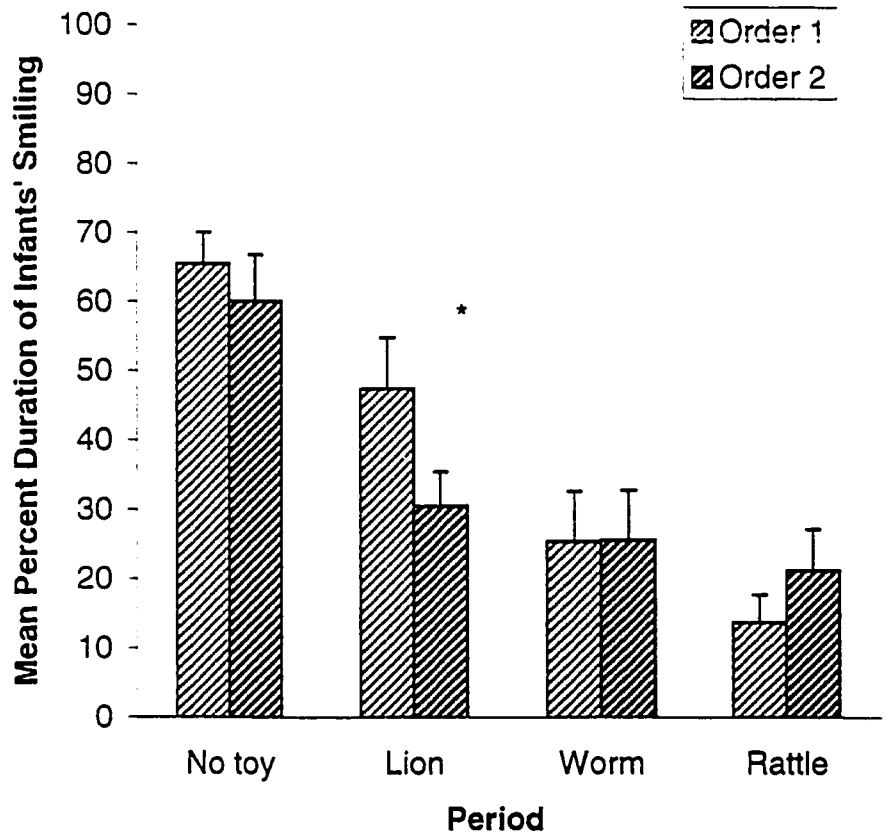


Figure 11. Mean percent duration of infants' smiling as a function of Order and Period. Standard errors are shown by vertical bars.

without toys (M = 62.34%), than in the lion (M = 15.22%), worm (M = 9.86%) or rattle periods (M = 9.04%). There was no Age by Period interaction as there had been for the cross-sectional sample. However, the means were obtained for comparison purposes, and in the same direction. Moreover, the magnitude of difference in the mean proportion of time of co-occurrences between the 7-month and 4-month-olds in the lion and worm periods were at least as much as those found in the cross-sectional sample. Seven-month-old infants showed a higher proportion of co-occurrence between gaze at face and smiling than the 4- month-olds (M = 19.62% vs. 10.63% for the lion; M = 13.80% vs. 5.92% for the worm; M = 14.28% vs. 3.80% for the rattle). For comparison and illustrative purposes, these means are plotted in Figure 1 of Appendix U, along with the accompanying figure for the Age by Period interaction found in Study 2a.

Discussion

Given the lack of studies examining triadic play in early infancy, Study 2 was designed to expand present knowledge concerning the emergence of triadic play. The Relational Play Category Coding Scheme developed in Study 1 was applied to dyads in Study 2 within the face-to-face play context, resulting in an examination of the play categories in a different play context. In addition to the application of the Relational Play Category Coding Scheme, the design of Study 2 enabled two unique issues to be explored. First, the investigation of play context was expanded from Study 1 by adding type of toy as a contextual variable to be examined. Second, the face-to-face play context of Study 2 enabled a systematic examination of infants' nonverbal communicative responses to play. More specifically, given that the dyadic and triadic play contexts are

the two primary play contexts within which infants learn about social interchange in the first year of life, infants' gazing and smiling behaviors were studied within these two contexts.

Three main objectives were addressed in Studies 2a and 2b, and results pertaining to each objective will be discussed in turn. The first objective was to examine developmental change in the content and organization of triadic play based on the application of the Relational Play Category Coding Scheme that was designed in Study 1. The development of the coding scheme afforded a window into the richness of the play contexts available for infants during triadic play bouts. Changes within these play categories were examined at the ages of 4 and 7 months in Study 2a, and tracked across developmental time within the same dyads at 4 and 7 months in Study 2b. The purpose of the present discussion is to integrate the findings from Studies 2a and 2b. The findings that reached statistical significance in the cross-sectional sample of Study 2a were not always significant in Study 2b, however, the means consistently fell in the predicted direction. The lack of significance may have been the result of the reduced sample size of the longitudinal sample.

In general, hypotheses regarding the direction of developmental change across play categories were supported. More specifically, Functional play was found to decrease with age in Study 2a, with a trend towards a significant age difference in Study 2b. Thus, mothers spent less time demonstrating the function of toys when infants were 7 as compared to 4 months. These results suggest that the decrease in Functional play found in Study 1 was not due simply to familiarity with the toys across the three visits that

resulted in a decline in mothers' demonstration of toys. Rather, it appears that the decrease in Functional play reflects a developmental change, given that the same pattern was found in a cross-sectional sample of infants.

It is likely that the decrease in mothers' demonstration of toys was due in part to infants' increasing abilities in holding and interacting with the toys. The fact that the encouragement of holding the toy during Developmental play decreased from 4 to 7 months suggests that infants were becoming more adept at this ability. In addition, developmental norms indicate that by 7 months, infants should have developed the ability to hold toys independently (Frankenburg et al., 1975). Findings are consistent with observations made by Fogel (1997) based on a longitudinal examination of infants ages 1 to 6 months. When infants could not manipulate objects independently, mothers tended to demonstrate the function of objects more than when infants had acquired the abilities to reach and manipulate objects. It follows that mothers of the 7-month-old infants in the present study would engage in less Functional play (i.e., demonstrations) given that the 7-month-olds had developed a greater facility in holding and exploring the toys than the 4-month-olds. At the same time, including a direct measure of infants' exploratory behaviors was beyond the scope of the present studies, and therefore infants' manual actions on the toys, other than touching/holding the toys, is not available from the present data. Nonetheless, previous research has documented that infants' exploratory actions become more discriminating within the first year of life, and this developmental progression would be expected within the present sample (Palmer, 1989).

Results correspond with the maternal scaffolding literature where mothers' involvement and intervention has been found to decline as infants' skills and involvement increase. For example, Bruner (1983) found that mothers' roles in scaffolding infant games changed with the skills of the infant. Likewise, Findji, Pêcheux, and Ruel (1993) found that 5-month-old infants required their mothers' support to focus and maintain their attention to objects, whereas the 8-month-olds were more autonomous. Thus, the amount of demonstration of the toys offered during Functional play is a relational phenomenon in that it is the result of the combination of infants' abilities and mothers' actions in play.

An unexpected interaction that emerged for Functional play was between Toy, Age and Order for Study 2a only. Age differences were evident in Functional play during the worm and rattle periods as a function of Order. When the worm period was preceded by the lion (Order 1), no age differences were apparent, whereas when the worm period was preceded by the rattle (Order 2), there was a significant difference with almost twice as much Functional play occurring at 4 months than at 7 months. Compared to the other toys, the rattle was used in the most Functional play. Perhaps beginning the play with the rattle primed mothers towards Functional play for the subsequent period. This effect may have been most pronounced at 4 months in light of the fact that higher levels of Functional play occurred at 4 months than 7 months in general. It is possible that when given the worm to include in their play, mothers of the 4-month-olds continued with demonstrating the multiple functions of the toy. Because the worm had both social and functional properties, mothers of the 7-month-olds may have engaged in higher levels of Social play given the result that more Social play was found to occur at 7 months in

general. An examination of the means for the worm period support this speculation, with more Social play and less Functional play occurring for the worm at 7 months compared to 4 months.

When the rattle was presented as the last toy (Order 1), more Functional play emerged for the 4-month-old infants and their mothers. This difference may not have been found in Order 2 because the rattle was the first toy presented, which could have contributed to mothers spending similar amounts of time demonstrating the toys in both cases. Notable however, is that the 4-month-olds did engage in more Functional play with every toy, even if not found to reach significance. Thus, the finding of an interaction with Order did not contradict the main hypothesis for Functional play, that there would be more Functional play in the 4-month-old as compared to the 7-month-old age group.

Results for the subcategories of Functional play revealed that across both the cross-sectional and longitudinal samples (Studies 2a and 2b), Mother-facilitated action was the least used method of Functional play, indicating that mothers did not often use physical intervention (e.g., hand-over-hand) to aid in their infants' discovering of the toys. The primary means of discovering a toy occurred when mothers demonstrated the function of the toy while infants' hands were also on the toy (Joint-action instrumental). Thus, the context of play was such that infants could observe mothers demonstrate the function of toys, while also jointly involved with the toys through physical contact.

All hypotheses for Developmental play were supported. There was a decrease in Developmental play from 4 to 7 months in both the cross-sectional and longitudinal samples of infants. In addition, of the Developmental play that did occur, mothers

fostered their infants' independence and adjusted their actions to their infants' capabilities by offering less physical assistance in completing developmental tasks with age. Encouragement of holding the toy decreased with age and encouragement of reaching for the toy increased with age. Few dyads engaged in Developmental play at 7 months. In light of the fact that in Study 1, over 90% of the time in Developmental play at 7 months was spent encouraging crawling, the lack of Developmental play at 7 months in Studies 2a and 2b was likely because crawling could not be encouraged given that infants were seated in an infant seat.

Some differences emerged in the content of Developmental play at 7 months between the cross-sectional and longitudinal samples of Study 2. However, it is important to note that these calculations were based on the very few infants that engaged in Developmental play at 7 months. Seven-month-old infants in both Studies 2a and 2b were encouraged to hold and reach for toys. In the cross-sectional sample, encouragement of giving the toy was also evident. In both studies, visual tracking was evident at 4 months but decreased significantly by 7 months. No visual tracking was evident at 7 months in the cross-sectional sample, however, minimal durations of visual tracking were evident in the longitudinal sample at 7 months.

Taken together, results from the Developmental play category testify to the dynamic interplay between infants' developmental capabilities and mothers' use of the toys. Mothers in the present studies were attuned to the developmental changes in their infants and altered their behavior accordingly. Given that mothers were the more competent play partners, they created experiences in the play through their

encouragement of different developmental behaviors that complemented their infants' abilities. Results are consistent with previous research on maternal scaffolding, which underscores the importance of the social context for learning (Hodapp et al., 1984).

While the present data do not indicate the success of the Developmental play behaviors encouraged (i.e., whether they were accomplished), there was a decline in mothers' encouragement of some behaviors and an increase in others. This shift over developmental time suggests that infants reached a level of competence that provided the impetus for mothers to encourage the development of different and more advanced behaviors. For example, reaching for the toy is more developmentally advanced than holding the toy, and occurred more frequently at 7 months.

The hypothesis that Supported play would decrease from 4 to 7 months in Studies 2a and 2b was partially upheld. Overall, type of toy included in play was found to have an effect, with more Supported play occurring for the rattle than the worm. However, the effect of type of toy was qualified by an interaction with Age which revealed that less Supported play occurred at 7 months for the lion period only. It is possible that this age difference was specific to play with the lion because the lion was light and compact without any specific functional features to discover, and thus easily held by the infants at 7 months. In contrast, the worm was long and had multiple components to explore (e.g., crinkly feet, Velcro fasten, etc.). This may have made it more likely for mothers to hold up the toy and support it while giving their infants the opportunity to touch the different parts of the toy. The rattle was the heaviest toy with multiple components, and thus support was offered at both 4 and 7 months during play with this toy. Although not

significant in Study 2b, the means for age revealed that Supported play occurred for less time at 7 months. As a whole, results suggest that Supported play is not just a function of the infants' ability, but is also tied to the bulkiness, weight and shape of the toy.

In Study 2a only, there was more Supported play in Order 1 when triadic play commenced with the lion followed by the worm and the rattle than in Order 2, where play commenced with the rattle followed by the worm and the lion. The Order effect likely does not represent any fundamental difference fostered by the different orders. While significant, the differences in the mean proportion of time devoted to Supported play were negligible, and considered to be a spurious finding.

There was an unexpected main effect for Sex in Study 2a, indicating that overall, Supported play occurred more frequently for the mother-daughter than mother-son dyads. Furthermore, a trend towards an interaction between Sex, Age, and Toy revealed that mothers of female infants at 7 months supported the rattle for their daughters to explore almost four times as long as mothers of male infants. No difference as a function of gender was found in Study 2b, however, an examination of the means revealed that they were in the same direction as found in Study 2a. Potential interpretations for this gender difference will be offered in a section pertaining specifically to sex effects following the discussion of the results from the other play categories.

