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Language, Social Interactions, and Attention as Predictors of Reading Development in Second Grade

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LANGUAGE, SOCIAL INTERACTIONS, AND ATTENTION AS PREDICTORS OF READING DEVELOPMENT IN SECOND GRADE

by

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ABSTRACT

Language, Social Interactions, and Attention as Predictors of

Reading Development in Second Grade

by

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Social interactions between 153 mother-infant dyads in the laboratory were examined for associations with language and play preferences when infants were 14 months old. Later associations with reading skills, attention, and book reading were examined at the end of second grade. Mothers and infants were videotaped in a 20-minute laboratory observation at 14 months, and joint visual attention and social toy play were coded from the interactions. Language was assessed at 14 months using a standardized instrument, and mothers rated their own and their infants' preferences for specific types of play. A follow-up study, conducted at the end of second grade, assessed decoding and reading comprehension skills, attention and distractibility in the classroom and at home, and the frequency of mother-child book reading. A path model was constructed to examine predictive relations from infancy to second grade. The results suggest that early social interactions are both directly and indirectly related to language

in infancy. Joint attention was associated with maternal responses during play and infant preferences for point and name games, which were in turn related to language development. Social interactions in infancy were negatively related to cognitive problems in second. There were small bivariate associations between infant langauge and play interactions with later reading skills. However, the strongest predictors of reading skills in second grade were children's abilities to sustain attention in relation to cognitive tasks in the classroom. The results suggest that early social interactions involving language and play may foster both language abilities and attention-sustaining abilities, which then influence the development of literacy skills.

(182 pages)

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CHAPTER I

STATEMENT OF THE PROBLEM

There are multiple contexts in which mother-infant social interactions are important to language development and later reading. These contexts include joint attention to objects and joint action on objects. Joint attention to objects represents a cognitive skill that is related to social, cognitive, and language development in infancy (Mundy & Gomes, 1998). Joint attention is defined as the ability to organize one's attention in relation to another person toward an outside object or event (Carpenter, Nagell, & Tomasello, 1998). The ability to focus attention is important during the school years as well. Poor self-regulation of attention in first grade can lead to reading and math problems (Alexander, Entwisle, & Dauber, 1993). Coregulated joint attention skills lay the foundation for later language, self-regulated attention, and reading skills. Therefore, it is important to understand how mothers help their infants focus and regulate attention early on.

Joint attention is a cognitive skill dependent upon both infant developmental level and maternal stimulation. There may be a biological argument for the development of joint attention skills, reflecting differences in children's attention-focusing abilities. Infants are capable of sustaining joint attention to objects as early as 6 months of age, but do not do so reliably until around 12 months of age (Corkum & Moore, 1995). Joint action, however, is much more dependent upon both mother's and infant's interpersonal social skills. Joint action involves not only gaze following, but coordinating actions with another person.

Joint actions occur during mother-infant social toy play. Social toy play is defined as social interactions with toys which are initiated and responded to reciprocally by infants and their adult play partners. Mother-infant social toy play is a very complex process of interactions, in which some mothers show much more skill than others. Some mothers are very good at following their infant's lead in play and responding to infant play initiations. Other mothers are less skilled in these areas, and tend to either ignore infant initiations altogether or direct the play sessions themselves. Infants also vary in their ability to coordinate social interactions in play.

It appears from the literature that early maternal initiations of play are important for inducing infant play and establishing a context for modeling play. In addition, specific information about toys provided by mothers increases infants' complexity of play more so than general attention directing (Landry, Garner, Swank, & Baldwin, 1996). Later, as infants become more skilled at "two-way interactions" between themselves and their mothers, maternal responsiveness becomes increasingly critical for reinforcing infant initiations and language use. Mothers who follow into and verbally respond to an infant's visual focus are fostering language and gestural abilities (Carpenter et al., 1998).

Joint actions on toys, in particular, facilitate language development. When infants and mothers are visually focused on the same objects, they are able to "discuss" (verbally or through actions) what is occurring in that particular context. This gives infants very specific information about the objects. However, when infants and mothers act together on an object, the infant is getting constant feedback not only about his/her actions on the object, but also mother's actions on the objects. Anyone who has tried to build a house

of cards with someone knows how difficult it can be to coordinate actions with another to create something meaningful. Any little mishap will ruin the endeavor, and the two must start over. This is likely how infants feel as they are beginning to coordinate object play with another. They must learn not only to interpret consequences of their own and their play partner's behavior, but they must also learn to anticipate the actions of others through repeated interactions.

Specific characteristics of social toy play, such as maternal responsiveness, are critical for both infant cognitive and social development. As mentioned previously, infants learn to anticipate maternal responses. Socially, then, they are much more likely to involve themselves with mother in play contexts if they are secure in the fact that she will reciprocate play. Infants then come to anticipate similar responses to their social bids from other adults (Moore & Corkum, 1994). Cognitively, mothers who respond to infant social play bids are offering much more information for their infants than mothers who do not respond. They are also offering more verbal responses during active toy play (Barratt & Roach, 1999). In fact, mothers are offering more information during joint play than the infant could have gotten from the environment alone, and they are offering a different kind of information. They are labeling and describing objects, as well as teaching infants about how objects work and how they can coordinate their interactions to facilitate sequences of behavior with bidirectional influences. This information is qualitatively different than naming properties of objects.

Without a context of at least joint attention to objects, it is likely that infants will pick up very little environmental information. They will assimilate much more and

richer information if they collaborate with mother (or another significant caregiver) in object-oriented play. However, there is likely an interaction between genetically linked language and attention abilities and socially reinforced behaviors. In line with Vygotsky's notion of the zone of proximal development (1934), there may be an upper threshold on what infants are capable of learning, based on both their current developmental level and differences in natural ability. Supportive play partners, however, may be able to advance infant cognitive and social skills by modeling first and then responding to social interactions with toys. In order to test this assumption, it is necessary to measure both joint visual attention to objects and joint action on objects during social play.

How do these effects on early language carryover into literacy learning in early childhood? First, as mentioned previously, maternal responsiveness in play may contribute to a child's internal working model of relationships, which may then stimulate or inhibit collaborative learning in school. Secondly, responsiveness may be a stable characteristic of parenting styles which influences children's learning tendencies both in infancy and early childhood. Thirdly, early language development fostered by maternal behaviors may give some children an advantage in verbal understanding related to words, and later printed materials. Mother's speech may foster infant's phonological awareness and vocabulary. Maternal attention directing early in infancy may direct infants toward contextual cues in language learning. This ability to use contextual cues in word learning may transfer to a supplemental reading skill in deciphering the meaning of written text. Attention-focusing skills, developed in infancy but important throughout the school

years, may affect reading outcomes in school. Lastly, preference for some types of early interactions may indicate a tendency toward effective communication using words and symbols, and those who are linguistically advanced will show higher scores on both infant measures of language as well as later measures of reading competence.

Purpose of the Study

The purpose of this study was to examine associations among early joint attention, early mother-infant social toy play, early language, and later reading development. Specific maternal and infant behaviors, such as initiations of social interactions with toys and responsiveness toward the initiations of the play partner, were examined. The longitudinal associations between these early social interactions and later attention, reading, and maternal book reading were explored, as well as longitudinal associations between early language and later reading.

Research Questions

Not all of the links established in the literature between early mother-infant interactions and language and later literacy can be tested in this sample. However, some specific research questions can be addressed.

1. Is mother-infant joint attention associated with mother-infant social toy play at 14 months?
2. Is mother-infant joint attention associated with infant language at 14 months?
3. Is mother-infant social toy play associated with infant language at 14 months?

4. Are mother and infant preferences for language and literacy activities associated with infant language at 14 months?

5. Are mother and infant preferences for language and literacy activities at 14 months associated with maternal book reading in second grade and children's reading skills in second grade?

6. Is there an association between infant language at 14 months and children's reading skills in second grade?

7. Are there associations between joint attention and mother-infant social toy play at 14 months, children's ability to sustain attention in second grade, and children's reading skills in second grade?

CHAPTER II

REVIEW OF LITERATURE

Reading failure has long-term consequences for students, and constitutes an urgent challenge to researchers and educators (Lyon, 1998). However, literacy is strongly related to early language development (Scarborough, 1990). Thus, the roots of literacy start very early in infancy, when infants are first learning about communication and speech sounds. In fact, there is variability in language trajectories by age two which is associated with lasting differences in linguistic and communicative competence, and these differences can be traced back to the language environment. In particular, parent-infant interactions across the first three years of life are strong predictors of later linguistic and literacy outcomes (Hart & Risley, 1995). The following literature review will describe the theoretical orientations and base of research literature which address early contexts affecting language learning, such as mother-infant social interactions, periods of joint attention, and language and literacy experiences in the home. Then, the implications for later attentiveness and reading will be described.

Theoretical Orientations

According to several theorists, cultural and environmental factors influence language development. This review of theoretical orientations will move from the broadest level of socio-historical cultural influence, to more specific mechanisms of cultural influence such as parent-infant interactions, and finally, to specific reinforcement techniques through which parents support early language learning.

Vygotsky

Vygotsky's socio-historical theory focuses on the cultural transmission of knowledge through cultural tools. This theory has implications for understanding the transmission of language and other cognitive tools to children. In 1929 Vygotsky wrote:

> In the process of development the child not only masters the items of cultural experience, but the habits and forms of cultural behavior and cultural methods of reasoning. We must, therefore, distinguish the main lines in the development of the child's behavior. First, there is the line of natural development of behavior which is closely bound up with the processes of general organic growth and maturation of the child. Secondly, there is the line of cultural improvement of the psychological functions, the working out of new methods of reasoning, the mastering of the cultural methods of behavior. (p. 415)

In this perspective, the culture defines appropriate ways of thinking, or the processes of cognition, in addition to the standards of evaluation of one's thinking. These concepts can be applied to the contextual influences on language learning, such as joint attention.

In infant language literature, there is a great emphasis on the development of joint attention skills in relation to language. Some of these skills are thought to stem from the "natural line of development," that is, as children get older and more physically mature, infant ability to focus attention toward objects emerges (Corkum & Moore, 1995). However, cultural "attunement" to an infant's developmental level helps infants to coregulate their attention by jointly focusing attention to objects with another person, to learn the association between joint visual focus and referential meaning, and to use

attention directing in communication. These are the "cultural tools" that are used to facilitate infant cognitive development and understanding of communicative behaviors (Tomasello, 1995). How are these tools related to language acquisition in Vygotsky's theory?

Language is a cultural tool that has evolved for a reason. According to Vygotsky (1934) "the primary function of speech is communication, social intercourse" (p. 6). For "understanding between minds" to occur, it is the meaning, rather than the sign or the sound, which must be transmitted between individuals. A mediating system of verbal language is necessary to transmit these meanings between individuals. Word meanings are not stable, but rather evolve as the child develops. In addition, the "sense" of the word, the "sum of the psychological events aroused in our consciousness by the word," will change with the context in which it appears, even when the meaning has become more developed and narrowed (p. 146). How is it that word meanings develop very early in infancy? A closer look at instructional strategies, as explained by Rogoff, will clarify this in the next section.

One point needs to be clarified regarding Vygotsky's theoretical framework before moving on to instructional strategies. Cognitive processes that occur on the intermental plane also occur on the intramental plane. That is, cognitive processes that occur at the individual level, such as memory, also occur between individuals, such as collective memory. Therefore, terms such as cognition, memory, and attention can apply equally as well to social interactions as to individual accomplishments. In this case, "some modifier must be attached" when referring to these terms on a social level. This is

where terms such as socially shared cognition and joint attention come from (Wertsch & Tulviste, 1992, p. 549). One important process that occurs at the social level is intersubjectivity, and is addressed by Rogoff's theoretical framework.

Rogoff

Rogoff's (1990) theoretical premises extend Vygotsky's notion of cultural transfer by describing the specific mechanisms through which this occurs. Primary and secondary intersubjectivity are terms that get at the heart of socially shared cognitions. Primary intersubjectivity refers to shared understanding between people, which often occurs through face-to-face interactions. Secondary intersubjectivity occurs when two individuals organize their attention mutually toward an outside object, such as playing together with a toy. In both cases, participants must adjust their perspectives to reach a mutual understanding. During the first year of life, there is a shift from primary intersubjectivity towards secondary intersubjectivity, changing from a focus on affect to a focus on outside entities and infant goal attainment. Responsive caregivers facilitate intersubjectivity through guided participation.

Guided participation bridges children's current level of skill and understanding with potential levels in social interactions. During guided participation, children's participation in joint actions is structured such that, as their skill level increases, they become increasingly active in arranging and carrying out the task. Adults structure tasks in ways that make them solvable for the child. Adults focus children's attention toward the task, simplify the problem, and maintain children's focus on attaining the goal. They also point out discrepancies between what the child has figured out and alternative

solutions, reduce frustration levels, and demonstrate effective solutions (Rogoff, 1990). Establishing intersubjectivity through such strategies as guided participation is important for language learning, because it allows the infant to understand the communicative intent even if they do not comprehend the words. Bruner's (1977, 1983) research on joint attention describes one way in which parents establish intersubjectivity with their infants in order to facilitate language learning.

Bruner

Bruner's (1977, 1983) work with joint attention and language fostered research endeavors as well as advancement of theory in these areas. Bruner's basic theoretical assumption is based on Vygotsky's idea that meaning is transmitted during interpersonal interactions. In order to communicate, humans must be focused on the same objects or topics. Carpenter et al. (1998) summarized Bruner's theoretical focus as such: "The basic idea is that joint-engagement interactions are based on social processes more basic than language and that they therefore make language acquisition possible by creating a shared referential framework within which the child may experientially ground the language used by adults" (p. 24). Linguistic conventions do not acquire meaning based on the properties of the objects or events themselves, but rather "gain communicative significance by agreement among users" (p. 24). In other words, the meaning of language is not tied to the objects themselves but rather on a shared understanding between communicative partners when both partners link the referrent to the word. If this is the case, then "the child can acquire active use of a linguistic convention only if

she enters into this agreement by participating in the kinds of social interactions that constitute that convention's communicative significance" (p. 25).

Language learning in the presence of the word referent has many advantages for infants. Since very young infants do not have the language base necessary to understand the meaning of words, they must have "other ways of establishing a shared referential framework in their social interactions" (Carpenter et al., 1998, p. 25). In this way, they are capable of understanding the communicator's intent without necessarily having full comprehension of the words used.

Bruner (1983) described language-learning formats as possessing several critical features, including simple content, repetitions, and clear adult-child role structures. These features are most apparent in familiar and routine transactional formats, such as games. The early formats which support language acquisition are often centered around "joint tasks" (Bruner, 1977). These tasks include infant goal attainment, daily care routines, and maintaining interactions in a game. Within joint tasks, infants shift from primarily a demand mode or a request mode to an exchange mode. The infant at 8 to 10 months is beginning to coordinate actions with objects toward another person. This mode is gradually transformed into a reciprocal mode, whereby the infant understands that action formats are reciprocal, with complementary roles. Formats such as "give and take" become routine. Within these formats of "give and take," infants begin initiating object exchanges, and infant vocalizations are inserted into the game. Turn-taking becomes routinized, and occurs for longer periods. These actions "provide a solid basis for language to enter the routine and, eventually, for language to become the carrier of

the routine" (Bruner, 1977, p. 287). The "action dialogue" is enhanced by the addition of a verbal dialogue.

Several characteristics of these formats may be reinforcing for infants who are learning to use language. In fact, through intersubjectivity within routinized interpersonal interactions, parents often set up situations where language and attention to interpersonal communication are reinforced. Skinner's theory will explain this in more detail.

Skinner

Skinner's *Verbal Behavior* (1957) outlines specific reinforcing effects on verbal behavior that can either increase or decrease the use of verbal language in social interactions. A child growing up in a family that reinforces verbal behavior is likely to produce verbalizations quite often. A child growing up in the absence of reinforcement for verbal behavior may be relatively silent or withdrawn. Quantity of verbal behavior (sociableness) may be reinforced, or particular styles or themes in verbal behavior may be reinforced. What is reinforcing to the listener will depend on the immediate contingencies and the listener's reinforcement history.

There are several ways in which language is reinforced naturally by parents within routinized interpersonal interactions. Parents often respond to desired verbal behaviors. Responses that may be reinforcing to infants and small children include parental verbalizations, eye contact, facial expressions, and physical touch. Maternal attention, including behaviors as simple as orienting her body, head, and gaze toward her infant, can have a reinforcing effect on desired infant behaviors (Perez & Gewirtz, 1999).

Parents also reinforce language in the natural context by shaping desired verbal behaviors. The desired form of language, whether it be pronunciation or correct grammatical form, is brought about by reinforcing successive approximations of the correct verbal behavior. An example would be shaping babbling into words and sentences (Gleason, 1997). Parents and others use specific teaching techniques, such as incidental teaching, to shape language skills. Incidental teaching involves responding to a child's verbal initiation, and asking for an elaboration or improvement of the child's request. If the child does not respond by elaborating or improving his/her request, the adult models or prompts an elaboration and then confirms appropriate responses (Hart & Risley, 1975; Mudd & Wolery, 1987). Reinforcement, by providing the object, assistance, or information the child requested, is "contingent upon an appropriate response or an approximation of it" (Cavallaro & Poulson, 1985, p. 2). Parents may do these things consciously, as when teaching a new word, or unconsciously, as when they try to understand children's first approximations of a word.

In fact, parents and other adults set up situations where language can be reinforced both by responding to the child's verbalizations and by using prompting and modeling techniques. This is particularly true during play routines, where parents prompt with questions like "What is this?" or "What color is this?" and model with comments like "That is a doggie."

The theoretical orientations covered in this section describe influences on infant language, ranging from a very broad perspective to very specific techniques used by parents and care givers. This leads us to the current research on two components of the

language environment, joint attention and social interactions, which facilitate language acquisition and affect later language outcomes, such as reading.

Research Literature

The asssociations between mother-infant interactions and infant language development cited in the following review of literature are generally small to moderate (ranging from an r of .20 to.50). Most of these studies are observational studies of mother-infant interactions, with small sample sizes. Therefore, power is limited, and statistical significance tests are conservative. Unless otherwise stated, associations reported can be assumed to be small to moderate. Nevertheless, the combined effects of multiple observational measures of mother-infant behaviors and maternal report of activities at home can account for up to 50% of the variance in infant language (Rollins, Marchman, & Mehta, 1998). In addition, the replication of findings from study to study, despite the lack of individually large effect sizes, supports the findings presented in the review of literature.

Language Trajectories

There is consistent evidence that gains or lags in early language development remain stable into early childhood. In fact, the gap between accelerated and disadvantaged language learners widens as they progress from infancy to school age (Hart & Risley, 1995). At 30 months the children in low SES homes already had only half the vocabulary size as those from more economically advantaged homes. By age 3,

then, children in economically disadvantaged environments have sizably smaller vocabularies and they are adding words to their existing vocabularies more slowly, thus producing this "ever-widening gap" (Hart & Risley, 1995, p. 164). Vocabulary size in kindergarten is strongly associated with vocabulary size in sixth grade for low-income children (DeTemple, 1999), suggesting that the growth curve differences remain stable throughout the elementary school years.

The vocabulary growth curve is also strongly associated with differences in the language environment. Reinforcement of verbal communication in infancy is predictive of later vocabulary size and use. Discouragements, and particularly prohibitions, are negatively correlated with children's vocabulary growth. The strongest overall predictor of children's vocabulary growth, however, is the amount of parent talk in the home. The total number of words parents said per hour, as well as the number of nouns, verbs, and modifiers used by parents, are associated with children's vocabulary growth and use. The variety of parental words used is also related to the variety of words used in children's speech at age 3. As part of the *culture* transmitted to the child, the amount that the child talked *stopped increasing* when the child reached the typical amount that the family talked, even though the child had the skills to talk more than the family usually did. Thus, not only vocabulary but also orientation toward communication is established very early in life (Hart & Risley, 1995). Other important parenting factors that influence children's language development include responsiveness, guidance style, symbolic emphasis in interactions, and joint attention with infants (Carpenter et al., 1998; Hart & Risley, 1995).

Joint attention and language. Joint attention episodes facilitate language development. The first intentionally communicative acts of infants emerge as communicative gestures in the context of joint attention (e.g., pointing). From these episodes of gesturing and checking back with the adult, the inference can be made that infants are understanding the referential purpose of their actions. Referential words emerge shortly thereafter (Carpenter et al., 1998).

The duration of time mother-infant dyads spend in joint attention is related to infant language and gesture use. In fact, 50% of the variation in receptive vocabulary at twelve months is associated with the combined effects of coordinated joint attention in a free play session and maternal report of the frequency of shared activities requiring joint attention at home (Rollins et al., 1998). Joint attention as early as 6 to 8 months of age is related to productive vocabulary at 17 and 24 months (Saxon, 1996). Mother's use of language to follow an infant's attentional focus is also related to infant language and gestural abilities (Carpenter et al., 1998). Maternal responsiveness to infant visual attention is related to infant language comprehension at 13 months (Baumwell, Tamis-LeMonda, & Bornstein, 1997).

What occurs in the context of joint attention which facilitates language development? Both mothers and infants speak more frequently and for longer durations during joint attention episodes than when they are not jointly focused on an object (Tomasello & Farrar, 1986). Mothers offer more support and engage in less off-topic speech when their 2-year-old is visually attending to the task. Toddlers also seek verbal help more frequently when they are attending to the task (Hustedt & Raver, 1998).

Infant vocabulary learning is strengthened during periods of joint attention (Dunham & Dunham, 1995; Yale & Fullmer, 1999). When mothers check and follow their infants' line of reference and respond contingently, there is a match between the child's visual target and mother's verbal cues and descriptions. This is an effective way to foster vocabulary growth. Toddlers are also more likely to learn the labels of objects when the label is provided for an object they are attending to rather than one they are not attending to (Dunham & Dunham, 1995). Following a training phase where an experimenter followed into the infant's lead and labeled a novel object the infant was focused on, as opposed to the condition where the experimenter labeled an object not focused on by the infant, infants were more likely to correctly shift attention to the labeled toy when asked "Where is it?" (Yale & Fullmer, 1999). Thus, their receptive skills and attention-following skills seem to correctly identify objects when labeling occurs in a "follow-in" condition.

The developmental trend in joint attention skills can be seen in the association between maternal and infant behaviors and language development. At 6 to 8 months of age, infants who engage in proportionally more joint attention tend to have higher productive vocabularies at the end of the second year than infants who do not engage in joint attention. However, maternal attention following or switching at this early time point is not related to later language (Saxon, 1997). Mutual gaze, rather than maternal gaze following, seems to be influential when infants are first learning how to organize attention.

Joint attention during social toy play and emerging language skills. Both mothers and infants are directing attention toward toys and each other during social toy play, in particular, when they are exchanging toys. Infants may use an imperative gesture, such as directing attention to obtain help in reaching a goal, or they may use a declarative gesture, such as directing attention to request mother's shared attention to an object (Carpenter et al., 1998). Offering toys to mother in social play might serve as an imperative request for mother to do something with the toy. Showing toys, on the other hand, would serve as a declarative gesture, requesting mother's attention to the toy, and serving the same function as pointing. Infants begin pointing to and showing toys between 10 and 13 months, but do so with greater frequency between 12 and 15 months (Carpenter et al., 1998). There is little consensus as to whether imperative or declarative gestures and words appear first, although both types of communication are developing around the same developmental time period, with gestures appearing before words (Carpenter et al., 1998). Mothers also use imperative and declarative gestures in social toy play to focus an infant's attention or to change the attentional topic.

