INTERACTIONAL SYNCHRONY BETWEEN MOTHER AND TODDLER
DURING BOOK READING

by

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ABSTRACT

Interactional synchrony refers to the degree to which two interactive partners synchronize their behaviors over time. Interactional synchrony between mother and infant is linked to infant socio-emotional development. However, very little is known about interactional synchrony beyond infancy. The present study was an attempt to investigate the interpersonal synchrony between mothers and their 2½-year-old toddlers (n=49) during book reading. The goals of this study were to explore individual differences in mother-toddler interactional synchrony and to examine the contributions of child (i.e., sex and temperament) and maternal (i.e., negative affect) characteristics as well as their joint effect to interactional synchrony. Results revealed that the majority of the mother-toddler dyads were moderately synchronized and highly positively matched. Toddler’s sex and temperament (effortful control and surgency) as well as maternal negative affect made separate and joint contributions to interactional synchrony indexed by gaze coordination as well as negative and positive affect matching.

INDEX WORDS: interactional synchrony, book reading, temperament, maternal negative affect, mother-toddler interaction
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I dedicate this work to my son, Harris Moorer, my inspiration and my life and my husband, Ray Moorer, for his love and continued support.
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Behavioral synchrony has been defined as the adjustment or moderation of one behavior to coordinate with another behavior (Bernieri, Reznick, & Rosenthal, 1988), which may occur within an individual or between individuals. Intrapersonal synchrony is observed when an individual synchronizes his/her body movements (e.g., hand gestures) to the rhythm and intonation of speech (Condon & Ogston, 1966). Interpersonal or interactional synchrony is found between two people during social interaction. A kinesic model (see Birdwhistell, 1970) has demonstrated that the greater the attraction between the speaker and the listener, the greater the synchrony (parallelism) between the speaker’s speech and the listener’s body movement. An absence of synchrony has been observed in people with learning disabilities such as dyslexia (Condon, 1982). Infants have also been observed to move their arms and legs in a precise manner to the rhythm of an adult’s speech structure (Condon & Sander, 1974). Thus, some researchers believe that interactional synchrony is an essential element of communication and language development (Wylie, 1985). The interactional synchrony between two individuals has been the focus of developmental research.

Research evidence suggests that interactional synchrony serves critical developmental functions. For example, interactional synchrony is positively correlated with child compliance (Rocissano, Lynch, & Slade, 1987), the emergence of self-control (Feldman, Greenbaum, & Yirmiya, 1999), infant-mother secure attachment (Isabella, Belsky, & Eye, 1989), and the absence of behavior problems in 10-year-old children (Criss, Shaw, & Ingoldsby, 2003). However, the majority of empirical studies on interactional synchrony have been focused on mother-infant face-to-face communication. The dynamics and synchrony of social-emotional
interaction between mothers and their toddlers still remain largely unexplored. The present study, therefore, was an attempt to investigate the interpersonal synchrony in mother-toddler dyadic interaction.

Interaction between a parent and a child during book reading provides an appropriate environment for language learning for younger children. As such, empirical investigations have focused their attention on maternal speech and speech pragmatics in reading to young children (Arnold, Lonigan, Whitehurst, & Epstein, 1994; Reese, & Cox, 1999; Wasik, & Bond, 2001; Weizman, & Snow, 2001; Wheeler, 1983; Whitehurst, Arnold, Epstein, Angell, Smith, & Fischel, 1994; Whitehurst, Falco, Lonigan, Fischel, DeBaryshe, Valdez-Menchaca, & Caulfield, 1988). The primary focus of this past research has been to understand the link between maternal book reading styles and child language acquisition. Using both correlational and experimental designs, it has been found that the quantity and sophistication of vocabulary as well as dialogic reading skills (a technique that makes the child an active listener by being prompted by the mother with open-ended questions during reading) used by mothers are strongly associated with their children’s later language advancement (Reese, & Cox, 1999; Valdez-Menchaca, & Whitehurst, 1992; Weizman, & Snow, 2001). Book reading between a mother and a child can also be a social and emotional experience. Nevertheless, very few studies have attempted to examine the social and affective behaviors and their synchrony exhibited by young children and their mothers during book reading.

Given the limited literacy skills of young children, the roles of the participants in book reading can be assumed. While the mother adopts the role of a reader, the child becomes the listener. At around the second year of life, children begin to show interest in the contents of books, and display social and affective involvement during book reading. According to Fletcher
and Reese (2004), book reading interaction involves three components: an adult, a child and a book. Each component interacts with each other and influences the quality of book reading. This transactional framework served as a useful heuristic for conceptualizing the book reading interaction between a mother and a toddler for the present study.

One of the limitations of the previous studies on the social-affective aspects of book reading is the lack of a more detailed analysis of both participants’ behaviors. For example, Bus et al. (1994) have assessed mothers’ and their infants’ behaviors globally by recording how frequently they occurred. Furthermore, in previous book reading research, mother and child have been viewed as two separate individuals reading the same book together, rather than two interactive partners engaging in a shared activity. In fact, book reading is a joint social-emotional activity involving mutual participation of both the mother and the child. During book reading, the mother and the child interact with each other both verbally and nonverbally. One partner’s behavior dynamically influences the other partner’s behavior across time, and vice versa. Thus, adopting a transactional framework, interactional synchrony between mother and toddler during book reading is conceptualized as the social-affective behaviors exhibited by an interacting dyad, rather than two separate individuals. The dyadic nature of book reading interaction can be best captured by the mutual coordination and reciprocal matching within the dyad.

The interaction between the two partners is complex and requires both participants’ active involvement. Because interactional synchrony involves the coordination between both interactive partners, personal characteristics of the toddler and the mother may contribute to individual differences in interactional synchrony. For example, gender differences have been found in infants’ and their mothers’ social-affective behavior during social interaction. Mother-
son dyads tend to be in more affective matching states than mother-daughter dyads (e.g., Tronick & Cohn, 1989). Moreover, boys have also been found to have more difficulty maintaining affective regulation, and to express more negative affect than girls when studied in still-face paradigm (Weinberg, Tronick, Cohn, & Olson, 1999). Compared to girls, boys have also been consistently found to be less compliant and to score lower on self-regulation (e.g., Kochanska, 1995). It is plausible that boys and girls differ in their social-affective behavior when interacting with their mothers during book reading. Thus, interactional synchrony between a mother and a toddler during book reading are expected to vary as a function of child sex.

Book reading is an interactive activity that places high demands on the toddler that require not only concentration of attention but also self-regulation. Whereas focused attention may reflect temperamental qualities such as high attentional focusing and low attentional shifting, self-regulation may reflect temperamental qualities such as low impulsivity, inhibitory control, and low frustration (Bates, Dodge, Pettit, & Ridge, 1998; Teti & Gelfand, 1991). It is likely that toddlers’ temperamental characteristics of attention and affect regulation may contribute to the interactional synchrony of book reading.

Mothers’ individual characteristics may also play a significant role in shaping interactional synchrony. For example, it is well documented that maternal depression is linked to decreased synchrony in mother-infant interaction (e.g., Field, Healy, Goldstein, & Guthertz, 1990). Neuroticism in mothers has also been linked to a forceful mothering style (Kochanska, Aksan, & Nichols, 2003). Mothers’ ability to take an empathetic perspective has also been linked to more reciprocal, mutually responsive interaction with their children (Kochanska, 1997). It is expected that mothers’ negative affect would be linked to low interactional synchrony.
Furthermore, according to the “goodness of fit” model (Thomas & Chess, 1977), mothers and their children may further jointly shape parenting and child developmental functioning. For example, the interaction between child temperament and maternal affect predicted the development of conscience (Kochanska, 1995, 1997) and externalizing behavior (Bates et al., 1998) in young children. It is also expected that interactional synchrony of mother-toddler book reading is likely to be a joint product of both partners.