In contrast to the play categories that contributed to a larger proportion of play at 4 months, percent durations of Social play were greater at 7 than at 4 months. The hypothesis that Social play would increase from 4 to 7 months was supported by Study 2a. Likewise, while the difference was not significant in the longitudinal sample, the

means fell in the predicted direction. Previous literature indicates that an increase in infant smiling can be expected with development, as can an increase in infants' own initiations during face-to-face play (e.g., Fogel et al., 1997a; Kaye & Fogel, 1980). The increase in smiling is due in part to maturational changes, but is also likely influenced by the social contingencies within infants' environments (Malatesta & Haviland, 1982). Infant smiles promote caregivers' ongoing engagement in interaction. Seven-month-old infants would have had a longer history of learning the contingency between their emotional responsiveness and their caregivers' behaviors. In addition, previous studies have shown that by 6 months, infants respond with enthusiasm and excitement to games during play, and become more active social participants (Gustafson et al., 1979; Kaye & Fogel, 1980; Rome-Flanders et al., 1995). Thus, infants' higher levels of involvement in the play may have contributed to the longer durations of Social play at 7 months.

As predicted, the proportion of time dyads engaged in Mother onlooking increased with age. In Study 2a, the predicted age differences were masked by a trend toward a three-way interaction between Age, Sex and Toy. At 7 months, Mother onlooking during the worm and rattle periods occurred more than twice as much in the mother-son dyads than the mother-daughter dyads. Thus, 7-month-old males were allowed more independence to play with the toys that had functional components than the females. In the longitudinal sample, an age effect emerged with more Mother onlooking occurring in dyads' 7-month-old visits compared to their 4-month-old visits. There was no main effect or interaction with sex at 7 months in the longitudinal sample, however, the means were in a consistent direction with those from the cross-sectional sample.

The developmental change in Mother onlooking can be attributed, in part, to the developing motor capabilities of the infant, resulting in more mature skills at holding and manipulating the toys (Palmer, 1989). Thus, the older infants were given more opportunities to interact with the toys independently while their mothers observed. In addition, complementing the findings from the Functional play category where mothers' demonstrations of toys decreased with age, it is probable that the increase in Mother onlooking is representative of mothers' modifying their support to offer more autonomy to their infants in tandem with their developing abilities (e.g., Bruner, 1983; Findji, 1993).

Gender was a mediating variable for the Mother onlooking and Supported play categories for Study 2a only. More Supported play occurred for female than male infants, and a trend toward more Mother onlooking for mother-son as compared to mother-daughter dyads was apparent, specifically with the functional toys. While not significant, the means were in the same direction for these play categories in the longitudinal sample. Gender effects need to be interpreted with caution and replicated in another sample before any firm conclusions can be drawn. There are presently no play studies with infants at similar ages that could confirm or disconfirm the present findings. An examination of gender differences in type of object play within early infancy has not been addressed in the majority of studies examining infants at this age. For instance, most studies examining maternal scaffolding and communication in mother-infant play have not included gender as a variable (e.g., Findji, 1993; Fogel, et al., 1997b; Hodapp et al., 1984; Pêcheux et al., 1992). Of studies that have included gender as a variable (excluding those

pertaining to sex stereotyped toys), significant gender differences have not emerged (e.g., Bakeman & Adamson, 1984; Ross & Lollis, 1987).

There are some previous studies involving samples of older children that have found gender differences in relation to play and everyday activities. For instance, mothers of elementary school boys were found to combine control in their helping, monitoring, decision making, and praising of their children with encouragement of autonomy more than mothers of girls, who tended to use control alone (Pomerantz & Ruble, 1998). Likewise, parents have been found to encourage less autonomy with daughters than with sons during problem-solving tasks (Block, 1983). Given the vastly different ages, results from these studies are tangential to the present work, yet they do lead to the intriguing question of when these gender differences begin. It is conceivable that parents' differential treatment of males and females begins even within the first year of life. For example, when adults were introduced to infants who were labelled as male or female (regardless of their true gender) differences in treatment emerged. Infants labelled as boys were seen as more active, were encouraged and rewarded for physical activity, and were more likely to be offered masculine toys such as cars and trains. Infants labelled as girls were given more interpersonal and social stimulation, more nurturing behavior, and offered more feminine toys such as dolls (Bell & Carver, 1980; Condry & Condry, 1976). Thus, it is possible that the gender differences that emerged in the present set of studies do signify real and meaningful differences. However, any interpretations of these sex differences are tentative and subject to modification, pending adequate replication when addressed in future studies.

The second objective, unique to Study 2, was to examine how type of toy included in play would affect the content of the play. A clear pattern of results emerged, and all hypotheses were supported. The hypotheses centred around the two main categories of toys, social and functional, that are included in play within the age ranges of the infants who participated in the studies. The type of toy included in play significantly affected the type of play that emerged, a finding that was consistent across both Studies 2a and 2b. Social play occurred for the longest duration with the social toy (lion), followed by the social/functional toy (worm), with the least amount occurring with the functional toy (rattle). The opposite pattern was found for Functional play, with the largest proportion of Functional play occurring with the functional toy (rattle).

While results for the effect of type of toy might appear intuitive, these findings underscore that the availability of both functional and social toys will facilitate infants' exposure to a diversity of play with their caregivers. Given the differing content of Social and Functional play, it follows that uses of social and functional toys promote different learning contexts for infants. Functional play is undertaken with the goal of discovering the toy, thus facilitating infants' knowledge of the nonsocial world. In Social play, the toy was a mediator in the affective interchange between mother and infant and often incorporated into anticipatory games such as "I'm gonna get you!" Thus, the findings addressing Objective 2 highlight the importance of the social context in cognitive development, given that different play contexts afford different learning opportunities in early infancy.

Mapping out changes in play categories based on type of toy was essential to the third and final objective of the present research. Objective 3 was to examine the communicative function of infant gazing and smiling which cannot be assessed apart from an understanding of the context within which they are embedded. Infants' patterns of gazing and smiling were addressed exclusively in Studies 2a and 2b. Given that dyadic play decreased and triadic play increased throughout the first year of life, an examination of how infants' communicative behaviors might vary across these two contexts of play was warranted.

Results from Studies 2a and 2b indicated that the context of play significantly affected infants' gazing and smiling behaviors. During the dyadic play period, infants gazed at their mothers' faces for more than half of the period, a finding that did not differ based on infant age. High levels of infant gazing toward mothers' faces is consistent with previous studies of dyadic play within the face-to-face play context (e.g., Fogel et al., 1992; Stack & Arnold, 1998; Stack & Colburne, 1996, van Beek et al., 1994). In contrast, during triadic play, infants' gazing toward mothers' faces was significantly reduced, with the toy drawing most of infants' attention. These findings corroborate previous research indicating that infants' gazing toward mothers' faces occurs at lower levels when toys are added into play (McCollum & Stayton, 1998; Stack & Colburne, 1996). Nonetheless, age differences in infants' gazing toward mothers' faces emerged, with the type of toy mediating levels of infant gaze.

During play with the social and social/functional toys (lion and worm), the 7-month-olds gazed at their mothers' faces for longer durations than the 4-month-olds. In

contrast, the 4-month-olds displayed similar levels of gazing at their mothers' faces regardless of the toy used. Findings from the longitudinal sample were in the same direction and thus complemented those from the cross-sectional sample. Interestingly, it is with the lion and the worm that the highest levels of Social play occurred. In contrast, when the rattle, which was found to elicit the highest levels of Functional play, was used, infants were more intently focused on the toy and no age differences in gazing at mothers' faces emerged. It appears that the 7-month-olds were more responsive to the Social play than their younger counterparts as indicated by gazing at their mothers' faces for longer durations during the lion and worm periods.

It is highly probable that infants' gazes at their mothers' faces were reciprocated, as previous research has indicated that when infants' gaze at their mothers during play, mothers are likely to be looking at them (Fogel et al., 1997a; Messer & Vietze, 1984). As a result, the social toy likely promoted a context where bouts of mutual gaze occurred. Observations of the types of games played with the lion and worm, such as looming games and peek-a-boo, indicate that during these play bouts mothers' goals were likely to engage in positive interchange with their infants. Thus, it is probable that infants' positive responses to the play contributed to continued use of the toy in a social manner, which occurred for longer durations at 7 months given infants' responsiveness to the play.

Results from infant smiling support the notion that 7-month-olds displayed a higher degree of social responsiveness based on their nonverbal communicative signals. As with the infant gaze at face measure, amount of infant smiling in the dyadic play period did not differ by age in both the cross-sectional and longitudinal samples. It was

when the toy was added to the interaction that age differences emerged, which were mediated by the type of toy included in play. In particular, play with the lion resulted in significantly more smiling at 7 than at 4 months. In Study 2a, a significant difference was also found for the worm period, with more smiling at 7 than at 4 months. Differences in the same direction were also evident in the worm period for the longitudinal sample, although not significant. Rather, significant differences emerged during the rattle period for Study 2b, which were also apparent but not significant in the cross-sectional sample.

The results from infant smiling in the present study extend previous research by underscoring that emotional expressions need to be understood from within the social context in which they are embedded. For example, past studies have indicated that infants display more positive emotion during toy play with their caregivers than during independent toy play (Garner & Landry, 1992). Differences have also been noted with play partner. More smiling is found when infants play with their mothers versus same-age peers (Adamson & Bakeman, 1985). Moreover, distinct types of smiles have been identified as occurring with particular types of play (Dickson et al., 1997). The present findings further indicate that the context of play, in terms of *how* the toy is being incorporated into the mother-infant interaction, is a determinant of infants' positive affect which varies with infant age. During the periods where greater proportions of Social play occurred, 7-month-olds engaged in higher levels of communicative behavior as indicated by smiling and gazing at their mothers' faces. As with infant gazing toward mothers' faces, 4-month-old infants showed little differentiation in their levels of smiling across the three different toys.

Also evident in Study 2b was an Order by Toy interaction, which was a marginal effect in Study 2a. Infants who were in Order 1, where the lion was presented first, smiled for longer durations than when the lion was presented last (Order 2). This difference in smiling may suggest a slight fatigue effect which emerged for the lion period only because at both ages, infant smiling was consistently the highest in the lion period. Nonetheless, levels of infant smiling may have been somewhat attenuated when the lion was presented as the last toy. An order effect may not have been found for the rattle period because levels of smiling were the lowest in this period compared to the other toys regardless of whether the rattle was presented first or last.

The communicative system is multimodal and dynamic, necessitating that different communicative behaviors be examined as they occur together (Fogel & Thelen, 1987). Thus, in addition to examining infant gazing and smiling as they occur individually, the co-occurrence measure in the present set of studies assessed the proportion of time that infants' smiling was accompanied by infants' gazing toward their mothers' faces. During the dyadic play period in both the cross-sectional and longitudinal samples, 4- and 7-month-old infants engaged in similar amounts of gazing toward mothers' faces while smiling, with differences emerging only when a toy was added into the interaction. That is, it was during the triadic play bouts that infants' patterns of communicative behaviors differed with age. In Study 2a, significant differences emerged for the lion and worm periods, where the longest durations of Social play were found to occur. Findings in the longitudinal sample did not reach significance but showed a similar magnitude of difference between the two age groups. There is no readily

available explanation to account for the main effect of Order that emerged for the co-occurrence measure in Study 2a, and the difference in mean co-occurrences between the two orders was small in magnitude. Infants in Order 1 where the toys were presented in the order of lion, worm, then rattle, had higher levels of gazing toward mothers' faces while smiling than infants in Order 2 where the toys were presented in the reverse order.

Results from the co-occurrence of infant smiling and gazing toward mothers' faces suggest that the 7-month-old infants were more socially responsive to the toy play than 4-month-old infants. That the older infants directed more of their smiles towards their mothers' faces reveals that there was more engagement and acknowledgment of their mothers' presence during triadic play as compared to the younger infants. It has been suggested that the shift from dyadic affective interactions to triadic interactions may involve a continuous process whereby attention regulation and affective exchange are elaborated to include reference to objects during play (Kasari, Sigman, Mundy, & Yirmiya, 1990). The present results provide a picture at two different points in this process. The 4-month-olds were mainly focused on the toys during triadic play without many socially-directed smiles whereas by 7 months, infants displayed a better ability to regulate their attention and exchange affect with their mothers given contexts rich with Social play.

Taken together, results from infants' nonverbal communicative behaviors demonstrated the effect of play context on infants' gazing and smiling behaviors. During face-to-face play where no toy was included, there was no difference between proportions of time that infants gazed toward their mothers' faces or smiled. In addition, during play

with the rattle where the highest proportions of Functional play took place, such as demonstrating the parts of the toy, age differences were not significant. This raises the question as to why age differences emerged during the lion and worm play periods as compared to the other periods. Alternative explanations are possible other than that infants at 7 months were more socially competent with better developed abilities to integrate their social and nonsocial worlds.

The content of the play may change between 4 and 7 months, and thus elicit higher levels of communicative behaviors. Dyads at 7 months did engage in significantly more Social play than they did at 4 months, although the difference between the two ages is not large in magnitude. That the higher levels of Social play fully account for the age difference in infants' gazing and smiling is unlikely. When co-occurrences were calculated between infants' gazing and smiling as they occurred during bouts of Social play, more gazing towards mothers' faces and smiling was still found to occur at 7 months. These results suggest that the difference in infants' nonverbal communicative behaviors is not merely a function of context. This issue could be further addressed by attempting to control, at least in part, for the differences in how mothers may engage with their infants at 4 and 7 months. As an alternative to the instructions for free play given in the present studies, where mothers were given no directives other than to include the toy in their play, mothers could be instructed to engage in Social play, or to engage in a particular social game such as a looming game. Gazing toward mothers' faces and smiling could then be systematically assessed at 4 and 7 months across the Social play context. Further, to control to a greater extent the level of stimulation and type of play

that the infants receive at both ages, an experiment could be conducted where the examiner engages in a standardized game with the infant (e.g., Eckerman, Hsu, Molitor, Leung, & Goldstein, 1999). Studies such as these would help to disentangle the differences in infants' communicative behaviors and engagement in play between 4 and 7 months apart from differences in play context.