During social toy play, mothers and infants have an opportunity to engage in joint attention. Initially, when infants are unable to focus their attention for long periods of time, mothers can use toys to direct and focus an infant's attention. As an infant's cognitive and attentional capacity increases, the infant is more likely to focus visual attention toward toys and to use toys in social exchanges (Messinger & Fogel, 1998). As this occurs, the mother's role may shift to that of a supportive partner. Whereas initially mother was responsible for "getting things going," she is now responsible for "keeping

things going." Mothers use responsive behaviors to support or extend an infant's verbal and behavioral attention toward an object. This occurs in social play through acknowledging infant initiations (smiling, verbalizing, etc.) or accepting toys which the infant offers. By manipulating a toy which the infant offered, mothers are providing specific cognitive and verbal information about the uses of the toy, which facilitates language development (Landry et al., 1996). In addition, mothers can extend the exchange back to the infant and stretch out the length of mutual attention toward that object. All of these behaviors are beneficial to infant language development. Mothers who engage in several of these kinds of "topic maintaining behaviors" (Baumwell et al., 1997) may have substantially stronger effects than those who engage in a few.

A mother may redirect her infant's attention during social play by taking toys from the infant that were not offered to the mother, taking back toys that were given to the infant, and offering and showing toys when the infant is visually focused on another object. This type of maternal control is not likely to foster language learning in social play. In fact, maternal control is associated with fewer language initiations by children and less overall amount of children's communication (Duchan, 1989). Maternal control and negative verbal feedback tone in mother-infant interactions, such as maternal prohibitions, disconfirmations, criticisms, and disparagements, are negatively associated with children's long-term vocabulary growth and use (Hart & Risley, 1995).

Labeling objects on which the infant is focused is beneficial to infant label learning (Dunham & Dunham, 1995). During infant-initiated toy exchanges, mothers are labeling and describing objects to which the infant is already attending. In periods of

coordinated joint attention to toys, infants are also alternating their gaze between mother and the toys. Mothers are more vocally responsive to their infant during active play and when the infant is visually focused on the mother, thus providing a more enriched language environment during these contexts (Barratt & Roach, 1999). During social toy play, mothers are providing both information and contextual cues about the objects and labels, which facilitates infant vocabulary growth.

Pointing during mother-infant social interactions is often followed by labeling and describing objects. The simple frequency of mother and child pointing sequences during book reading and toy play is moderately related to 14-month productive vocabulary (Rowe, 1999). This suggests that "the successive use of the pointing gesture by mother and child around an object of joint attention may be conducive to child vocabulary development" (p. 2).

Mothers and infants are also engaging in "routinized activities" during social toy play. These routinized, coordinated games and gestures require the intersubjectivity described by Rogoff (1990). Activities such as peekaboo, patty cake, chasing, singing, dancing, and playing "so big" are highly routinized such that infants know what to expect from the situation. In this context, they can establish a shared meaning and apply new words to those they already have learned. These kinds of routinized attention-directing activities, assessed from maternal report on the MacArthur CDI at 12 months in a recent study, require coordinated attention to carry out the routine and are associated with receptive vocabulary (Rollins et al., 1998).

Both joint attention and social toy play will vary depending on the child's current developmental level. In order to understand the contributions that mothers make to language learning in these contexts, it is first necessary to outline the developmental sequence of infant capability in initiating and maintaining joint attentional interactions.

The development of joint attention. Human infants learn early in their first year of life to use collective human knowledge to guide their own actions (Bruner, 1983). In order to access this collective knowledge, infants must learn to organize their attention in relation to another's visual focus. Joint attention develops between 9 and 15 months, progressing from mutual gaze to following another's gaze to directing another's attention (Carpenter et al., 1998). Infants are capable of sharing attention to an object by around 9 months of age, and the frequency and duration of episodes of joint engagement increase dramatically from 12 to 18 months (Adamson & Bakeman, 1985). However, mutual gaze does not indicate infant awareness of intention. Infants may learn to follow mother's gaze as a discriminative stimulus, without really comprehending the mother's line of reference (Carpenter et al., 1998).

Gaze alternation, or looks alternating between the adult and a toy, is indicative of the infant's awareness of another's visual perspective. Once this awareness occurs, infants are capable of coordinating attention to an object by following mother's gaze. Scaife and Bruner (1975) reported that infants as young as 2 to 4 months are capable of following the experimenter's gaze, but do not do so reliably until 11 to 14 months. Ability to follow another's gaze is also dependent upon contextual factors as well, such

as the position of the target in the infant's visual field and the number of targets within the scan path (Butterworth & Jarrett, 1991).

Once the awareness of a distinction between the infant's and the mother's visual line of reference has been established, infants begin directing another's attention. Attention-directing occurs through intentional communication in which the infant uses words or gestures aimed at the adult, and the infant realizes that these communicative acts can serve to change the adult's behavior. Gaze alternation between the adult and the object is indicative of the infant directing attention toward the adult and not simply looking at the goal (simply looking at or reaching for the object itself) (Carpenter et al., 1998).

Joint attention to persons versus objects. Face-to-face social interactions with adults are the precursor to infants' joint attention abilities. As newborns, infants often engage in social interactions with their mothers which are termed "primary intersubjectivity" (Carpenter et al., 1998). Later, episodes of "secondary intersubjectivity" occur as objects or other persons are added to these social interactions. It is during periods of secondary intersubjectivity that infants learn "from and through others about the environment and about the artifacts used by members of their culture to mediate interactions with the environment" (Carpenter et al., 1998, p. 26, citing Rogoff, 1990). Infants are capable of "primary intersubjectivity" from birth, and frequently engage in mutual face to face social exchanges with mothers and other caregivers. However, it is not until about 9 to 12 months that infants start showing signs of "secondary intersubjectivity." At this point they begin to experience attention that is

mutually focused with another person toward an object. When this occurs, infants begin engaging in cooperative behaviors, and show affective responses to another's actions on objects (Baldwin, 1995).

The developmental changes in infant ability to engage in joint attention are related to corresponding maternal behaviors, such as responsiveness and encouragement of attention (Karrass, Mullins, & Burke, 1999). The match between infant developmental level and maternal supportive behaviors that help to coregulate infant attention may have an impact on infant language learning (Tomasello & Farrar, 1986).

Maternal visual attention and maternal responsiveness. Maternal responsiveness to infant cues may be in response to either distress or social bids. Responsiveness to distress can be either positive or negative. A warm response will serve to calm the child and regulate negative emotions. Responsiveness to infant social bids, however, likely has a completely separate function from emotion regulation. When the child is already in a state of positive affect, the adult has the opportunity to engage the child with objects. In addition, when the child initiates a social exchange with a toy, they already have their attention focused on an object or person, so a shift in attention is not necessary. It is difficult for infants to shift their attention and discern the adult's line of attention (Tomasello & Farrar, 1986). Infant-initiated social toy play provides a unique environment in which mothers can follow infants' attentional focus. It is within this very rich context of shared, infant-directed attention that optimal language learning can occur.

Maternal visual and verbal responsiveness as reinforcement. Maternal visual and verbal responses to infant behavior can have a reinforcing effect. In an experimental

investigation, Perez and Gewirtz (1999) reported that maternal tactile, auditory, and visual stimulation each functioned as a reinforcer for infant behavior (infant leg kicks) around 4 months of age. One outstanding point teased out by their design was that maternal visual attention paired with other contingent stimuli (auditory or tactile) was more effective in increasing behavior than was maternal attention, verbalizations, or touch alone. Maternal attention in conjunction with other responsive behaviors, then, seems to have a particularly strong effect on early infant behaviors.

The reinforcing effect of maternal behaviors on children's language use was examined extensively by Hart and Risley (1995). Their longitudinal study of infant language trajectories found that parental feedback tone that was reinforcing (positive) to infant behavior and vocalizations was related to long-term increases in infant vocabularies, up to seven years later. Positive feedback tone included behaviors such as "repetitions, extensions, expansions of child utterances, confirmations, praise, and approval" (p. 151). According to Hart and Risley, the cumulative effects of feedback tone in the home can either orient a child toward language learning or discourage a child from verbal communication.

Maternal attention-directing versus attention-following and infant language. When mothers and infants are communicating, infants hear words they do not yet understand. If both mother and infant are focused on the referent, infants can use the context to determine word meanings. When mother directs the infant's attention to something new in the environment, the infant must shift attentional focus and discern what the adult is referring to. However, when the adult follows an infant's attentional

focus, then joint engagement can occur without a shift in infant focus. This proves to be beneficial for the infant (Carpenter et al., 1998). Tomasello and Farrar (1986) found that there was a relation between the tendency of mothers to use language which followed the infant's attentional focus at 15 months, and the infant's vocabulary size at 21 months.

There is a further distinction which must be made when discussing mothers' attention-directing strategies. Directing an infant's unorganized attention is not the same as *redirecting* attention from one object to another. Mothers who "encourage attention" early in infancy have children with more advanced language development during the second year (Tamis-LeMonda & Bornstein, 1989). At 6 and 8 months of age, infants engaged in more overall joint attention with their mothers in free play if their mothers persisted in initiating collaborative attention episodes (Saxon & Reilly, 1998). This suggests that mothers are capable of increasing infant joint attention by encouraging infants to direct attention toward toys.

Maternal encouragement of attention has been proposed by Karrass et al. (1999) to affect the association between infant attention capabilities (task orientation) at four months and infant language development at 12 months. Two statistical models were tested, with maternal encouragement of attention as either a mediator or a moderator. Neither model was statistically significant, and the interaction term between maternal encouragement and infant attention abilities was also not statistically significant. Maternal encouragement of attention at four months was directly associated with receptive language at 12 months, however (Karrass et al., 1999). Maternal encouragement of attention toward objects is also related to higher levels of noun

comprehension at 13 months (Vibbert & Bornstein, 1989). These studies suggest that mothers' attention-directing behaviors may not mediate or moderate the relation between infant attention abilities and language, but rather have a unique association with emerging receptive language skills.

Mothers' behaviors may or may not increase infants' attention-focusing capacity, but they do add a distinctive element to the language-learning environment which fosters comprehension of language around the first year. One way in which maternal attention directing or maintaining facilitates infant development is through infant level of play. Infants tend to play at higher cognitive levels when mothers either maintain infant attention or direct them to toys when attention is unorganized. The level of play drops remarkably when mothers redirect an infant's focused attention toward another object (Landry et al., 1996). Infants also engage in more frequent object exploration in the second year if their mothers were organizing unfocused infant attention early in infancy (Tamis-LeMonda & Bornstein, 1989). Thus, maternal attention affects language as well as other cognitive domains.

Redirecting infant attention away from one object toward another puts great demands on the emerging infant attention capacity. This type of attention-directing is intrusive (Baumwell et al., 1997). Tomasello and Farrar (1986) found that when mothers initiated interactions by redirecting their infant's attention away from one object and toward another, those infant's had smaller productive vocabularies at 21 months. This same trend has been examined in maternal conversations and infant play by Baumwell et al. (1997). Verbal intrusiveness in infant play occurs when mothers verbally interrupt the

focus of an infant's attention in play, or negate or discourage a child's behavior. Maternal verbal sensitivity is indicated by verbal responsiveness to infant visual or vocal activity, verbal maintaining of infant attention, or verbal directing of unfocused infant attention. Verbal intrusiveness at nine months was not associated with language comprehension at 13 months, but maternal sensitivity was, even when controlling for initial levels of comprehension. Maternal verbal sensitivity had stronger effects on children who were initially low on language comprehension at nine months. This again highlights the importance of structuring tasks to fit the developmental level of the child. Interrupting infant attention may not have the same effects at nine months, when attention capacity is just being organized, as it does later in the second year.

The influence of mother-infant social interactions on infant language development may have lasting implications for later language-dependent tasks, such as learning to read. The connections between early language and later reading will be discussed next.

Language learning and reading development. The causes of reading problems have been explored from many angles, including "problems with the visual word center of the brain, ... lack of full hemispheric specialization, and ... difficulties in sequential perception" (Byrne, 1992, p. 2). Very strong evidence, however, points to correlations between early language problems and later reading delays. In fact, none of the non-linguistic cognitive or visual deficiencies account for group differences in reading abilities when measurement and sampling techniques are taken into account (Byrne, 1992). Even restricting the correlates to the language domain is insufficient. Because reading is multifaceted, different language problems can lead to different reading

problems. Liberman and Shankweiler's (1985) review suggests that phonological problems in language learning can lead to problems with "word identification, ... performing metalinguistic tasks, and the ... use of phonetic properties as a basis for the short-term working memory operations" in reading (p. 15). "Phonemic awareness," the understanding that verbal language is composed of phonemes or sound units, is necessary for progress to the "alphabetic stage" of reading (Byrne, 1992). Early vocabulary is also predictive of later reading success (DeTemple, 1999). The specific connections between language and reading need to be understood in the context of the development of basic reading skills.

The development of basic reading skills. The early development of reading skills is crucial for later reading competence and school achievement. In a sample of normal readers, dyslexics, and poor readers, there was stability in reading group differences at ages 9, 10, and 11. In fact, for the phonological task these differences increased (Molfese & Modglin, 1999). Lyon (1999), referring to a deficit model, reported that "growth curves (between groups of at-level and poor readers) are differentiated in reading from age 6 to 14. The poor readers never catch up and the lines never converge" (p. 4). Without extensive and intensive intervention, children who fall behind in first-grade reading have only a one in eight chance of catching up to grade level (Lyon, 1998). Therefore, understanding skills that are prerequisite to or supportive of the process of learning to read is essential to understanding the correlates of reading development.

There are several basic skills necessary for reading development. At a general level, text understanding, or literacy, requires skill in decoding and comprehension

(Gough, Juel, & Griffith, 1992). Decoding involves converting the text into phonological units (such as letter sounds or phonemes) while comprehension involves combining the sounds back together into something meaningful to the reader. Each of these two general components involves several subskills (Lyon, 1998).

Whole word and phonological decoding as steps to word recognition. The skill of decoding text develops through several phases, including the logographic, alphabetic, and orthographic phase (Ehri, 1992). During the first phase of reading, word recognition may occur without phonological decoding. During this logographic phase, words are identified via paired associations between visual representations and auditory or lexical representations. Any characteristic of the word which is "visually salient or distinctive" can be used as cues. Readers in this phase recognize words by rote memorization. Connections between visual cues and word meanings are memorized, with little awareness of the letter-sound system. Reading at this phase, then, is based on arbitrary connections between visual cues and word meaning. The logographic phase of reading has also been termed "sight word reading"(Ehri, 1992).

The next two phases of decoding rely on phonological decoding, which requires readers to break written text down into phonological units. Readers first use phonological decoding during the alphabetic phase, when they master the "alphabetic principle," the concept that each letter represents a sound. During the alphabetic phase, beginning readers learn the names and shapes of the letters in the alphabet, and begin to form "visual-phonetic connections between letters seen in spellings and sounds detected in pronunciations of words they are learning to read" (Ehri, 1992, p. 127). During this

phase, the connections between letters in text and verbal pronunciations become systematic rather than arbitrary. Reading at this phase is more reliable because connections are based on spellings and specific pronunciations rather than arbitrary visual cues and word meaning.

What is necessary for beginning readers to understand the alphabetic principle? Liberman, Shankweiler, and Liberman (1989) pointed out that the alphabetic principle is the understanding by the reader that "discrete letters of the alphabet represent discrete sounds" (p. 6). Data reported by Byrne (1992) suggest that both phonemic awareness (awareness of the sound units in oral speech) and letter-sound knowledge are necessary for beginning readers' understanding of the alphabetic principle.

In the shift from the logographic to the alphabetic phase, readers may use a combination of strategies. For example, they may use the first and last letters as cues in reading the word, but errors can occur when other words have the same "visual-phonetic cues, for example, *jail* and *jewel*" (Ehri, 1992, p. 127). For efficient decoding to occur, readers must progress to the orthographic phase.

When beginning readers reach the orthographic phase, they get insight into the orthographic principle, the concept that sequences of letters in spelling correspond to blends of phonemes (Ehri, 1992). This is the second step in learning how to phonologically decode text. At this point, combinations of letters (such as the vowel-vowel combinations *ou* or *ea*) take on a distinct phonological pronunciation, whereas the individual letters in text might have had several different pronunciations (long or short vowel sounds, for example). With the aid of the orthographic processor, Ehri (1992)

explains that readers are making the connection between word spelling and pronunciation "in a way that fully determines the pronunciation and consequently the meaning and that excludes words with similar pronunciations" (p. 133). The rules of letter combinations are becoming apparent such that "cipher readers" (those who know the code, or the letter combination rules) can distinguish even silent letters and their role in word pronunciation, for example "final -*e* marking a preceding vowel tense ... long" (p. 133). Indeed, orthographic processing goes beyond identifying patterns of adjacent letters, but rather combines "multiple letter units" in such a way that even irregular spelling patterns are recognized and decoded automatically. The code of interletter associations is "a classic case of the whole working better than the sum of its parts" (Adams, 1990, p. 109).

The orthographic phase requires both phonemic segmentation skills and recoding skills (Ehri, 1992). Within a spoken language, a limited sequence of phonemes are allowed, and some sequences occur more frequently than others. Since the grapheme (the letters in the written word) is meant to represent something meaningful in verbal language, the grapheme combinations must be limited by the phonemes they represent. Therefore, certain grapheme combinations will be likely, infrequent, or will never occur. For instance, the letter combinations -hv and -kj, common in the Norwegian language, do not occur in English verbal language, and therefore do not appear in written letter combinations. Breaking written words down into constituent grapheme patterns will transfer into syllable patterns that can be processed (Adams, 1990). Recoding is necessary when the phonetic transcription (the individual letter sounds strung together) does not match phonemic transcription or the sound of the combined letter patterns

(Tunmer & Hoover, 1992). For example, sounding out the individual letter sounds in the word *pitch* will not match the phonemic transcription, which ends with the -tch sound. The sound -tch is very different from the sounds of the individual letters -t, -c, and -h combined.

Decoding strategies used by readers. Children at different phases of learning to read may use each of the three reading strategies, logographic, alphabetic, and orthographic, to varying degrees depending on the difficulty of individual words in the text. Differences in the types of decoding strategies used are predictive of reading disabilities. Siegel and Chiappe (1999) used a pseudo-word reading task at the end of grade one to determine which decoding strategy early readers were using, and if this task could correctly predict reading disability in grade three. The two strategies assessed by the task were analogy and phoneme correspondence. The analogy strategy was used when children decoded a pseudo-word by analogy to a known and similar word (for example, mive pronounced like give, and tays pronounced like says). Children using this strategy relied on comparisons between visual cues from unknown words and similar known words, and replaced the unsimilar component with the letter sound (i.e., mive looks like give, but replace the -g sound with an -m sound). These are skills that are learned in the logographic and alphabetic phases. The phonological strategy was used when children decoded the pseudo-word by sounding out the phonemes. This skill is learned during the orthographic phase. Those children who were classified as "reading delayed" at the end of grade three had used the phonological strategy about 60% of the time, and analogy about 40% of the time. In contrast, the "normal developing readers"

had used the phonological strategy about 80% of the time, and analogy only about 20% of the time. Thus, greater reliance on comparisons between visual cues and letter sound correspondence, skills which are learned during the earlier phases of reading, were not as effective for later reading than was breaking down the unknown word into its phonological components, a skill learned in the later orthographic phase.

Comprehension and the context processor. The second component of reading, beyond decoding strategies, is the comprehension of text. Text comprehension is dependent upon several strategies and skills, including decoding strategies, linguistic skills, vocabulary, and regulation of attention. In addition, comprehension of text is related to prior experience with language and text in the environment. The first processes affecting text comprehension, discussed in the previous section, is decoding and "recognition" of word meanings.

Effective decoding skills are vital to reading comprehension. If readers have poorly developed decoding skills, then a greater allocation of attention towards the decoding process will leave "very little in terms of cognitive resources left over to connect to what they already know" (Lyon, 1999). Efficient phonological decoding skill, in combination with other word recognition and comprehension skills, "frees up cognitive resources" which can be shifted toward higher level comprehension tasks (Tunmer & Hoover, 1992). Decoding is followed by word comprehension.

Readers will recognize and comprehend the word meanings only if they have encountered them in the past and have assimilated them into their vocabulary. One way to increase reading comprehension skill is to build readers' vocabularies orally before the

children can decode the words. This can occur through listening comprehension skills, where children are read to and try to figure out the meaning of the passage, or through language interactions that do not involve text (Lyon, 1998).

How is it that children come to understand text when they are unable to decode or recognize all of the words? Other strategies are used to facilitate text comprehension. According to Adams (1990), there are context-processing skills which readers use to construct a coherent interpretation of the text. How "predictable" the context is will determine how much input from the letter recognition system is needed. This implies that the decoding skills and the context-processing skills are complementary. If children are good at using context-processing skills, those skills can compensate for poor decoding skills. Context-processing facilitates recognition of correct meanings, but can also produce inappropriate meanings. The use of decoding strategies and the context-processing strategies vary according to skill level and level of text comprehension.

Levels of text comprehension. Text comprehension is described as a "hierarchically layered process," dependent on decoding skills, linguistic skills, and the allocstion of attention at various levels (Adams, 1990). At the bottom level, the readers recognize and comprehend individual words by decoding them. However, when word recognition is slow or laborious using phonological decoding skills, context processing skills may augment the processing of individual words. In this case, the context is used to determine the meaning of individual words (Adams, 1990). For instance, readers may use syntactic clues to process an unfamiliar word.

At the next level, the context processing helps to provide meaning to strings of

words connected in text. Decoding skills, vocabulary, and syntactic knowledge aid in comprehension at this level. The more quickly individual words are recognized, the more efficiently the meaning of these strings of words can be analyzed. In addition, word strings must be analyzed at one of two breaking points, either at syntactic junctures or based on the length or difficulty of the text. Syntactic boundaries are preferable, as the syntactic structure of the sentence offers information about word meanings. However, when greater time is invested in deciphering the individual words, syntactic boundaries may be too long. Readers must then break at a point when they are still capable of remembering the individual words meanings and can combine them together into a phrase (Adams, 1990).

The highest level of text comprehension requires that readers combine their understanding of the phrase or clause they have just read with "their overall interpretation of the text so as to revise and update their understanding of what the text means and where it is going" (Adams, 1990, p. 142). It is at this level that "true understanding" of the text comes into play. This highest level requires "active attention and thought" (p. 142). It would seem, then, that children who are better able to self-regulate their attention will be more successful at text interpretation. This point will be considered more extensively below.