In sum, the present study was aimed to investigate individual differences in interactional synchrony among mother-toddler dyads during book reading and to examine the separate as well as joint contribution of child (i.e., sex and temperament) and maternal (i.e., negative affect) characteristics to book-reading interactional synchrony.
CHAPTER 2
Review of the Literature

In the early 1970s, social psychologists discovered the phenomenon of interactional rhythm and synchrony in human behavior during social interaction. It is believed to be present not only within individuals, but also between individuals. Condon (1974) has suggested that people are “neurologically unified organisms” moving in the rhythm and timing of their culture (p.66). In adult literature, behavioral synchrony has often been associated with terms such as rhythm and tempo. While the rhythm of interaction refers to the co-occurrence of any two or more behavioral actions, the tempo of interaction refers to the patterns of behavior. These two terms are commonly used together to define behavioral synchrony. Furthermore, the co-occurrence of rhythmic patterns of differentiated flows in the behaviors of a single individual is defined as the intrapersonal synchrony, and the co-occurrence of rhythmic patterns in the behaviors of two or more people is commonly referred to as interactional (interpersonal) synchrony (Mathiot & Carlock, 1974, p.178).

Developmentalists have also extensively explored the construct of interactional synchrony in the context of mother-infant face-to-face interactions. Various studies have employed terms such as affect and/or behavioral state matching, attunement, mutual responsiveness, and reciprocity when defining interactional synchrony. Despite the broad array of terms used, all are intended to describe the level of coordination between a mother and a child. Depending on the focus, previous studies can be divided into two broad categories—structure-focused and content-focused. Structure-focused studies on interactional synchrony are concerned with how consistently mother-child dyads coordinate their behavior across time regardless of the content of their behaviors. The structure-focused synchrony is operationalized
in terms of coordination in behavioral cycles (e.g., Brazelton, Koslowksi, & Main, 1974). The correlation between the two time series, maternal behavior and child behavior, within each domain can also be computed as the index for coordination.

On the other hand, content-focused studies on interactional synchrony examine the degree to which a mother and a child are in the same behavioral and/or affective state at the same time with respect to occurrence, valence, and/or intensity. The conditional probability of the mother and the child exhibiting a match for each of the behavioral domains can be calculated as an index for behavioral matching (e.g., Feldman & Eidelman, 2004; Tronick & Cohn, 1989).

The present study employed both a structure-focused and a content-focused approach to examine the dynamics of mother-toddler book reading interaction, focusing not only on the degree to which mothers and toddlers coordinate their social and affective behaviors across time, but also on the degree to which mothers and toddlers consistently match their social and affective behaviors. Coordination and matching in mother-toddler social interaction can be assessed using a micro-analytic method. The micro-analytic approach typically involves first segmenting social interaction into small, discrete units. For example, in adult literature the coding units range from minutes to milliseconds (Condon, 1982). The presence and intensity of each partner’s interactional behavior is coded for each behavioral modality separately (e.g., facial expression and vocalization) or as a configuration for each time unit. In the developmental literature, one of the widely used behavioral coding systems for mother-infant interactional synchrony is the Monadic Phases (Tronick, Als, & Brazelton, 1980). In this coding system, the intensity of each partner’s behavior is judged by the presence and/or absence of a behavioral configuration of several expressive modalities, including face, voice, head and eye orientation, body posture, and specific gestures. Although the social-affective dynamics between the mother and toddler
become more complex with development, the behavioral dimensions involved in the
determination of interactional synchrony are similar, including looking, vocalization, and/or
facial expression.

*Developmental Significance of Interactional Synchrony*

Evidence from infancy research suggests that interactional synchrony between parent and
infant plays a significant role in later developmental outcomes such as compliance, self-
regulation, attachment security, joint attention, and language. For example, Isabella et al. (1989)
found that infants interacting in synchrony with their mothers at 1 and 3 months were more likely
to be classified as securely attached at 12 months. In contrast, low interactional synchrony has
been linked to the development of behavior problems in children. For example, Feldman and
Eidelman (2004) found that behavior problems at 24 months were predicted by the lack of
mother-infant and father-infant interactional synchrony assessed at 3 months. These findings
strongly support the notion that parent-child interactional synchrony plays an important role in
shaping infant development in the social-emotional domain. It has been suggested that
appropriate interactional synchrony between mother and infant may be the first context where a
child develops self-control skills.

In toddlerhood, synchronous interactions with parents may also provide an appropriate
environment for a child to practice self-regulatory skills such as compliance. It has been
hypothesized that maternal responsiveness, one of the key components of interactional
synchrony, is linked to high levels of child compliance (Lay, Waters, & Park, 1989; Parpal
&Maccoby, 1985). A study by Feldman et al. (1999) confirmed this hypothesis. It was found
that maternal synchrony (infant-leads-mother-follows) at 3 months and mutual synchrony (both
mother and infant are responsive to changes in the partner’s behavior) at 9 months predicted children’s self-control at 2 years.

Another important developmental implication of interactional synchrony is the establishment and maintenance of joint attention between mother and child, which can further facilitate language acquisition in young children. It has been demonstrated that toddlers are more likely to stay in prolonged episodes of joint attention with their caregivers during synchronous interactions (Rocissano et al., 1987). In a study with children born prematurely, Rocissano and Yatchmink (1983) demonstrated that mothers engaged in synchronous interactions were likely to monitor their children’s attention focus and thus used it as a source for shared topics. Tomasello and Farrar (1986) found that both mothers and children talked more and engaged in longer conversations during periods of joint attention. They also observed that when children were introduced to a new object during joint attention if their mothers followed their children’s ongoing attentional focus, children were more likely to learn the name of the object. Furthermore, maternal responses to child vocalizations and/or play contributed above and beyond child variables (e.g., object exploration, toy play, looking at mother) to the prediction of the achievement of major language milestones (Tamis-LeMonda, Bornstein, & Bumwell, 2001). Taken together, it appears that interactional synchrony between a mother and her child may serve a function of regulating and maintaining optimal interaction, which, in turn, promotes young children’s social and emotional competence, joint attention, and language acquisition.

Child Characteristics as Contributors to Interactional Synchrony

The nature of social and emotional interactions between a caretaker and a child cannot be fully understood if the child’s individual characteristics such as sex and temperament are not
considered. Although empirical studies on sex differences in children’s behavior have produced mixed reports, the presence of sex differences in the first years of life has been documented. Male infants tend to engage in less self-regulatory behavior and experience greater difficulties in maintaining affective regulation than female infants (Brazelton et al., 1974; Brazelton, 1984; Moss, 1967). Boys have been shown to rely more heavily on maternal scaffolding in the regulation of negative affect. For example, during a still-face procedure, male infants were found to make more negative social bids and to have higher negative affect than girls (Carter, Mayes, & Pajer, 1990). It is, therefore, reasonable to suggest that these distinct differences between boys and girls in infancy may contribute to the dynamics of their social interactions with mothers. Male infants’ greater irritability, crying, and facial grimacing would require their mothers to invest more effort to establish and maintain interactional synchrony than mothers of girls. This may explain why some studies have shown higher state matching during the interaction with male infants than with females. For example, Tronick and Cohn (1989) demonstrated that mothers were more likely to be in matched states with their distressed male infants than with their distressed female infants after the maternal still face procedure. Given sex differences in behavioral characteristics in social interaction and their influences on maternal behavior, it is expected that the interactional synchrony of mother-toddler dyads would differ significantly between boys and girls.