However, while useful, such experimental studies where maternal behavior is manipulated have their own limitations, given that the play engaged in may not represent that which is typical for a given mother-infant dyad. For instance, if instructed to engage in a looming game, mothers may continue with the looming game even if their infants have lost interest in the game. Further, mothers might be instructed to engage in a game that is not normally a part of their play repertoire, and therefore not representative of a play interaction at that stage in their relationship. It would be challenging to create a context whereby infants at 4 and 7 months would receive a similar but natural play experience, against which to compare infants' communicative behaviors. Even with the standardized instructions to engage in Social play, each dyad is unique and it is difficult to experimentally control the content of the play.

Nonetheless, it remains possible that the content of the Social play differed between the two age groups, and was a significant contributing factor to the differences in communicative behaviors as a function of infant age. For instance, perhaps at 7 months mothers used more maternal vocalizations and upper body movements than mothers of 4-month-olds, which may have in turn attracted the attention of their infants towards their faces. The higher levels of gazing toward mothers' faces at 7 months could reflect these

differences in maternal behavior rather than an inherent difference in infants' social abilities or a developmental shift in their ability to engage in triadic play. Although beyond the scope of the present thesis, it would be possible to code the Social play bouts occurring in a given play period for more detailed aspects of the content of the Social play in order to further ascertain what differences may be apparent between the two age groups. In order to obtain a comprehensive picture, more studies are warranted, and directions for future research will be further elaborated upon in the general discussion contained in chapter 4.

However, as underscored by the systems approach to development, the behavior of the parent will be effected by the social abilities of the infant and vice versa (Fogel, 1997). Given the bidirectionality of the mother-infant interaction and their co-construction of the play interaction across time, separating out the relative contributions of the mother and infant is in itself an impossible task. Infants' nonverbal communicative behaviors as they occur embedded within the ongoing play are the product of a complex interactive process that is not simply the sum of each partner's individual contribution. It makes intuitive sense that the content of Social play would have changed somewhat between 4 and 7 months given the developing relationship of the mother and infant, greater experience in toy play, and increased motor and cognitive abilities of the infant at 7 months. Thus, the different components of the process are inextricably linked. As a result, the higher levels of infants' gazing and smiling found in the lion and worm periods of Study 2 cannot be considered solely a difference in maternal behaviors or in infant maturation. Rather, it is probable that a combination of the different explanations

accounted for the differences in nonverbal communication. The weight of the evidence does indicate that there are changes in infants' social competence between 4 and 7 months that were likely demonstrated during the lion and worm periods. With higher levels of smiling evident with infant age, greater initiations in social games, and more experience with toys at 7 months, the older infants in the present studies appeared to be more active participants in the Social play as evidenced by their nonverbal communicative behaviors (Gustafson et al., 1979; Kaye & Fogel, 1980; Messinger et al., 1999; Rome-Flanders et al., 1995).

The fact that different triadic play contexts promoted different infant communicative behaviors is particularly important during the transitional phase from dyadic to triadic play. Dyadic play bouts are contexts that offer the opportunity for positive affective interchange, whereas infant smiling has been found to decrease during triadic play interchanges (Stack & Colburne, 1996). The present studies indicate that this is particular to play context, and that it is possible that triadic play can also afford opportunities for high levels of positive affect, especially for the older infants. For example, in Study 2a, levels of infant smiling during dyadic play at 7 months were almost equivalent to smiling during triadic play with the social toy, lasting for almost two thirds of the play session in each period. Given that the display of positive affect has been one factor associated with secure attachment relationships with caregivers, it is important to ascertain the triadic play contexts which promote such interchange (Masten & Coatsworth, 1998).

As a whole, results from Studies 2a and 2b suggest that the content of play bouts are modified as infants develop, based on the proportions of time that dyads engage in different categories of play. Results reflect the diverse play environments available for infants during triadic play between 4 and 7 months. Further, the change in proportions of time devoted to different play categories with age reflects the interplay between mothers' facilitation of toy play and infants' developing abilities. In the present studies, mothers provided less demonstrations of the function of toys, provided less physical assistance when encouraging infants to engage in Developmental play, and provided more opportunities for infants to explore toys independently as age increased. Mothers' attunement and sensitivity to infants' changing abilities were apparent in the different types of Developmental play that were encouraged with age. Results from infants' communicative behaviors converge to suggest the powerful influence of play context on infants' communicative development. Seven-month-old infants, whose interests were turning more and more to their nonsocial surroundings, appeared to have a better developed ability to acknowledge their caregiver in bouts of triadic play with a social focus. This ability is particularly important during the transitional phase from dyadic to triadic play because the inclusion of objects in play marks the beginning of new communicative possibilities that were not available during dyadic play.

CHAPTER 4: General Discussion

Identifying different play contexts in infancy is essential to understanding the process by which infants develop into increasingly competent social beings. Infants' first play experiences take place in a dyadic play context which gradually shifts to a predominantly triadic play context as they turn their attention toward their nonsocial surroundings. With the addition of objects to the play interaction, new communicative opportunities are possible. While infants' explicit communicative gestures such as pointing, which emerge at the end of the first year of life, mark a significant developmental milestone, their experience with objects prior to this time undoubtedly plays a role in the forms of communication that eventually develop. Yet, surprisingly, few studies have examined this transition from dyadic to triadic play in infants between the ages of 4 and 7 months.

The present set of studies was developed with two general objectives in mind. First, in order to enrich and extend the present knowledge on the emergence of triadic play, the delineation of play contexts prevalent when infants were between the ages of 4 and 7 months was undertaken. Given that parent-infant play is an integral component of infants' cognitive, socioemotional, and motor development, delineating the different contexts of play to which infants are exposed was warranted (Beeghly, 1993; Tamis-LeMonda & Bornstein, 1993). Previous studies examining toy play in the middle of the first year of life have used general categories such as whether the infant is engaged with an object or a person, without providing a description of the actual content of the toy play (e.g., Bakeman & Adamson, 1984). The development of the Relational Play Category

Coding Scheme in Study 1 afforded an opportunity to describe and observe the richness of infants' early play environments between 4 and 7 months. Study 2 was designed to further examine play context, by including type of toy as a potential variable that influenced the type of play that unfolded. The second general objective was to examine infants' nonverbal communicative behaviors, namely, patterns of gazing and smiling within the different play contexts created by the use of different toys. This objective was achieved in Study 2 within a face-to-face play context.

Taken together, the results from the present set of studies indicated that: (a) there are developmental changes in the content of mother-infant play between the ages of 4 and 7 months; (b) the type of toy is an important contextual variable to consider as different types of toys promote different play contexts; (c) the play context has a powerful influence on infants' nonverbal communicative behaviors; and (d) 7-month-old infants show signs of a developing ability to integrate their social and nonsocial environments given certain triadic play contexts. The findings will first be discussed, followed by a section on applied implications of the findings from Studies 1 and 2. Finally, directions for future research into the nature of triadic play in the middle of the first year of life will be presented.

Triadic Play Context

The Relational Play Category Coding Scheme developed in Study 1 revealed that there were five main categories of triadic play which accounted for over eighty percent of the play occurring between 4 and 7 months. These categories were: Functional play, Social play, Developmental play, Supported play, and Mother onlooking. The

development of the coding scheme enabled a description of how mother-infant play is organized when toys are included in play, and revealed the rich diversity of play to which infants are exposed. Mothers in both Studies 1 and 2 were given no specific instructions regarding how to include toys in play. Yet, play varied from mothers demonstrating the functions of the toys, to encouraging developmental behaviors such as holding and reaching, to watching their infants explore toys independently. Thus, the complexity and diversity of mother-infant interactions around toys is apparent. The fact that the organization of the play shifted between 4 and 7 months underscores that triadic play is a relational phenomenon. The developmental changes in the triadic play category cannot be accounted for solely by mothers' interventions, nor exclusively due to infants' own active roles in the play. Rather, it appears that mothers in the present studies modified the structure of the play in relation to their infants' own developing competencies which contributed to changes in the organization of play across time.

The present results underscore the potency of the social context for learning opportunities in early infancy. Indeed, it is likely that many of infants' first developmental behaviors occur within the context of play with their caregivers, and this is consistent with assertions that learning occurs most effectively in a playful manner (Papoušek, Papoušek & Harris, 1987). Likewise, results correspond with the contention that caregivers provide contexts that facilitate learning which shift over time from the adult playing the lead role, to the infant taking on a greater role with development, thereby establishing a bridge between infants' social and cognitive worlds (Hodapp et al., 1984; Vygotsky, 1978). As a whole, results from Studies 1 and 2 converge to suggest

that infants are becoming more autonomous in toy play as they develop. Complementing this finding was the fact that mothers spent less time demonstrating the functions of toys as infants' age increased. In addition, bouts of play where mothers physically supported the toys for their infants generally decreased with age. Findings from the subcategories of Developmental play also revealed encouragement of autonomy with infant age. Mothers often facilitated Developmental play at 4 months by physically intervening but most often allowed their infants to attempt Developmental play on their own at 7 months. At the same time, at all three ages studied (4, 5 ½ and 7 months) mothers' presence played a key role in the organization of the play that unfolded. In fact, even with the greater autonomy that was evident, mothers were still playing an active and direct role in encouraging and facilitating the diversity of play that was observed. For example, at 7 months in the free play context of Study 1, mothers were directly involved in the play through their engagement in Functional, Social, Supported, and Developmental play for over one third of the play period.

It appears that as infants are first gaining experience with toys, mothers serve as mediators in facilitating infants' interactions. At the same time, mothers are sensitive to infants' developmental abilities and alter their behaviors accordingly. With the onset of visually guided reaching, infants become better able to attain objects of interest in their environments without the aid of their mothers (Fogel et al., 1992). With experience, infants' actions become progressively more tailored to objects (Palmer, 1989; Rochat, 1989). These developmental changes may have resulted in mothers providing longer opportunities for infants to interact with the toys directly with increasing age.

The decline in Developmental play with age found in the present studies should not be considered to imply that Developmental play decreases indefinitely after 4 months of age. Rather, given the dynamic nature of infant development which is changing over time, it is likely that in the wake of new developmental milestones, there is an ebb and flow of mothers' encouragement of Developmental play. Around 4 months of age when infants are first exposed to toys, there are a vast number of developmental behaviors to be attained such as holding and reaching for a toy. Infants' developing competencies result in a decline of mothers' encouragement of some behaviors, accompanied by an increase in others (e.g., crawling). Infants in Study 1 were too young to walk, yet some mothers did encourage their infants to move one foot in front of the other while they supported their bodies. Thus, there is likely to be a resurgence of Developmental play around the time when infants' are showing a readiness to develop a new developmental milestone. For example, mothers might encourage their infants to walk towards toys or objects out of reach, much like when they encouraged crawling in Study 1. In fact, given that infants' first steps are such a significant developmental milestone, it is likely that parents spend a great deal of time encouraging this behavior within playful interchanges.

A strength of the present set of studies is that the Relational Play Category Coding Scheme was applied across two different play contexts, that of floor play and face-to-face mother-infant play. That the findings from the triadic play categories remained largely consistent, despite the change in play context and toys used between the two studies, indicates that the present findings may represent general developmental trends between 4 and 7 months. Nonetheless, the differences between Studies 1 and 2 should also be

highlighted. A difference emerged between Study 1 and Studies 2a and 2b in the predominant subtype of Functional play in which dyads engaged. In Study 1, the greatest proportions of Functional play consisted of Infant onlooking, where infants watched their mothers demonstrate the function of the toys without being physically involved with the toy themselves. In contrast, in Studies 2a and 2b, the primary means of discovering a toy occurred when mothers demonstrated the function of the toy while infants' hands were also on the toy (Joint-action instrumental). Thus, in Studies 2a and 2b, the context of play was such that infants could watch mothers demonstrate the function of toys, while they were jointly involved with the toys through physical contact.

It is likely that the difference in predominant forms of Functional play between Studies 1 and 2 is a result of the change in play context and postural positioning. Study 1 was a free play context where mothers and infants could situate themselves as they wished. Mothers in Study 2 were seated directly in front of their infants and as a result the toy was always within close proximity. Infants could have had their hands on the toys while their mothers were demonstrating the function of the toys, even prior to the development of reaching, due to the close context of the play. In contrast, infants in Study 1 were in several different positions, including on their backs and stomachs. When infants lie on their stomachs, the mobility of their arms is restricted, while arm mobility is not hampered when they are supported by an infant seat. When infants are on their backs, they could only have their hands on a toy if the mothers held it close enough so that they could reach it, or close enough for them to touch if they could not yet reach. Moreover, five toys were present simultaneously in Study 1. As a result, infants in Study 1 may not

have had their hands on the toys while mothers were demonstrating because their hands were busy with another toy. However, the degree to which infants' postural positioning or involvement with other toys may have contributed to the difference in the form of Functional play is beyond the scope of the present studies and without further investigation remains speculative.