The use of context in relation to reading outcomes. Are there benefits to using "context processing" to facilitate reading comprehension at these various levels? Tunmer and Hoover (1992) are not as convinced about the benefits of context processing for poor or beginning readers as they are about instruction in decoding skills. They describe the

current polarization in the field of reading research concerning reading instruction. Compared to other necessary skills, such as phonological awareness, the ability to use context in word recognition does not distinguish between poor and skilled readers. This is a supplementary skill that is not necessary in reading instruction. When beginning to read, children need a minimum amount of "context-free word recognition skill before they can use context to facilitate word recognition in ongoing sentence processing" (p. 178). The use of context may fall into several categories. It may range from a fast, automatic process to a slow, conscious form of guessing (as outlined by Gough, 1984). The fast process allows readers to use context unconsciously to facilitate word recognition, whereas the slow process forces readers to use context to decipher passage comprehension. Tunmer and Hoover (1992) outline a third type of context processing whereby sentence context is used to "facilitate the acquisition of knowledge of grapheme-phoneme correspondence rules" (the reader recognizes the verbal word from the sentence context and learns the letter-sound correspondence rules for that word). This use of context would actually help readers map sounds onto letter combinations.

These different uses of sentence context in reading are related to reading skill. The good readers are rapidly recognizing words in the passage, and therefore use contextual information to aid comprehension rather infrequently. However, poor readers compensate for word recognition problems by relying heavily on sentence context to recognize words (Tunmer & Hoover, 1992). Language skills which precede and coincide with early reading are related to decoding and comprehension skills, and will be discussed in the next section.

Reading and Language

Language skills in infancy and preschool are related to the development of later reading deficits (Molfese & Modglin, 1999). In fact, in a longitudinal study of 392 school-age children, the strongest predictors of reading in first grade were language and psycholinguistic abilities, and the correlations between these factors and reading ability increased up to sixth grade (Butler, Marsh, Sheppard, & Sheppard, 1985).

There are several points in the development of specific reading precursors where early language development is crucial. One point examined extensively is the development of phonological awareness (awareness of word sounds) in verbal language (Liberman & Shankweiler, 1985).

Phonological awareness in spoken language is a precursor to basic decoding skills. Biological factors, such as auditory perception of phonological segments in verbal language, is an automatic process necessary for verbal comprehension, but must be extended and expanded when making the connection between printed text and corresponding phonological units (Liberman & Shankweiler, 1985). Newborns' ability to make phonological discriminations, measured as brain responses to speech and nonspeech syllables, can effectively differentiate between dyslexic, poor, and normal readers eight years later (with 81.25% accuracy for a sample of 48 children, with 22 of the 24 reading-delayed children correctly classified and 5 normal children misclassified). This indicates that speech sound perception is important from birth on. The perceptual abilities apparent at birth may provide an advantage or disadvantage in language development that is carried through to reading development (Molfese, 1999). Poor

pronunciation in productive language at 30 months is associated with poor phonemic awareness and letter-sound knowledge at 5 years of age, and reading problems in early school age, particularly dyslexia (Scarborough, 1990). Thus, children who have more limited perception and knowledge of pronunciations early on are not as capable of "catching on" to the alphabetic and orthographic principles as they enter the world of reading at school age. Phonological awareness in language and reading is facilitated through literacy activities such as connecting words to print during parent-child book reading and playing with sounds during language games (Bryant, Maclean, & Bradley, 1990; Caravolas & Bruck, 1993; Dickinson et al., 1999).

Another basic skill necessary for reading is syntactic awareness. Knowledge of syntax facilitates text comprehension at the sentence and multisentence level, and when the words are too difficult to decode, syntactic structure may also give a clue about word meanings for difficult words (Adams, 1990). Syntactic awareness develops during the first 3 years of life, when young children start understanding word combinations and combining words in their productive language. Children with particularly short mean length of utterance (MLU) and deficient syntactic complexity at 30 months were later found to be dyslexic at school age (Scarborough, 1990).

A third influential factor in reading skill is verbal vocabulary. Once words have been decoded, comprehension occurs much more efficiently if meaning is identified quickly (the meaning is established for the "sounded out" word). The words can then be strung together into meaningful chunks of information (Adams, 1990). Early vocabulary acquisition has been associated with reading development in past studies. Deficits in

receptive vocabulary and poor object-naming skills at age three are related to dyslexia in grade school (Scarborough, 1990). From fourth grade on, most of the variance in reading comprehension is associated with knowledge of word meanings (Lyon, 1998).

Reading and Attention

Sufficient self-regulation of attention, such as sustaining attention toward and persisting at a task, are necessary for efficient reading. As outlined previously, poor decoding skills can put a strain on attention capacity in reading (Lyon, 1999). In addition, self-regulated attention and memory are needed for the level of text comprehension where text is analyzed in larger chunks (Adams, 1990; Tunmer & Hoover, 1992). Thus, starting and stopping during decoding is not conducive to interpreting the text at a multisentence level, because it takes mental attention and thinking capacity away from comprehension strategies. "To the extent that readers struggle with the words, they necessarily lose track of meaning" (Lyon, 1998, p. 23).

The self-regulation of attention in the classroom can have long-term consequences for both reading and math achievement. Teacher ratings of poor regulation of attention at the beginning of first grade were related to lower reading test scores and lower grades at the end of first grade. This same association between regulation of attention and reading scores was found from the beginning to the end of second grade. These associations were consistent and strong even with fall reading ability statistically controlled. In addition, poor regulation of attention in first grade had lasting associations

with reading achievement and test scores at the end of fourth grade (Alexander et al., 1993).

Poor self-regulation of attention and reading disability frequently co-occur, with an average of 50% co-occurrence reported in many studies (Riccio & Jemison, 1998). Although attentional problems such as attention deficit hyperactivity disorder, or ADHD, may not interfere with basic reading skills, some beginning readers with ADHD may also have previously existing language difficulties, particularly a deficit in phonological processing. Thus, it may be difficult to separate the causal associations between attention regulation deficits and language deficits in relation to reading difficulties (Riccio & Jemison, 1998).

There are at least three ways in which regulation of attention and reading skills might be associated (Riccio & Jemison, 1998). First, inability to self-regulate attention in the classroom can interfere with basic academic skill acquisition (Riccio & Jemison, 1998). There is currently little evidence supporting this premise. Secondly, academic difficulty, such as requiring children with reading delays to process text which is more difficult than their reading level, can cause difficulties with attention regulation and poor concentration (Riccio & Jemison, 1998). Thirdly, a bidirectional relation may exist between inattentiveness and reading difficulty. This bidirectional relation between inattentiveness and reading difficulty may be mediated by other psychosocial factors, such as attitude toward reading (Pennington, Grossier, & Welsh, 1993; Riccio & Jemison, 1998; Rowe & Rowe, 1992).

The first premise, that poor attention regulation affects the acquisition of reading skills, has been negated when language factors are accounted for. Scarborough (1990) found that language and verbal abilities, rather than attention skills, were directly related to basic reading skills. In particular, phonological awareness and processing skill were related to reading fluency. Scarborough's work emphasizes the importance of finding specific connections between development and learning disabilities, rather than examining overall disability factors.

The second premise, that academic difficulty contributes to inattention and poor concentration ability, has been supported by some educators and professionals. If the task put forth to the child is too difficult or far beyond the child's current reading skill, the child may become frustrated and overwhelmed. The resulting behaviors are interpreted as inattention and distractability on the child's part, and the child may also exhibit conduct problems (Riccio & Jemison, 1998).

The third premise, that reading and attention regulation have bidirectional influences, has been examined extensively by Rowe and Rowe (1992). They found that inattentiveness lowers reading achievement, but previous reading success combined with environmental support for reading achievement increases attentiveness in the classroom. When controlling for demographic factors, poor attention skills related to ADHD were associated with lowered reading achievement as well as lowered attitude toward reading and less frequent reading done at home with parents. Inversely, a positive attitude toward reading, combined with frequent book reading at home with parents and well-established reading skills, was associated with increased attentiveness at school. Pennington et al.

(1993) found that when language delays and reading difficulties co-occur in conjunction with environmental factors, children's behaviors may look like those characteristic of ADHD. Tunmer and Hoover (1992) suggested that speed and automaticity in decoding are necessary to free up cognitive resources for comprehension tasks. However, poor attentional abilities (as well as other factors) can impair decoding and listening comprehension. Thus, the relation between self-regulation of attention and reading ability (in combination with past language experiences and development) appears to be bidirectional and multifaceted. Whereas poor language skills and inadequate sustained attention can hinder the development of basic reading skills, poor reading can likewise strain children's attention capacity.

Environmental Factors and Reading

Much research on emergent literacy focuses on environmental factors fostering the skills necessary for reading development. Factors within the home, such as book reading and attitudes toward reading, are associated with later reading performance (DeTemple, 1999; Rowe & Rowe, 1992). Reading and writing in the home are also associated with greater decoding skills at the end of kindergarten. Home literacy experiences, such as reading to children, reading and writing activities, storytelling, and and having books available in the home, foster language and emergent reading skills, which "ease the burden of decoding and later reading comprehension" (Mason, 1992, p. 236). Scores on the HOME inventory at age 3 are related to reading and decoding skills between the ages of 8 and 11 (Molfese & Modglin, 1999). Literacy experiences in the

home, including book reading, also seem to support phonemic awareness in the preschool years for low-income children (Dickinson et al., 1999).

Book reading may be connected to emerging reading skills in several ways. Reading is a way to introduce children to literacy and establish that texts are used to communicate something meaningful. In addition, book reading fosters vocabulary acquisition, listening comprehension, and decoding skills (Mason, 1992). Repeated readings, in particular, facilitate knowledge about print such as directionality of print, word boundaries, punctuation markers, and letter-sound patterns in the context of a previously established shared meaning (Mason, 1992). Language and literacy experience in infancy and preschool can also facilitate "phoneme awareness," the understanding that spoken words can be segmented into constituent abstract sounds (Lyon, 1999).

Particular aspects of book reading may support phoneme awareness and letter-sound knowledge. Parents help children connect verbal language to print by pointing to the print and letters as they read the text and by helping children to analyze the print. They may leave simple words out and ask children to fill them in by looking at the text while listening to the story. Parents also allow children to retell stories from memory or by looking at the pictures. In addition, choosing books that play with language by using rhymes and tongue twisters may facilitate phoneme awareness (Mason, 1992).

Summary and Conceptual Model

In summary, there are multiple connections between early mother-infant interactions and early language, and between early language and later literacy. The

specific connections between these constructs need to be examined in a multivariate manner. The previous research cited pinpoints specific influences on early language in the context of parent-child interactions and the richness of the home environment, and specific influences on later reading development. This study expands current literature in several ways. First, this study examines multiple predictors of early language, including joint attention, play interactions, and preferences for specific play activities. Second, this study examines, in a theoretically-guided manner, the connections between these early play contexts and later literacy outcomes. Third, this study clarifies relations among predictors and developmental outcomes by mapping out specific pathways based on a conceptual model. And last, this study explores new areas of research, such as the connections from early coregulation of attention to later independent regulation of attention.

The conceptual model proposed in Figure 1 may help clarify the multiple associations between early linguistic factors and later literacy outcomes. This conceptual model of early language environment and language development in infancy, environmental literacy factors and attention in early childhood, and reading development was explored in this study.

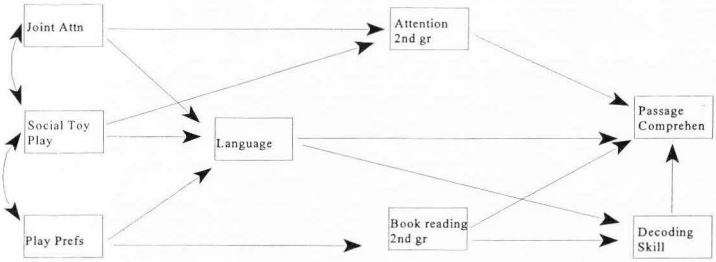

Figure 1. Conceptual model predicting second-grade reading.

CHAPTER III

METHODS

Participants

This study was part of a larger infancy study that was conducted from 1990 to 1994 and continued longitudinally from 1998-2000 when participants were in second grade. The original infancy samples were recruited by contacting mothers who had announced the birth of their infant in the newspaper. Two samples of mothers were recruited to come into the laboratory with their infants for short videotaped observations and infant assessments, and those with complete data were asked to return for a second infant assessment. For the infant assessment mothers completed questionnaires while their infants played nearby. These sessions were videotaped in a laboratory situation. For the second-grade assessment, all families located within the state were contacted for an in-home assessment of the child, as well as teacher and maternal questionnaires to be completed. Those living out of state were mailed teacher and maternal questionnaires.

Participants in this study included the two samples of mother-infant dyads who were assessed in the larger infancy study. Sample I included infants who were tested at 11 and 14 months of age. Sample II included infants who were tested at 14 months and again at 17 months. Only the 14-month data from the two samples were used in this study. A table listing the longitudinal sample sizes for the two infancy samples can be found in Appendix A. Descriptive statistics are reported for the two individual samples next.

Family socioeconomic status was evaluated in this study using the Hollingshead (1975) Four Factor Index of Social Status. The Hollingshead is a weighted score based on two factors for each parent, education level and occupation status, and is used to estimate the family status position. The Hollingshead scores can be interpreted as falling into several categories of social strata, with family scores ranging from 55-66 considered Upper SES, 40-54 as Middle SES, 30-39 Lower Middle SES, and 8-19 as Low SES (1975, p. 23).

Sample I

Participants in this sample included 83 14-month-olds (mean age = 14.42 months) and their mothers who had been tested previously at 11 months as part of a longitudinal study (40 sons and 43 daughters). All participants were full-term, born within 4 weeks of the expected due date. All infants came from middle-socioeconomic-status households, as measured by the Hollingshead (1975) Four Factor Index (M = 43.65, range of 22.50-66.00). The average number of siblings was 2.88.

Independent samples t tests were used to assess group differences between infants with longitudinal language data from 11 to 14 months and those with incomplete longitudinal data. There were no statistically significant differences at 11 months between those who dropped from the study and those who returned at 14 months on the 11-month language measures. Appendix B lists the reasons for attrition for this sample, as well as the effect size of group differences.

Sample II

Participants in Sample II included 70 infant-mother dyads (37 sons and 33 daughters) who were assessed at 14 months (mean age = 14.24 months) and invited back again at 17 months. All participants were full-term, born within 4 weeks of the expected due date. All infants came from middle socioeconomic-status households, as measured by the Hollingshead (1975) Four Factor Index M = 43.67, range of 24.50-63.50 on the Hollingshead (1975) Four Factor Index. The average number of siblings was 3.11.

Independent samples t tests were used to assess group differences between infants with longitudinal language data from 14 to 17 months and those with incomplete longitudinal data. There were no statistically significant differences at 14 months between those who dropped from the study and those who returned at 17 months on the 11-month language measures. Appendix B lists the reasons for attrition for this sample, as well as the effect size of group differences.

Second-Grade Sample Characteristics

The two samples from infancy were followed longitudinally into second grade, and infant data from the two samples were combined for data analysis purposes. The longitudinal sample in second grade was primarily middle SES (mean = 49.19, range of 19.0-66.00 on the Hollingshead). There were 52 males and 53 females in the sample. The average number of siblings was 4.25, ranging from 0 to 10 siblings. Birth order ranged from one to eight. Attrition information from infancy to second grade is listed in Appendix A.

Procedures

Participants in both infant samples were recruited by contacting mothers who had announced the birth of a child in a public newspaper. Families were first contacted by letter and then by telephone and invited to participate in the study. Those who agreed were sent a packet of forms two weeks prior to scheduled visits. These forms, which elicited family demographic information, were completed and brought to the scheduled laboratory visit. Written informed consent (see Appendix C) was obtained at the laboratory assessment, and participant mother-infant dyads were assigned an ID number to be used on all data records. The infant study and the second-grade follow-up study both received approval from the Institutional Review Board of Utah State University (Appendix D).

Mothers and infants were videotaped for 20 minutes in a laboratory playroom. During the first 10 minutes, infants were seated in a high chair with a set of nesting cups. Mothers sat in a chair next to the infants with a questionnaire they were asked to complete. Mothers were given the following instructions:

> "We are asking you to fill out the forms to get a lot of information about your child but also to keep the situation fairly normal--mom is busy but nearby while baby is playing. We are interested in how your baby plays with these cups, but you can help if he/she needs you. Some babies drop the cups and we're interested in their reaction if they do. You may pick up the cups if you want, but not unless all the toys are on the floor. Here are the cups. So we have a set starting time, I'll knock and then you can put them on the highchair tray."

From this 10-minute session, joint attention was coded.

During the next 10-minute play segment, the child was allowed to play on the floor with a set of developmentally appropriate toys. Toys were chosen so that a range of developmental levels of cognitive and social play would be elicited. Mothers were seated in a chair nearby and given the following instructions:

> "After ten minutes, I'll knock again. Then you can take your child out of the highchair and take the lid off of that toy box. After another ten minutes, we'll do some other things."

Frequency of mother-infant social toy play behaviors was coded from this 10-minute play session.

After the 20-minute play observation, each infant was tested using the Bayley Mental Development Index (Bayley, 1969). Only performance on language items from this test was used for this study.

A follow-up of children from the combined 14-month samples was conducted as students passed through the end of second grade. This assessment point was chosen based on funding issues and conceptual issues. The purpose of the follow-up study was to examine associations between earlier development and later reading skills and achievement. Reading skills prior to grade two may fluctuate within a normal range for beginning readers, but by the end of grade two more persistent problems may be apparent. Thus, participants were tested at the end of second grade to identify possible reading delays. In addition, the assessments were grade-based as opposed to age-based. Although this may confound findings due to diffferences in age at the time of the

assessment, reading skills are dependent upon both developmental level and prior instruction. Grade-based assessments were chosen to control for the variability in the amount of prior instruction in the school setting.

Families participating in the follow-up study were recontacted by mail and then by telephone for the follow-up study at the end of second grade. Consent forms were mailed to all participant families who were able to be located, both within and out of state. Participants were telephoned two weeks later and asked to mail back the consent forms or arranged a time to pick up the consent forms (see Appendix E). Teachers were mailed an information letter explaining the project. A packet of forms was delivered to each teacher at school and a time scheduled to pick the forms up. Data collection in the home was then scheduled with the mother.

Two trained testers administered a set of questionnaires and standardized tests to the second-grade child, while the mother filled out a set of questionnaires. Mothers were told they may remain in the room or fill out the questionnaires in another room, whichever they thought would be most comfortable for the child. All parents and children signed an informed consent form, and children were instructed that they could stop the test at any time.

For out-of-state families who returned the consent forms, a packet of materials was sent including a letter to be given to the teacher along with the teacher forms and a return envelope. The packet also included questionnaires for mothers to fill out along with a return envelope. Children in the out-of-state families were not tested.

Attrition from infancy to second grade occured when families were unable to be located. Of those who agreed to participate but missed a scheduled appointment, appointments were rescheduled if possible. A chart detailing the attrition from infancy to second grade for years one, two, and three testing can be found in Appendix A.

Measures

Multiple measures were used in this study to assess several aspects of social and cognitive development, including measures of language, social toy play between mothers and infants, joint attention, and play preferences at 14 months, as well as measures of reading, attention, and the home literacy environment in second grade.

Bayley Scales of Infant Development

The Mental Development Index of the Bayley Scales of Infant Development (Bayley, 1969) was used to assess infant language ability. For consistency in the set of items administered to infants in the study, the Bayley items were selected to overlap 4 months on either side of the targeted age, because the Bayley is age specific in months. Therefore, basal and ceiling rules were not followed during administration of items. Rather, each infant was administered all items in the set selected at 14 months. Each item was scored as pass or fail, and some items were scored using either observation or parental report, following the instructions in the Bayley (1969) manual.

For this study, selected items from the Bayley MDI that assess aspects of language skill were used to generate a total language score, as well as preverbal, receptive, and productive language scores. This method of extracting language items

from the Bayley MDI has been used in previous studies (Bee et al., 1982; Karrass et al., 1999; Leevers & Chelius, 1999). The items selected were very similar to the items selected for expressive and receptive language scales by Reznick, Corley, and Robinson (1997).

Total language scores reflect the total number of items passed in each set. The total language score at 14 months included 11 items that assessed preverbal, receptive, and productive skills. Specifically, these items assessed infants' ability to jabber, vocalize syllables, use gestures, indicate referents, respond to commands and requests, imitate words, produce words, and name objects and pictures. These items are listed in Appendix F. Cronbach's alpha for the set of items in the Total Language Scale was .58 at 14 months, indicating moderate internal consistency.

Research assistants were trained in administering this test prior to data collection for the larger longitudinal study. They observed and scored tapes of others administering the Bayley. Their scores were then compared with those of a previously trained tester. They also were videotaped while administering the Bayley to five pilot study babies, and a previously trained tester scored the videotapes. An overall criterion of 95% agreement was met by all testers. Accuracy of Bayley testing was checked for both samples. For Sample I ($n = 26$), item-by-item percent agreement was 93%, Kappa was .91, and interrater intraclass r was .89. For Sample II ($n = 37$), item-by-item percent agreement was 93%, Kappa was .94, and interrater intraclass r was .88.

Social Toy Play

Frequency of social toy play behaviors was coded at 14 months from videotapes of infants and mothers during the 10-minute free-play session. Coding occurred in 15-second intervals using a revised version of the coding procedure developed by Roggman, Langlois, and Hubbs-Tait (1987). Two coders were trained to code frequency of toy exchanges by practicing with pilot study data to establish reliability. A criterion of 90% or higher incident-by-incident agreement between coders was established prior to coding data. Accuracy of coding social toy play in this study was maintained by checking every fourth videotape. The criterion for incident-by-incident agreement was set at 80% agreement per code, as suggested by Hartmann (1982). The average agreement in this study was 94%, with agreement per tape ranging from 80% to 100%. Kappa could not be calculated for this measure because there could be more than one code per interval, so chance or expected agreement could not be calculated. Simple frequency of the following behaviors was coded for both mothers and infants: offer, show, take, retake, retract. Responses to toy shows and offers was coded as follows: ignore, acknowledge, accept, respond to an accepted toy, return, and complex exchange (manipulate and return a toy). For a more detailed description of these codes, see Appendix G.

Joint Attention

Joint attention at 14 months was coded in this study by two separate coders using a Macintosh computer system and software which provides timed sequential records of looking behaviors. One observer coded mothers' looking behavior, and the other coded infants' looking behavior. There are four possible codes: looking at the toys on the tray,

looking at toys on the floor, looking away, and looking at the face (of either the mother or the baby, depending on who is being coded). Continuous coding occurs for the 10-minute high-chair session, from the time the cups are set on the tray by the mother until the end of 10 minutes. Any behavior occurring for less then one second was filtered out by the computer to eliminate brief looks away which do not represent significant breaks in attentional focus. This procedure of filtering brief looks away has been used in other studies of infant attention (Bakeman & Adamson, 1984; Barton & Tomasello, 1991; Tamis-LeMonda & Bornstein, 1990; Tomasello & Farrar, 1986).