In addition to child sex, child temperament has been viewed as another individual characteristic contributing to the partner’s social-affective behavior and interactional synchrony. Although there is no unified view on temperament, most researchers agree that temperament is biologically rooted and lays the foundation for later adult personality. For example, Strelau (1998) believes that temperament reflects differences in individual behavior and reactions (e.g.,
intensity, speed, energy), which are stable and have biological bases. Thomas and Chess (1977) consider temperament as a behavioral style can be observed from the first days of a child’s life. For example, they observed great variability among infants in their perceptual reactions, feeding and sleeping patterns, social responsiveness, and so on. After a systematic analysis of behavioral differences in infants, they identified different dimensions in temperament Derryberry and Rothbart (1988) identified emotional reactivity and self-regulation as the two principal subconstructs of temperament that play a central role in later personality. During toddlerhood, the regulation of attention and affect are two major aspects of child temperament.

**Attentional Patterns**

Visual attention has been shown to play an important role in social communication between mother and child. An infant is capable of regulating his/her internal state by controlling his/her gaze patterns (Stern, 1974). For example, shifting attention away from a negative stimulus can serve to attenuate or contain arousal, while shifting attention towards the positive stimulus can enhance or maintain elicited arousal (Derryberry & Rothbart, 1988). Visual attention can also serve as an indicator of readiness and intention to engage in social interaction or as a signal to terminate unwanted or high intensity interaction (Ruff & Rothbart, 1996). Although with development, toddlers acquire other cognitive skills, such as language, gaze remains an important part of their behavioral repertoire (i.e., Martin, Crnic, & Belsky, 2003).

Attentional span changes with development. Ruff and Capozzoli (2003) found that at about 26 months of age toddlers’ attention makes a transition from a pattern governed strongly by stimulus factors and novelty to a pattern governed more by cognitive factors. Depending on the demands and motivations that a particular situation places on a child, attentional patterns also show individual variations (Ruff, Capozzoli, & Weissberg, 1998). There is some evidence
suggesting that young children’s attentional patterns are linked to their social and emotional experience. For example, Martin et al. (2003) found that social looking (looking to mother’s face) exhibited by 36-month-old boys was observed more frequently during positive emotional events. Individual differences in attentional patterns have also been attributed to variability in temperament. Children who are prone to distress and frustration may have a harder time staying on a task requiring attentional focus or flexible attentional shifting. Certain situational characteristics, such as the level of stimulation, may affect individual variability in attentional focus and attentional shifting. Individual differences in toddlers’ attentional patterns may not only play a role in the level of their attentional engagement but also make contributions to mother-toddler interactional synchrony.

Self–Regulation

In toddlerhood, children show increased ability to regulate their own behaviors. Impulsivity, inhibitory control, and frustration are related but contrasting temperamental characteristics of toddlers that may contribute to their self-regulatory abilities. Impulsivity is conceptualized as speed of response initiation, where the underlying feature is high activity level (Putnam, Gartstein, & Rothbart, 2006). It is positively related to externalizing problems in preschool children, suggesting a lack of self-regulation. Overall, boys seem to be more impulsive than girls based on their activity levels (Victor, Montague, & Halverson, 1985).

Inhibitory control has been defined as the capacity to stop, moderate, or refrain from a behavior (Putnam et al., 2006). Individual differences in inhibitory control have strong implications for a child’s socialization, particularly for conscience formation. Specifically, Kochanska (1993) has proposed that one of the important components of conscience development is behavioral control, which was conceptualized as a capacity to suppress attractive
but prohibited behavior and to execute mundane but socially accepted acts. In one of the empirical investigations by Kochanska et al. (1997), toddlers who were rated high by their mothers on inhibitory control were found to show better compliance and internalization of conduct standards. By contrast, deficiency in inhibitory control was related to externalizing behavior problems in children, such as failure to suppress antisocial impulses (Rothbart, 1989). It is believed that poorly developed inhibitory control may explain impulsive behaviors in younger children (Schachar & Logan, 1990). Also, children who show lower inhibitory control tend to score higher on activity level measures and lower on cognitive tasks measuring persistence (Eisenberg et al., 2005). There is also some evidence for gender differences in inhibitory control. In the study by Kochanska et al. (1997) mothers rated girls higher on inhibitory control than boys.

Frustration is negative affect such as irritability and proneness to anger, which is related to interruption of ongoing tasks or goal blocking (Putnam et al., 2006). Young children who get frustrated easily have been described as having a low threshold for expression of negative affect. This is a disposition that has serious negative consequences for social and emotional development. Irritable infants who showed more fussing and crying were also less attentive and less responsive to their mothers and displayed less positive affect and tended to be insecurely attached to their mothers (e.g., van den Boom, 1989, 1991, 1994). Easily frustrated infants might have “pushed away” their mothers (e.g., van den Boom, 1989, 1991, 1994). As a result, their mothers were less responsive and sensitive in parenting. Van den Boom (1994) referred to the interaction pattern between irritable babies and their mothers as a negative cycle. Even when the actual amount of crying and fussing decreased with development, mothers of irritable babies continued to be less responsive and less sensitive to their children.
The interaction between mothers and older children who are prone to frustration has also been characterized by maternal coercive discipline and child resistance to mothers’ control (e.g., Lee & Bates, 1985). Children who are prone to frustration tend to be predisposed to later negative affect (Rothbart, Evans, & Ahadi, 2000) and aggressive behavior (Rothbart & Ahadi, 1994). Gender differences in children’s proneness to frustration have been documented. Specifically, parents reported that boys were more likely to get angry than girls (Goldsmith, Buss, & Lemery, 1997).

It is reasonable to suggest that young children who are high on impulsivity and frustration and low on inhibitory control may have a harder time paying attention and may require more help from their mothers to regulate their activities during interaction. Thus, while impulsivity and frustration in toddlers may be negatively associated with interactional synchrony, inhibitory control in toddlers may be positively related to interactional synchrony. Taken together, individual differences in toddlers’ temperamental self-regulatory characteristics are expected to shape mother-toddler interactional synchrony.

**Maternal Characteristics as Contributors to Interactional Synchrony**

Research shows that maternal characteristics, such as personality, parenting style, and affective style can affect child’s behavior. For example, neurotic mothers have been shown to use more power assertion in parenting. The effect of maternal neuroticism on power use in parenting is above and beyond that of child temperamental difficulty (Clark, Kochanska, & Ready, 2000; Kochanska, Aksan, & Nichols, 2003). Maternal controlling style has also been found to moderate the relationship between child impulsivity-unmanageability and externalizing behavior problems in middle childhood (Bates et al., 1998). In the study by Bates et al. (1998) children’s temperamental resistance to control was predictive of later behavior problems.
However, the children whose mothers were less restrictive (used less prohibition, warning, or scolding) exhibited more externalizing behavior problems in middle childhood than those children whose mothers were more restrictive.

Although by the end of the second year, toddlers increasingly take on a more active role during social interaction, mothers remain significant in shaping the quality of interactional synchrony. For example, Kochanska and Aksan (2004) demonstrated that during the transition from infancy to toddlerhood (from 7 to 15 months) mothers begin to adjust to the increasingly active role of their children by decreasing their social-interactive bids and mood regulation to allow their toddlers to lead during social exchanges and regulate distress, and at the same time, by increasing their influence on the toddlers by imposing social norms and safety rules. Kochanska et al. (2004) concluded that this pattern of interactions is positively linked to the emergence of mutual responsiveness. In addition, a mother’s perspective-taking ability may also be one of the important personal qualities in facilitating this process (Kochanska, 1997). One of the key characteristics in the establishment and maintenance of interactional synchrony is maternal sensitivity. Mothers who are sensitive and attuned to their children’s signals are likely to establish and maintain joint attention with their children. For example, when a child makes a change in the topic of conversation during interaction, a sensitive mother tends to redirect the child’s focus or follow the new topic initiated by a child, and thus contributes to the overall interactional synchrony (Rocissano et al., 1987).