An inconsistent finding between Studies 1 and 2 was a difference in Functional play as a function of gender. Study 1 revealed significantly more Functional play between mother-son than mother-daughter dyads, yet no gender difference emerged in Study 2a or 2b. While the difference found in Study 1 is intriguing, it is difficult to explain given the results from Study 2. Further, as already discussed in Chapter 3, most studies examining maternal scaffolding and communication in mother-infant play have not included gender as a variable (e.g., Findji, 1993; Fogel et al., 1997b; Hodapp et al., 1984; Pêcheux et al., 1992). Perhaps no gender difference emerged in Study 2 because mothers were explicitly instructed to include the toys in their play, which may have resulted in mothers of both males and females demonstrating how the toys worked. Compared to the 8 minutes of free play in Study 1, the toys were also available for 90 seconds each in Study 2. This may have reduced the potential variability for the ways that toys were used as a function of infant gender. While there has been no previous research with young infants to substantiate this gender finding, existing research with older children does not support this result. Parents have been found to encourage less autonomy with their daughters than their sons, and it follows that more demonstrations of the toys might therefore be expected for the female infants (Block, 1983; Pomerantz &

Ruble, 1998). However, without further replication and consistency in findings across studies, interpretations of this gender difference should be made cautiously.

Taken together, results from the application of the Relational Play Category Coding Scheme indicate that the mother-infant relationship is a dynamic entity where there are mutual influences of each partner on the other. This is evidenced by the shifting contexts of play across developmental time. Ironically, while the parent-infant relationship is the means through which infants learn much about their social and nonsocial environments, most parents are unaware of their competence in teaching their infants. In fact, many cannot consciously report the strategies they use when asked (Papoušek & Bornstein, 1992). Yet, clearly mothers are using strategies that are attuned to their infants' abilities as they engage in play.

In addition to the delineation and examination of the different categories of triadic play, play context was assessed based on the type of toy included in play. Toys were selected for Study 2 based on their social and/or functional characteristics. Previous studies have not included type of toy as a variable, with the exception of those studies designed to investigate gender differences in play with sex-stereotyped toys (e.g., O'Brien & Huston, 1985). As predicted, the social toy resulted in the highest level of Social play, the functional toy resulted in the highest level of Functional play, and play with the social/functional toy resulted in moderate levels of both Social and Functional play. The importance of using different types of toys in triadic play stems from the fact that the different play contexts created by the use of social and functional toys provide infants with different learning opportunities. Thus, maximum learning opportunities occur when

dyads are exposed to different types of toys (McCollum & Stayton, 1988). Further, communicative interchange is promoted to differing degrees based on the toy used. This has implications for previous research that has examined infants' affective responses during triadic play across a broad array of toys. When results are reported across toy play in general (e.g., Adamson & Bakeman, 1985) developmental changes may be masked compared to reporting results based on the type of toy used. Given previous research that has underscored the importance of contextual factors, such as play partner, during play in promoting differing infant responses, it follows that type of toy is one such contextual factor that requires systematic investigation (e.g., Adamson & Bakeman, 1985; Dickson, Walker & Fogel, 1997; Garner & Landry, 1992). Indeed, type of toy affected infants' gazing and smiling behaviors at 7 months, supporting the contention that type of toy needs to be included as a variable when conducting studies pertaining to communicative development during toy play.

Communication During Triadic Play

By using the face-to-face play paradigm in Study 2, it was possible to systematically investigate infants' nonverbal communicative behaviors during play bouts. It was evident that the context of play (dyadic or triadic) and the type of toy included in play had a powerful impact on infants' gazing and smiling behaviors. One goal of dyadic play has been considered to be reciprocal affective interchanges, in which the 4- and 7-month-old infants in the present studies were found to actively participate. No difference in infants' gazing toward mothers' faces or smiling was evident between 4 and 7 months during dyadic play. Infants' gazing and smiling behaviors differed by age only when a

toy was added into the interaction, indicating that there was a developmental progression in infants' communicative competence within the triadic play context.

During triadic play, the majority of infants' gazing was directed towards the toy at both 4 and 7 months. Given that gaze is one medium through which infants' acquire information about their surroundings, it is not surprising that the toys captured infants' gaze (Pêcheux et al., 1992). Nonetheless, age differences emerged and were particularly striking for the periods of play with the social toys. Within the first months of life, infants' visual-motor systems are sophisticated enough to allow infants voluntary control over their perceptual input (Stern, 1977). Thus, the fact that 4-month-olds had lower levels of gazing at their mothers' faces cannot be attributed to differences in the maturation of their visual-motor systems, but rather may indicate a difference in their social and cognitive abilities to integrate both their social and nonsocial surroundings. The 4-month-olds would likely have had limited experience in the triadic play context, whereas by the time infants were 7 months, they would have accumulated more experience of having toys embedded into their play interactions with caregivers.

The finding that the 7-month-old infants were able to direct their attention away from the toy towards their mothers' faces for a greater proportion of time than at 4 months is particularly significant given previous research that has found infants to focus almost exclusively on the toy during triadic play (McCollum & Stayton, 1988; Stack & Colburne, 1996). Gaze is an integral aspect of the communicative process, and infants' gazing toward mothers' faces during toy play was likely interpreted by mothers to have communicative significance (Mayo & Lafrance, 1978). The present results suggest that

infants' gazing toward their mothers' faces during triadic play varies as a function of type of toy included in the play and infant age.

Increased levels of infants' gazing toward their mothers' faces provides the opportunity for them to attend to their mothers' own affective responses to the toy play. These interpersonal exchanges within the context of toy play are significant given that mothers' faces display the emotions that infants develop the ability to use for social referencing (Hornik & Gunnar, 1988; Sorce et al., 1985). The Social play that was promoted through the use of the social toy provides infants with an opportunity for the integration of their social and nonsocial worlds. The integration of these two worlds as manifested in infants' understanding that they can share affect and attention regarding an object is essential to the development of coordinated attention and social referencing which begins to emerge around 12 months of age (Feinman, 1982; Hornik & Gunnar, 1988; Sorce et al., 1985). The affective interchange that took place in Social play was one context where 7-month-old infants showed awareness of their caregivers, even in the presence of the toy, prior to the development of social referencing or proto-communicative gestures. This was not as salient during Functional play where infants' attention was largely focused on the toy, regardless of age.

The results also extend previous findings indicating that smiling is sensitive to play context. Research has indicated that infants smile for longer durations in mother-toy centered play than when playing with toys alone (Garner & Landry, 1992). The present results underscore the power of embedding the toy in a social context in eliciting different degrees of affective responsiveness. Remarkably, during play bouts with the lion, infants'

smiling at 7 months was comparable to the high levels of smiling they displayed during face-to-face play without toys. Thus, levels of smiling depend on the play context and age of the infant, and it is possible to maintain high levels of smiling at 7 months when a social toy is used. As such, triadic play is also a play context rich with the opportunity for positive affective interchange as has already been found for dyadic play bouts (Messinger et al., 1999). Given that time spent in dyadic play has been found to decline throughout infants' first year, while time spent in triadic play bouts increases, it is important to consider how triadic play may continue the process of infants' development of attachment to their caregivers through the promotion of positive affective interchanges.

Several researchers (e.g., Fogel & Thelen, 1987; van Wulfften Palthe & Hopkins, 1984; Weinberg & Tronick, 1994) have suggested that co-occurrences between expressive behaviors and gazing at mothers' faces enhance the communicative significance of these signals. In Study 2, no age difference was apparent in infants' gazing toward their mothers' faces while smiling during the dyadic play bouts without toys. As with the smiling and gazing results, it was during the periods with the toys that elicited the highest levels of Social play where differences between the 4- and 7-month-old infants emerged. In particular, during the lion and worm periods, 7-month-old infants were found to gaze toward their mothers' faces while smiling more than twice as much as the 4-month-olds during the same periods. Thus, their smiles may have been social displays that communicated their delight in the ongoing play to their mothers.

Taken together, results from Studies 1 and 2 have advanced past research on infant play through their focus on elucidating the play contexts to which infants are

exposed as they become increasingly interested in their nonsocial worlds. Further, the effect of type of toy in eliciting different contexts of play and different communicative behaviors was apparent. Including measures of infants' gazing and smiling provided the opportunity to examine these salient communicative behaviors across play contexts and developmental time. Particularly striking was the difference that emerged in these behaviors depending on whether the play context was dyadic or triadic. No age differences emerged in infants' gazing towards their mothers faces or smiling in the dyadic play context. Within the triadic play context, levels of infant gazing and smiling varied depending on the play context created by the type of toy used and the age of the infant. These findings underscore the powerful influence of play context in relation to infants' behavior.

Applied Implications from the Present Studies

The present set of studies were a first step to deriving normative data as to the emergence of triadic play between the ages of 4 and 7 months. Results from the application of the Relational Play Category Coding Scheme indicated that opportunities are afforded by engaging in play with a more competent play partner that would not be present if the infant was left to discover toys alone. The beneficial effects of toy play on the development of infants' language and attention skills and exploratory competence would not be possible without the triadic play context where the caregiver is present and facilitating learning (Baldwin, 1991; Landry & Chapieski, 1989; Lawson et al., 1992; Pêcheux et al., 1992; Tomasello & Farrar, 1986).

Based on the findings from Studies 1 and 2, mother-infant play between 4 and 7 months is a diverse and shifting context for development. In particular, results from Study 1 tracked the decrease in dyadic play and increase in triadic play, and indicated that at these ages (4, 5 ½, and 7 months) infants show a high level of interest in the toys. Within triadic play bouts, a variety of learning opportunities were evident. Mothers demonstrated the function of toys, supported toys so that infants could explore them, encouraged the development of motor milestones such as reaching, observed their infants' play with toys independently, and used some of the toys in social games. Each of these contexts resulted in a different level of involvement from the mother and the infant. For example, during Functional play, infants witnessed and experienced the different facets of the toy in a way that would not be possible without a more competent play partner. Further, Social play created a context where the toy was integrated into the social interchange and used in games that promote mutual gaze and positive affect.

The long term implications of infants' exposure to these different types of play are unknown, but speculations can be made from previous research. Infants' experiences within the triadic play context have been shown to be important for subsequent development (Bruner, 1983). For example, research has shown that infants' attentional skills, exploratory behaviors, and language are better developed when they had mothers who scaffolded their play at younger ages (e.g., Baldwin, 1991; Findji et al., 1993; Lawson et al., 1992). Further, Social play promotes positive affect, and social competence has been associated with a tendency to express positive emotion (Rothbart &

Bates, 1998). Thus, exposure to contexts that promote positive interchanges is likely to contribute to positive long term outcomes.

Replication of results on a different sample of infants would add further support to the changes in play categories and nonverbal communication arising across developmental time. Establishing the developmental trajectory of triadic play is valuable in order to inform clinical expectations. Research on infant solitary play has delineated progressively more complex forms of toy play that emerge with development, and has been used as a measure of infants' cognitive competence (Beeghly, 1993; Belsky & Most, 1981; Doehring et al.,1997; Zelazo & Kearsley, 1980). Likewise, early parent-infant interactions are formative for infants' healthy emotional development and serve as a model for infants' competence in future relationships (Bowlby, 1969). The relationship between a mother and her infant develops across time, and one way to assess the quality of this relationship may be to observe mother and infant engaging in triadic play.

Infants in the present studies were healthy full-term infants. A comparison of normative groups with risk samples would provide a means of ascertaining differences in mother-infant play among atypical populations which could be used to inform researchers of the processes most relevant to healthy developmental outcomes (Ciccheti, Cummings, Greenberg, & Marvin, 1990). Given the bidirectional nature of infants' interactions with their caregivers, if the infant, caregiver, or both are compromised in some way, the effects may be apparent in play interactions. For example, very low birth weight infants aged 4 months were found to show less positive arousal and more negative arousal when compared to full-term infants in a standardized game of peekaboo with an examiner

(Eckerman et al., 1999). Parent-infant interactions may be adversely affected by such behavioral differences. For example, premature infants who were delayed in smiling were smiled to less by their mothers (Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986). Findings extend to other special needs infants, and indicate that infants and their mothers engage in differing communicative and play interactions than that seen for normally developing infants (Brooks-Gunn & Lewis, 1982; Legerstee & Bowman, 1989).

Five different triadic play contexts were observed in Study 1 and incorporated into the Relational Play Category Coding Scheme. Changes in proportions of time spent in triadic play categories in Studies 1 and 2 occurred, in part, because mothers were sensitive to the developing capabilities of their infants. Mothers' engagement in the play categories making up the Relational Play Category Coding Scheme involves complex processes. In order to continue their interpersonal involvement when the toy is added into the play, mothers need to assimilate information concerning their infants' focus of attention, when it might be appropriate to enter into the interaction (timing), as well as their infants' affect in terms of whether they are content with what is happening (McCollum & Stayton, 1988). That dyads in Studies 1 and 2 were found to engage in negligible levels of the Unengaged category indicate that mothers were attuned to their infants and reading their cues, resulting in the mutual orientation of mother and infant to a given activity. It may be that when the Relational Play Category Coding Scheme is applied to a risk sample, higher levels of Unengaged emerge.

Research examining mothers who are abusive or neglectful, depressed, or suffering from psychiatric disorders has indicated that they may be less sensitive to their

infants' signals, and offer minimal levels of stimulation (Crittenden, 1981; Dodge, 1990; Zahn-Waxler, Cummings, McKnew & Radke-Yarrow, 1984). Depressed mothers were found to display more negative affect (e.g., irritation and intrusiveness) during face-to-face interactions than non-depressed mothers (Cohn, Campbell, Matias, & Hopkins, 1990). Further, infants of depressed mothers display diminished positive affect even in interactions with non-depressed women (Field et al., 1988).

Infants' early social experiences also affect their relationship to their nonsocial world. Cohn et al. (1986) found that infants of depressed mothers not only showed a lack of interest in their mothers, but also in objects. In contrast, infants' security in their relationships with their caregivers has been found to manifest greater exploratory behaviors, which engender further learning (Ainsworth, Blehar, Waters, & Wall, 1978). In addition, maternal responsiveness is presumed to foster a sense of control in the infant which motivates engagement with the environment (Clarke-Stewart 1973; 1977). An understanding of the developmental trajectory of triadic play and the role it plays in child development may help in identifying factors that promote social and cognitive competence.