The files for mother and infant looking were then merged using computer software, thus detecting when the mother and infant were simultaneously focusing attention on the toys or each other or looking away. Barton and Tomasello (1991) used a similar coding procedure for coding joint attention, and they checked 20% of the tapes (randomly selected) for reliability purposes. They reported a second-by-second agreement of .85, with Cohen's Kappa of .77. Attention codes in this study were checked for reliability, and second-by-second agreement was calculated for each code. Every fourth videotape was checked by a second coder. A total percent agreement for the 10-minute play session was calculated. The criterion for agreement was 80% agreement per code, as suggested by Hartmann (1982). Average percent agreement for all mother and infant codes was 90%, with the reliability of counts or durations of individual codes ranging from 79% to 98% agreement.

Parent-Toddler Play Preferences Questionnaire

The Parent-Toddler Play Preferences Questionnaire (Roggman, 1991) is a maternal report measure of mother and infant preferences for various types of play, including sensory games, language games, pretend games, and coordinated activities (see Appendix H). Mothers are instructed to rate their own and their infant's preference for each play activity on a 5-point scale, ranging from "Don't do at all" to "Likes a lot." They are also asked to check who initiates each type of play, parent or infant. Internal consistency estimates of subscales for each play type were estimated by coefficient alpha in a previous study. Reliability of infant play preferences for a sample of 98 10-month-olds was estimated at .55 for sensory games, .70 for language games, .73 for pretending games, and .67 for coordinated games. Reliability of mothers' play preferences was estimated at .61 for sensory games, .71 for language games, .71 for pretend games, and .68 for coordinated activities. Convergent validity was established by Boyce, Benson, Roggman, and Cook (1997) and by Roggman, Cook, Boyce, and Benson (1998) by examining the correlation between mother ratings of mother and infant preference for pretend play and infant level of symbolic play in the laboratory, although the association was weak ($r = .30$, $p < .05$).

Conners' Rating Scales-Revised

Teacher and parent reports of attention problems in second grade were assessed using the Conners' Teacher Rating Scales-Revised (CTRS-R) and the Conners' Parent Rating Scales-Revised (CPRS-R). These scales measure a range of childhood behavior problems, including attention deficit hyperactivity disorder (ADHD) (Conners, 1997).

Parent and teacher ratings on only four ADHD/attention-related subscales and the cognitive problems subscale were used in this study (see Appendix I).

The cognitive problems subscale reflects learning difficulties, such as learning more slowly than peers, problems organizing schoolwork, and difficulty concentrating on and completing tasks. The hyperactivity subscale reflects difficulty sitting still or remaining at a task and feeling restless and impulsive. The ADHD index is a set of items identifying children "at risk" for an ADHD diagnosis. Two additional subscales, based on the DSM-IV definition of ADHD, distinguish between hyperactive-impulsive behaviors versus inattentive behaviors. The DSM-IV: inattentive subscale reflects inattention and distractability, while the DSM-IV: hyperactive-impulsive subscale reflects disruptive behavior and restlessness (Conners, 1997).

Norms, reliability, and validity of the CRS-R were established by the test authors using a sample of over 8,000 students from 200 schools. Children's ages ranged from 3 to 17. Internal reliability coefficients for the five subscales listed above (for the age group 6 to 8 years) on the CTRS-R ranged from .90 to .96. Internal reliability coefficients for the same age group on the CPRS-R ranged from .91 to .94. Test-retest reliability on the five subscales for 49 children assessed 6 to 8 weeks apart ranged from .67 to .85 on the CPRS-R and from .47 to .80 on the CTRS-R (Conners, 1997). Convergent validity was established with the normed sample by examining correlations between teacher and parent report and intercorrelations among subscales. Correlations between teachers and parents on the five subscales ranged from .37 to .49 for males and from .36 to .55 for females. The intercorrelations among subscales of the CPRS-R

ranged from .51 to .92 for males, and from .50 to .91 for females. The intercorrelations among subscales of the CTRS-R ranged from .55 to .97 for males, and from .45 to .95 for females. Discriminant validity of the DSM-IV symptoms subscales was assessed by comparing an ADHD clinically diagnosed sample with a matched (by age and sex) sample. The ADHD group scored significantly higher than the non-ADHD group on both the parent and teacher ratings, using t tests. Discriminant validity of the teacher subscale was also assessed by comparing children with a clinical diagnosis with a matched sample. The CTRS-R significantly discriminated among the three groups: nonclinical, ADHD, and emotional problems (Conners, 1997).

The reliability and validity information suggest that some subscales may be redundant or measuring the same construct. All subscales were retained for data analysis but checked for high intercorrelations. Low estimates of convergent validity between teachers and parents for some subscales indicate that they are rating problem behaviors differently. Both teacher and parent report are useful, since differences in reporting may be due to differences in observable behavior at home and in school, or differences between teachers and parents in observing and reporting young children's behavior problems (Conners, 1997).

Woodcock-Johnson Tests of Achievement

Two tests from The Woodcock-Johnson Tests of Achievement Standard and Supplemental Batteries were used to test reading skills in second grade. The Woodcock-Johnson assesses cognitive abilities, scholastic aptitudes, and achievement (Woodcock & Johnson, 1989-1990; Woodcock & Mather, 1989-1990). The batteries can be used for a

wide age range, and are well suited to testing both cognitive ability and achievement during the school years. Reading achievement tests were used in this study, including Word Attack and Passage Comprehension. These two tests measure both basic reading skills and achievement in reading comprehension.

Word Attack assesses phonics skills by testing the pronunciation of unfamiliar printed words. The participant is asked to read aloud "letter combinations that are linguistically logical in English but that do not form actual words (nonsense words), or words that constitute low frequency words in the English language" (Woodcock & Mather, 1989-1990, p. 15). Phonetical pronunciation and structural analysis, as opposed to recognition of familiar words, is assessed using this test.

Passage Comprehension items measure the ability to read a short passage and supply the missing key word. The participant is asked to read the passage to themselves and to "state a word that would be appropriate in the context of the passage" (Woodcock & Mather, 1989-1990, p. 13). This test assesses a variety of reading skills including decoding, comprehension, and vocabulary skills.

A normative sample of 6,359 participants was used to standardize the WJ-R tests and to gather reliability and validity information (Woodcock & Mather, 1989-1990). For students at age 9, internal consistency coefficients calculated using the split-half reliability procedure on the three reading tests ranged from .88 to .94. Concurrent validity correlations of the WJ-R Broad Reading cluster with other commonly used measures of reading achievement (BASIS, KABC, KTEA, PIAT, and WRAT-R) at age 9 ranged from .63 to .86. Construct validity of the WJ-R tests was assessed by examining

intercorrelations among tests within and across curricular areas. The intercorrelations among the reading tests of the WJ-R at age 9 ranged from .64 to .80. These correlations are higher than those among WJ-R reading tests and WJ-R achievement tests in other curricular areas, such as math and science. The WJ-R Broad Reading cluster also discriminated among four groups of children, gifted, normal, learning disabled, and mentally retarded, with scores increasing from the retarded to the gifted group.

The reliability and validity information suggests that the WJ-R reading tests are measuring both basic skills and reading achievement, and with moderate intercorrelations, they are each providing unique information pertaining to reading skill. The two tests were used in data analysis to test for theoretical links between infant language and specific components of second-grade reading.

Book Reading Activities

The extent to which mothers read to their children in second grade was assessed from the child's report on an item from The Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter & Pike, 1984). The question is phrased as, "This child's mom reads to him/her a little, this child's mom reads to him/her a lot, which one are you more like?" When the child points to the child which he/she is more like, a follow-up question is asked, "Are you a lot like this child or a little like this child?" This question is scored from a range of 1 (hardly ever reads to me) to 4 (reads to me a lot). Reliability and validity of this particular item have not been established. However, reliability and validity of children's report of their own social competence with mothers and peers has been established, with scale alphas in the mid to high .80s and

discriminant validity established by comparing scores for children held back and score for children who were advanced to the next grade (Bierer, 1981; Harter & Pike, 1984).

Research Hypotheses

Based on the overview of theory and current research findings, several hypotheses were constructed. The research hypotheses were as follows:

1. Mother-infant joint attention will be associated with mother-infant social toy play at 14 months.

2. Mother-infant joint attention will be associated with infant language at 14 months.

3. Mother-infant social toy play will be associated with infant language at 14 months.

4. Mother-infant preferences for language and literacy activities will be associated with infant language at 14 months.

5. Mother-infant preferences for language and literacy activities in infancy will be associated with maternal book reading in second grade and children's reading skills in second grade.

6. Infant language abilities will be associated with children's reading skills in second grade.

7. Mother-infant joint attention and mother-infant social toy play, children's ability to self-regulate attention in second grade, and children's reading skills in second grade will be associated.

Rival Hypotheses

Due to the long period of time between infancy and early childhood assessments, rival hypotheses may explain associations between mother-infant interactions, infant development, and later reading and attention. This design did not allow for the testing of rival hypotheses due to the lack of data between infancy and second grade. However, previous studies have identified early parent and child characteristics and abilities (with newborns) "which can discriminate later developmental outcomes over a large age range with high accuracy" (Molfese, 1999, p. 6). Child language skills in infancy and the preschool years, as well as parent-child interactions at age 3 (including quality of parental feedback and richness of interaction with their children) have been correlated with reading at age 7 (r = .55 to .79) (Wells, 1981). This study adds to the literature by exploring mother-infant interactions that facilitate infant language development, which in turn may affect later reading.

Usefulness of Observational Measures

The observational sessions used in this study were brief (10 minutes in length). Past research has found that some brief observations in unstructured naturalistic settings may be unreliable measures of the desired constructs (Leyendecker, Lamb, Fracasso, Schölmerich, & Larson, 1997). However, past research has also found that even brief 10- to 15-minute observations can yield "microanalytic measures such as frequency counts" of behaviors that are good indicators of underlying patterns of mother-infant interactions (Smith et al., 1996). There are several examples of studies in which the play setting was structured to stimulate the social behaviors of interest, such as joint attention (Bakeman

& Adamson, 1984; Tomasello & Farrar, 1986), directiveness and stimulation in play (Bornstein, Haynes, O'Reilly, & Painter, 1996; Smith et al., 1996; Tamis-LeMonda & Bornstein, 1989, 1994), supportive behaviors (Roach, Barratt, Miller, & Leavitt, 1998), and infant social bids (Mosier & Rogoff, 1994). In fact these fairly brief laboratory observations are often correlated with other measures of the same construct. Similar patterns of mother and infant behavior are found when measured with both observational methods in the laboratory and parental report of infant behaviors (Pederson & Moran, 1995; Teti & Ablard, 1989). These brief observations are also predictive of later developmental outcomes (Tamis-LeMonda & Bornstein, 1989).

The laboratory situation was structured to be similar to other situations which mothers and infants encounter in daily activities where they are required to wait in a waiting room (such as a doctor's office). This structured setting does limit the ecological validity of the results (Leyendecker et al., 1997). However, by standardizing the instructions to mothers, the types of toys available, the length of observations, and the location of the observation, the likelihood that the target behaviors would occur and the reliability of coding those behaviors were both increased. In addition, the likelihood of interruptions and distractions that would vary from home to home was reduced in the laboratory setting, which strengthened the internal validity of the study (Pedhazur & Schmelkin, 1991, p. 251). The intent of this study was to do initial explorations of the mother-infant interaction correlates of early language in a controlled setting. Further research should extend these results to naturalistic settings to increase the ecological validity of the findings from this study.

Data Reduction and Analysis

Social Toy Play

Social toy play was assessed using both frequency and percentage scores. Frequency scores represent a total of how frequently mothers and infants were engaging in social interactions with toys, and are obtained by tallying the coded behaviors in each ten-minute session. Maternal and infant responses, however, depend on toy initiations by the play partner. Therefore, percentage scores were also calculated to assess the extent to which mothers or infants responded to their play partner's toy initiations (Baumwell et al., 1997). These scores were computed as the proportion of responses to the play partners toy initiations. A table listing all constructed social toy play variables and definitions is provided in Appendix J. The variables and rationale for constructing them are also described in more detail below.

Maternal encouragement of attention has been measured in other research as the frequency of attempts to verbally or physically orient toddlers' attention toward the environment or as the frequency of 15-second intervals in which this type of attention directing occurred (Landry & Chapieski, 1989; Tamis-LeMonda & Bornstein, 1989, 1990). For analysis, a composite measure of mothers' attention-directing toward toys, labeled *maternal initiations*, was calculated by totaling the frequency of offers and shows. A composite measure of responses to initiations, labeled *maternal responses*, was calculated by totaling the frequency of accepting or acknowledging infant toy initiations. A similar composite of exchanges, labeled *maternal exchanges*, was computed from the total frequency of simple (accept and then return) and complex (accept, manipulate/label,

and then return) toy exchanges. To assess infant contributions to social play, the same composite variables were created from infant codes, and labeled *infant initiations, infant responses,* and *infant exchanges*.

Previous research has indicated that mothers vary their attention-directing strategies according to infant behavior and level of development (Bornstein & Tamis-LeMonda, 1990). Therefore, it is important to assess the number of maternal initiations in proportion to infant initiations. First, a composite of the directing behaviors (offer, show, take, retake, retract) was computed for both mothers and infants, and a total of these behaviors for the dyad were calculated. *Maternal-directing* was computed by dividing the total of mother-directed behaviors by the total for the dyad.

It has been suggested that maternal responsiveness may be an even better predictor of child outcomes than maternal attention directing (Tamis-LeMonda & Bornstein, 1990). *Maternal responsiveness* is a measure of how often the mother was following the infant's lead. In addition, it is possible to measure how frequently an infant responded to maternal attention-directing strategies. *Maternal responsiveness* was computed as the percentage of infant initiations to which mothers responded by accepting the toy, and *maternal coordinations* as the percentage of infant toy initiations which mother coordinated with the infant by accepting and then attempting to return the toy. *Infant responsiveness* and *infant coordinations* were computed as proportions of infant accepting and exchanging in relation to mother initiations.

Joint Attention

The merged mother- and infant-looking files were analyzed for duration of looks, as well as sequential and overlapping looks. *Maternal gaze following, mother-* and *infant-initiated joint attention*, and *mother-* and *infant-initiated coordinated joint attention* were assessed from the merged data files (for definitions of these variables, see Appendix K).

Reading Scales

Total raw scores from the WJ-R reading tests were used in data analysis. In addition, a cut-off score will be used to identify children as reading delayed. This identification of reading delay is often useful in making clinical decisions. To identify children at risk for reading problems, a criterion score of 1.4 standard deviations below the mean score for grade two on the normed sample was used to classify children as reading disabled. This procedure was used by O'Connor and Jenkins (1999) and classified approximately 6-8% of their participants in each sample as reading disabled, a figure in line with national estimates of reading disability. These categories may be used in further statistical analysis if an appropriate number of children are classified as "reading disabled" (at least 10% of the sample).

Statistical Analyses

One problem inherent in longitudinal studies spanning several years is missing data. Of the 153 children from the combined infancy samples, only a proportion could be located and tested in second grade. Independent samples t tests were conducted using

infancy data, to determine if the children who did not participate in second grade differed significantly from those who did participate. Differences between the two groups on SES and gender were also examined. Given no statistically significant differences and small effect sizes between the two groups, it may be concluded that "although this problem of attrition dictates caution in the interpretation of results, it seems unlikely that it would have any substantial influence on the conclusions of the present investigation" (Butler et al., 1985, p. 354). In this case, although attrition may reduce the statistical power of inferential tests, it would not threaten the internal validity of the study.

For those who participated in this study both in infancy and in second grade, missing data on any of the variables assessed was replaced with the group mean for each variable, following the procedure of Butler et al. (1985). This provided a consistent sample size for further analysis.

Zero-order Pearson correlation and multiple regression were used to analyze the data. Correlations showed the associations among variables in infancy and second grade, and regressions further explained these relations by partialling out covariation among independent variables.

A model of early and later influences on reading development was constructed using regression and path analysis. Although structural equation modeling (SEM) is preferred for assessing the "fit" of data to a model, the sample size in this study is not sufficient for using SEM (Loehlin, 1992). Path coefficients, statistical significance of paths and regression models, and R were reported for each step in the path analysis, following the procedure of Butler et al. (1985).

CHAPTER IV

RESULTS

Statistical Significance Versus Practical Significance

Statistical significance testing was used in this study, but several concerns arise. One issue is alpha inflation. When multiple tests of statistical significance are used, the actual alpha level for the study was substantially larger than the alpha level set for each significance test (Stevens, 1996). Another issue related to significance testing is randomization. This study did not use random selection procedures, and therefore this assumption of inferential tests has been violated and the generalizability of results limited (Pedhazur & Schmelkin, 1991). The third issue is that of practical significance. Associations or group differences that are statistically significant may not have practical meaning (Glass & Hopkins, 1996). Given these concerns, effect sizes that indicate the magnitude of findings, including standardized mean differences and the magnitude of correlations, are reported whenever possible, to address practical as well as statistical significance of results (Pedhazur & Schmelkin, 1991).

Combining the Infancy Samples

The two samples initially recruited in infancy were combined for further data analysis. Several steps were taken to check for differences in sample characteristics. Independent samples *t* tests and effect sizes were used to assess differences between the two samples. Explanations for possible differences were explored by examining

differences in infant age in the two samples, as well as the correlation between infant age and other variables. Histograms and scatterplots were examined for outliers in each sample prior to combining the two infancy samples. Extreme outliers on age or other variables were removed and independent samples *t* tests and effect sizes were recalculated to check for differences. Each step is described next.

Independent samples *t* tests were used to assess differences in sample means on infant language, mother-infant social toy play, joint attention, and play preferences, with a test-wise alpha level set at $p \leq .05$. The standardized mean difference, a measure of effect size, was obtained by calculating the difference between the two means (Sample I minus Sample II) for each variable, and dividing by the average of the two variable standard deviations. The resulting effect size is the difference between groups in units of standard deviations. Based on criteria suggested by Cohen (1977), .20 is considered small, .50 moderate, and .80 large.

The *t* tests and standardized mean differences indicated that there were differences between the two infancy samples on about three fourths of the variables with effect sizes ranging from .07 to 1.09. One explanation for the differences in sample means on infant language, mother-infant social toy play, joint attention, and play preferences in the two samples may be a difference in the age of the infants in the two samples. Infants in Sample I (mean age = 14.38 months) were slightly older than infants in Sample II (mean age = 14.24 months), but this difference was small and not statistically significant, $t(151) = -1.90$, $p = .06$, standardized mean difference = .30. Although in practical terms the mean difference was only 4.2 days, the distributions

differed in skewness. For the younger sample, the distribution was negatively skewed, with most cases falling between 14.25 and 14.75 months, but several cases in the tail at the lower end of the distribution. For the older sample, the distribution was less skewed, with the majority of cases falling between 14.00 and 14.75 months, and a few cases in the tails at each end of the distribution. These difference in age range and distribution may account for the differences in other infant variables. Six outliers were identified whose age was greater than 15 months or less that 13 months, and these cases were excluded from further analysis. After removing these outliers, infants in Sample I (mean age = 14.39 months) remained older than infants in Sample II (mean age = 14.21 months) and the difference between sample means on infant age was statistically significant, t (145) = -3.01, p = .00, standardized mean difference = .52. In fact, outliers less than 13 months of age were removed from the older group (Sample I) and outliers older than 15 months were removed from the younger group (Sample II), resulting in greater differences in mean age between the samples. Thus, with the outliers removed, the two samples differed on the average age of assessment, even though for both samples the ages ranged from 13 to 15 months.

This difference in age may be related to other infant variables. The correlations between infant age and all other 14-month language and play variables were examined after the age outliers were removed (see Table 1). For this study, strong correlations were defined as an absolute value of r ranging from .65 to 1.00, moderate correlations were defined as an absolute value of r ranging from .30 to .65, and weak correlations were defined as an absolute value of r ranging from .00 to.30. There were no strong or

Table 1

Correlation Between Infant Age and Infant Outcome Variables

Variable	Infant age at 14-month assessment (n = 152)
Preverbal language	.06
Receptive language	.16
Productive language	.07
Total language	.16
Maternal responsiveness	.13
Freq. maternal responses	.13
Infant initiations of social play	.05
Freq. maternal gaze following	-.07
Mom-initiated joint attention	.01
Infant-initiated joint attention	-.07
Mom-initiated coordinated joint attention	-.02
Infant-initiated coordinated joint attention	-.04
Mom pref. for language activities	-.04
Infant pref. for language activities	-.10
Mom pref. for shared activities	.16
Infant pref. for shared activities	.09

statistically significant associations between age and infant variables, although there were some small correlations. Within the age range examined, the relationship was weak, probably due to restriction in range of age. All of the infants, after removing the outliers

on age, were between 13 and 15 months of age. Because age was not associated with other infant variables, it was not included as a covariate in further analyses.

Histograms and Scatterplots

Histograms and scatterplots of individual infant variables and infant language were examined next for normality and homoskedasticity, for Sample I, Sample II, and the Combined Sample. The histograms of infant variables revealed that some variables were not normally distributed. Preverbal language was negatively skewed, indicating a ceiling effect such that at 14 months, most infants passed all of the preverbal langauge items. Mother and infant preference for language activities were somewhat negatively skewed, suggesting that mothers and infants preferred most of the language activities listed at 14 months.

For variables such as infant-initiated and maternal-initiated coordinated joint attention, the distribution was positively skewed due to a large proportion of scores of zero, indicating that many mothers and infants were not engaging in coordinated joint attention at 14 months or were doing it infrequently. Social toy play variables, such as infant responses and exchanges, and maternal initiations and responses, were also positively skewed, suggesting that many mothers and infants were not engaging in these behaviors at 14 months.

Outliers were found in several distributions, including frequency of maternal gaze following, and both infant- and maternal-initiated coordinated joint attention. Some mothers and infants engaged in joint attention much more frequently than the rest of the

sample. There were also outliers in the distributions of infant exchanges, maternal initiations, and maternal exchanges. The distributions suggested that some mothers and infants had acquired these skills, and used them during play, whereas other mother-infant dyads did not perform the skills at all during the play observation.

Some variables, such as maternal and infant coordinations and responsiveness, were computed as percentages (ranging from 0 to 100%) of initiations to which the play partner responded. Because of the nature of the variables, some mothers and infants scored very low on these variables if there were few or no opportunities to respond. Most of these variables had distributions which were either positively skewed with extreme outliers or they had distributions with no discernible pattern.

Productive, receptive, and total language distributions were fairly normally distributed, as were distributions of maternal and infant preferences for shared activities. Distributions of Infant initiations were normal as well. There was a more normal distribution of scores on the joint attention versus the coordinated joint attention variables, with coordinated joint attention being slightly more positively skewed. This suggests that whereas some infants had the lower level skill of simple joint attention, fewer infants were capable of coordinated joint attention at 14 months.

It should be noted that for most of the variables, the histogram of the combined scatterplot was more normally distributed than the histograms of either individual sample. Because the distributions of the two samples were not completely overlapping, combining them increased the range of scores for most variables. In addition, the combined distributions were less skewed, and looked more like the normal bell curve.

Scatterplots of individual variables with infant total language revealed that 14-month play variables were linearly related to infant language. In general, there was a fairly even scatter of data points for most variables. However, the assumption of homoskedasticity being met is questionable for some variables. Because of the underlying distributions of some variables (i.e., they were negatively skewed), there was more variability in play variables at the low end of the language distribution than at the high end. Seven extreme outliers in scatterplots of joint attention and social toy play variables with infant language were identified and removed from further analyses.