Even though it can be expected that maternal positive affect is likely to be associated with more positive and sensitive parenting behaviors in monitoring a child’s attentional focus and in achieving joint attention and positive interactional synchrony, research on the effect of maternal positive affective style on the quality of social interaction and developmental outcome
is scarce. Maternal negative affective style is one of the most extensively researched topics in investigating the effect of maternal characteristics on child development. For example, maternal depression has been linked to learning deficits in infants (Kaplan, Dungan, & Zinser, 2004) and to various externalizing behavior problems in children, such as conduct disorder, substance use disorder, and violent behaviors (Brennan, Katz, Hammen, & Le Brocque, 2002; Hay, Angold, Sharp, Pawlby, & Harold, 2003). Therefore, it comes as no surprise that, compared to nondepressed mothers, the interactional synchrony between depressed mothers and their infants tends to be characterized as negative (e.g., Field et al., 1990; Moore & Calkins, 2004). It is expected that maternal negative affect would contribute to mother-toddler interactional synchrony.

“Goodness of Fit” Between Child Temperament and Maternal Negative Affect

Thomas and Chess (1977) were among the first to use the concept of “goodness of fit” to better understand the relationship between child temperament and the environment. They suggest that when individuality does not fit the environmental characteristics, maladaptive functioning is likely to occur. Developmental research indicates that parental and child characteristics jointly shape parent-child interaction and child development. It is the goodness-of-fit between parental and child characteristics that make a unique contribution to parent-child interaction and child development, which is above and beyond individual characteristics of the parent and the child. Clark, Kochanska, and Ready (2000) have found that maternal and child characteristics jointly shape parenting style. Mothers who were either high in extraversion or low in empathy were more likely to use more power assertion with their emotionally negative children. Similarly, toddlers with different temperamental qualities may respond differently to the same maternal behavior. When mothers use more restrictive power with their highly
resistant children, these children behave better than those highly resistant children whose mothers use less restrictive power. Furthermore, mothers’ use of gentle parenting has been shown to work successfully with fearful children, but not with fearless children, to promote the development of conscience (Kochanska, 1995, 1997). It can be expected that interactional synchrony between mother and toddler is also jointly shaped by the characteristics of both partners.

**Interactional Synchrony During Book Reading**

A growing body of literature suggests that book reading interaction between mother and child has both cognitive and social-emotional benefits for a young child (Baker, 1999; Bus, van Ijzendoorn, & Pellegrini, 1995; DeLoache & DeMendoza, 1987; Neuman, 1996; Sonnenschein, Brody, & Munsterman, 1996). However, empirical data mostly come from studies focusing on the quality of mothers’ reading styles and speech pragmatics (Arnold et al., 1994; Corte et al., 1983; Wasik, & Bond, 2001; Weizman, & Snow, 2001; Wheeler, 1983; Whitehurst et al., 1988; Whitehurst et al., 1994). Within this line of research, a strong relationship has been found between the size of maternal vocabulary and the language development in young children. Dialogic reading, which is a style of reading that allows the child to become the active teller of the story while the mother takes on the role of the active listener by prompting and rewarding the child’s efforts to talk, has also been identified to be one of the most beneficial to young children’s language improvement (i.e., Reese, & Cox, 1999; Valdez-Menchaca, 1992; Weizman, & Snow, 2001).

In addition to linguistic gains, it has also been suggested that mother-child book reading interaction can promote young children’s social and emotional development. However, despite such claims, there are only three known empirical studies on the linkage between book reading
and socio-emotional development. In two of the studies, the quality of mother-child book reading interaction was explored within an attachment paradigm. The study by Bus and van IJzendoorn (1994) found that mother-infant dyads differed in their quality of book reading interaction as a function of attachment security. Specifically, 44- to 63-week-old insecurely attached infants were more likely to be distracted and less likely to stay on their mothers’ laps as compared to the securely attached infants. In addition, compared to mothers of securely attached infants, mothers of insecurely attached infants were also more likely to display physical force in controlling their infants’ behavior, to restrict their infants’ movement, and to keep the book out of reach.

The study by Frosch, Cox, and Goldman (2001) yielded similar results. They found that in comparison to mothers of toddlers with a history of insecure attachment, mothers of toddlers classified as securely attached as infants were warmer and more supportive and less detached, hostile, and intrusive during book reading interaction. Similarly, toddlers who were securely attached to their mothers when they were infants showed a greater involvement in book reading; they were more enthusiastic, showed more positive mood, and were more focused, as compared to those who were insecurely attached to their mothers as infants.

Book reading situations impose inherent environmental demands on both young toddlers and their mothers. During book reading, toddlers are required to focus their attention and refrain from gross motor movements for an extended time. Mothers are required to establish and maintain their toddlers’ attention and interest in the book reading activity by continuously attuning to the child’s signals and providing positive and reciprocal response. Depending on their temperamental attentional style, impulsivity, inhibitory control, and proneness to frustration, toddlers may or may not meet these specific environmental demands. Mothers also
vary in their affective styles, which may or may not be able to facilitate social interaction with their toddlers. The goodness-of-fit between the mother’s and the toddler’s personal characteristics may further affect the dynamics of book reading interaction. Given individual differences in maternal affect and toddler temperamental characteristics, mothers and their toddlers are expected not only each separately contribute to interactional synchrony, but also to jointly make additional contribution to interactional synchrony that is above and beyond individual characteristics of the mother and the toddler.

In sum, given the developmental significance of interactional synchrony between parents and their young children, the overarching goal of the present study was to explore the level of synchrony in the social and affective dynamics of mother-child interaction within a book reading context. The present study applied a microanalytic coding strategy to capture the dynamics of gaze and affect between mother and toddler. Specifically, the present study took two different approaches to examine interactional synchrony: a structure-focused (i.e., coordination) and a content-focused (i.e., matching) approach. The first approach measured the level of coordination between a mother and a child over time regardless of the content of their behavior for each behavioral modality (gaze and affect). The second approach measured the degree of state matching between the two partners in the behavioral modality of gaze and affect. Thus, the first goal of the current study was to document individual differences in coordination and state matching in mother-toddler dyads during book reading. The second goal of this study was to examine the differences in the interactional synchrony between mother-son and mother-daughter dyads during book reading. The third goal of the present study was to examine the contribution of toddler’s temperamental regulation of attention and affect as well maternal negative affect on book-reading interactional synchrony. The final goal of this study was to examine the joint...
effect of maternal and child characteristics on interactional synchrony.
CHAPTER 3

Methods

Participants

Forty-nine mothers and their 2 ½ year olds were recruited to participate in a study on mother-toddler social interaction. About 59% of the toddlers were males and 50% were first-borns. The majority of the mothers were European Americans (82%) who were married (92%) and had some college education (90%). This current sample apparently represents families from middle- to upper-middle socioeconomic backgrounds.

Research procedure

Mothers and their toddlers were invited to visit the laboratory playroom for approximately two hours. During the visit, mothers and their toddlers engaged in social interactions in a variety of contexts. The book reading interaction took place during the second half of the visit after mothers and toddlers had snacks together. The mothers were instructed to sit on the couch with their toddlers and to read two wordless books for about 10 minutes. According to previous studies (e.g., Frosch et al., 2001), wordless books tend to elicit more variability in mothers’ reading affective and expressive style. One book consisted of 12 black-and-white pictures with a coherent theme depicting a little boy’s interaction with his mother before and after a disciplinary event. The second book consisted of 18 colored pictures depicting preschool-age children’s social interactions with their peers, siblings, and/or parents in a variety of emotional contexts.