Bowlby's attachment theory has influenced the thinking of developmental psychologists as to the importance of the emotional bond that develops between the mother and her infant during the first year of life (Bowlby, 1969). The developmental outcome of children is affected by their attachment to their caregiver, as the mother-infant relationship is an important foundation for infants' positive emotional development and serves as a model for future relationships (Bowlby, 1969). The present results suggest

that certain forms of triadic play may be better than others at fostering positive emotional experiences that could contribute to the development of a secure attachment relationship. For instance, during play with the functional toy between 4 and 7 months, infants rarely acknowledged their mothers' presence through gazing toward their faces or smiling . Even so, the presence of the mother enabled infants to gain information about the toy that they may not have discovered on their own. In contrast, it was evident that at 7 months, bouts of play with the social toy created a context that resulted in the exchange of positive affect and mutual regard that could contribute to the development of a secure attachment relationship. One implication of these findings is that when interactive disturbances between mothers and infants are apparent, play with social toys may create one context for positive interactive behavior. Play with social toys may need to be modelled initially in the form of the diversity of games that could be played. In addition, parents who are lacking sensitivity to their infants' cues could be informed as to how infants' nonverbal behaviors of gazing and smiling can be used to indicate their readiness to engage in play.

In addition to the application of knowledge regarding play context in the form of play categories and types of toys, knowledge of the developmental progression of infants' nonverbal behaviors across different play contexts has the potential to be applied as a means of early identification of infants who are showing deviant patterns of social communication. For example, autism is a developmental disorder characterized in part by impaired social relationships and abnormal language and communicative development. Many researchers view deficits in social relating and reciprocity as the core characteristics of autism (Volkmar et al., 1987).

Given compelling evidence that early intervention is beneficial for children with autism (e.g., Lovaas, 1987; Rogers & Lewis, 1989), discovering means of early identification is imperative. Results from studies of infants 20 months of age and older diagnosed with autism have shown differences in gazing such as gaze avoidance and deviant patterns of reciprocal gaze (Rutter & Schopler, 1987). Infants with autism spontaneously oriented less to people and more to objects as compared to two control groups consisting of non-autistic developmentally delayed infants and typically developing infants in free play (Swettenham et al., 1998). Moreover, infants with autism showed fewer shifts of attention between object and person and between person and person compared to the two control groups. Rather, they preferred to shift their attention between object and object. Infants with autism have also been found to display less positive affect relative to controls (Snow, Hertzig, & Shapiro, 1987). Positive affect has been found to occur in self-absorbed activity in children with autism rather than in interaction with social partners (Snow et al., 1987).

That older infants who were identified with autism showed differences in gazing and smiling behaviors points to the intriguing question of whether there are differences in gazing and smiling behaviors at younger ages. More specifically, would differences in gazing toward mothers' faces and smiling be apparent even within the first year of life for children who are later diagnosed with autism? Children with autism are heterogeneous in their manifestation of symptoms, with some parents reporting that development appeared relatively normal until the second year of life when infants started to lose words that were

already acquired. Yet, there appears to be at least a subgroup who showed behavioral differences prior to their second year based on parental report (Volkmar et al., 1987).

Early intervention with at-risk dyads would be facilitated if a systematic means of determining when infants' responses to social interaction deviate significantly from the norm could be delineated. This step is not possible without first describing the normal developmental trajectory of mother-infant triadic play, to which the present set of studies contributed. While the gap is wide between current knowledge of the development of communication during play within the first year of life and the ability to use this knowledge clinically, the present studies mark a beginning towards further understanding the emergence of triadic play. In addition, the present studies raise possibilities for future research that could contribute to the description of normal developmental trajectories of triadic play which would provide researchers and clinicians with knowledge regarding the processes relevant to healthy developmental outcomes (Ciccheti, Cummings, Greenberg, & Marvin, 1990).

Future directions

Given that previous research has not sought to categorize triadic play in early infancy, the development of the Relational Play Category Coding Scheme was a significant contribution to delineating the play contexts to which infants are exposed as they become increasingly adept at interacting with their social and nonsocial surroundings. Results from the application of the Relational Play Category Coding Scheme in Studies 1 and 2 converged to suggest the mutual influence of mother and infant on the context of early play interactions whereby the content of play was modified

with infants' development. In addition, results from Study 2 indicated the powerful influence of play context on infants' communicative development. Infants' nonverbal communicative behavior did not differ by infant age across dyadic play bouts, but it did differ during triadic play. Furthermore, type of toy was a significant factor in promoting infants' communicative responses to the play. Notwithstanding the importance of the contributions of the present studies, a few limitations which restricted some interpretations and generalizations were evident. However, many of these can be dealt with in future research projects.

Results from Study 2 indicated that type of toy clearly has an influence on the type of play that unfolds. The pattern of developmental change in play categories may represent a general developmental pattern (e.g., decline in Functional play with age) but the timing of these changes may vary based on the type of toys available, and infants' experience with the toys. A diverse set of toys were used in the present studies that had social and functional properties. Proportions of time spent in the different play categories were similar between Studies 1 and 2 despite the change in play context (i.e., floor versus chair play). Results suggest that the changes in play found with age may be robust at least across these two different play contexts as well as across the toy sets included. The toys in the present studies were appropriate for the age range of the infants in the study, and were selected based on the assumption that caregivers most often choose to include age appropriate toys in play. However, if toys that are above the infants' level such as building blocks had been available, it is likely that higher levels of Functional play would have remained apparent at 7 months of age, and declined sometime after that.

This speculation is supported by a longitudinal study of mother-infant object play where toy difficulty had an effect on amount of maternal scaffolding offered during play (Stevens, Blake, Vitale, & Macdonald, 1998). The total frequency of maternal scaffolding activities (e.g., demonstrations of the toy) declined for a toy train, but increased for a shape toy between visits when infants were 9 and 15 months of age. Results demonstrate the variability of maternal scaffolding based on toy difficulty. Likewise, with experience playing with particular toys such as familiar toys in the home, it is likely that mothers' demonstrations would decrease once the toys are no longer novel and infants' abilities develop such that they can manipulate the toys on their own. Thus, while the play category results were obtained from two play contexts and a total of 8 different toys, they are context-bound and might vary based on alterations to the play context (e.g., toy difficulty).

The durations of time dyads spent in different play categories was used as a measure of developmental change in the present studies. Based on this method, developmental change was apparent across all of the play categories. The developmental changes in the play categories were most often apparent between the 4 month visit as compared to the 5 ½ and 7-month-old visits in Study 1, and were consistently evident between the 4-month-old and 7-month-old age groups in Study 2. Thus, while the spread in development between 4 to 7 months yielded differences in mean durations of time spent in different play categories, it appears that there were not significant developmental changes between the 5 ½ and 7-month-old visits based on Study 1. Yet, previous research has indicated that by the end of the first year, infants use gestures such as

pointing to recruit caregivers' attention to topics of shared interest, and many infants have acquired their first words (e.g., Butterworth & Grover, 1990; Trevarthen & Hubley, 1979). Given the rapid rate of development in infancy, it is unlikely that there would not be changes within this time frame. The most plausible explanation for the lack of developmental difference in some of the play categories between the 5 ½ and 7 month-old visits is that the developmental changes that took place were not captured by the measure of mean duration of time employed in the present set of studies. One avenue for future studies to pursue is to include other measures of play that might uncover developmental differences within this time frame.

One means of further assessing triadic play would be to examine aspects of play such as tempo and the timing of shifts between different play categories. With increased durations of Mother onlooking, where infants explore toys independently, and decreased Functional play with age, it raises the question as to how mothers' demonstrations of toys change with infant development. Timing of actions is part of the communicative process (Nwokah, Hsu, Dobrowolska, & Fogel, 1994; Trevarthen, 1977), and it would be interesting to determine how the timing and tempo of mothers' scaffolding behaviors during Functional play change with infant age. For example, mothers' demonstrations of how the rattle works could be tracked by measuring the length of pauses between mothers moving parts of the rattle. Perhaps at 4 months mothers introduced the rattle by initially spending a long bout showing their infants the different parts of the rattle. In contrast, at 7 months, perhaps mothers watched infants play with the rattle, and offered demonstrations and assistance in short bursts when needed. Further, investigations of

tempo of mother-infant face-to-face play have revealed that altering the tempo of the play has an effect on the amount of infant gaze towards the parent and positive facial expressiveness (Arco & McCluskey, 1981). Thus, tempo of triadic play may also have implications for infants' communicative behaviors.

Another means by which to examine developmental changes in infants between the ages of 5 ½ and 7 months is to more intensively study this period of time through frequent visits within this time frame. For instance, developmental changes could be tracked by having dyads engage in play every 1 to 2 weeks between 5 ½ and 7 months. Such an intensive approach is challenging to implement given potential participant attrition and the time involved. Nonetheless, this longitudinal approach involving frequent visits has been employed in previous studies (e.g., Fogel et al., 1997b; Nwokah, et al., 1994), and is a method amenable to studying change processes over time. Rather than comparing two points in development, studying infants and their mothers at shorter intervals would enable researchers to gain a clearer picture of the process of developmental change during triadic play.

Future research studies could also serve to elucidate the function and meaning of infants' gazing and smiling behaviors at different ages and within different play contexts. Some researchers have argued that one way to understand the meaning of a behavior and the process of developmental change is to examine changes through written narratives (e.g., Pantoja, 1997). Narrative approaches are a qualitative means of understanding social interaction where researchers act like historians in tracking developmental changes by providing a written description of the play (Polkinghorne, 1995). Rather than

developing categories a priori, categories that emerge as recurring themes are noted in the written narratives. Seven-month-olds demonstrated higher levels of gazing toward mothers' faces and smiling when the lion and worm were used. Written narratives could describe the context of play within which these gazes toward mothers' faces were embedded, and may bring to the fore developmental differences in the function of these behaviors. For example, results may reveal that at 4 months, infants' gazing at their mothers' faces most commonly occurred when infants were mouthing a toy. In contrast, perhaps gazing at mothers' faces at 7 months occurred during anticipatory segments of play, or during other socially meaningful situations of play such as when infants are surprised or seemingly pleased with the play. Ascertaining the contexts within which infants' gazing towards mothers' faces and smiling occur will add further depth and richness to the interpretations of the results.

Sequential analysis of smiling and gazing would also have the potential to further elucidate the meaning and function of these communicative signals. Co-occurrence results from Study 2 indicated that the 7-month-olds gazed at their mothers' faces while smiling more frequently than the 4-month-olds during play with the lion and worm. By examining the sequencing of infant gazing and smiling within the play bout, it could be determined whether infants smiled before gazing toward their mothers' faces, or smiled after gazing at their mothers' faces. The former may represent a sequencing of behaviors indicative of infants' attempts to share their positive affect about the toy play with their mother.

Communication is a multi-channel phenomenon, and the communicative context includes not only how the toy is incorporated into the play, the focus of each partners' attention, and infant gazing and smiling, but also other communicative modalities that were beyond the focus of the present studies. By continuing to study the different communicative aspects of triadic play bouts, the learning experiences that are supported by different types of play contexts will be further elucidated. In fact, there are several modes of expression that caregivers imbue with meaning during play with their infants. Further, the combinations of behaviors that signal positive affect have been found to change with infant age. For example, in early infancy, affective displays were found to contain a motoric element (e.g., moving legs) which declined with age (Bakeman & Adamson, 1985). Infants' posture, hand gestures and vocalizations are all a part of the constellation of behaviors that are observed as they interact with their caregivers. Thus, another intriguing avenue for exploration would be to ascertain whether the differential effects on communication observed for the different types of toys at 7 months also extend to other communicative modalities such as infant vocalizations. Further, examination of infants' communicative behaviors as they co-occur would help in ascertaining their meaning in terms of infant expression and emotional experience during triadic play (Weinberg & Tronick, 1994).

Infants' expressive behavior during play is part of the caregiver-infant communicative system, and examining some of mothers' expressive behaviors such as vocalizations and smiling would also contribute to understanding how the context of play changes with development and across different play categories. For example, mothers

may increase their use of vocalizations with infant age, which would complement the findings of decreased Functional play and increased Mother onlooking. It is possible that as mothers' proximal involvement in the play through physical demonstrations of the toys lessen, they communicate the function of the toys through their vocalizations. For instance, labelling of the toy or its properties, suggesting actions to the infant, praising of the infant, and commenting on the play or asking questions regarding the play were found to increase when infants were between the ages of 9 to 15 months (Stevens et al., 1998). Likewise, mothers of 9-month-old infants were found to make more utterances per minute than mothers of 3-month-old infants (Kruper & Uzgiris, 1987). These results suggest that maternal vocalizations would likely change between 4 to 7 months, and would indicate maternal sensitivity to infants' developing competencies resulting in moving from more proximal forms of assistance during toy play (e.g., physical intervention) to more distal forms (e.g., vocal explanation). A finding of increased maternal vocalizations from 4 to 7 months would complement results from the present studies that there is a decline in mothers' physical demonstrations of the toys and an increase in infants' autonomy during triadic play with age and experience.