As a final step, independent samples t tests were used to re-assess differences in sample means after all outliers were removed, with a test-wise alpha level set at $p \leq .05$. The standardized mean difference, a measure of effect size, was also calculated (see Table 2). The reason that test-wise alpha was set at .05, as opposed to setting experiment-wise alpha at (.05/number of tests) was because the purpose of this set of analyses was to check for sample differences on each variable, not to test hypotheses.

The removal of outliers reduced the differences between samples on some variables, but effect sizes were still small to moderate for most variables, and for some variables the effect sizes were large. The characteristics of the variables suggest that there were many differences in the samples which remained, C due to the difference in age distributions of the two samples as well as the nature of the variables.

Because there is no other rationale for the differences beyond what was explored, data from the two samples were combined for further analysis. There is no advantage to analyzing the data separately for the two samples, and in fact, doing so would decrease

Table 2

Independent Samples t Tests to Assess Differences in Original Infancy Sample Means

Construct	Sample I mean	Sample II mean	t	df	Sig t	Standardized mean difference
	(n = 83)	(n = 70)				
Age	14.39	14.21	-3.07	145	.00	.51
Total language	7.88	6.72	3.76	152	.00	.63
Preverbal language	2.62	2.47	1.36	152	.18	.22
Receptive language	1.90	1.53	3.55	152	.00	.57
Productive language	1.12	.76	2.60	152	.01	.42
Maternal initiations	8.93	5.89	1.88	136	.06	.34
Maternal responses	5.57	4.60	1.01	136	.32	.17
Maternal exchanges	1.33	1.97	-1.44	136	.15	.25
Infant initiations	9.25	7.03	2.04	136	.04	.35
Infant responses	4.97	5.55	-.60	136	.55	.10
Infant exchanges	.74	1.35	-1.74	136	.08	.30
Maternal-directing	.41	.43	-.29	136	.77	.03
Maternal responsiveness	.18	.26	-2.02	135	.05	.33
Maternal coordinations	.10	.18	-2.73	135	.01	.42
Infant responsiveness	.45	.66	-4.79	124	.00	.82
Infant coordinations	.07	.14	-2.41	124	.02	.41
Maternal gaze following	8.02	11.03	-2.89	130	.00	.50
Infant-initiated joint attention	.46	.68	-2.52	130	.01	.43

(table continues)

Construct	Sample I mean	Sample II mean	t	df	Sig t	Standardized mean difference
	(n = 83)	(n = 70)				
Maternal-initiated joint attention	.42	.58	-1.86	130	.07	.40
Infant-initiated coordinated joint attention	.58	.93	-3.31	130	.00	.57
Materal-initiated coordinated joint attention	.37	.45	-1.18	130	.24	.19
Maternal preference for language games	3.22	2.54	5.37	144	.00	.88
Infant preference for language games	2.77	2.26	4.09	144	.00	.66
Maternal preference for shared games	2.92	2.22	6.55	144	.00	1.07
Infant preference for shared games	2.93	2.29	6.43	144	.00	1.05

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

the statistical power of subsequent analysis. In addition, combining the two samples normalized the bivariate distributions of infancy variables with infant language.

Longitudinal Attrition

Independent samples t tests were conducted to test for attrition bias in the longitudinal sample, from infancy (14 months, combined sample) to second grade. The results are listed in Table 3. Independent samples t tests suggest that differences between those who remained in the longitudinal sample and those who dropped out were small,

Table 3

Independent Samples t Tests for for Attrition Bias in Longitudinal Sample, from 14 Months to Second Grade

14-month variables	Longitudinal sample mean (infancy to second grade) mean scores on infancy variables n = 105	Attrition group mean (infancy to second grade) mean scores on infancy variables n = 48	t	df	Sig t	Standardized mean difference
Mean preverbal language	2.60	2.47	-1.24	152	.22	.20
Mean receptive language	1.67	1.78	1.04	152	.30	.16
Mean productive language	.97	.91	-.43	152	.67	.07
Mean total language	7.39	7.17	-.68	152	.50	.11
Maternal responsiveness	.24	.18	-1.35	135	.18	.26
Freq. maternal responses	5.88	3.96	-1.96	136	.05*	.36
Infant initiations of social play	8.88	7.18	-1.53	136	.03*	.27
Freq. maternal gaze following	10.26	8.23	-1.88	130	.06	.35
Maternal-initiated joint attention	.46	.54	.95	130	.35	.16

(table continues)

14-month variables	Longitudinal sample mean (infancy to second grade) mean scores on infancy variables n = 105	Attrition group mean (infancy to second grade) mean scores on infancy variables n = 48	t	df	Sig t	Standardized mean difference
Infant-initiated joint attention	.59	.52	-.70	130	.48	.12
Maternal-initiated coordinated joint attention	.36	.48	1.65	130	.10	.29
Infant-initiated coordinated joint attention	.80	.66	-1.22	130	.23	.23
Maternal pref. for language activities	2.85	2.96	.79	144	.43	.13
Infant pref. for language activities	2.53	2.50	-.32	144	.75	.05
Maternal pref. for shared act.	2.53	2.64	.91	144	.37	.15
Infant pref. for shared act.	2.61	2.63	.16	144	.88	.03

Note. Scores represent mean scores on infancy data for those who remained in the sample from infancy to second grade (longitudinal) and those who dropped from the sample (attrition).
*$p < .05$

with effect sizes ranging from .03 to .36. There were small, statistically significant differences in the frequency of maternal responses and infant initiations of social play.

Hypothesis Testing

Assumptions of Correlation and Regression

Several of the assumptions of correlation and regression have not been met for some variables in this sample, including the assumption of normality of the distribution of scores and the assumption of homoskedasticity. Because these assumptions have been violated, results should be interpreted cautiously. However, most statistical procedures are fairly robust to some degree of violation of the assumptions. Stevens (1996) suggested that statistical tests based on the linear model, such as analysis of variance, are not seriously affected by violations of certain assumptions, such as non-normality. In fact, he suggests that they are "robust with respect to Type I error" and that "skewness has very little effect on power" and therefore on Type II errors (p. 238). Glass and Hopkins (1996) similarly reported several studies which suggest that for two-tailed *t* tests, the violation of the assumption of normality "has almost no practical consequences" for Type I and Type II errors (p. 291). To the extent that the assumptions have been met, the results will be accurate.

Hypothesis 1

Hypothesis 1 proposed that mother-infant joint attention would be related to mother-infant play behaviors at 14 months. Correlations between joint attention and social toy play are displayed in Table 4. The pattern of associations indicates that there

Table 4

Correlations Between Joint Attention and Mother-Infant Social Toy Play at 14 Months

Social toy play (n = 127)	Freq. maternal gaze following	Maternal-initiated joint attention	Infant-initiated joint attention	Maternal-initiated coordinated joint attention	Infant-initiated coordinated joint attention
Maternal initiations	.07	.22*	.08	.24**	.10
Maternal responses	.28**	.22*	.06	.11	.22*
Maternal responsiveness	.16	.19*	.00	.08	.14
Maternal coordinations	.27**	.21*	.02	.08	.18*
Infant initiations	.12	.09	.00	.03	.09
Infant responses	.18*	.26**	.06	.22*	.16
Infant responsiveness	-.04	-.04	-.07	-.04	-.06
Maternal-directing	.06	.22*	.08	.25**	.09

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

are consistent, positive associations between joint attention and social toy play. The correlation coefficients are positive and small, ranging from r (126) = .00 to r (126) = .28. Only infant responsiveness was negatively associated with joint attention variables, although those associations were very small, ranging from r (126) = -.04 to r (126) = -.07, and were not statistically significant. In addition, the associations between infant-initiated joint attention and the social toy play variables were very small, ranging from r (126) = .00 to r (126) = .08, and nonsignificant, as were the associations between infant initiations during social toy play and the joint attention variables. The overall pattern of positive associations is in line with current theory and research, which suggest that joint attention is a necessary skill required for engaging in social play with objects.

Correlations between joint attention and mother-infant play preferences are displayed in Table 5. The pattern of associations is not consistent. Rather, preferences for specific types of play are positively associated with joint attention variables, although the associations are small, ranging from r (127) = .01 to r (127) = .25, and some were not statistically significant. The frequency of maternal gaze following was associated with both mothers' and infants' preferences for point-and-name games and give-and-take games. Both joint attention and coordinated joint attention initiated by the mother were associated with mothers' or infants' preferences for point-and-name games, naming body parts, and tossing the ball back and forth. Both joint attention and coordinated joint attention initiated by the infant were associated with mothers' and infants' preferences for point-and-name games and infants' preferences for reading books.

Table 5

Correlations Between Joint Attention and Mother-Infant Play Preferences at 14 Months

Play preferences (n = 128)	Freq. maternal gaze following	Maternal-initiated joint attention	Infant-initiated joint attention	Maternal-initiated coordinated joint attention	Infant-initiated coordinated joint attention
Maternal preferences for language activ.	.09	.02	.05	.06	.02
Point-and-name games	.28**	.11	.17	.12	.18*
Infant preferences for language activities	.10	.04	.10	.08	.07
Point-and-name games	.26**	.09	.19*	.10	.19*
Reading books	.11	.06	.25**	.11	.18*
Naming body parts	.08	.18*	.01	.16	.09
Maternal preferences for shared activities	.05	.02	.01	.03	-.03
Give and take games	.15	.12	.09	.08	.15
Tossing ball back and forth	.08	.07	.05	.13	.00
Infant preferences for shared activities	.03	.03	-.02	.06	-.07
Give and take games	.11	.08	.06	.06	.10
Tossing ball back and forth	.08	.11	.04	.17*	-.01

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

Hypothesis 2

Hypotheses 2, 3, and 4 explored the relations among mother-infant play and infant language. Hypothesis 2 suggested that joint attention would be associated with infant language at 14 months. Correlations between mother-infant joint attention and infant language are presented in Table 6. The pattern of correlations indicates that joint attention was not related to infant language in this sample, contrary to what was expected. There were very small positive and negative associations between joint attention and infant language, ranging from r (130) = .00 to r (130) = -.15, but none of these associations were statistically significant.

Table 6

Correlations Between Joint Attention and Infant Language at 14 Months

Joint attention (n = 131)	Total language	Preverbal language	Receptive language	Productive language
Maternal gaze following	-.10	-.05	-.15	-.04
Infant-initiated joint attention	-.08	.01	-.10	.00
Maternal-initiated joint attention	.02	.03	.07	-.02
Infant-initiated coordinated joint attention	-.08	-.05	-.09	.00
Maternal-initiated coordinated joint attention	.02	.08	.08	.02

Hypothesis 3

Hypothesis 3 suggested that mother-infant social toy play would be associated with infant language at 14 months. Correlations between mother-infant social toy play and infant language are presented in Table 7. The pattern of correlations indicates that maternal initiations, responses, responsiveness, and directing, as well as infant responses, are positively associated with infant language abilities at 14 months. The associations are small, ranging from r (136) = .01 to r (136) = .26. Preverbal language had the lowest associations with mother-infant social toy play, perhaps because of a ceiling effect with this measure (infants passed most or all of the items).

Table 7

Correlations Between Mother-Infant Social Toy Play and Infant Language at 14 Months

Social toy play (n = 137)	Total language	Preverbal language	Receptive language	Productive language
Maternal initiations	.19*	.03	.14	.25**
Maternal responses	.26**	.14	.15	.20*
Maternal responsiveness	.14	.10	.18*	.01
Maternal coordinations	.14	.11	.10	.10
Infant initiations	.15	.11	.07	.13
Infant responses	.22*	.13	.13	.23**
Infant responsiveness	-.04	.05	-.14	-.02
Maternal-directing	.20*	.04	.15	.26**

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

Hypothesis 4

Hypothesis 4 suggested that mother-infant preferences for language and literacy activities would be associated with infant language at 14 months. Correlations between mother-infant preferences for language and literacy activities and infant language are presented in Table 8. The pattern of correlations indicates that, in general, mother and infant preferences for several language activities and shared activities are positively associated with infant language, although the associations are small, ranging from r (144) = .14 to r (144) = .33. In addition, there are associations between preferences for specific types of play and infant language abilities. The strongest associations were between infant language and mother and infant preferences for point-and-name games and naming body parts, r (144) = .14 to r (144) = .33.

Hypothesis 5

Hypothesis 5 proposed that mother-infant preferences for language and literacy activities in infancy would be related to maternal book reading in second grade and children's second-grade reading skills. Correlations between play preferences in infancy and maternal book reading and children's reading skill in second grade are presented in Table 9. Both maternal and infant preferences for language activities in infancy were associated with passage comprehension in second grade. Maternal preferences for point-and-name games and infant preferences for point-and-name games, rhymes and songs, and reading books were also associated with reading skills in second grade. The associations were small, ranging from r (87) = .01 to r (87) = .24. Maternal book reading in second grade was not consistently related to either maternal or infant preferences for

Table 8

Correlations Between Mother-Infant Play Preferences and Infant Language at 14 Months

Play preferences (n = 145)	Total language	Preverbal language	Receptive language	Productive language
Maternal preferences for language activities	.30**	.16*	.17*	.21*
Point and name games	.16*	.14	.09	.12
Infant preferences for language activities	.33**	.15	.20*	.22**
Point and name games	.21*	.11	.11	.15
Reading books	.12	.02	.13	.11
Naming body parts	.26**	.10	.19*	.14
Maternal preferences for shared activities	.27**	.18*	.21**	.20*
Give and take games	.12	.16	.00	.02
Tossing ball back and forth	.08	.02	.07	.11
Infant preferences for shared activities	.28**	.14	.24**	.20*
Give and take games	.14	.19*	.07	.03
Tossing ball back and forth	.05	.00	.10	.05

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

activities at 14 months. In contrast to theory, maternal and infant preferences for action rhymes and rhymes and songs were not associated with word attack, in fact the correlations were very close to zero.

Table 9

Correlations Between Mother-Infant Preferences for Language and Literacy Activities and Second-Grade Reading

Play preferences	Maternal second-grade book reading	Word Attack	Passage Comprehension
Maternal preferences for language activities (n = 88)	.04	.10	.22*
Point and name games	.00	.22*	.22*
Naming body parts	.06	.16	.16
Action rhymes	-.15	-.09	.01
Rhymes and songs	-.01	-.05	.19
Reading books	.10	.07	.14
Infant preferences for language activities (n = 88)	.07	.11	.19
Point and name games	-.03	.24*	.10
Naming body parts	.16	.01	.02
Action rhymes	-.06	-.02	.05
Rhymes and songs	.03	.04	.21*
Reading books	.12	.15	.22*

*$p < .05$

Hypothesis 6

Hypothesis 6 proposed that there would be an association between infant language abilities and second grade reading skills. Table 10 lists the correlations between language skills in infancy and reading skills in second grade. Contrary to what was expected, there were very weak associations between language skills at 14 months

Table 10

Correlations Between Language, Joint Attention, and Mother-Infant Play at 14 Months with Second-Grade Reading

Infant language (n = 90)	Word Attack	Passage Comprehension
Total language	-.06	.12
Preverbal language	-.09	.12
Receptive language	-.06	.14
Productive language	.00	.03

and reading skills in second grade. Although none of the associations were statistically significant, there were small positive associations between total, preverbal, and receptive language and passage comprehension, r (89) = .12 to r (89) = .14.

Hypothesis 7

Hypothesis 7 proposed that there would be associations between joint attention and social toy play in infancy with reading and attention skills in second grade. Table 11 displays the correlations between joint attention and social toy play with second grade reading outcomes. Somewhat surprisingly, there were small, negative associations between joint attention and infant responsiveness in social toy play with later reading, and some of these associations were statistically significant. In contrast, maternal behaviors during social toy play had small positive associations with later passage comprehension, r (82) = .10 to r (82) = .22.

Table 11

Correlations Between Joint Attention and Mother-Infant Play at 14 Months with Second-Grade Reading

Infant play	Word Attack	Passage Comprehension
Joint attention (n = 80)		
Maternal gaze following	.12	-.02
Infant-initiated joint attention	-.07	-.10
Maternal-initiated joint attention	-.16	-.15
Infant-initiated coordinated joint attention	.04	-.02
Maternal-initiated coordinated joint attention	-.31**	-.27**
Social toy play (n = 83)		
Maternal initiations	-.01	.11
Maternal responses	.06	.19
Maternal responsiveness	.07	.22*
Maternal coordinations	.11	.10
Infant initiations	.08	.20
Infant responses	.00	.09
Infant responsiveness	-.10	-.10
Maternal-directing	-.01	.11

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

Table 12 displays the correlations between infant joint attention and social toy play with maternal report of second-grade attention capacity. The pattern of correlations suggests a negative association between mother-infant joint attention and social toy play and later cognitive and attention problems as reported by the mother. The strongest

Table 12

Correlations Between Joint Attention and Mother-Infant Play at 14 Months with Maternal Report of Second-Grade Attention Capacity

Infant play	Cognitive problems	Hyper-activity	ADHD symptoms	Inattentive	Hyperactive-impulsive
Joint attention (n = 84)					
Maternal gaze following	-.16	-.13	-.17	-.17	-.16
Infant-initiated joint attention	-.02	-.05	-.02	-.05	-.08
Maternal-initiated joint attention	-.06	-.06	-.10	-.07	-.14
Infant-initiated coordinated joint attention	-.07	-.09	-.10	-.08	-.14
Maternal-initiated coordinated joint attention	-.04	-.06	-.07	-.09	-.14
Social toy play (n = 84)					
Maternal initiations	-.15	-.16	-.15	-.18	-.10
Maternal responses	-.16	-.05	-.08	.01	-.06
Maternal responsiveness	-.05	-.12	-.05	.00	-.11
Maternal coordinations	-.13	-.13	-.10	-.05	-.16
Infant initiations	-.13	.01	-.05	.06	-.01
Infant responses	-.17	-.21*	-.18	-.23*	-.20
Maternal-directing	-.15	-.16	-.15	-.18	-.10

*$p < .05$

associations were among maternal initiations and infant responses during social toy play and maternal gaze following with later attention and cognitive problems, although the associations are still small, r (83) = -.10 to r (83) = -.23.

Table 13 displays the correlations between infant joint attention and social toy play with teacher report of second grade attention capacity. The associations are similar to those reported in Table 12, although they are somewhat weaker and less consistent, r (89) = -.21 to r (89) = .19. Hypothesis 7 also suggested that there would be associations between second grade reading skills with second-grade attention capacity. There was a consistent pattern of small, negative correlations between both maternal and teacher report of cognitive and attention problems with reading skills in second grade (see Table 14). However, teacher report of cognitive problems and attention problems in the classroom was more strongly associated with poor reading in second grade, with small to moderate associations, r (90) = -.12 to r (90) = -.48.

Regression and Path Analysis

A model of early and later influences on reading development was constructed using regression and path analysis, based on conceptual links as well as statistically significant correlations among variables. Regression models were constructed using complete data from age 14 months to second grade. To establish a consistent sample size across all measures (n = 96), all missing data were replaced with the sample mean for variables in the model if data were available on both infant language and second-grade reading for a participant. To increase the power to detect effects in the model, the

Table 13

Correlations Between Joint Attention and Mother-Infant Play at 14 Months with Teacher Report of Second-Grade Attention Capacity

Infant play	Cognitive problems	Hyper-activity	ADHD symptoms	inattentive	Hyperactive-impulsive
Joint attention (n = 90)					
Maternal gaze following	-.09	.01	-.07	-.12	-.02
Infant-initiated joint attention	.11	-.01	.02	.06	-.05
Maternal-initiated joint attention	.00	.08	.01	.01	.04
Infant-initiated coordinated joint attention	-.02	-.08	-.08	-.06	-.12
Maternal-initiated coordinated joint attention	.13	.19	.12	.13	.14
Social toy play (n = 90)					
Maternal initiations	-.06	-.08	-.07	-.07	-.10
Maternal responses	-.20	-.06	-.08	-.17	-.03
Maternal responsiveness	-.09	-.05	-.03	-.09	.00
Maternal coordinations	-.21*	-.09	-.13	-.17	-.08
Infant initiations	-.17	-.04	-.07	-.15	-.02
Infant responses	-.06	-.04	-.05	-.06	-.06
Maternal-directing	-.06	-.09	-.08	-.08	-.10

*p < .05

Table 14

Correlations Between Second Grade Reading and Maternal and Teacher Report of Second Grade Attention

Second-grade attention	Word Attack	Passage Comprehension
Maternal report (n = 94)		
Cognitive problems	-.14	-.26*
Hyperactivity	-.13	-.09
ADHD symptoms	-.10	-.13
Inattentive	-.01	.00
Hyperactive-impulsive	-.10	-.08
Teacher report (n = 91)		
Cognitive problems	-.44**	-.48**
Hyperactivity	-.27**	-.16
ADHD symptoms	-.33**	-.26*
Inattentive	-.39**	-.42**
Hyperactive-impulsive	-.26*	-.12

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

number of cases per predictor in the regression equations satisfies criteria outlined by Stevens (1996). Citing a study by Park and Dudycha (1974), Stevens reported that with a sample size of about "15 subjects per predictor the amount of shrinkage is small," or in other words the regression equation is more likely to be reliable and generalizable (cross validate well) (Stevens, 1996, p. 125). A larger sample size would certainly increase the power to detect true effects, but the ratio of cases per predictors in the regressions here is adequate given the general guidelines.

In constructing the models, theoretical links were considered first, and bivariate correlations were used to select the strongest predictor(s) from a group of variables (e.g., joint attention) to reduce the ratio of predictors to dependent variables. Models were tested, and nonsignificant paths with small path coefficients were dropped and the model was rerun to check for differences in the model. This process produces the most parsimonious model which tests the causal relations of the variables in the model (Loehlin, 1992).

Although structural equation modeling is preferred for assessing the "fit" of data to a model, the sample size in this study was not sufficient for using SEM (Loehlin, 1992). Path coefficients (Beta weights) as well as the statistical significance of paths and each regression equation in the model are reported in Table 15 for each step in the path analysis, following the procedure of Butler et al. (1985).

The regression models reported in Table 15 are all statistically significant, except for the model predicting infant preference for point-and-name games, which approached statistical significance. In addition, the predictors in each model accounted for 6-26% of the variance in the dependent variables, with the strongest regression models predicting the key outcomes variables, decoding skills and passage comprehension. Overall, the predictor variables accounted for 25% of the variance in decoding skills and 26% of the variance in passage comprehension. Most of the beta weights which were left in the regression models (after the models were rerun) were small but statistically significant. The strongest beta weights were from maternal and teacher report of cognitive problems in second grade with decoding skills and passage comprehension in second grade.