The book reading interaction was videotaped using three remote controlled cameras. One of the cameras captured the frontal view of both the mother and the child. A second camera also focused on both the mother and the child. The better view from these two cameras was selected.
and merged with the image from a third camera, which was focused on the book. The timer was superimposed on the merged video image for later coding.

**Behavioral Measures**

A 5-second time sampling strategy was employed to record mother’s and toddler’s social-affective behavior in two modalities - gaze and affective expression. Each behavior modality was coded in a separate pass. For each 5-second coding interval, the behavior of mother (see Appendix A) or child (see Appendix B) was classified as one of the hierarchically structured states. The codes for gaze ranged from 0 (i.e., looking away from child and book) to 5 (i.e., looking at child) for mothers and ranged from 0 (i.e., looking away from mother and book) to 4 (i.e., looking at mother) for toddlers. The codes for affective expression ranged from 0 (i.e., moderate negative affect) to 5 (i.e., intense positive affect) for mothers and ranged from 0 (i.e., intense negative affect) to 8 (i.e., intense positive affect) for toddlers. Ten mothers (20%) and 10 toddlers (20%) were randomly selected and coded by an independent coder for reliability evaluation. Interrater reliability indexed by Kappas were .89 and .62 for mothers’ gaze and affective expression, respectively, and were .73 and .89 for toddlers’ gaze and affective expression, respectively.

**Mother-Toddler Interactional Synchrony**

The extent to which the mother and the toddler synchronize their social-affective behaviors during book reading interaction was assessed by a structure-focused (i.e., coordination) and a content-focused (i.e., matching) approach. Coordination emphasizes the degree to which the mother and the toddler move together over time. It was derived by computing the zero-order correlation between the mother’s and the toddler’s gazing and affective behaviors within each behavioral modality across the 120 coding blocks for each dyad separately.
Thus, two correlation coefficients were derived for each dyad to index gaze and affect coordination, ranging from -1.0 to +1.0. A greater magnitude of the correlation reflects a greater level of interactional synchrony and the sign indicates the direction of the interactional synchrony.

State matching focuses on the match in the valence of gaze and affective expression between mother and toddler. Following Tronick and Cohn (1989), the classification of maternal and toddler gaze and affective expression were classified as positive, neutral, and negative. Neutral state matching was excluded from the analysis in this study. Two types of state matching indices were derived: (1) positive match—the proportion of the total coding intervals in which the toddler and the mother displayed a positive state simultaneously; (2) negative match—the proportion of the total coding intervals during which the toddler and the mother were in a negative state at the same time. The proportion of the state matching between mother and toddler was computed separately for each behavioral modality. As a result, indices of positive and negative gaze matching as well as positive and negative affect matching were derived for subsequent analysis.

Toddlers’ Temperament

Mothers completed the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006) that is one of the most comprehensive instrument measuring children temperament between the ages of 1 and 3. The ECBQ includes a total of 201 items rated on 7-point Likert scales and is designed to assess 18 different temperamental dimensions of children between the ages of 18 and 36 months. Five subscales believed to be relevant to the toddlers behavioral patterns displayed during book reading were selected, namely, attentional focusing, attentional shifting, impulsivity, inhibitory control, and frustration. Attentional
focusing scale includes 12 items (e.g., “My child becomes easily distracted.”) designed to measure the child’s sustained duration of orienting on an object of attention and resisting distraction. Attentional shifting scale includes 12 items (e.g., “My child easily switches attention from speaker to speaker.”) designed to measure the child’s ability to transfer attentional focus from one activity/task to another. Impulsivity scale includes 10 items (e.g., “My child jumps into the task before it was fully explained.”) to measure speed of response initiation. Inhibitory control scale includes 12 items measuring capacity to stop, moderate, or refrain from a behavior under instruction (e.g., “My child seem unable to wait for as long as 1 minute.”). Frustration scale also includes 12 items (e.g., “My child becomes easily frustrated.”) designed to measure negative affect related to interruption of ongoing tasks or goal blocking. The validity of ECBQ was demonstrated by the correspondence between the behavioral assessment and mother-rated temperament found in the study by Kochanska, Murray, Jacques, Koenig, and Vandegreest (1996). The behavioral observations were significantly correlated with maternal reports of toddlers’ inhibitory control and impulsivity.

The five temperament dimensions are moderately correlated ($r’s=.20$ to $.53$, $p’s= ns$ to $.001$). To reduce the number of variables, a principal-component analysis was performed. Two principal components emerged (see Table 1). The first, labeled as Effortful Control, included three temperamental dimensions with positive loadings of inhibitory control and attentional focus, and a negative loading of frustration. The second principal component, labeled as Surgency, included two temperament dimensions with positive loadings of attentional shifting and impulsivity. The factor scores of the Effortful Control and Surgency were used in further analysis.
Table 1

Factor Loadings: Toddlers’ Temperament Subscales

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Effortful Control</th>
<th>Surgency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attentional Focus (.75)</td>
<td>.784</td>
<td></td>
</tr>
<tr>
<td>Attentional Shifting (.66)</td>
<td></td>
<td>.880</td>
</tr>
<tr>
<td>Impulsivity (.87)</td>
<td></td>
<td>.845</td>
</tr>
<tr>
<td>Inhibitory Control (.56)</td>
<td></td>
<td>.856</td>
</tr>
<tr>
<td>Frustration (.80)</td>
<td>-.659</td>
<td></td>
</tr>
<tr>
<td>% of variance explained</td>
<td>38</td>
<td>32</td>
</tr>
</tbody>
</table>

Note. Values in the parentheses are the internal consistency indexed by Cronbach’s alphas.

**Mother’s Negative Affect**

Maternal affect, was assessed using the Positive and Negative Affect Scale (PANAS) developed by Watson, Clark, and Tellegen (1988). This instrument was chosen because of its relatively high reliability and validity as well as its brevity and ease in administering (see Watson et al. 1988). The questionnaire was designed to measure two primary dimensions of mood—positive and negative affect. The positive affect reflects the extent to which an individual feels active, enthusiastic, and alert, while the negative affect reflects an individual’s state of distress and a variety of negative moods (e.g., anger, contempt, fear, and guilt). The PANAS scale consists of 10 positive adjectives (attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong, and active) and 10 negative adjectives (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid). Mothers were instructed to rate their current feelings by rating the two sets of positive and negative adjectives on 5-point Likert scales when they first arrived at the laboratory playroom. Only the negative affect scale was
used in the current study. The internal consistency for the negative affect scale reported in the literature was .85. In the present study, the internal reliability indexed by the Cronbach’s alpha for the negative affect scale was .72. The validity of the negative affect scale has been demonstrated by significantly correlations with measures of related constructs such as depression, anxiety, and other psychopathological symptoms (Watson et al., 1988).
CHAPTER 4

Results

*Individual Differences in Interactional Synchrony*

Preliminary analyses were conducted to examine the association of family background variables such as mother’s education, marital status, and the number of work hours with interactional synchrony measures. No significant relationships were found. The number of children in a family had a positive relation with affect coordination and a negative relation with positive gaze matching. Given the inconsistent pattern of association, this variable was not included in the subsequent analyses.

The pattern of structured-focused synchrony in gaze and affect coordination was quite similar. About 10% of the dyads were negatively coordinated (i.e., correlation coefficients between mother and child behavior were negative) in both gaze and affect. A mean of .24 in the dyadic correlation of gaze and affect suggested a low to moderate level of positive coordination in these two behavioral modalities.