Conclusions

Parent-infant play provides a context within which infants develop an understanding of the process of communication during social interchange. The opportunities provided during play in the infancy period play an integral role in the development of infants' cognitive, socioemotional and motor abilities (Beeghly, 1993; Tamis-LeMonda & Bornstein, 1993). The Relational Play Category Coding Scheme was

developed to delineate the different triadic play contexts prevalent when infants are between the ages of 4 and 7 months. Results from the application of the coding scheme in Studies 1 and 2 revealed that the content of play bouts, in terms of allocation of time to different types of play, changes as infants develop. Mothers engaged in fewer demonstrations of the function of toys, offered less physical assistance when encouraging infants to engage in Developmental play, and provided more opportunities for infants to explore toys independently with age. In addition, mothers' sensitivity to infants' changing abilities was apparent in the different types of Developmental play that were encouraged with age. As infants became more active participants in social interchange, mothers engaged in more triadic Social play. Importantly, type of toy was found to be a mediating variable in the types of play that dyads engaged in, as well as in the communicative behaviors that were promoted within these play contexts. As a result, it is clear that type of toy is a contextual variable that should be included in studies of infant play. In addition, the increasingly sophisticated competence of the infant in interacting with toys was evident by the degree of physical involvement of their mothers, who promoted greater autonomy in play with age.

Findings from the present studies signify the changing communicative contexts apparent in play as dyads discover and experience new communicative possibilities when play interactions are expanded beyond the dyad to include toys. Triadic play provides opportunities to apply and continue to develop the communicative skills infants acquired within the dyadic play context which embodied their first exposure to the social world (Stern, 1977). In addition, triadic play provides a context where partners can share a topic

of mutual interest, that of communication around a toy. While infants do not initially acknowledge their caregiver's presence during play with toys, triadic play provides the context within which coordinated attention and referential learning eventually emerges. Results indicated that toys are incorporated into play in diverse ways when infants are aged 4 to 7 months, and underscore the importance of the social context in facilitating infants' interaction with and discovery of the world around them.

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Appendix A

The Relational Play Category Coding Scheme:

Triadic Play Category Definitions

Definitions of Triadic Play Categories, Study 1

Play Category	Description
Functional play	when the mother demonstrates some function of a toy, which includes bouts of play where the mother explores the physical characteristics/properties of a toy with her infant.
a) Mother-facilitated	when the mother facilitates her infants's exploration of the toy by guiding her infant's physical action on the toy in a functional manner (e.g., the mother makes the infant's hands play the piano).
b) Joint-action	when the mother is demonstrating a function of the toy, and the infants' hands are also on the toy.
c) Infant onlooking	when the infant demonstrates the function of the toy, but the infant is not physically involved with the toy but is onlooking.
Social play	when the toy is used in a social game such as peek-a-boo, hide-and-seek, or a looming game.

Developmental play	when a mother promotes a developmental behavior from her infant (e.g., reaching, holding, crawling) by using a toy. Independent developmental play occurs when the infant attempts the behavior independently, Mother-facilitated developmental play occurs when the mother physically facilitates her infant's developmental play (e.g., pushes his/her feet to help him/her crawl).
Supported Play	coded when mothers play a supportive role in infants' play by holding a toy for an infant to gaze at or explore manually.
Mother Onlooking	coded for bouts of play where mothers observe their infants who are either physically involved with a toy or gazing at a toy.

Appendix B

The Process for Determining and Applying the Time Code for

The Relational Play Category Coding Scheme, Study 1

The methods that previous studies have used to code infant play were reviewed. Most studies have used frequency counts, or time sampling based on set intervals to record occurrences of behaviors during play. For example, frequency counts of dependent variables such as mothers' attention directing strategies, mothers' game-facilitating behaviors, or mothers' direct verbal instructions have been obtained and compared across different groups (e.g., full-term and preterm) or ages of infants (Hodapp et al., 1984; Landry et al., 1996; Rome-Flanders et al., 1995). Time sampling procedures in studies of play most often record occurrences of behaviors within a set time period. For example, Zelazo and Kearsley (1980) compared the occurrences of three classes of play in 10-second periods over a 15 minute session.

Information is lost by using time sampling procedures, because often only one behavior is given credit for a set interval. If more than one behavior occurred in a given interval, the behavior that took up the most time in the interval most often would receive the credit for occurring, whereas the other behaviors would not be recorded. For example, Belsky and Most (1980), in examining infant independent free play, used a time sampling procedure whereby the most competent level of play observed within a given 10-second interval was recorded. Likewise, Malone and Langone (1998) used a 15-second interval coding procedure where the play occurring for most of the interval was the play variable that was given credit for that time segment. While coding is more efficient using frequency counts compared to obtaining exact start and stop times of a behavior, measures of frequency are also limited in the amount of information that they convey. Behaviors could be equally frequent in occurrence at different ages, yet vary

substantially in terms of duration of time that dyads engaged in certain behaviors. As a result, obtaining solely frequency counts could mask developmental changes.

Studies that obtain exact start and stop times which can be reduced to provide durations of time in play provide more detailed information, which is particularly important when looking at changes in play across time. Bakeman and Adamson (1984) obtained exact durations by viewing the videotapes in real time until a change in engagement state occurred. The time of the change was recorded, accurate to a second. Likewise, Dickson, Walker and Fogel (1997) categorized different play types by obtaining the precise time to the second of changes from one play type to the next, enabling the calculation of the durations spent in each play type, as well as data concerning the sequencing of behaviors across the play session. In a like manner, the recording of stop and start times to the second was chosen as a means of coding play in the Relational Play Category Coding Scheme. Obtaining exact time durations in each play category provided a more comprehensive view of the development of play compared to methods such as frequency counts or time sampling procedures. Moreover, the window of developmental time examined in the present study was between 4 and 7 months. The more precise the measure used, the greater probability of capturing developmental changes that may be subtle across time.

In order to make a decision as to the minimal time that should be coded to signify a play category, data from the pilot infants was examined. Only 19 occurrences of 1 second time codes were evident and these were present for only 6 of the 10 pilot infants. This amounted to only 0.35% of the total play categories coded for the pilot infants. The

segments of play coded as occurring for one second were then investigated to determine whether they were distributed evenly across play categories, or whether they appeared to be more frequent in a particular play category. Results indicated that 100% (19/19) of the categories occurring for a duration of 1 second occurred during functional play. In terms of the toys involved. 16/19 occurred with the piano where the mothers played only one note and stopped, and 3 occurred when the mother gave quick shakes to the blue rattle. There were 74 occurrences of play categories lasting for 2 seconds based on the 10 pilot infants, which amounted to 1.36% of the total number of play categories coded. These 2 second time codes occurred during the play for all 10 pilot infants, and unlike the 1 second time code, were distributed across play categories.

Based on the results from the pilot infants, 2 seconds was adopted as the minimum time criterion of engagement to be coded as a play category. The time criteria of 2 seconds has also been used in a relational play coding scheme developed by Fogel, Walker and Dodd (1997) designed to capture different features of interpersonal communication and applied to mother-infant play. There were two exceptions to the 2 second time criterion in the present study. Given that some mothers appeared to demonstrate the functions of some toys, (i.e., the piano) in short bursts, it was decided that Functional play should be coded whenever it occurred, even if only 1 second in duration. Second, to be coded as Unengaged, the mother and infant had to be engaged in different activities for at least 3 seconds or more. This criteria was chosen so that brief fluctuations of attention (i.e., < 3 seconds) would not be counted as Unengaged.

Inherent in the definition for all five categories was that infants and mothers were engaged in the ongoing play. Consequently, if either member of the dyad became unengaged during a bout of play (e.g., turned away) for $\geq$ 3 seconds, the code for that particular play category was terminated. A criterion of 3 seconds has been similarly used in previous research (Bakeman & Adamson, 1984).

Appendix C

Consent Form for Study 1

Informed Consent Form

This study is designed to look at the different behaviors used by both caregivers and infants during play. I understand that my aby and I will participate in a study lasting approximately 45 minutes. My baby will remain in the room with me at all times. My baby and I will play together on a carpeted floor for approximately 8 minutes in a designated area during which time I will be asked to play with my baby as I normally would at home. There will be toys available for me to use if I wish. All toys used in the study are non-toxic, and all toys are washed after each use.

Under no circumstances will any manipulation be harmful to my baby. The entire session will be videotaped so that at a later point my responses, and those of my baby's may be observed. However, these recordings are kept in the strictest of confidence and are not shown to others without my permission. In all cases, recordings will be destroyed after coding is completed.

I understand that my participation in this study is totally voluntary. I know that I may withdraw at any time and for any reason. In the event that the results of the study are published, my name and the name of my baby will be kept confidential.

In the even that I have any unanswered concerns or complaints about the study, I may express these to dr. Dale Stack (848-7565) or Karen Colburne (848-7547) of the Psychology Department at Concordia University. In addition, the patient representative of the Jewish General Hospital is Roslyn Davidson (340-8222).

Thank you for your cooperation.

I _____ Do hereby give my consent for my baby

_____ To participate in a study conducted by Dr.

Dale Stack and Karen Colburne at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of this consent form has been given to me.

Signature: _____ Date: _____

Witness: _____ Date: _____

Appendix D

Demographic Questionnaire

Demographic Information

Order: _____ Study #: _____
Test Date: _____ Infant #: _____

Infant's Name: _____ D.O.B.: _____ E.D.O.B.:____ Age: _____

Mother's Name: _____ Age: _____
Language's Spoken: _____

Father's Name: _____ Age: _____
Language's Spoken: _____

Phone #: _____
Address: _____
_____

Sex: _____ Birth Weight: _____ Length of Labour: _____

Pregnancy Complications and Delivery Status: _____
_____
Medical History: _____

Breast Fed: _____ Bottle Fed: _____

Siblings:	Age	Sex
	___	___
	___	___
	___	___
	___	___

Father's Occupation: _____ Education: _____

Mother's Occupation: _____ Education: _____

Mother's Recent Work History: Full/Part-time/Home
Father's work History: Full/Part-time/Home

Hours spent with infant all day:
Mother: all day 3/4 ½ 1/4 < 1/4
Father: all day 3/4 ½ 1/4 < 1/4

Caretaking History (# of caretakers, day/homecare, hours, since when):
_____
Would you be interested in participating in future studies conducted at the Centre for Research in Human Development (CRDH)? Yes No

Appendix E

Examples of Functional and Social Play by Toy.

Study 1

Table E1

Examples of Functional Play by Toy, Study 1

Toy	Description
Rock-a-Stack	stacking the rings on the post
	rolling the rings on the mat
	spinning the rings on the mat
	rocking the rock-a-stack
	labelling any parts/colours of the stack while pointing them out
Blue rattle	shaking the rattle
	spinning the round ball in the middle of the rattle
	lying the rattle flat on the mat and spinning it
	labelling any parts/colours of the rattle while pointing them out
Book	reading the book (e.g., labelling animals)
	turning the pages of the book and looking at the pictures
	squeaking the book
Winnie-the-Pooh rattle	shaking the rattle
	labelling any parts of the rattle (e.g., nose, eyes, colours)
Piano	playing the piano
	labelling any parts/colours of the piano while pointing them out

Table E2

Examples of Social Play by Toy, Study 1

Toy	Description
Rock-a-Stack	putting the rings on the infant's body (e.g., head)
	looking through the rings at her infant
	playing hide and seek with the rings or post
Blue rattle	tickling the infant with the rattle
	playing tug-of-war with the rattle
	playing hide-and-seek with the rattle
Book	playing peek-a-boo with the book
Winnie-the-Pooh rattle	tickling or kissing the infant with the rattle
	playing an "I'm going to get you" game with the rattle
	singing with the rattle and making it dance/move
	making the rattle `talk' to the infant while moving it
Piano	the piano was not observed to be used in a social manner

Appendix F

ANOVA Summary Table and Post-Hoc Comparison for

Dyadic Play, Study 1

Table F1

Analysis of Variance for Dyadic Play, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	4.92*
S within-group error	20	(313.63)
	Within Subjects	
Age (A)	2	6.89**
A x S	2	1.37
A x S within-group error	39.94	(154.97)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$. **$p < .01$.

Table F2

Tukey Multiple Comparisons on the Age Effect for Dyadic Play

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5.5 months	9.49	9.13*
4 months vs. 7 months	12.99	11.60**
5.5 months vs. 7 months	3.5	9.13

*$p < .05$. **$p < .01$.

Appendix G

ANOVA Summary Table and Post-Hoc Comparison

for All Triadic Play Categories Combined, Study 1

Table G1

Analysis of Variance for Total Triadic Play, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.99	8.68*
A x S within-group error	41.78	(213.64)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .001$

Table G2

Tukey Multiple Comparisons on the Age Effect for the Total Triadic Play, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	12.68	10.72*
4 months vs. 7 months	17.85	13.62**
5 ½ months vs. 7 months	5.17	10.72

*$p < .05$. **$p < .01$.

Appendix H

ANOVA Summary Tables, Post-Hoc Comparisons,

and Mean Tables for the Triadic Play Categories, Study 1

Table H1

Analysis of Variance for Total Functional Play, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	7.59*
S within-group error	20	(244.79)
	Within Subjects	
Age (A)	1.86	9.01**
A x S within-group error	37.3	(170.26)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$. **$p < .001$.

Table H2

Tukey Multiple Comparisons on the Age Effect for Functional Play, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	14.91	12.16*
4 months vs. 7 months	14.86	12.16*
5 ½ months vs. 7 months	0.05	9.57

*$p < .01$.

Table H3

Analysis of Variance for Mother-Facilitated Action, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.84	6.98*
A x S within-group error	38.61	(205.68)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .01$

Table H4

Tukey Multiple Comparisons for Mother-Facilitated Action, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	1.93	10.52
4 months vs. 7 months	14.85	13.36**
5 ½ months vs. 7 months	12.92	10.52*

*$p < .05$, **$p < .01$.