Table 15

Summary of Multiple Regressions for Variables Used in the Path Model Predicting Decoding and Passage Comprehension

Variables entered	β	t	R^2	F for model
Dependent variable				
Maternal responses			.10	5.37**
Predictors				
Frequency of maternal gaze Following	.40	3.27**		
Infant-initiated joint attention	.23	1.84*		
Dependent variable				
Infant pref. point-and-name games			.06	2.69
Predictors				
Frequency of maternal gaze following	.13	1.04		
Infant-initiated joint attention	.13	1.03		
Dependent variable				
Infant pref. reading books			.13	4.59**
Predictors				
Frequency of maternal gaze following	-.04	-.32		
Infant-initiated joint attention	.28	2.25*		
Dependent variable				
Total language 14 months			.09	4.35**

(table continues)

Variables entered	β	t	R^2	F for model
Predictors				
Maternal responses	.24	2.40*		
Infant pref. point-and-name games	.16	1.64		
Dependent variable				
Teacher report cognitive problems			.08	4.26*
Predictors				
Maternal responses	-.20	2.04*		
Infant pref. point-and-name games	-.20	2.02*		
Dependent variable				
Decoding (Word Attack)			.25	7.73**
Predictors				
Infant pref. point-and-name games	.14	1.51		
Maternal book reading second grade	-.20	-2.21*		
Teacher report cognitive problems	-.39	-4.20**		
Dependent variable				
Passage Comprehension			.40	11.68**
Predictors				
Infant pref. reading books	.11	1.32		
Maternal book reading second grade	-.08	-.98		
Teacher report cognitive problems	-.25	-2.68**		
Decoding (Word Attack)	.42	-4.50**		
Total language 14 months	.13	1.54		

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

The path analysis model, constructed from the regression equations in Table 15, is shown in Figure 2. This model shows the direction and strength of paths from exogenous to endogenous variables in the model. Statistical significance of path coefficients are indicated with an asterisk.

Direct, indirect, and total effects were calculated for all predictor variables in the path model, and are displayed in Tables 16 and 17 for decoding skills and passage comprehension respectively. The strongest total effects on decoding skills were from infant preference for point-and-name games in infancy, teacher report of cognitive problems and inattention in second grade, and maternal book reading in second grade. The strongest direct effect was from teacher report of cognitive problems. The strongest total effects on passage comprehension were from infant preference for reading books and infant preference for point-and-name games in infancy, teacher report of cognitive problems and inattention in second grade, and maternal book reading in second grade. The strongest direct effect was again from teacher report of cognitive problems to passage comprehension.

Reading Delay

It was proposed that discriminant analysis would be used to assess the usefulness of infant and second-grade variables in discriminating among poor and adequate readers if an appropriate number of participants (at least 10% of the sample) fell into the "reading delayed" category. This was not the case. Only one participant was classified as reading

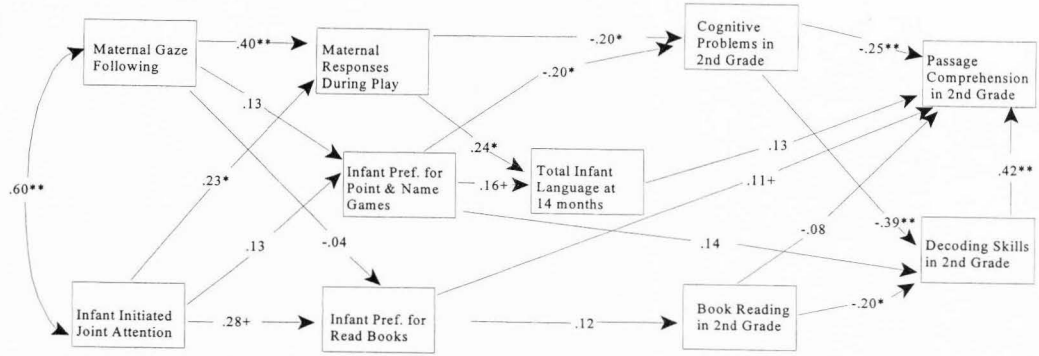

Figure 2. Path analysis model predicting second-grade reading outcomes.

Table 16

Summary of Direct, Indirect, and Total Effects on Decoding Skills

Predictors	Direct effects	Indirect effects	Total effects
Maternal gaze following			
MG→MR→CP→DS		.03	
MG→IP→CP→DS		.01	
MG→IP→DS		.02	
MG→IR→BR→DS		.00	.06
Infant initiated joint attention			
IJ→MR→CP→DS		.02	
IJ→IP→CP→DS		.01	
IJ→IP→DS		.02	
IJ→IR→BR→DS		.01	.06
Maternal responses			
MR→CP→DS		.08	.08
Infant pref. for point-and-name games			
IP→CP→DS		.08	
IP→DS	.14		.22
Infant pref. for reading books			
IR→BR→DS		.02	.02
Teacher report cognitive problems			
CP→DS	.39		.39
Maternal book reading second grade			
BR→DS	.20		.20

Note. MG = Maternal Gaze Following, IJ = Infant Initiated Joint Attention, MR = Maternal Responses, IP = Infant Point-and-Name Games, IR = Infant Read Books, TL = Total Language at 14 months, CP = Teacher Report Cognitive Problems, IA = Teacher Report Inattention, BR = Maternal Book Reading Second Grade

Table 17

Summary of Direct, Indirect, and Total Effects on Passage Comprehension

Predictors	Direct effects	Indirect effects	Total effects
Maternal gaze following			
MG→MR→CP→PC		.02	
MG→MR→CP→PS→PC		.01	
MG→MR→TL→PC		.01	
MG→IP→CP→PC		.01	
MG→IP→CP→DS→PC		.00	
MG→IP→TL→PC		.00	
MG→IR→PC		.00	
MG→IR→BR→PC		.00	
MG→IR→BR→DS→PC		.00	.05
Infant initiated joint attention			
IJ→MR→CP→PC		.01	
IJ→MR→CP→DS→PC		.01	
IJ→MR→TL→PC		.01	
IJ→IP→CP→PC		.01	
IJ→IP→CP→DS→PC		.00	
IJ→IP→TL→PC		.00	
IJ→IR→PC		.03	
IJ→IR→BR→PC		.00	
IJ→IR→BR→DS→PC		.00	.07

(table continues)

Predictors	Direct effects	Indirect effects	Total effects
Maternal responses			
MR→CP→PC		.05	
MR→CP→DS→PC		.03	
MR→TL→PC		.03	.11
Infant pref. for point-and-name games			
IP→CP→PC		.05	
IP→CP→DS→PC		.03	
IP→TL→PC		.02	.10
Infant pref. for reading books			
IR→PC	.11		
IR→BR→PC		.01	
IR→BR→DS→PC		.01	.13
Total language at 14 months			
TL→PC	.13		.13
Teacher report cognitive problems			
CP→PC	.25		
CP→DS→PC		.17	.42
Maternal book reading second grade			
BR→PC	.08		
BR→DS→PC		.08	.16

Note. MG = Maternal Gaze Following, IJ = Infant Initiated Joint Attention, MR = Maternal Responses, IP = Infant Point-and-Name Games, IR = Infant Read Books, TL = Total Language at 14 months, CP = Teacher Report Cognitive Problems, BR = Maternal Book Reading Second Grade

delayed on Word Attack, while no participants were classified as reading delayed on Passage Comprehension. Therefore, discriminant analysis was not performed.

Students were classified by calculating a standard score from the raw score for each of the two reading tests administered, and comparing this standard score with the norming sample at the end of second grade (grade level 2-9). The mean of the standard score in the norming sample was 100, with a standard deviation of 15. Participants who fell below 1.4 standard deviations from the mean on the norming sample were classified as reading delayed. As stated above, only one child was classified as reading delayed on decoding skills in this sample.

The path model suggests that the variables measured in infancy and second grade are useful in predicting later reading abilities. However, due to the low frequency of reading delay in this sample, these same variables will not be used to classify participants as reading delayed versus adequate readers.

CHAPTER V

DISCUSSION

Summary of Results

This study examined multiple aspects of mother-infant social interactions which were suggested in the literature as important for language development and thus possibly for later reading development. These interactions included joint attention, social toy play, and language and literacy activities. The connections between these social interactions and resulting language and literacy skills were both direct and indirect. Each connection, addressed by the research questions outlined in Chapter I, will be discussed next.

The Development of Social Toy Play and Joint Attention

The results of this study suggest that most mothers and infants were engaging in social toy play and joint attention episodes during the 10-minute observational laboratory sessions, but some behaviors were more common than others at 14 months. An examination of the means suggests that both mothers and infants were initiating interactions with toys and responding to their play partners' initiations. However, neither mothers nor infants were exchanging toys frequently at 14 months, meaning that they were not coordinating their interactions with their play partner during the laboratory observation. In addition, mothers and infants were, on average, engaging in joint attention rather infrequently during the high-chair session, although the range spanned

from a total of zero to five minutes of joint attention within this 10-minute laboratory session. Adamson and Bakeman (1985) have suggested that, although infants are capable of sharing attention to an object by around 9 months of age, the frequency and duration of episodes of joint engagement increase dramatically from 12 to 18 months. Infants also start showing signs of "secondary intersubjectivity" around 9 to 12 months (attention that is mutually focused with another person toward an object), and then begin engaging in cooperative behaviors with their play partner (Baldwin, 1995). Because infants are just acquiring the skill of coordinating their attention and actions with another person, it is not surprising that they are not coordinating play behaviors frequently at 14 months. Thus, examining infants at an older age point may clarify the developmental progression of joint attention and social toy play behaviors. In addition, these behaviors need to be examined across other contexts, such as the home setting.

On average, mothers were directing about 40% of the social toy play interactions, while infants were directing about 60% of the interactions. This is in line with past research that has found that infants increasingly initiate play with mothers across the second year of life. According to Carpenter et al. (1998), by 15 months infants are making the transition from following another's gaze to directing another's attention in play; they begin pointing towards toys and showing toys to their play partner, in an effort to direct or request another's attention.

Relations Between Joint Attention, Social Toy Play, and Play Preferences

Joint attention was associated with maternal and infant behaviors during social

toy play. Mothers who were directing and responding to infant attention were also engaging infants in social toy play. Specifically, mothers who were following infant gaze direction during the high-chair session were more likely to respond to infant toy initiations during the free-play session. Likewise, mothers who were initiating joint attention during the high-chair session were more likely to initiate social toy play during the free-play session. Also, maternal gaze following and maternal-initiated joint attention during the high-chair session were related to greater frequency of infant responses during social toy play. Thus, there was consistency across the two settings in the frequency of maternal and infant social behaviors.

Mother-infant joint attention was also associated with mother-infant play preferences at home. The frequency of maternal gaze following in the lab was associated with both mother and infant preferences for point-and-name games at home. Maternal-initiated joint attention and coordinated joint attention were associated with infant preferences for naming body parts and tossing a ball back and forth. Infant-initiated joint attention and coordinated joint attention were associated with infant preferences for point-and-name games and reading books, as well as maternal preferences for point-and-name games at home. Thus, preferences for games requiring mutually focused attention towards an outside object were related to laboratory measures of this skill.

Relations Between Joint Activities and Language

Joint attention was not directly related to language at 14 months. Past research has identified an association of joint attention and joint interactions with infant language

(Carpenter et al., 1998; Rollins et al., 1998). However, this association was lagged, meaning that early interactions were related to later language development (Karrass et al., 1999; Saxon, 1996, 1997). An examination of later language for this sample may find a lagged association between joint attention at 14 months and later language development.

One way that joint attention episodes facilitate infant language development is through the amount of language and labeling of objects that occurs within these episodes (Dunham & Dunham, 1995; Tomasello & Farrar, 1986). The amount of speech occurring in the joint attention episodes was not measured in this study. Rather, only the direction of mothers' and infants' eye gaze was assessed, and joint attention measures were based on the frequency and duration of the overlap between mothers' and infants' direction of eye gaze. This research could be expanded by examining the amount of language that actually occurred during mother-infant joint attention episodes.

Other research has found that social interactions that are purely social in nature (not related to linguistic or symbolic intents) are not necessarily helpful in supporting infant communication. Yoder, Waren, and Hull (1995) found that person-only engagement of children with developmental disabilities was negatively associated with increases in prelinguistic intentional requests. However, there was a positive association between level of symbolic play and increases in prelinguistic intentional requests. These results suggest that, to promote established linguistic communicative competence, interactions between adults and infants should not be purely social in nature but should include objects.

Components of mother-infant social interactions centered around toys were

associated with language in this study. Maternal responses to infant toy initiations were associated with receptive, productive, and total language scores. Maternal responsiveness was associated with receptive and total language scores. Maternal responsiveness in play, and particularly verbal responsiveness, has been associated with infant language in past studies (Baumwell et al., 1997; Tomasello & Farrar, 1986).

Maternal initiations and directing during social toy play were associated with receptive, productive, and total language scores in this study. The context in which mothers were directing play (that is, whether or not the child was previously engaged with a toy) was not examined in this study. Therefore, it is not clear whether mothers were directing infants' unfocused attention or redirecting infants away from toys they were engaged with. Maternal encouragement of attention through the initiation of play activities has been associated with infant language in past studies (Karrass et al., 1999; Tamis-LeMonda & Bornstein, 1989; Vibbert & Bornstein, 1989). However, redirecting an infant's attention away from one object toward another puts greater demands on infant attention capacity. This type of intrusiveness is associated with poorer infant language development (Baumwell et al., 1997; Tomasello & Farrar, 1986).

Language Rich Activities and Infant Language

Mother-infant preferences for language-rich activities were associated with infant language development in this study. Both mother and infant preferences for language activities and shared activities were associated with preverbal, receptive, productive, and total infant language scores. In particular, mother and infant preferences for point-and-

name games were associated with infant total language scores, and infant preferences for naming body parts were associated with receptive, productive, and total language scores. Infant preferences for give and take games were associated with preverbal and total language scores. These types of coordinated games and gestures are highly routinized and require coordinated attention to carry out the routine, which becomes an important context in which language learning can occur (Bruner, 1977). Routinized attention-directing activities have been uniquely associated with infant vocabulary development (Rollins et al., 1998).

Mother-Infant Play Activities and Later Book Reading

Past research has found that early language and literacy activities were associated with later literacy activities and skills (DeTemple, 1999; Dickinson et al., 1999; Mason, 1992; Rowe & Rowe, 1992). However, in this study, there were no associations between mother and infant play preferences for book reading and later book reading. One limitation of this study is that the item measuring book reading in second grade simply asked the child about the frequency of maternal book reading. There may be several other components of literacy activities in second grade that are associated with language and literacy activities in infancy, such as the quality of book reading interactions, rationale for maternal book reading (i.e., the child cannot read themselves), and the quality of book reading with other family members or caregivers (e.g. fathers, siblings, child care providers, etc.). These associations should be further explored.

Infant Language Development and Play Activities and Later Reading Skills

Language and literacy activities in infancy were associated with reading skills in second grade. Both maternal and infant preferences for language activities in infancy were associated with passage comprehension in second grade. Preferences for point-and-name games, rhymes and songs, and reading books in infancy were also associated with later passage comprehension. Play with language, such as using rhymes and tongue twisters, may facilitate key preliteracy skills, such as phoneme awareness, which in turn foster later reading development (Mason, 1992). However, in this study, infant preferences for play activities that involved word play and rhyming were not associated with decoding skills, but more basic early language play such as point and name games were associated with decoding in second grade. This is in contrast to current reading theory; however, the activities measured in this study were in infancy rather than the preschool period. One possible explanation of these findings is that several types of language play in infancy will facilitate infant vocabulary acquisition, which will then support later reading comprehenion. However, the experiences which support decoding skills, namely, word play with rhymes and tongue twisters, are more benefical during the preschool period, when children already have a language base on which to build.

Infant preferences for reading books at 14 months were associated with passage comprehension skills in second grade. Mother-infant book reading in infancy may also support later preliteracy skills, such phoneme awareness and letter-sound knowledge. During joint book reading, parents may help children connect verbal language to print by pointing to the print and letters as they read the text, leaving simple words out and asking

children to fill them in, and allowing children to retell stories (Mason, 1992). These kinds of activities are beneficial for both early language and later reading.

Early language development has been associated with later literacy skills and reading (Butler et al., 1985; Byrne, 1992; DeTemple, 1999; Liberman & Shankweiler, 1985; Molfese & Modglin, 1999; Scarborough, 1990). However, in this study there were no significant associations between infant language skills and later passage comprehension or decoding skills. One limitation of this study is the lack of specificity of the language measures. Although the items were grouped to measure preverbal receptive, productive, and total language, the Bayley was not designed as a measure of language, and the items are scored as pass/fail. The Bayley items have been used in past research as one measure of language, although other well-established measures of language such as the MacArthur CDI measure more specific language skills resulting in a wider range of scores. One interesting extension of this study would be to check the effectiveness of the Bayley items in measuring infant language skills, by correlating this measure with other well-established measures of language. These specific language skills, such as receptive and productive vocabulary size, and early phonological skills, have been associated with preliteracy and literacy skills in early childhood (DeTemple, 1999; Liberman & Shankweiler, 1985; Scarborough, 1990).

Mother-Infant Play and Later Attention Problems

Associations of mother-infant joint attention and social toy play with later attention-regulation problems in second grade were explored in this study. Both mothers

and teachers completed questionnaires asking about inattention and cognitive problems in second grade. There were essentially no associations between coregulated joint attention in infancy and maternal and teacher report of self-regulated attention in second grade. There were small, negative associations between social toy play behaviors and later attention-regulation problems. There were negative associations of maternal initiations, coordinations, and directing behaviors with later maternal report of cognitive problems, hyperactivity, and inattention. There were small, negative associations of maternal responses and coordinations and infant initiations of social toy play with teacher report of cognitive problems in second grade. Engagement in these coordinated play activities very early in the second year was associated with fewer cognitive problems, hyperactivity, and inattention in second grade.

Attention Problems and Reading Skills in Second Grade

Attention-regulation problems in early childhood have been associated with poorer reading skills and school performance (Alexander et al., 1993; Lyon, 1999; Riccio & Jemison, 1998). The results of this study suggest that teacher report of cognitive problems, hyperactivity, and inattention were all associated with poorer decoding and comprehension skills. In addition, maternal report of cognitive problems was associated with poorer reading skills in second grade. The results suggest that inability to self-regulate attention in the classroom may affect reading skills more than inability to self-regulate attention at home does. Also, academic difficulty due to poor

reading skills may contribute to inattention and poor concentration in the classroom (Riccio & Jemison, 1998).

Results of the Path Analysis

The path model constructed for statistical analysis in this study was based on theoretical links and past research presented in the conceptual model in Chapter II (Figure 1). The specific variables chosen for the model were based on zero-order correlations among predictor variables and outcomes, with the strongest predictors chosen for inclusion in the model. An initial model was tested for nonsignificant and/or redundant paths, and such paths were deleted to produce the most parsimonious model. The final model is presented in Figure 2. Each construct presented in the theoretical model will be compared to the corresponding variable(s) in the statistical model next.

In contrast to the theoretical model, the statistical model was constructed by putting joint attention in the model as an indirect rather than direct predictor of 14-month language. It was hypothesized that joint attention, social toy play, and preferences for language and shared activities would all be associated with infant language at 14 months. However, joint attention was associated with other play activities but not directly associated with infant language. Therefore, joint attention was placed in the model as a predictor of social toy play and play preferences in the model, which then were associated with infant language. The paths from joint attention variables (maternal gaze following and infant-initiated joint attention) to maternal responses during social toy play and infant play preferences (preferences for point and name games and preferences for reading books) were direct but weak (path coefficients ranging from .28 to .40).

The paths from mother-infant play to infant language were in line with the theoretical model. Both maternal responses during social toy play and infant preferences for point and name games were weak but statistically significant predictors of total infant language at 14 months.

The next two constructs presented in the theoretical model were maternal book reading in second grade and attention in second grade. When examining the bivariate assocoations between variables, both inattention and cognitive problems in second grade were related to second-grade reading skills. However, with both paths in the model, teacher report of cognitive problems shared the largest portion of unique variance with reading skills, and therefore the paths from inattention were dropped from the statistical model. The path from social toy play to cognitive problems was in line with the theoretical model. Interestingly, just as joint attention had not been directly related to langauge in infancy, neither was it directly related to later cognitive problems. However, infant preference for point and name games was directly related. Thus, there were direct paths from maternal responses and infant preference for point and name games, and an indirect path from joint attenion, through maternal respones during social toy play and infant play preferences.

The final path model indicated that the connections from early language and literacy activities were weak direct predictors of second-grade reading abilities. The strongest predictor of reading skill was concurrent teacher report of cognitive problems in the classroom. Mother-infant social interactions had an indirect effect on later reading through cognitive problems in second grade. The connection from infant language to

later reading comprehension was weak and not statistically significant. However, book reading both in infancy and second grade were associated with reading skills in second grade. Interestingly, maternal book reading in second grade was negatively associated with children's reading skills in second grade. It may be that children are more likely to be read to in elementary school if they are poor readers themselves. Since there was no information about the quality or the purpose of maternal book reading during this time period, there is no certain explanation for those results.

In general, most of the paths identified in the model were in line with the theoretical premises of this study. Joint attention in infancy was related to shared activities which require shared attention between mothers and infants. These joint, language-rich activities were related to increased infant language at 14 months and less frequent cognitive problems in the classroom. While infant preference for book reading and infant language at 14 months were associated with greater reading skills in second grade, cognitive problems and maternal book reading in second grade were associated with poorer reading skills. Thus, both early and later cognitive skills and social interactions were accounting for unique contributions to reading achievement at the end of second grade.

One factor which may have limited the results of the path analysis is the socio-economic status of this sample. Most families within the sample were classified as "middle SES," which may have limited the range of developmental skills in this study. None of the participants were reading substantially below grade level, and therefore they were not classified as reading delayed. As discussed previously, the language scores in

infancy were also restricted. The connections from early development to later reading would most likely be stronger given greater variability in language scores in infancy and reading scores in second grade.

Limitations

There are several limitations of the sample and research design used in this study. One limitation of this study is that the sampling technique used was convenience sampling. Therefore, generalizations from this study to other populations should be made with caution. Indeed, "the validity of a statistical inference depends on how representative the sample is of the population" (Glass & Hopkins, 1996, p. 225). However, the study design was correlational rather than simply descriptive, and there is little reason to assume that the volunteers in this sample show different patterns over time than would a sample of nonvolunteers randomly selected from the population. In addition, nonprobability sampling is commonly used in sociobehavioral research due to "feasibility and economic constraints" (Pedhazur & Schmelkin, 1991, p. 321), which makes replication of the findings an important consideration in future research. The particular findings from this study that should be replicated include the associations of infant book reading, maternal book reading in second grade, and infant preferences for rhyming activities with later decoding and passage comprehension.

There was another limitation of this study related to sampling issues. The two samples in infancy differed on several variables. There was no clear explanation for this difference except for a small difference in age. However, because the infants were

assessed one year apart, and one group of infants had visited the laboratory previously, other factors may have contributed to the sample differences. The difference between infant samples may further limit the generalization of results to other populations of infants.

A third limitation of this study was the nature of the data. Some variables in infancy were not normally distributed, and therefore the assumptions of the statistical techniques used were violated. The type of data used in this study may not lend itself to normal distributions, due to the developmental nature of the skills represented. A trend apparent in the data was that many infants lacked a skill entirely, some had low levels of the skill, and a few had high levels of the skill, resulting in distributions which were positively skewed. Nevertheless, general linear model analyses such as those used in this study are known to be robust in relation to the distribution of the data (Pedhazur & Schmelkin, 1991).