A similar pattern of content-focused synchrony in negative gaze and affect matching was also observed. On average, the dyads showed only 14% negative matching during interaction. No negative gaze or affect matching was observed between mothers and daughters. More mother-daughter dyads showed a perfect positive match in their gaze than did mother-son dyads. On average, the dyads matched their gaze and affect positively for more than 50% of the time. As a group, the dyads exhibited a much higher mean proportion of positive than negative matching in gaze and affect. (see Table 2).
Table 2  
**Descriptive Statistics: Structure-Focused and Content-Focused Measures of Interactional Synchrony**

<table>
<thead>
<tr>
<th></th>
<th>Mother-Daughter Dyads</th>
<th></th>
<th>Mother-Son Dyads</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>No Match</td>
<td>Perfect Match</td>
<td>Range</td>
</tr>
<tr>
<td></td>
<td>N (Mean, SD)</td>
<td>Minimum-Maximum</td>
<td></td>
<td>N (Mean, SD)</td>
</tr>
<tr>
<td><strong>Structure-Focused Synchrony: Coordination</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaze</td>
<td>18 (.28, .31)</td>
<td>-.35 -.82</td>
<td>--</td>
<td>27 (.22, .22)</td>
</tr>
<tr>
<td>Affect</td>
<td>20 (.20, .15)</td>
<td>-.05 -.47</td>
<td>--</td>
<td>29 (.27, .16)</td>
</tr>
<tr>
<td><strong>Content-Focused Synchrony: State Matching</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Gaze</td>
<td>20 (.00, .00)</td>
<td>.00 .00</td>
<td>100 %</td>
<td>29 (.00, .01)</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>20 (.00, .00)</td>
<td>.00 .10</td>
<td>100 %</td>
<td>29 (.01, .02)</td>
</tr>
<tr>
<td>Positive Gaze</td>
<td>20 (.90, .15)</td>
<td>.40 1.0</td>
<td>0 %</td>
<td>29 (.85, .25)</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>20 (.25, .18)</td>
<td>.02 .52</td>
<td>0 %</td>
<td>29 (.28, .23)</td>
</tr>
</tbody>
</table>

(table continues)
Table 2
Continued

<table>
<thead>
<tr>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Structure-Focused Synchrony: Coordination</td>
</tr>
<tr>
<td>Gaze</td>
</tr>
<tr>
<td>Affect</td>
</tr>
<tr>
<td>Content-Focused Synchrony: State Matching</td>
</tr>
<tr>
<td>Negative Gaze</td>
</tr>
<tr>
<td>Negative Affect</td>
</tr>
<tr>
<td>Positive Gaze</td>
</tr>
<tr>
<td>Positive Affect</td>
</tr>
</tbody>
</table>
Sex Differences in Interactional Synchrony

To examine the effect of child sex on mother-toddler interactional synchrony, three separate multivariate analyses of variance were performed with children’s sex as the between-subjects factor and the indices of interactional synchrony as the dependent variables. In the first MANOVA, the two indices of structure-focused synchrony of coordination in gaze and affect served as the dependent variables. The main effect for child sex was marginally significant, Wilks’ $\Lambda = .89$, $F(2, 42) = 2.68, p < .10$, partial $\eta^2 = 5.37$. Univariate tests revealed that mother-son dyads tended to have a higher degree of affect coordination ($M = .293$, $SD = .142$) than mother-daughter dyads ($M = .208$, $SD = .153$).

To analyze the effect of child sex on the content-focused synchrony of state matching, two more MANOVAs were run. In the first MANOVA, the negative state matching in dyadic gaze and affect served as the dependent variables. The overall effect of child sex was approaching significance, Wilks’ $\Lambda = .89$, $F(2, 46) = 2.83, p < .10$, partial $\eta^2 = 5.66$. Univariate tests indicated that mother-son dyads had proportionally more negative gaze matching ($M = .003$, $SD = .008$) as compared to mother-daughter dyads ($M = .000$, $SD = .000$). In the second MANOVA, the positive state matching in dyadic gaze and affect served as the dependent variables. There was no significant child sex effect, Wilks’ $\Lambda = .97$, $F(2, 46) = .755$, $ns$, partial $\eta^2 = 1.51$.

Contribution of Maternal and Toddler Characteristics to Interactional Synchrony

Descriptive statistics for maternal negative affect and infant temperament composite scores are reported in Table 3. A total of six sets of hierarchical regression analysis were performed to examine the individual and joint contributions of mother’s and toddler’s
characteristics to interactional synchrony. To control for the effect of child sex, this variable was entered first in each set of regression analysis. Mother’s negative affect was entered the next followed by the two composite scores of toddler’s temperament (effortful control and surgency). The interaction terms between maternal negative affect and each of the two temperament measures were created (maternal negative affect x effortful control and maternal negative affect x surgency), which were entered into the model the last.

Table 3

Desciptive Statistics: Measures of Mothers’ Negative Affect and Toddlers’ Temperament

<table>
<thead>
<tr>
<th>Individual</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Affect</td>
<td>45</td>
<td>1.23</td>
<td>.219</td>
</tr>
<tr>
<td>Toddler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Focus</td>
<td>49</td>
<td>4.30</td>
<td>.688</td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td>49</td>
<td>4.29</td>
<td>.704</td>
</tr>
<tr>
<td>Frustration</td>
<td>49</td>
<td>3.30</td>
<td>.942</td>
</tr>
<tr>
<td>Attentional Shifting</td>
<td>49</td>
<td>4.31</td>
<td>.598</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>49</td>
<td>4.81</td>
<td>.630</td>
</tr>
<tr>
<td>Composite Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effortful Control</td>
<td>49</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Surgency</td>
<td>49</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Structure-Focused Synchrony: Coordination

Gaze Coordination. The overall main effect model with child sex as a predictor was not significant, $F(1, 39) = .134, \text{ ns}$. The addition of maternal negative affect contributed significantly to gaze coordination, $F(2,38)=2.47, p<.05$. Mothers scored low in negative affect had a higher level of gaze coordination with their children, $t(40) = -2.19, p < .05$ The addition of toddler’s temperament did not increase the fit of the model, $F (4, 36) = 1.32, \text{ ns}$. The overall joint effect model was approaching significance, $F (6, 34) = 1.90, p < .10$. The joint effect between maternal negative affect and toddler’s level of surgency contributed significantly to gaze coordination, $t(40) = 1.95, p < .05$, which was over and above the main effects of maternal negative affect and toddler temperament.

To further examine the joint effect of maternal negative affect and toddler surgency, a follow-up test was conducted. Based on a median split, the level of maternal negative affect was dichotomized as high or low. Similarly, child surgency was also dichotomized. The values of both variables were plotted on the respective x- and y-axis to represent the joint effect of maternal and surgency on dyadic gaze coordination. The highest gaze coordination was found in the dyads of mothers with low negative affect and toddlers with low surgency. By contrast, the dyads of mothers with high negative affect and toddlers with low surgency exhibited the lowest synchrony in gaze (see Table 4 and Figure 1). Thus, when interacting with children rated low on temperamental surgency, mothers’ affective negativity altered the level of dyadic coordination in gaze. By contrast, when interacting with children high on surgency, mothers’ negative affective made little or no contribution to their gaze coordination.
Table 4

Summary of Hierarchical Regression Analysis for Structure-Focused Synchrony: Gaze Coordination

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
<th>R²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>.003</td>
<td>.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>-.03</td>
<td>.08</td>
<td>-0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>.115</td>
<td>.111*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>.00</td>
<td>.08</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Negative Affect</td>
<td>-.39</td>
<td>.18</td>
<td>-0.34*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>.128</td>
<td>.013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>-.02</td>
<td>.09</td>
<td>-0.04</td>
<td></td>
<td></td>
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<tr>
<td>Maternal Negative Affect</td>
<td>-.38</td>
<td>.19</td>
<td>-0.34*</td>
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<td></td>
</tr>
<tr>
<td>Effortful Control</td>
<td>-.03</td>
<td>.04</td>
<td>-0.10</td>
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<td></td>
</tr>
<tr>
<td>Surgency</td>
<td>.02</td>
<td>.04</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
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<td>.123†</td>
<td></td>
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</tr>
<tr>
<td>Sex</td>
<td>-.01</td>
<td>.08</td>
<td>-0.03</td>
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</tr>
<tr>
<td>Maternal Negative Affect</td>
<td>-.30</td>
<td>.18</td>
<td>-0.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effortful Control</td>
<td>-.24</td>
<td>.35</td>
<td>-0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgency</td>
<td>-.72</td>
<td>.38</td>
<td>-2.90†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Negative Affect × Effortful Control</td>
<td>.19</td>
<td>.31</td>
<td>0.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Negative Affect × Surgency</td>
<td>.61</td>
<td>.31</td>
<td>3.00*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05
† p < .10
Figure 1. Interaction effect of mother’s negative affect and toddler’s surgency on gaze coordination. High and low values correspond to above and below the median scores, respectively.