Table H5

Analysis of Variance for Joint-Action Instrumental, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	0.15
S within-group error	20	(333.28)
	Within Subjects	
Age (A)	1.93	1.64
A x S	1.93	0.07
A x S within-group error	38.62	(331.55)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

Table H6

Analysis of Variance for Infant Onlooking, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	0.35
S within-group error	20	(755.29)
	Within Subjects	
Age (A)	1.82	0.7
A x S	1.82	0.46
A x S within-group error	36.42	(656.67)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

Table H7

Analysis of Variance for Social Play, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	4.32
S within-group error	20	(56.23)
	Within Subjects	
Age (A)	1.38	2.13
A x S	1.38	0.72
A x S within-group error	27.69	(20.24)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

Table H8

Analysis of Variance for Triadic Developmental Play, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.65	4.00*
A x S within- group error	34.6	(51.92)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$.

Table H9

Tukey Multiple Comparisons on the Age Effect Triadic Developmental Play, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	5.48	5.28*
4 months vs. 7 months	5.15	5.28
5 ½ months vs. 7 months	0.33	5.28

*$p < .05$.

Table H10

Analysis of Variance for Supported Play, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.46	16.27*
A x S within-group error	30.65	(82.37)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .001$.

Table H11

Tukey Multiple Comparisons on the Age Effect for Supported Play, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	8.86	8.46**
4 months vs. 7 months	15.56	8.46**
5 ½ months vs. 7 months	6.7	6.66*

*$p < .05$. **$p < .01$.

Table H12

Analysis of Variance for Age effect for Mother Onlooking - Physical, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.77	31.49*
A x S within-group error	37.25	(236.27)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .001$.

Table H13

Tukey Multiple Comparisons on the Age Effect for Mother Onlooking - Physical, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	27.26	14.32*
4 months vs. 7 months	35.02	14.32*
5 ½ months vs. 7 months	7.76	14.32

*$p < .01$.

Table H14

Analysis of Variance for Mother Onlooking - Gaze, Study 1

Source	df	F
	Between subjects	
Sex (S)	1	0.68
S within-group error	20	(65.81)
	Within Subjects	
Age (A)	2	0.47
A x S	2	0.04
A x S within-group error	40	(25.48)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

Appendix I

ANOVA Summary Table and Post-Hoc Comparison for the Unengaged Play Category, Study 1

Table I1

Analysis of Variance for Unengaged, Study 1

Source	df	F
	Within Subjects	
Age (A)	1.59	4.34*
A x S within-group error	33.47	(30.67)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$.

Table I2

Tukey Multiple Comparisons on the Age Effect for Unengaged, Study 1

Comparison	Mean Absolute Difference	Critical Difference
4 months vs. 5 ½ months	2.27	4.06
4 months vs. 7 months	4.91	4.06*
5 ½ months vs. 7 months	2.64	4.06

*$p < .05$.

Appendix J

Consent Form for Study 2

Informed Consent Form

This study is designed to look at the development of mother-infant communication and the different behaviors used by mothers and their infants during toy play. I understand that my aby and I will participate in a study lasting approximately 45 minutes. During the study, I will be seated facing my baby. For the first period I will be asked to play with my baby as I normally would at home, without using a toy, for a period of two minutes. Following this period there will be three periods where I will be asked to play with my baby as I normally would at home including a toy in my interaction. Each period will be brief, lasting approximately 90 seconds in length. The toys available for use are non-toxic, and are washed after each mother and infant play with them.

Under no circumstances will any manipulation be harmful to my baby, and my baby will remain in the room with me at all times. The entire session will be videotaped so that at a later point my responses, and those of my baby's may be observed. However, these recordings are kept in the strictest of confidence and are not shown to others without my permission. In all cases, recordings will be destroyed after coding is completed.

I understand that my participation in this study is totally voluntary. I know that I may withdraw at any time and for any reason. In the event that the results of the study are published, my name and the name of my baby will be kept confidential.

In the even that I have any unanswered concerns or complaints about the study, I may express these to dr. Dale Stack (848-7565) or Karen Colburne (848-7547) of the Psychology Department at Concordia University. In addition, the patient representative of the Jewish General Hospital is Roslyn Davidson (340-8222).

Thank you for your cooperation.

I _____ Do hereby give my consent for my baby

_____ To participate in a study conducted by Dr.

Dale Stack and Karen Colburne at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of this consent form has been given to me.

Signature: _____ Date: _____

Witness: _____ Date: _____

Appendix K

Examples of Functional and Social Play by Type of Toy, Study 2

Table K1

Examples of Functional Play by Toy, Study 2

Toy	Description
Lion	shaking the lion to make it rattle
	labelling any parts/colours on the lion while pointing them out
	helping the infant feel the texture of the toy
Worm	shaking the worm to make it rattle
	demonstrating and/or helping the infant explore the parts of the toy (e.g., squeaking the toy, crackling the feet)
	labelling any parts/colours on the worm while pointing them out
	demonstrating how the worm opens and closes with the velcro
	helping the infant to explore the different textures of the worm
Rattle	shaking the rattle
	demonstrating and/or helping the infant explore the parts of the toy (e.g., spinning the sun, sliding the spaceship)

Note. All toys made a sound when moved. Shaking of a toy was considered Social play when it was accompanied by a game-like movement of the toy and/or animation of the toy, as well as any of the behaviors listed under social play for each toy.

Table K2

Examples of Social Play by Toy, Study 2

Toy	Description
Lion	playing a looming game
	using the lion to tickle the infant
	using the lion to kiss the infant
	making the lion dance and/or talk to the infant
	playing hide-and-seek with the lion
Worm	playing a looming game
	using the worm to tickle the infant
	using the worm to kiss the infant
	making the worm dance and/or talk to the infant
	playing hide-and-seek with the worm
	making the worm "crawl" on the infant
	making the worm "slither" through the air in a game-like fashion
Rattle	using the rattle to hide behind in a game of peek-a-boo
	playing hide-and-seek with the rattle
	playing tug-of-war with the rattle
	singing the "Mr. Sun" song while moving the rattle rhythmically

Note. All toys made a sound when moved. Shaking of a toy was considered Social play when it was accompanied by a game-like movement of the toy and/or animation of the toy, as well as any of the behaviors listed under social play for each toy.

Appendix L

ANOVA Summary Tables, Post-Hoc Comparisons,

and Mean Tables for the Triadic Play Categories, Study 2a

Table L1

Analysis of Variance for Total Functional Play, Study 2a

Source	df	F
	Between subjects	
Age (A)	1	15.00**
Order (O)	1	0.58
A x O	1	0.5
S within-group error	54	(348.68)
	Within Subjects	
Toy (T)	1.95	124.04**
T x A	1.95	0.06
T x O	1.95	0.68
T x A x O	1.95	3.53*
T x S within-group error	105.11	(177.22)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .001$.

Table L2

Analysis of Variance for Social Play, Study 2a: Square Root Transformation

Source	df	F
	Between subjects	
Age (A)	1	5.33*
S within-group error	56	(6.34)
	Within Subjects	
Toy (T)	1.92	178.11**
T x A	1.92	0.11
T x S within-group error	107.31	(2.56)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$. **$p < .001$.

Table L3

Tukey Multiple Comparisons on the Main Effect of Toy for the Social Play Category.

Study 2a: Square Root Transformation

Comparison	Mean Absolute Difference	Critical Difference
Lion vs. Worm	2.42	0.88*
Lion vs. Rattle	5.6	0.88*
Worm vs. Rattle	3.18	0.88*

*$p < .01$.

Table L4

Transformed Means for the Percent Duration of Social Play by Infant Age, Study 2a: Square Root Transformation

Age	M	SE
4-month-olds	3.33	0.31
7-month-olds	4.21	0.33

Table L5

Transformed Means for the Percent Duration of Social Play by Type of Toy, Study 2a: Square Root Transformation

Toy	M	SE
Lion	6.42	0.25
Worm	4.01	0.32
Rattle	0.83	0.19

Table L6

Analysis of Variance for Supported Play, Study 2a: Square Root Transformation

Source	df	F
	Between subjects	
Age (A)	1	2.1
Order (O)	1	4.72*
Sex (S)	1	7.81**
A x O	1	0.01
A x S	1	0.04
O x S	1	0.25
A x O x S	1	1.88
S within-group error	50	(4.68)
	Within Subjects	
Toy (T)	1.98	8.35***
T x A	1.98	5.05**
T x O	1.98	0.37
T x S	1.98	2.67
T x A x O	1.98	0.22
T x A x S	1.98	2.78
T x O x S	1.98	0.03
T x A x O x S	1.98	1.43
T x S within-group error	98.78	(2.34)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*p < .05. **p < .01. ***p < .001.

Table L7

Transformed Means for the Percent Duration of Supported Play by Order, Study 2a: Square Root Transformation

Order	M	SE
One	2.55	0.21
Two	1.88	0.19

Table L8

Transformed Means for the Percent Duration of Supported Play by Sex, Study 2a: Square Root Transformation

Sex	M	SE
Male	1.77	0.19
Female	2.63	0.21

Table L9

Transformed Means for the Percent Duration of Supported Play for the Toy by Age Interaction, Study 2a: Square Root Transformation

Age	Toy		
	Lion	Worm	Rattle
4-month-olds	2.82 (0.29)	1.98 (0.33)	2.70 (0.31)
7-month-olds	1.30 (0.32)	1.44 (0.34)	2.98 (0.45)

Note. Values enclosed in parentheses represent standard errors.

Table L10

Analysis of Variance for Mother Onlooking, Study 2a

Source	df	F
	Between subjects	
Sex (S)	1	4.70*
S within-group error	56	(473.6)
	Within Subjects	
Toy (T)	1.9	2.61
T x S	1.9	3
T x S within-group error	106.54	(146.61)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$.

Appendix M

ANOVA Summary Table, Post-Hoc Comparisons and Transformed Means for Infants' Gaze at Mothers' Faces, Study 2a

Table M1

Analysis of Variance for Infants' Gaze at Mothers' Faces, Study 2a: Square Root Transformation

Source	df	F
	Between subjects	
Age (A)	1	5.80*
S within-group error	56	(3.72)
	Within Subjects	
Period (P)	2.8	234.10**
P x A	2.8	3.20*
P x S within-group error	156.94	(1.34)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*p < .05. **p < .001.

Table M2

Transformed Means for the Percent Duration of Infant Gaze at Mothers' Faces, Study 2: Square Root Transformation

Age	Period			
	No Toy	Lion	Worm	Rattle
4 months	6.90 (0.31)	2.38 (0.23)	1.86 (0.19)	1.60 (0.21)
7 months	6.88 (0.23)	3.64 (0.32)	2.64 (0.26)	2.01 (0.28)

Note. Values enclosed in parentheses represent standard errors.

Appendix N

ANOVA Summary Table for Infant Gaze at Toy,

Study 2a

Analysis of Variance for Infant Gaze at Toy, Study 2a

Source	df	F
	Between subjects	
Age (A)	1	17.11***
Order (O)	1	8.02**
Sex (S)	1	0.32
A x O	1	0.89
A x S	1	4.38*
O x S	1	0.68
A x O x S	1	0.94
S within-group error	50	(176.54)
	Within Subjects	
Toy (T)	1.53	57.55***
T x A	1.53	11.24**
T x O	1.53	4.19*
T x S	1.53	2.09
T x A x O	1.53	0.9
T x A x S	1.53	3.08
T x O x S	1.53	1.25
T x A x O x S	1.53	3.5
T x S within-group error	76.68	(77.8)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*p < .05. **p < .01. ***p < .001.

Appendix O

ANOVA Summary Table for Infant Smiling, Study 2a

Analysis of Variance for Infant Smiling, Study 2a

Source	df	F
	Between subjects	
Age (A)	1	22.19**
Order (O)	1	0.17
Sex (S)	1	0.12
A x O	1	2.2
A x S	1	0.11
O x S	1	5.04*
A x O x S	1	0.32
S within-group error	50	(643.37)
	Within Subjects	
Period (P)	2.87	111.71**
P x A	2.87	12.71**
P x O	2.87	6.25**
P x S	2.87	1.57
P x A x O	2.87	0.71
P x A x S	2.87	2.08
P x O x S	2.87	0.82
P x A x O x S	2.87	0.84
P x S within-group error	143.68	(205.61)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*p < .05. **p < .001.

Appendix P

ANOVA Summary Table and Transformed Means for the Co-occurrence of Infants' Gaze at their Mothers' Faces and Infant Smiling, Study 2a

Table P1

Analysis of Variance for the Co-occurrence of Infant Gazing at Mothers' Faces Given Infant Smiling, Study 2a

Source	df	F
	Between subjects	
Age (A)	1	8.54**
Order (O)	1	5.29*
A x O	1	0.31
S within-group error	54	(4.87)
	Within Subjects	
Period (P)	2.52	151.04***
P x A	2.52	3.67*
P x O	2.52	1.63
P x A x O	2.52	0.66
P x S within-group error	136.09	(2.81)

Note. Values enclosed in parentheses represent mean square errors.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table P2

Transformed Means for the Percent Duration of Co-occurrence of Infant Gazing at Mothers' Faces Given Infant Smiling by Age and Toy, Study 2a

Age	Period			
	No Toy	Lion	Worm	Rattle
4 months	7.87 (0.27)	2.65 (0.30)	1.74 (0.39)	1.28 (0.32)
7 months	7.60 (0.22)	4.18 (0.39)	3.30 (0.43)	1.93 (0.39)

Note. Values enclosed in parentheses represent standard errors.