A fourth limitation of the data in this study is related to the change from age-based to grade-based assessment at the end of second grade. For the reasons specified in the procedures section, all children in the follow-up study were tested at the end of second grade. However, the statistical analyses did not control for variability in age. Future analysis of this data should control for age at the time of the assessment, since developmental level may influence reading skills.

The lack of additional data in this study limits the specification of the pathways from infant development to reading in early childhood. There were no teacher-level data on children's reading achievement in school, or on the instructional strategies and

curriculum used in the classroom. There was no in-depth information gathered about pre-literacy activities in the home during the preschool period (such as reading books that rhyme or play with words, activities that foster pre-writing skills). There were no assessments conducted between infancy and second grade that measured the skills required before reading instruction begins, such as letter-word identification or phonemic awareness. Additional data would make the path analysis model more clear and complete.

A final limitation, but also strength, of this study is the fact that the infancy portion of the study was conducted in a controlled laboratory study. Pedhazur and Schmelkin (1991) comment that although the "internal validity of laboratory experiments is potentially high ... (it) is achieved at the expense of low external validity, that is, low generalizability" (pp. 251-252). Nevertheless, Dipboye and Flanagan's (1979) meta-analysis of field research in industrial and organizational psychology concluded "that blanket statements concerning the inherent external validity of field research are not only inaccurate but serve to hinder the development of ... a field of study" (p. 149). Thus, researchers must weigh both the costs and benefits of controlling for extraneous variables in a laboratory setting.

Future Research

The conclusions drawn from this study could be supported by replicating and extending the present study. Replicating this study with a larger sample that was randomly selected would strengthen this study in several ways. Data collected using a

larger sample would lend itself to structural equation modeling, where the fit of the data to the model could be tested. In addition, a larger sample size would increase the power to detect significant pathways in the model. Power is dependent upon the alpha level chosen ($p = .05$ for this study), sample size, and effect sizes (Pedhazur & Schmelkin, 1991). Karney and Bradbury (1985) suggested that sample sizes of less than 100 are a problem, in that the likelihood is greatly reduced of detecting small effects with an alpha level set at .05. This increases the necessity for replication of the research findings. In addition, a randomly selected sample and procedures that rely less on efforts of participants to come to the research location may result in a sample from which results are more generalizable.

In addition to a larger, randomly selected sample, this research could be extended by including additional measures and additional assessment points from infancy to second grade. Measures in preschool and kindergarten might include the frequency and quality of book reading and other language activities, phonemic awareness, vocabulary size, syntactic awareness, and mean length of utterance. Future studies should include additional measures of basic reading skills in early childhood, such as letter-word identification, as well as listening comprehension skills. Inclusion of these additional measures would clarify whether the associations from infant language and play to later reading are through language pathways, general cognitive functioning, or pathways associated with attention regulation.

Conclusions

Indicators of early linguistic competence, apparent in mother-infant interactions as early as 14 months, may be important in identifying children at risk for later language and literacy delays. However, the results from this study suggest that the direct associations may be weak. A comprehensive model of associations from joint attention, social toy play, mother and infant play preferences, and infant langauge with later cognitive problems and reading skills suggested that there are indirect effects as well as direct effects. The strongest indirect effect was from early social interactions to fewer cognitive problems, which were then related to higher reading scores. The results of this study need to be replicated and extended in order to further delineate specific pathways from early mother-infant play to later language and literacy development.

REFERENCES

Adams, M. J. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Adamson, L. B., & Bakeman, R. (1985). Affect and attention: Infants observed with mothers and peers. Child Development, 56, 582-593.

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. Child Development, 64, 801-814.

Bakeman, R., & Adamson, L. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. Child Development, 55, 1278-1289.

Baldwin, D. A. (1995). Understanding the link between joint attention and language. In C. Moore & P. J. Dunham (Eds.), Joint attention: Its origin and role in development (pp.131-158). Hillsdale, NJ: Erlbaum.

Barratt, M. S., & Roach, M. A. (1999, April). Contextual limits on mother-infant conversation. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.

Barton, M. E., & Tomasello, M. (1991). Joint attention and conversation in mother-infant-sibling triads. Child Development, 62, 517-529.

Baumwell, L., Tamis-LeMonda, C. S., & Bornstein, M. H. (1997). Maternal verbal sensitivity and child language comprehension. Infant Behavior and Development, 20, 247-258.

Bayley, N. (1969). Bayley Scales of Infant Development. New York: Psychological Corporation.

Bee, H. L., Barnard, K. E., Eyres, S. J., Gray, C. A., Hammond, M. A., Spietz, A. L., Snyder, C., & Clark, B. (1982). Prediction of IQ and language skill from perinatal status, child performance, family characteristics, and mother-infant interactions. Child Development, 53, 1134-1156.

Bierer, B. (1981). Preference for challenge among children who over-rate, under-rate, and accurately rate their cognitive competence. Unpublished doctoral dissertation, University of Denver.

Bornstein, M. H., Haynes, O. M., O'Reilly, A. W., & Painter, K. M. (1996). Solitary and collaborative pretense play in early childhood: Sources of individual variation in the development of representational competence. Child Development, 67, 2910-2929.

Bornstein, M. H., & Tamis-LeMonda, C. S. (1990). Activities and interactions of mothers and their firstborn infants in the first six months of life: Covariation, stability, continuity, correspondence, and prediction. Child Development, 61, 1206-1217.

Boyce, L., Benson, B., Roggman, L. A., & Cook, G. (1997, April). Influence of infant-mother play at home on infants' level of cognitive play in a laboratory setting. Poster presented at the biennial meeting of the Society for Research in Child Development, Washington, DC.

Bruner, J. S. (1977). Early social interaction and language acquisition. In H. R. Schaffer (Ed.), Studies in mother-infant interaction (pp. 271-289). New York: Academic.

Bruner, J. S. (1983). Child's talk: Learning to use language. New York: Norton.

Bryant, P., Maclean, M., & Bradley, L. (1990). Rhyme, language, and children's reading. Applied Psycholinguistics, 11, 237-252.

Butler, S. R., Marsh, H. W., Sheppard, M. J., & Sheppard, J. L. (1985). Seven-year longitudinal study of the early prediction of reading achievement. Journal of Educational Psychology, 77, 349-361.

Butterworth, G. E., & Jarrett, N. L. M. (1991). What minds have in common in space: Spatial mechanisms serving joint visual attention in infancy. British Journal of Developmental Psychology, 9, 55-72.

Byrne, B. (1992). Studies in the acquisition procedure for reading: Rationale, hypotheses, and data. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), Reading acquisition (pp. 1-34). Hillsdale, NJ: Erlbaum.

Caravolas, M., & Bruck, M. (1993). The effect of oral and written language input on children's phonological awareness: A cross-linguistic study. Journal of Experimental Child Psychology, 55, 1-30.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. Monographs of the Society for Research in Child Development, 63 (255).

Cavallaro, C. C., & Poulson, C. L. (1985). Teaching language to handicapped children in natural settings. Education and Treatment of Children, 8, 1-24.

Cohen, J. (1977). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Conners, C. K. (1997). Conners' Rating Scales-Revised: Technical manual. North Tonawanda, NY: Multi-Health Systems.

Corkum, V., & Moore, C. (1995). Development of joint visual attention in infants. In C. Moore & P. J. Dunham (Eds.), Joint attention: Its origin and role in development (pp. 61-84). Hillsdale, NJ: Erlbaum.

DeTemple, J. M. (1999, April). Home and school predictors of sixth grade vocabulary and reading skills of children from low-income families. Poster presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.

Dickinson, D. K., Wolf, A., Abbott-Shim, M., Bryant, D., Lambert, R., & Peisner-Feinberg, E. (1999, April). Phonemic awareness in Head Start children: Relationship to language and literacy and parenting variables. Poster presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.

Dipboye, R. L., & Flanagan, M.F. (1979). Research settings in industrial and organizational psychology. Are findings in the field more generalizable than in the laboratory? American Psychologist, 34, 141-150.

Duchan, J. (1989). Evaluating adults' talk to children: Assessing adult attunement. Seminars in Speech and Language, 10, 17-27.

Dunham, P. J., & Dunham, F. (1995). Optimal social structures and adaptive infant development. In C. Moore & P. J. Dunham (Eds.), Joint attention: Its origin and role in development (pp.159-188). Hillsdale, NJ: Erlbaum.

Ehri, L. C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), Reading acquisition (pp. 107-143). Hillsdale, NJ: Erlbaum.

Glass, G. V., & Hopkins, K. D. (1996). Statistical methods in education and psychology (3rd ed). Needham Heights, MA: Allyn & Bacon.

Gleason, J. B. (1997). The development of language. Needham Heights, MA: Allyn & Bacon.

Gough, P. B. (1984). Word recognition. In P. D. Pearson, R. Barr, M. Kamil, & P. Mosenthal (Eds.), Handbook of reading research (pp. 225-253). New York: Longman.

Gough, P. B., Juel, C., & Griffith, P. L. (1992). Reading, spelling, and the orthographic cipher. In P. B. Gough, L.C. Ehri, & R. Treiman, (Eds.), Reading acquisition (pp. 35-48). Hillsdale, NJ: Erlbaum.

Hart, B., & Risley, T. (1975). Incidental teaching of language in the preschool. Journal of Applied Behavior Analysis, 8, 411-420.

Hart, B., & Risley, T. R. (1995). Meaningful differences in the everyday experience of young American children. Baltimore, MD: Paul H. Brookes.

Harter, S., & Pike, R. (1984). The Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. Child Development, 55, 1969-1982.

Hartmann, D. P. (1982). Assessing the dependability of observational data. In D.P. Hartmann (Ed.), Using observers to study behavior: Vol. 14, New directions for methodology of social and behaviors science (pp. 51-66). San Francisco: Jossey-Bass.

Hollingshead, A. B. (1975). The four factor index of social status. Unpublished manuscript, Yale University. (Available from A. B. Hollingshead, Department of Sociology, Yale University, New Haven, CT 06520).

Hustedt, J. T., & Raver, C. C. (1998, April). Scaffolding in low-income mother-child dyads: Relations with joint attention and reciprocity. Poster presented at the International Conference on Infant Studies, Atlanta, GA.

Karney, B. R., & Bradbury, T. N. (1995). The longitudinal course of marital quality and stability: A review of theory, methods, and research. Psychological Bulletin, 118, 3-34.

Karrass, J., Mullins, J., & Burke, J. E. (1999, April). Infant temperament and maternal encouragement of attention as predictors of early language development. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.

Landry, S., & Chapieski, M. (1989). Joint attention and infant toy exploration: Effects of Down Syndrome and prematurity. Child Development, 60, 103-118.

Landry, S. H., Garner, P. W., Swank, P. R., & Baldwin, C. D. (1996). Effects of maternal scaffolding during joint toy play with preterm and full-term infants. Merrill Palmer Quarterly, 42(2), 177-199.

Leevers, H. J., & Chelius, L. (1999, April). Gestures to familiar, novel, and placeholder objects and language, imitation, and cognition at 12, 16, and 24 months. Poster presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Leyendecker, B., Lamb, M. E., Fracasso, M. P., Schölmerich, A., & Larson, C. (1997). Playful interaction and the antecedents of attachment: A longitudinal study of Central American and Euro-American mothers and infants. Merrill-Palmer Quarterly, 43, 24-47.

Liberman, I. Y., & Shankweiler, D. (1985). Phonology and the problems of learning to read and write. Remedial and Special Education, 6, 8-17.

Liberman, I. Y., Shankweiler, D., & Liberman, A. M. (1989). The alphabetic principle and learning to read. In D. Shankweiler & I. Y. Liberman (Eds.), Phonology and reading disability: Solving the reading puzzle (pp. 1-33). Ann Arbor: University of Michigan Press.

Loehlin, J. C. (1992). Latent variable models: An introduction to factor, path, and structural analysis. Hillsdale, NJ: Erlbaum.

Lyon, R. G. (1998). Learning to read: Components of a comprehensive balanced reading program: Module 1. (Available from National Institute of Child Health and Human Development, Bethesda MD 20892).

Lyon, R. G. (1999, April). Longitudinal studies of reading abilities: Biological and educational influences on development and persistence. Paper presented at the

biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Mason, J. M. (1992). Reading stories to preliterate children: A proposed connection to reading. In P.B. Gough, L. C. Ehri, & R. Treiman (Eds.), Reading acquisition (pp. 215-241). Hillsdale, NJ: Erlbaum.

Messinger, D. S., & Fogel, A. (1998). Give and take: The development of conventional infant gestures. Merrill-Palmer Quarterly, 44, 566-590.

Molfese, D. L. (April, 1999). Predicting reading performance at eight years of age from auditory brain potentials recorded at birth. Paper presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Molfese, V. J., & Modglin, A.A. (1999, April). Longitudinal studies of reading disabilities: The role of language abilities, environment, and changes over time. Paper presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Moore, C., & Corkum, V. L. (1994). Social understanding at the end of the first year of life. Developmental Review, 14, 349-372.

Mosier, C. E., & Rogoff, B. (1994). Infants' instrumental use of their mothers to achieve their goals. Child Development, 65, 70-79.

Mudd, J. M., & Wolery, M. (1987). Teaching head start teachers to use incidental teaching. Journal of the Division for Early Childhood, 11, 124-134.

Mundy, P., & Gomes, A. (1998). Individual differences in joint attention skill development in the second year. Infant Behavior and Development, 21, 469-482.

O'Connor, R. E., & Jenkins, J. R. (1999). Prediction of reading disabilities in kindergarten and first grade. Scientific Studies of Reading, 3, 159-197.

Park, C., & Dudycha, A. (1974). A cross validation approach to sample size determination for regression models. Journal of the American Statistical Association, 69, 214-218.

Pederson, D. R., & Moran, G. (1995). A categorical description of mother-infant relationships in the home and its relation to Q-Sort measures of mother-infant attachment. In E. Waters (Ed.), Caregiving, cultural, and cognitive perspectives on secure-base behavior and working models: Growing points of attachment theory and research, Monographs of the Society for Research in Child Development, 60, 234-254.

Pedhazur, E. J., & Schmelkin, L. P. (1991). Measurement, design, and analysis: An integrated approach. Hillsdale, NJ: Erlbaum.

Pennington, B. F., Grossier, D., & Welsh, M. C. (1993). Contrasting cognitive deficits in attention deficit hyperactivity disorder versus reading disability. Developmental Psychology, 29, 511-523.

Perez, H., & Gewirtz, J. L. (1999, April). The nature of attention and its reinforcer efficacy for infant behavior. Poster presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Reznick, J. S., Corley, R., & Robinson, J. (1997). A longitudinal twin study of intelligence in the second year. Monographs of the Society for Research in Child Development, 62, (249), 1-160.

Riccio, C. A., & Jemison, S. J. (1998). ADHD and emergent literacy: Influence of language factors. Reading and Writing Quarterly, 14(1), 43-58.

Roach, M. A., Barratt, M. S., Miller, J. F., & Leavitt, L. A. (1998). The structure of mother-child play: Young children with Down syndrome and typically developing children. Developmental Psychology, 34, 77-87.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. New York: Oxford University Press.

Roggman, L. A. (1991). Assessing mother-infant interaction in play. In C. E. Schaefer, K. Kitlin, & A. Sandgrund (Eds.), Play diagnosis and assessment. New York: Wiley.

Roggman, L. A., Boyce, L., Cook, G., & Benson, B. (1998, March). Maternal influence on infant level of play: A longitudinal analysis. Paper presented at the Meetings of the Southwestern Society for Research in Human Development, Galveston, TX.

Roggman, L., Langlois, J., and Hubbs-Tait, L. (1987). Mothers, infants, and toys: Social play correlates of attachment. Infant Behavior and Development, 10, 233-237.

Rollins, P. R., Marchman, V. A., & Mehta, J. (1998, April). Infant gaze following, joint attention, and vocabulary development. Poster presented at the International Conference on Infant Studies, Atlanta, GA.

Rowe, K. J., & Rowe, K. S. (1992). The relationship between inattentiveness in the classroom and reading achievement (Part B): An explanatory study. Journal of the American Academy of Child and Adolescent Psychiatry, 31, 357-368.

Rowe, M. L. (1999). Pointing during interaction between mothers and their fourteen-month-old children: Relationship to child lexical development. Poster presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Saxon, T. F. (1996, April). Joint attention at 6 and 8 months and later language competence. Poster presented at the 10th biennial meeting of the International Conference on Infant Studies, Providence, RI.

Saxon, T. F. (1997, April). The relationship between maternal following or switching verbal references to objects and infant language competence. Poster presented at the biennial meeting of the Society for Research in Child Development, Washington, DC.

Saxon, T. F., & Reilly, J. T. (1998, April). Joint attention and toddler characteristics: Race, sex, and socioeconomic status. Poster presented at the International Conference on Infant Studies, Atlanta, GA.

Scaife, M., & Bruner, J. S. (1975). The capacity for joint visual attention in the infant. Nature, 253, 265-266.

Scarborough, H. (1990). Very early language deficits in dyslexic children. Child Development, 61, 1728-1743.

Siegel, L. S., & Chiappe, P. (1999, April). The early identification of children at risk for dyslexia. Paper presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Skinner, B. F. (1957). Verbal behavior. New York: Appleton-Century-Crofts.

Smith, K. E., Landry, S. H., Swank, P. R., Baldwin, C. D., Denson, S. E., & Wildin, S. (1996). The relation of medical risk and maternal stimulation with preterm infants' development of cognitive, language, and daily living skills. Journal of Child Psychology and Psychiatry and Allied Disciplines, 37, 855-864.

Stevens, J. (1996). Applied multivariate statistics for the social sciences (3rd ed.). Hillsdale, NJ: Erlbaum.

Tamis-LeMonda, C., & Bornstein, M. (1989). Habituation and maternal encouragement of attention in infancy as predictors of toddler language, play, and representational competence. Child Development, 60, 738-751.

Tamis-LeMonda, C., & Bornstein, M. (1990). Language, play, and attention at one year. Infant Behavior and Development, 13, 85-98.

Tamis-LeMonda, C., & Bornstein, M. (1994). Specificity in mother-toddler language-play relations across the second year. Developmental Psychology, 30, 283-292.

Teti, D. D., & Ablard, K. E. (1989). Security of attachment and infant-sibling relationships: A laboratory study. Child Development, 60, 1519-1528.

Tomasello, M. (1995). Joint attention as social cognition. In C. Moore & P. J. Dunham (Eds.), Joint attention: Its origin and role in development (pp.103-130). Hillsdale, NJ: Erlbaum.

Tomasello, M., & Farrar, M. (1986). Joint attention and early language. Child Development, 57, 1454-1463.

Tunmer, W. E., & Hoover, W. A. (1992). Cognitive and linguistic factors in learning to

read. In P. B. Gough, L. C, Ehri, & R. Treiman (Eds.), Reading acquisition (pp. 175-214). Hillsdale, NJ: Erlbaum.

Vibbert, M., & Bornstein, M. H. (1989). Specific associations between domains of mother-child interaction and toddler referential language and pretense play. Infant Behavior and Development, 12, 163-184.

Vygotsky, L. S. (1929). The problem of the cultural development of the child. Journal of Genetic Psychology, 36, 415-434.

Vygotsky, L. S. (1934). Thought and language (A. Kozulin, trans.). Cambridge, MA: MIT Press, 1986.

Wells, G. (1981). Some antecedents of early educational attainment. British Journal of Sociology of Education, 2, 181-200.

Wertsch, J. V., & Tulviste, P. (1992). L. S. Vygotsky and contemporary developmental psychology. Developmental Psychology, 28, 548-557.

Woodcock, R. W., & Johnson, M. B. (1989-1990). Woodcock-Johnson Psycho-Educational Battery-Revised. Allen, TX: DLM Teaching Resources.

Woodcock, R. W., & Mather, N. (1989-1990). WJ-R tests of achievement: Examiner's manual. In R. W. Woodcock & M. B. Johnson (Eds.), Woodcock-Johnson Psycho-Educational Battery-Revised. Allen, TX: DLM Teaching Resources.

Yale, M., & Fullmer, C. (1999, April). Gaze monitoring during early word learning. Poster presented at the biennial meeting of the Society for Research in Child Development, Albuquerque, NM.

Yoder, P. J., Waren, S. F., & Hull, L. (1995). Predicting children's response to prelinguistic communication intervention. Journal of Early Intervention, 19, 74-84.

APPENDIXES

Appendix A

Sample Sizes and Attrition

Table 18

Longitudinal N Sizes for Infancy Samples

Cohort	Contacted	Agreed	Participated	Complete data Time 1	Complete data Time 2 (longitudinal sample)
Sample I					
11 months	223	125	103	98	
14 months longitudinal	100	85	83		83
Sample II					
14 months	139	87	86	70	
17 months longitudinal	70	52	51		51

Table 19

Longitudinal N Sizes from Infancy to Second Grade

Description	Spring 1998	Spring 1999	Spring 2000
Number from infancy Sample I and II	89	10	79
Not found or outside of area	16	3	12
Number contacted	73	7	67
Other attrition	7 declined 1 deceased	1 declined	11 declined
Agreed	65	6	56
Tested	65	6	53
Complete data at Time 3: 2nd Grade	60	6	53
Complete from 14 months to 2nd Grade	47	6	43

Note. 13 additional participants from Time 1 were not contacted at Time 2, they would have fallen into a 4th year wave of the study.

Appendix B

Description of Attrition Within Infancy Samples

Table 20

Independent Samples t Tests for Attrition Bias in Sample I (11 to 14 months)

Infant language	Complete language data (n = 86)	Incomplete language data (n = 16)	t	df	sig t	Standardized mean difference
Mean preverbal language	2.40	2.33	-.36	97	.72	.09
Mean receptive language	3.34	3.50	.45	96	.65	.14
Mean productive language	1.30	1.40	.36	96	.72	.09
Mean total language	7.04	7.14	.18	95	.86	.05

Note. Reasons for attrition include: 15 declined to return; 7 assessment period fell near Christmas; 4 had incomplete data at 11 months and not asked to return

Table 21

Independent Samples t Tests for Attrition Bias in Sample II (14 to 17 months)

Infant language	Complete language data (n = 52)	Incomplete language data (n = 28)	t	df	sig t	Standardized mean difference
Mean preverbal language	2.52	2.40	-.76	78	.45	.17
Mean receptive language	1.52	1.57	.36	78	.72	.08
Mean productive language	.77	.75	-.12	78	.90	.03
Mean total language	6.63	6.96	.84	78	.40	.21

Note. Reasons for attrition include: 17 declined to return; 9 poor video tapes, not asked to return; 2 incomplete data at 14 or 17 months

Appendix C

Informed Consents for the Infancy Assessment

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322-2905
Department of Family and Human Development
Telephone (801) 750-1501
College of Family Life

CONSENT FORM
PARENT-TODDLER PLAY STUDY

You and/or your child are invited to participate in a study of the development of play behavior. We hope to learn more about how and why children play differently at different ages. We are inviting subjects to participate who are in the age group of interest, or are parents of that age group, or are adults with some interest in child development or psychology.