Affect Coordination. As shown in Table 5, the overall main effect model with child sex as a predictor was approaching significance, $F(1, 43) = 3.20$, $p < .10$. However, no other main- or joint-effect models were found to be significant for maternal negative affect, $F(2, 42) = 2.11$, $ns$, toddler’s temperament measures, $F(4, 40) = 1.11$, $ns$, and the interaction terms, $F(6, 38) = .738$, $ns$. No further test was performed.
Table 5

*Summary of Hierarchical Regression Analysis for Structure-Focused Synchrony: Affect Coordination*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
<th>R²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
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<td>0.07</td>
<td>.069†</td>
</tr>
<tr>
<td>Sex</td>
<td>.080</td>
<td>.05</td>
<td>.263†</td>
<td></td>
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<tr>
<td>Step 2</td>
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<td></td>
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</tr>
<tr>
<td>Sex</td>
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<td>.232</td>
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†p < .10
Content-Focused Synchrony: Matching

Negative Gaze Matching. As shown in Table 6, the overall main effect model with child sex as a predictor was approaching significance, $F(1, 43) = 2.95, p < .10$. No other main- or joint-effect models were found to be significant for maternal negative affect, $F(2, 42) = 1.55, ns$, toddler’s temperament measures, $F(4, 40) = 1.03, ns$, and the interaction terms, $F(6, 38) = 1.12, ns$.

Table 6

Summary of Hierarchical Regression Analysis for Content-Focused Synchrony: Negative Gaze Matching

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†$p < .10$

Negative Affect Matching. The main effect model with child sex, $F(1, 43) = 1.99, ns$, and maternal negative affect, $F(2, 42) = .972, ns$, was not significant. However, the addition of
two toddler’s temperament measures was significant, $F(4, 40) = 2.16, p < .05$. Toddlers who were rated high on surgency tended to engage in more negative affect matching with their mothers, $t(44) = 2.36, p < .05$. The joint effect model was also significant, $F(6, 38) = 5.96, p < .01$. Specifically, mothers rated high on negative affect engaged in more negative affect matching with their toddlers rated low on effortful control, $t(44) = -3.55, p < .01$, and high on surgency, $t(44) = 4.18, p < .01$, (see Table 7, Figure 2 and Figure 3). By contrast, when mothers rated low on negative affect, the level of toddler’s effortful control and surgency had little impact on the match of their negative affect.

Table 7

Summary of Hierarchical Regression Analysis for Content-Focused Synchrony: Negative Affect Matching

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**$p < .01$.**

* $p < .05$.
**Figure 2.** Interaction effect of mother’s negative affect and toddler’s effortful control on negative affect matching. High and low values correspond to above and below the median scores, respectively.

**Figure 3.** Interaction effect of mother’s negative affect and toddler’s surgency on negative affect matching. High and low values correspond to above and below the median scores, respectively.
Positive Gaze Matching. As shown in Table 8, none of the main effect models, including child sex, \( F (1, 43) = 1.53, \text{ ns} \), maternal negative affect, \( F (2, 42) = 1.22, \text{ ns} \), toddler surgency and effortful control, \( F (4, 40) = .702, \text{ ns} \), or the joint effect model, \( F (6, 38) = .642, \text{ ns} \), were able to explain dyadic differences in positive gaze matching. No further tests were performed.

Table 8

Summary of Hierarchical Regression Analysis for Content-Focused Synchrony: Positive Gaze Matching

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Positive Affect Matching. The two main effect models with child sex, \( F (1, 43) = .426, \text{ ns} \), and maternal negative affect, \( F (2, 42) = 1.36, \text{ ns} \), as the predictor were not significant. However, the addition of toddler’s temperament measures was approaching significance, \( F (4, 40) = 2.13, p < .10 \). Specifically, toddler’s effortful control, \( t(44) = 2.33, p < .05 \), was a significant contributor to dyadic positive affect matching. Toddlers with high effortful control

39
engaged in more positive gaze matching with their mothers. The joint effect model was not significant, $F(6, 38) = 1.40, ns$ (see Table 9).

Table 9

Summary of Hierarchical Regression Analysis for Content-Focused Synchrony: Positive Affect Matching

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<th>Variable</th>
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* $p < .05$.
† $p < .10$
CHAPTER 5
Discussion

A large body of empirical literature on mother-infant interactional synchrony has now been accumulated. Findings strongly support the idea that interactional synchrony between a mother and an infant is associated with various aspects of social and emotional development. Toddlerhood is one of the important transitional stages in child development. However, little is known about the nature of interactional synchrony between a mother and her toddler. Thus, the main goal of the present study was to explore interactional synchrony during toddlerhood in a selected context of book reading.

*Individual Differences in Mother-Toddler Interactional Synchrony*

Overall, mothers and toddlers were moderately synchronized during book-reading interaction. This is consistent with previous studies demonstrating that middle class mothers and their infants tend to maintain a moderate level of synchrony during face-to-face interaction (Fogel, 1977, 1982; Tronick & Cohn, 1989). Some researchers have suggested that a moderate rather than a high level of synchrony is optimal for children’s social and emotional development. For example, Jaffe, Beebe, Feldstein, Crown, and Jasnow (2001) discovered that a midrange vocal coordination between mothers and their 4-month-old infants was associated with secure attachment at 12 months. In contrast, high and low vocal coordination was associated with insecure attachment. One of the current explanations is that when dyadic interaction is loosely organized, it may allow infants to practice self-regulatory skills, and thus, promote the development of emotional regulation (Moore & Calkins, 2004). This same interpretation may also be applicable to toddlers.
The majority of the dyads in the present study had a high proportion of positive gaze and affect matching. Mize and Pettit (1997) also found a similar pattern in their sample of middle-class families. The majority of the mothers and their young children (3- to 5-year olds) were rated mostly in or above the mid-range level for their positive synchrony. Shared positive affect within mother-child dyads is closely related to various developmental outcomes, such as secure attachment (Ainsworth, Blehar, Waters, & Wall, 1978), child compliance and internalization of maternal values (Kochanska & Aksan, 1995; Kochanska, Aksan, & Koenig, 1995). Presumably, children from low-risk families are willing to cooperate and to establish a bond with their mothers in mutually responsive and positively infused interactions (Kochanska, 1997).