Table P3

Transformed Means for the Percent Duration of Co-occurrence of Infant Gazing at Mothers' Faces Given Infant Smiling by Order, Study 2a

Order	M	SE
One	3.47	0.27
Two	4.16	0.29

Appendix Q

ANOVA Summary Tables, Post-Hoc Comparisons,

and Mean Tables for the Triadic Play Categories, Study 2b

Table Q1

Analysis of Variance for Functional Play, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	3.33
A x S within-group error	18	(170.88)
Toy (T)	1.62	52.67*
T x S within-group error	29.17	(299.11)
T x A	1.85	1.04
(T x A) x S within-group error	33.31	(106.78)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .001$.

Table Q2

Tukey Multiple Comparisons on the Main Effect of Toy for the Functional Play Category, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
Lion vs. Worm	26.17	17.34**
Lion vs. Rattle	40.1	17.34**
Worm vs. Rattle	13.93	13.65*

*$p < .05$. **$p < .01$.

Table Q3

Analysis of Variance for Social Play, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	1.12
A x S within-group error	18	(287.63)
Toy (T)	1.73	120.40*
T x S within-group error	31.12	(149.34)
T x A	1.66	0.2
(T x A) x S within-group error	29.83	(101.15)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .001$.

Table Q4

Tukey Multiple Comparisons on the Main Effect of Toy for the Social Play Category, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
Lion vs. Worm	23.67	12.48*
Lion vs. Rattle	43.44	12.48*
Worm vs. Rattle	19.77	12.48*

*$p < .01$.

Table Q5

Analysis of Variance for Supported Play, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	1.29
A x S within-group error	18	(43.58)
Toy (T)	1.86	7.63*
T x S within-group error	33.4	(48.99)
T x A	1.75	2.06
(T x A) x S within-group error	31.57	(43.72)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .01$.

Table Q6

Tukey Multiple Comparisons on the Main Effect of Toy for the Supported Play Category, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
Lion vs. Worm	2.67	5.52
Lion vs. Rattle	3.58	5.52
Worm vs. Rattle	6.25	5.52*

*$p < .05$.

Table Q7

Analysis of Variance for Mother Onlooking, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	10.25*
A x S within-group error	18	(175.43)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .01$.

Appendix R

ANOVA Summary Table, Post-Hoc Comparisons, and Figure for Infants' Gaze at Mothers' Faces, Study 2b

Table R1

Analysis of Variance for Infants' Gaze at Mothers' faces, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	2.43
A x S within-group error	18	(203.57)
Period (P)	1.55	169.82*
P x S within-group error	27.87	(103.96)
P x A	1.58	1.02
(P x A) x S within-group error	28.45	(125.75)

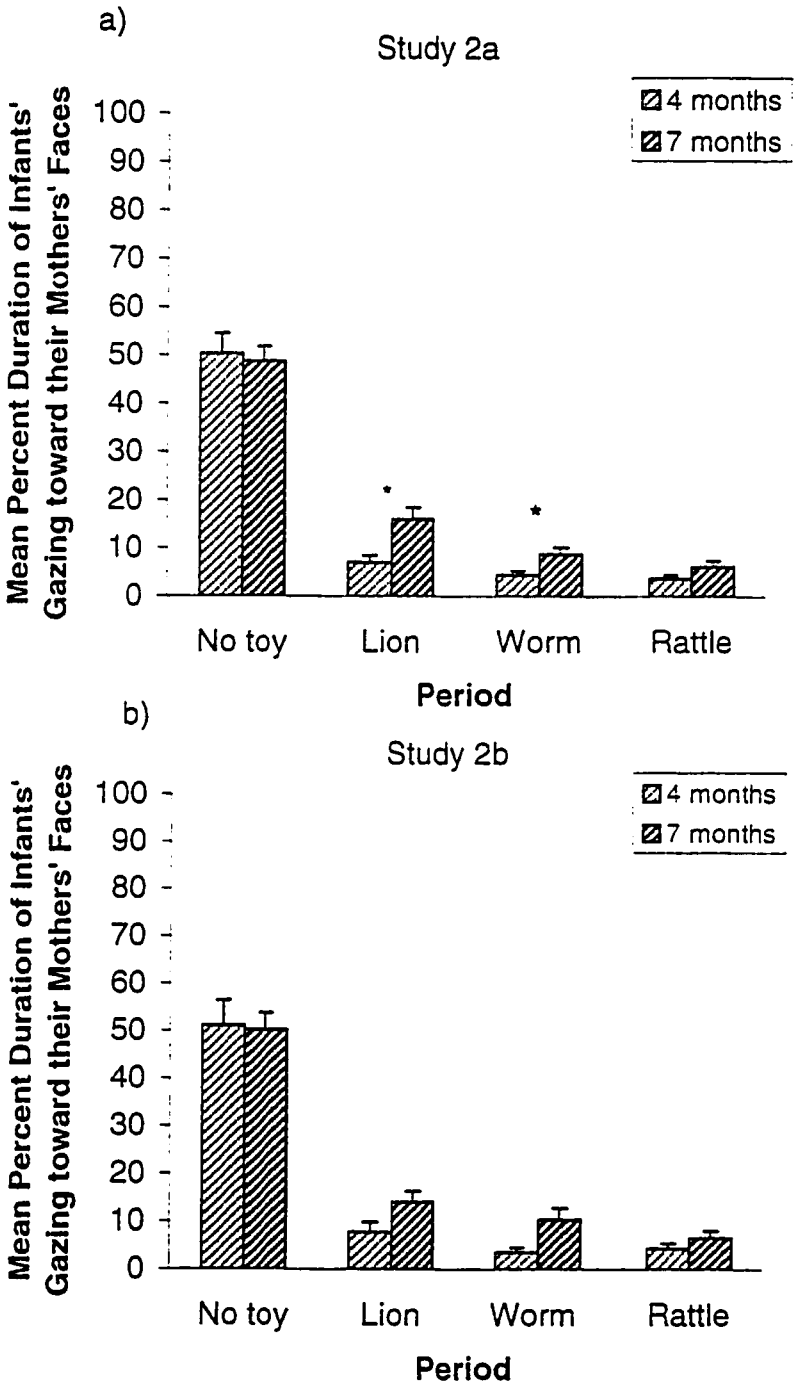
Note. Values enclosed in parentheses represent mean square errors. S = subjects.

Table R2

Tukey Multiple Comparisons on the Main Effect of Period for Infants' Gaze at Mothers' Faces, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
No Toy vs. Lion	39.74	10.76*
No Toy vs. Worm	43.68	10.76*
No Toy vs. Rattle	45.18	10.76*
Lion vs. Worm	3.94	10.76
Lion vs. Rattle	5.44	10.76
Worm vs. Rattle	1.5	10.76

*$p < .01$.



Figures 1a and 1b. Mean percent duration of infants' gazing toward their mothers' faces as a function of Period for Study 2a (1a) and 2b (1b).

Appendix S

ANOVA Summary Table and Post-Hoc Comparisons for the Infant Gaze at Toy, Study 2b

Table S1

Analysis of Variance for Infant Gaze at Toy, Study 2b

Source	df	F
	Between subjects	
Order (O)	1	4.90*
S within-group error	17	(193.94)
	Within Subjects	
Age (A)	1	8.44**
A x O	1	0.18
A x S within-group error	17	(156.34)
Toy (T)	1.46	32.46***
T x O	1.46	0.99
T x S within-group error	24.89	(66.07)
A x T	1.43	1.6
A x T x O	1.43	0.53
A x S within-group error	24.39	(92.28)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table S2

Tukey Multiple Comparisons on the Main Effect of Infant Gaze at Toy, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
Lion vs. Worm	11.66	8.30*
Lion vs. Rattle	14.73	8.30*
Worm vs. Rattle	3.07	8.3

*$p < .01$.

Appendix T

ANOVA Summary Table for Infant Smiling, Study 2b

Analysis of Variance for Infant Smiling, Study 2b

Source	df	F
	Between subjects	
Order (O)	1	0.29
S within-group error	17	(705.11)
	Within Subjects	
Age (A)	1	6.15*
A x O	1	0.58
A x S within-group error	17	(426.36)
Period (P)	2.54	113.44***
P x O	2.54	7.64***
P x S within-group error	43.22	(128.56)
A x P	2.13	5.60**
A x P x O	2.13	1.27
A x S within-group error	36.15	(182.47)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*p < .05. **p < .01. ***p < .001.

Appendix U

ANOVA Summary Table, Post-Hoc Comparisons and Figure for the Co-occurrence of Infants' Gaze at their Mothers' Faces and Infant Smiling, Study 2b

Table U1

Analysis of Variance for the Co-occurrence of Infant Gazing at Mothers' Faces Given Infant Smiling, Study 2b

Source	df	F
	Within Subjects	
Age (A)	1	5.18*
A x S within-group error	18	(287.3)
Period (P)	1.88	89.30**
P x S within-group error	33.8	(279.77)
P x A	2.01	2.18
(P x A) x S within-group error	36.17	(147.78)

Note. Values enclosed in parentheses represent mean square errors. S = subjects.

*$p < .05$. **$p < .001$.

Table U2

Tukey Multiple Comparisons on the Main Effect of Period for the Co-occurrence of Infant Gazing at Mothers' Faces Given Infant Smiling, Study 2b

Comparison	Mean Absolute Difference	Critical Difference
No toy vs. Lion	47.22	13.02*
No toy vs. Worm	52.48	13.02*
No toy vs. Rattle	53.3	13.02*
Lion vs. Worm	5.26	13.02
Lion vs. Rattle	6.08	13.02
Worm vs. Rattle	0.82	13.02

*$p < .01$.

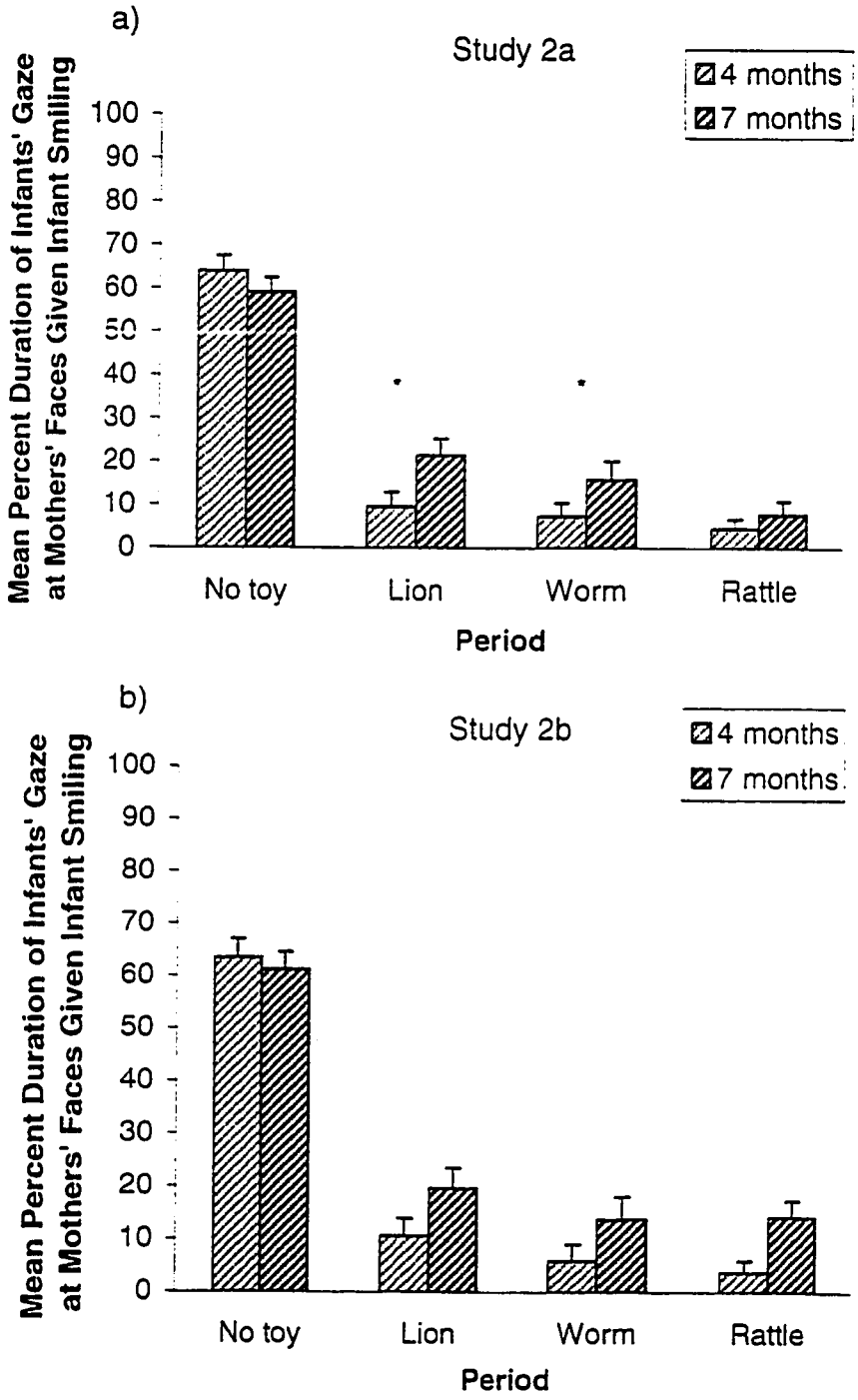


Figure 1a and 1b. Mean percent duration of infants' gaze at mothers' faces given infant smiling as a function of Age and Period for Study 2a (a) and 2b (b). Standard errors are shown by vertical bars.