If you decide to participate, we will be asking you to answer some questions and also to participate in the following procedures:

1. completion of questionnaires or card sorting activities that provide information about your (background, play preferences, attitudes, demographic information, etc.)
2. completion of questionnaires or card sorting activities that provide information about your child (background, play preferences, attitudes, demographic information, etc.)
3. observation and videotaping of your child's responses to selected toys and activities in your presence.

The observation session will last approximately one hour.

There are no risks or discomforts in any of these procedures and it is likely to be fun. However, if for any reason you or your child become distressed, we will stop the study. You are also free to stop for any reason at any time.

Any information that is obtained in connection with this study that can be identified with you (or your child) will remain confidential. Data, video tapes, and questionnaires will be labeled by an ID number and not names. Videotapes will be used for this study and may also be used later for research and educational purposes only.

Your decision whether or not to participate will not affect your (or your child's) future relations with Utah State University.

If you have any questions, please ask. If you have any additional questions later, Dr. Roggman of the Department of Family & Human Development at USU (750-1544), will be happy to answer them. You may have a copy of this form to keep. Your signature indicates that having read the above information, you have decided to participate.

You may withdraw your permission to participate or to allow use of photographs or videotapes at any time without penalty.

Your Signature _____ Date _____

Appendix D

Approval from the Institutional Review Board of Utah State University

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322-1450

OFFICE OF THE VICE PRESIDENT
FOR RESEARCH
Telephone (801) 750-1180

MEMORANDUM

TO: Dr. Lori A. Roggman

FROM: Sydney Peterson SP

DATE: February 20, 1991

SUBJECT: Institutional Review Board Approval

The following proposals were reviewed by the Institutional Review Board: (1) "Children's Responses to Peers' Clothing;" (2) "The Effects of Physical Appearance on Others' Expectations and Preferences;" (3) "Temperament and Attractiveness as Predictors of Children's Selection as Observation Subjects by Undergraduate Students;" and (4) "Parent-Toddler Plan in Relation to Mother-Infant Attachment and Cognitive Abilities." The Institutional Review Board members requested that some of the basic elements of informed consent be included, particularly with regard to the photographs and videotapes that will be taken of children. You need to clarify for parents where the current photos will be used, how long they will be used, if they are for the current study only or for further research and training purposes, and if they will be destroyed upon completion of the study. The informed consent forms should also include: (1) a list of each procedure to be used in the study (no checklist); (2) withdrawal from the project without penalty (withdrawal should include withdrawal of photos and videotapes); (3) the expected duration of the subject's participation; and (4) the name of the institution and phone number of the principal investigator. The proposals were approved with the above changes. Please call me at 750-6924 if you have any questions.

Utah State
UNIVERSITY

VICE PRESIDENT FOR RESEARCH OFFICE
Logan, Utah 84322-1450
Telephone: (801) 797-1180
FAX: (801) 797-1367
INTERNET: [pgerity@champ.usu.edu]

March 2, 1998

MEMORANDUM

TO: LoriRoggman
Gina Cook

FROM: True Rubal, Secretary to the IRB

SUBJECT: Temperament, Attachment and Parenting Stress in Infancy: Relations to Social Competence of Second-Graders

The above referenced proposal was reviewed and approved by the IRB. You may consider this letter to be your approval for your study.

Any deviation from this protocol will need to be resubmitted to the IRB. This includes any changes in the methodology of procedures in this protocol. A study status report (stating the continuation or conclusion of this proposal) will be due in one year from the date of this letter.

Please keep the committee advised of any changes, adverse reactions or the termination of this study. I can be reached at x71180.

Appendix E

Informed Consent for the Second-Grade Assessment

Utah State UNIVERSITY

DEPARTMENT OF FAMILY AND HUMAN DEVELOPMENT
College of Family Life Phone: (801) 797-1501
Logan, UT 84322-2905 FAX: (801) 797-3845

CONSENT FORM
PARENT-TODDLER FOLLOW-UP STUDY

You and/or your child are invited to participate in a follow-up study of how early development is related to how well children are doing in the school years. We are inviting subjects to participate who were in our Parent-Toddler play study as infants.

If you decide to participate, we will be asking you to:

1. answer questions about you (family demographic information, parenting practices, parenting stress, temperament).
2. answer questions about your child (temperament, behavior).
3. give permission to contact your child's school teacher for getting information about your child (behavior, social skills) and standardized test scores (state testing).
4. give permission to test your child's reading and math and ask questions about self-perceived competence and acceptance.

There are no risks or discomforts in any of these procedures, and it is likely to be interesting for both you and your child.

Any information obtained in connection with this study that can be identified with you or your child will remain confidential. All forms, questionnaires, and data files will be labeled by an ID number only (no names) and kept in a locked cabinet in a locked room. Reports based on this data will include group summary information and will not include information that could be identified with any individuals. Only the Principal Investigator and trained researchers will have access to the data. After all data are entered, analyzed, and printed in hard copy form, the original forms will be destroyed.

Your decision whether or not to participate will not affect your (or your child's) future relations with Utah State University.

If you have any questions, Dr. Roggman of the Department of Family & Human Development at USU (797-1544), will be happy to answer them. You may have a copy of this form to keep. Your signature indicates that, having read the above information, you have decided to participate. You may withdraw your permission to participate at any time without penalty.

Your Signature _____ (print name)_____

Researcher's Signature _____ Date_____

Utah State UNIVERSITY

DEPARTMENT OF FAMILY AND HUMAN DEVELOPMENT
College of Family Life Phone: (801) 797-1501
Logan, UT 84322-2905 FAX: (801) 797-3845

PERMISSION TO CONTACT SCHOOL AND TEACHER

As the parent of (child's name) _____,
I give my permission for researchers working for the Parent-Toddler Follow-Up study at Utah State University to contact my child's school teacher and to test my child.

Teacher _____

Grade _____

School _____

City _____

School District _____

Parent's Name _____

Parent's Signature _____

Appendix F

Bayley Language Items

Table 22

Language Items from the Balyey Scales of Infant Development (Bayley, 1969

Item # and Description	14 Month Language Subscales
	14 Month Preverbal Language
101. Jabbers expressively (tone and inflection)	X
106. Imitates words	X
116. Gestures to make wants known	X
	14 Month Receptive Language
90. Following a demonstration, puts a cube in a cup on command	X
126. Follows 2 of 3 directions about doll: 1) sit doll in chair, 2) give doll a drink, 3) wipe doll's nose	X
128. Points to three parts of a doll on command	X
132. Names 3 pictures on 2 cards on command OR points to 3 pictures on 2 cards on command	X
	14 Month Productive Language
113. Says 2 words	X
124. Names 1 object when asked (order: ball, watch, pencil, scissors, cup)	X
130. Names 1 picture on card when asked	X
138. Names 2 objects when asked	X
	14 Month Language Total
All previous 14 month items in one scale	

Appendix G

Description of Social Toy Play Codes

Table 23

Social Toy Play Coding

Play responses	Description
Code 1	Ignores an offer: is offered/showed a toy, but does not accept it
Code 2a	Accepts an offer: is offered/showed a toy and takes it
Code 2b	Acknowledges an offer: smiles or talks about a toy that is shown/offered, but does not accept it
Code 3	Responds to accepted toy: manipulates a toy that has been accepted from the other Or talks about an accepted toy (labels, describes, labels actions appropriate to the object, etc.)
Code 4	Returns the toy: offers to return the toy after accepting it from the other, but without responding to the toy (May say "Thank you," "Your turn," etc.)
Code 5	Complex exchange: attempts to/returns the toy that has been accepted and responded to. This is coded for the person offering to return the toy. If it is a continuing complex exchange (with the same toy) keep coding 5's, not 6a's.
Play initiations	
Code 6a	Offers a toy: hands a toy towards the other (within arms reach) or sets it down in front of them, may or may not release if other tries to accept
Code 6b	Shows a toy: looks at or gestures towards the other person with toy in hand
Code 7	Retracts a toy: pulls back toy other tries to accept after offer or show
Code 8	Takes a toy: takes a toy from the other that the other has not offered
Code 9	Retakes: takes back an unoffered toy that the other had previously accepted or taken

Note. Roggman, Langlois, and Hubbs-Tait's 1987 (revised)

Appendix H

Parent-Toddler Play Preferences Questionnaire

Parent-Toddler Play Preferences Questionnaire

Individual Items	Play Preferences Scale	Child's Enjoyment	Parent's Enjoyment	Who initiates
	Language Activities			
Where's your [body part]?				
What's that? (point & name)				
Action rhymes (pat-a-cake, piggies, etc.)				
Rhymes and songs				
Read books				
Other				
	Sharing Activities			
General exploration				
Give & take game				
Toss/roll ball back and forth				
Help with blocks, puzzles, etc.				
Help with wagon, swing, trike, slide, etc.				
Help with art materials (crayons, etc.)				
Help with water, sand, snow				
Other				

Individual Items	Play Preferences Scale	Child's Enjoyment	Parent's Enjoyment	Who initiates
	Pretending Activities			
Eating, cleaning, sleeping				
Talking on the phone				
Trucks, cars, trains				
Dolls, puppets, animals as characters				
Other				
	Sensory Activities			
Peek-a-boo				
Tickle games ('eat you up')				
Bounce, toss, swing baby				
Dance				
Chase, 'catch you'				
Hide & seek				
Tumbling, wrestling				
Cuddly, kissy games				
Other				

Appendix I

Conners Rating Scale

Conners Rating Scale

Individual Items	Conners' Parent Rating Scale
	Cognitive Problems
41. Fails to give close attention to details, careless mistakes	
2. Difficulty doing/completing homework	
50. Forgetful in daily activities	
51. Cannot grasp arithmetic	
9. Avoids tasks requiring sustained mental effort	
12. Fails to complete assignments	
58. Sloppy handwriting	
19. Trouble concentrating in class	
22. Needs close supervision to get through assignments	
29. Doesn't follow through on instructions, fails to finish work	
71. Loses things necessary for tasks	
74. Spelling is poor	
	Hyperactivity
3. Always "on the go"	
13. Hard to control (malls, grocery shopping)	
23. Runs/climbs excessively in inappropriate situations	
28. Excitable, impulsive	
32. Restless, squirmy	
42. Difficulty waiting in lines, waiting turn in games/groups	
52. Run around between mouthfuls at meals	
59. Difficulty playing in leisure activities quietly	
80. Blurts out answers before questions completed	

ADHD Index

9. Avoids tasks requiring sustained mental effort

19. Trouble concentrating in class

29. Doesn't follow through on instructions, fails to finish work

38. Inattentive, easily distracted

45. Distractibility /attention span a problem

48. Gets distracted when given instructions

55. Fidgets with hands/feet, squirms in seat

56. Short attention span

63. Messy/disorganized

69. Only attends if something he/she interested in

76. Leaves seat when remaining in seat expected

78. Easily frustrated

DSM Inattentive

18. Restless or overactive

28. Excitable, impulsive

37. Fails to finish things

38. Inattentive, easily distracted

47. Temper outbursts

62. Fidgeting

66. Disturbs other children

68. Demands must be met easily--easily frustrated

75. Cries often and easily

77. Mood changes quickly and drastically

DSM Hyperactive-Impulsive

3. Always "on the go"

23. Runs/climbs excessively in inappropriate situations
39. Talks excessively
42. Difficulty waiting in lines, waiting turn in games/groups
49. Interrupts/intrudes on others
55. Fidgets with hands/feet, squirms in seat
59. Difficulty playing in leisure activities quietly
76. Leaves seat when remaining in seat expected
80. Blurts out answers before questions completed

Appendix J

Social Toy Play Variable Definitions

Maternal Initiations	Total frequency of mother offers and shows
Maternal Responses	Total frequency of accepting or acknowledging infant toy initiations
Maternal Manipulations/Labels	Total frequency of manipulating and/or labeling infant toy initiations
Maternal Exchanges	Total frequency of simple (accept and then return) and complex (accept, manipulate or label, and then return) mother toy exchanges.
Maternal-Directing	Total of mother-directed behaviors (offer, show, take, retake, retract) divided by the total number of directives for the dyad.
Maternal Responsiveness	Percent of infant initiations to which mothers responded by accepting the toy
Maternal Coordination	Percent of infant toy initiations which mother coordinated with the infant by accepting and then attempting to return the toy
Infant Initiations	Total frequency of infant offers and shows
Infant Responses	Total frequency of accepting or acknowledging mother toy initiations
Infant Manipulations/Labels	Total frequency of manipulating and/or labeling mother toy initiations
Infant Exchanges	Total frequency of simple (accept and then return) and complex (accept, manipulate/label, and then return) infant toy exchanges.
Infant Responsiveness	Percent of mother initiations to which infants responded by accepting the toy
Infant Coordination	Percent of mother toy initiations which infant coordinated with the mother by accepting and then attempting to return the toy

Appendix K

Joint Attention Variable Definitions

Maternal Gaze Following	total frequency of sequences where mother followed infant looks to the toys
Infant-Initiated Joint Attention	total duration of sequences involving maternal looks to toys followed by infant looks to toys.
Mother-Initiated Joint Attention	total duration of sequences involving infant looks to toys followed by mother's looks to toys.
Infant-Initiated Coordinated Joint Attention	total duration of sequences involving maternal looks to toys followed by infant looks to toys, interspersed with infant looks to mother's face.
Mother-Initiated Coordinated Joint Attention	total duration of sequences involving infant looks to toys followed by mother's looks to toys, interspersed with infant looks to mother's face.

CURRICULUM VITAE

12/1/00

LISA A. NEWLAND
1700 W 2700 N #158
Ogden, UT 84404
Home (801) 786-0263
Office (435) 797-3578

Education

2001	Ph.D. Utah State University, Logan, UT. Family and Human Development: Emphasis in Infancy and Early Childhood. Dissertation: Language, Social Interactions, and Attention as Predictors of Reading Development in 2nd Grade.
1997	M.S. Utah State University, Logan, UT. Family and Human Development, Emphasis in Infancy and Early Childhood. Thesis: Language, Play, and Toy Sharing in Infancy.
1994	B.A. (magna cum laude) Concordia College, Moorhead, MN. Major in Scandinavian Studies, Minor in Chemistry.
1994	University of Oslo; Oslo, Norway. The Oslo Year Abroad exchange program.

Professional Employment

2000	Assistant Professor of Educational Psychology The Division of Counseling and Psychology in Education The University of South Dakota, Vermillion, SD

Honors and Recognitions

Graduated with Honors, Concordia College, 1994.
Marshall H. and Nellie Alworth Memorial Fund Scholar, 1990-1994. Awarded to students who show significant potential and accomplishment in the natural sciences.
Research Vice-Presidential Fellow, Utah State University, October 1997-May 1998.
Phi Kappa Phi National Honor Society member 2000.
Student Research Award, 2000. Southwestern Society for Research in Human Development.

Research Experience

1999-2000 **Observational Research Coordinator and Data Archiving Assistant: Early Head Start.** The objective of this project is to study 200 low income families with infants and toddlers, at 14, 24, and 36 months, randomly

assigned to the intervention or control group. Managed all aspects of observational coding, including development, revision, and supervision of coding schemes measuring mother-infant social play, cognitive level of infant play, parental sensitivity, parental and infant language, shared book reading behaviors, and affect and physical proximity in play. Recruited and supervised graduate and undergraduate students. Set up data files, analyzed data, and disseminated data through professional conference presentations and publications. Also assisted in evaluation of program quality.

1998-2000 **Data Coordinator: From 1 to 7 Project.** The objective of this project is to study the association between early language and home environments with later reading, academic achievement, and social competence. Coordinated all aspects of participant recruitment, data collection and management. Recruited, trained, and supervised graduate and undergraduate students to conduct both observational coding and direct assessment of children and families. Supervised data entry and file management, and analysis and dissemination of findings. Assessed the psychometric properties of instruments and subscales. Disseminated data through professional conference presentations and publications, archived data and research findings.

1996-2000 **Research Assistant: Parent-Toddler Play Project.** The objective of this project is to study factors associated with early social, cognitive, and linguistic competence in infants at 11,14, and 17 months, within the context of mother-infant interactions. Conducted observational coding, and developed and revised coding schemes. Assisted with data entry and management, and supervised graduate and undergraduate research assistants.

1996-1997 **Research Assistant: Dean's Office Retention Study, College of Family Life.** The long-term objective of this project is to construct survey measures to assist in mentoring and advising college students, which will lead to higher college completion rates. Individual, family, and community variables (ethnicity, SES, family size, marital status, religious orientation and participation, self-efficacy, and number and quality of support networks) will be identified as predictors for school performance and completion. Assisted with data collection, entry, analysis, and revision of survey measures. Assessed the psychometric properties of measures. Compiled information for reports for the College of Family life.

1996 **Research Assistant: Neighbor Care Child Care Study.** The purpose of this study is to provide and evaluate child care training sessions for family child care providers. Specific components of child care quality, such as language and math activities, as well as family, child, and provider characteristics, were assessed for relations with outcomes in early childhood. Facilitated child care training sessions. Assisted with data entry, analysis and file management of child care data.

Teaching Experience

Spring 2000 **Guest lecturer: Research methods** (FHD 3130).
Systematic Observational Research.
Department of Family and Human Development, Utah State University.

Spring 2000 **Guest lecturer: Research methods** (FHD 3130).
Developmental Research Designs.
Department of Family and Human Development, Utah State University.

Fall 1999 **Instructor: Infancy and Early Childhood** (FHD 3510).
Department of Family and Human Development, Utah State University.

Fall 1996-Present **Instructional Assistant: Independent Study in Infancy Research** (FHD 490, 4990). Assisted with instruction of students, including training, supervision, grading, and review of lab reports.
Department of Family and Human Development, Utah State University.

Fall 1999 **Guest lecturer: Infancy and Early Childhood** (FHD 3510).
Biological and Environmental Influences on Language Development, Gestures and Non-Verbal Communication.
Department of Family and Human Development, Utah State University.

Fall 1999 **Guest lecturer: Human Development Across the Lifespan** (FHD 1500).
Language Development Across the Lifespan.
Department of Family and Human Development, Utah State University.

Summer 1999 **Lecture assistant: Disseminating Infancy Data** (FHD 7910).
Troubleshooting Data Problems.
Department of Family and Human Development, Utah State University.

Winter 1996 **Teaching Assistant: Children from 2 to 5** (FHD 379).
Assisted with Lectures, media presentations, testing, and grading papers.
Department of Family and Human Development, Utah State University.

Winter 1996 **Teaching Assistant: Child Guidance** (FHD 260).
Assisted with Lectures, media presentations, testing, and grading papers.
Department of Family and Human Development, Utah State University.

Instructional Training

August 1998 Completed Seminar on College Teaching for Graduate Teaching Assistants, a one week intensive course on instructional styles, techniques, and technology.
Utah State University.

Publications

Roggman, L.A., Boyce, L.K., & Newland, L.A. (2000). Assessing mother-infant interaction in play. In C. E. Schaefer, K. Kitlin, & A. Sandgrund (Eds.) Play Diagnosis and Assessment, 2nd Edition. NY: Wiley.

Coyl, D.D., Roggman, L.A., & Newland, L.A. (Accepted for publication). Stress, maternal depression, and negative mother-infant interactions in relation to infant attachment. Infant Mental Health Journal.

Newland, L. A., Roggman, L, A., & Boyce, L. K. (In submission). The development of social play and language in infancy. Infant Behavior and Development.

Grants Proposals

1999 Bilingual Early Language and Literacy Support. A collaborative grant submitted in coordination with M. Innocenti, Early Intervention Research Institute. Funded by the National Institute of Child Health and Human Development, Office of Educational Research and Improvement.
Position: Research Consultant
Responsibilities: Training and coordination of language transcriptions and analysis, data analysis and dissemination.

2000 Native American PRIDE: Promoting Rural Involvement in Developmental Experiences. A collaborative grant submitted in coordination with H. Freeman, University of South Dakota. Submitted to the Administration on Children, Youth, and Families, Department of Health and Human Services.
Proposed Position: Co-Principal Investigator.

Conference Presentations

Roggman, L. A., Newland, L. A., & Coyl, D.D. (2001, April). Language-Rich Activities and Toddler Language Development. Poster submitted to the Biennial Meeting of the Society for Research in Child Development, Minneapolis, MN.

Newland, L. A. & Roggman, L. A. (2000, October). Mother-infant play: Changing patterns to fit infants' level of development. Poster presented at the First Annual Children's Symposium, Vermillion, SD.

Newland, L. A., Roggman, L. A., & Crook, C. A. (2000, July). Joint attention and coordinated interactions with toys in relation to language development. Poster presented at the International Conference on Infant Studies, Bristol, England.

Coyl, D.D., Roggman, L. A., & Newland, L. A. (2000, July). The Influence of mothers' relationship attitudes, maternal depression, and discipline strategies on infants' attachment security. Poster presented at the International Conference on Infant Studies, Bristol, England.

Roggman, L. A., Newland, L. A., & Cook, G. A. (2000, June). Home visits and parents' mental health. Poster symposium presented at Head Start's Fifth National Research Conference, Washington D.C.

Roggman, L. A., Coyl, D. D., & Newland, L. A. (2000, June). Mothers' relationship attitudes and home visits. Poster presented at Head Start's Fifth National Research Conference, Washington D.C.

Newland, L. A., Roggman, L. A., Coyl, D. D., Boyce, L., & Cook, G. (2000, April). Mother and infant play preferences in relation to infant language competence. Poster presented at the Southwestern Society for Research in Human Development, Eureka Springs, AR.

Roggman, L. A., Newland, L. A., Slocum, T., Cook, G., & Boyce, L. (2000, April). From 1 to 7: Predicting 2nd grade reading and math from infant language and cognitive skills. Poster presented at the Southwestern Society for Research in Human Development, Eureka Springs, AR.

Cook, G.A., & Newland, L.A. (1999, April). Temperament in infancy and age 7: Relations to social competence in second grade. Poster presented at the Biennial Meeting of the Society for Research in Child development, Albuquerque, NM.

Newland, L. A., Roggman, L. A., Boyce, L., & Cook, G. (1998, April). Mother-infant social play related to infant language and play behaviors at 11 and 14 months. Poster presented at the International Conference on Infant Studies, Atlanta, GA.

Newland, L. A., Roggman, L. A., Boyce, L. & Cook, G. (1997, April). Toy sharing, symbolic play, and language development in infancy. Poster presented at the 23rd Annual Meeting and Conference for the Association for the Study of Play, Washington, D.C.

Conference Submissions

Roggman, L. A., Coyl, D.D., Newland, L. A., & Cook, G. (2001, August). Attachment Measures in Infancy, Childhood, Adulthood: Reliability, Stability, and Continuity. Poster accepted for presentation at the Annual Meeting of the American Psychological Association, San Francisco, CA.

Internet and Newsletter Articles

Newland, L. A. (1999). Parenting Through a Crisis, USU Extension Cord, www.ext.usu.edu

Newland, L. A. (1999). Schools Can Help Kids Through the Divorce Process, USU Extension Cord, www.ext.usu.edu

Newland, L. A. (1999). Picking Up a Crying Infant. Center for Early Childhood Education newsletter.

Professional Societies

Society for Research in Child Development

International Society for Infant Studies

The Association for the Study of Play