Contribution of Maternal and Toddler Characteristics to Individual Differences in Interactional Synchrony

Child Sex

In this study, mothers and sons engaged in a higher level of affect coordination than did mothers and daughters. Although the results were only marginally significant, these findings replicated prior infancy research that mothers and sons tend to have a higher affect coordination compared to mothers and daughters (Tronick & Cohn, 1989; Weinberg, et al., 1999). One interpretation is that boys are in need of more external emotion regulation (Tronick, 1980). The observed high level of affect coordination between mothers and male toddlers may be a result of mothers’ high attunement to scaffolding their male toddlers’ affective state. A longitudinal study by Malatesta et al. (1989) seems to support this interpretation, in which a high level of maternal contingent response to their 4-month-olds’ signals tends to benefit boys’ but not girls’ later social looking behavior (higher level of gazing at mother at 2 years of age).
In addition to a higher level of affect coordination, mothers and sons had a higher proportion of negative gaze matching during book reading. These findings are consistent with the stated hypothesis that because boys are more temperamentally active and less attentive (low in effortful control) they would have a more difficult time sustaining their attention during book reading. Although the results with child sex are in the expected direction, they should be considered with caution for two reasons. First, the results were only approaching statistical significance. Second, no other studies have found any sex differences in child behavior during book reading interaction (Deloache & Demendoza, 1987; Frosch, 2001 Goodsitt, Raitan, & Perlmutter, 1988). It is very possible that the effect size of child sex on individual differences in interactional synchrony in the context of book reading is small. More studies with larger sample sizes are needed to elucidate the effect of child sex on book reading interaction (see Fletcher and Reese, 2005).

**Child Temperament**

In addition to child sex, the main effect of child temperament on individual differences in mother-toddler interactional synchrony was evident in affect. Toddlers’ temperament characteristics made significant contributions to negative and positive affect matching between mother and toddler. Mothers were more likely to engage in negatively matched affective interaction with toddlers who were more impulsive, more easily frustrated and who frequently shifted their attention (high in surgency). By contrast, they were more likely to engage in positively matched affective interaction with toddlers who showed a pattern of effortful attention. Taken together, these findings replicate previous studies that impulsive toddlers with inadequate effortful control may experience a negative cycle of social and emotional interactions with their parents (Dumas, Serketich, & LaFreniere, 1995). Moreover, Calkins and Johnson
(1998) found that when 18-month-old toddlers displayed aggressive behavior and acted out, their mothers demonstrated more distress and intrusive behavior. The same study also revealed that toddlers who were temperamentally easily frustrated (e.g., fussing, fretting, crying) were likely to use less constructive regulatory behaviors (e.g., kicking, hitting). It appears that temperamentally difficult toddlers (impulsive, easily frustrated) are dispositionally less adequately equipped to practice self-regulation. Such temperamental style may evoke certain parental reactions. For example, when toddlers are asked to complete a task that may evoke frustration (e.g., a puzzle), some mothers of difficult toddlers may do the work for them to avoid frustrated outbursts from the toddlers (Calkins & Johnson, 1998) and some mothers practice coercive, harsh discipline (Dumas et al., 1995).

**Maternal Negative Affect**

Mothers’ high levels of negative affect was associated with low levels of gaze coordination with their toddlers, but not any other interactional synchrony measures. This relatively weak finding may be due to the fact that mothers in this study were predominantly from a demographically low-risk population. Most of the mothers demonstrated a low negativity in affect (with an average of 1.23 on a 5-point scale). Given that low-risk mothers tend to have low negative affect, perhaps in the future research it will be more meaningful to examine the differences in maternal positive affect and its effect on social interaction with the child.

Even though their overall negative affect was low as a group, mothers who were on the high end had significantly lower gaze coordination with their toddlers. This finding reveals that gaze may be a more sensitive behavioral measure than affect. Mothers may be able to mask their negative affect, but they may not be as effective in concealing their gaze patterns. This explanation is consistent with research findings on the effects of mood on social gaze behavior.
For example, Natale (1977) demonstrated that depressed college students (induced depressed mood) looked less frequently at their social partner (the interviewer) and the duration of looking was shorter as compared to the students who were neutral or positive in their affective state.

The nonsignificant finding with negative and positive gaze matching can be attributed to the nature of the book reading context. It is likely that mothers with high negative affect and their children tend to look at the book, rather than at each other. Looking simultaneously at the book was coded as a positive match. As a result, positive and negative gaze matching was mixed together. One way to solve this confounding is to code positive match only when both partners look at each other. Another way is to examine dyadic gazing patterns within a different context. For example, significant differences in gaze matching between mother-infant dyads have been found during free play when both partners are not constrained by any contextual variables (Feldman & Eidelman, 2004).

Joint Effect of Mother and Child

The “goodness of fit” model was able to explain the systematic variation in dyadic gaze coordination and negative affect matching. When interacting with underregulated, difficult toddlers who were more impulsive and less attentive (high surgency), mothers’ high or low affective negativity did not affect the level of gaze coordination between the two partners. By contrast, when interacting with easy toddlers who were less impulsive and more attentive (low surgency), mothers’ low affective negativity facilitated dyadic gaze coordination, whereas mothers’ high affective negativity hindered dyadic gaze coordination. These patterns are generally consistent with the established association of difficult child temperament with insensitive, unresponsive, and coercive parenting (e.g., Lee & Bates, 1985; van den Boom, 1994). When interacting with a highly difficult and inattentive child, it may be extremely challenging
for the mother to predict and coordinate her gaze with her child’s. However, when the child is more positive and attentive, the mother plays a more influential role in co-regulating their gaze patterns. Low affective negativity in the mother may enhance her attunement and sensitivity to the child’s gaze signals, which in turn, lead to higher dyadic gaze coordination. By contrast, high affective negativity in the mother may interrupt or bias her perception of the child’s gaze signals. Consequently, low gaze coordination is likely to emerge from interaction.

The most robust joint effect between a mother and toddler was found in the matching of their negative affect. When interacting with difficult toddlers who were more impulsive and less attentive (high surgency), mothers’ high affective negativity amplified the extent of negative affect matching between the two partners. Similarly, when interacting with under-regulated toddlers who were less attentive and frustrated easily (low effortful control), mothers’ high affective negativity also amplified the extent of negative affect matching between the two. By contrast, when interacting with their easy/well-regulated or difficult/under-regulated toddlers, mothers’ low affect negativity tended to be associated with a reduced negative dyadic affect matching. These patterns of consistent with the findings that maternal negative affective state are associated with either intrusive or withdrawal parenting behavior (Field et al., 1990), Apparently, mothers who are positive or emotionally more stable are able to adjust to their child’s temperament and to create a better fit between the child and environmental demands. For example, they may be more patient when the child acts out, and they may be more willing to create a more positive and enjoyable environment during book reading. It is also possible that these mothers have an overall more positive relationship with their children to begin with, and thus, children are more willing to engage with their mothers in a more mutually positive book reading interaction (Fletcher & Reese, 2005).
Overall, the joint contribution of maternal and toddler characteristics to dyadic gaze and affect patterning observed in mother-toddler book reading is consistent with previous studies demonstrating that mothers with different characteristics react differently to their children with different temperamental qualities. For example, mothers in the study by Clark et al. (2000) used more power assertion with their emotionally negative children if they were high in extraversion or low in empathy. Together with previous findings, results from this study provide further support for the contention that mother-toddler interactional synchrony is a joint product of both partners.

Limitations and Future Research

Some limitations of the present study need to be noted. First, although the coding system was designed to capture mother’s and child’s gaze shifting, often times their glances were fleeting and too subtle to be captured by the time-sampling behavioral coding strategy. Computer-assisted devices designed for real time coding may be useful in future research to improve coding precision.

Second, the main effect model was able to explain only a small proportion of variance of the positive state matches in the present study. This may be due to the constraints imposed by the social context of book reading. The activity of book reading requires both participants to look at the book. Positive gaze matching was mostly a reflection of joint attention of mother and toddler. Natural fluctuations and individual variations in gaze exchanges are likely to be inhibited in this restricted context. Similarly, the joint attention of mother and toddler on a book reduces affective exchanges. Mothers’ and toddlers’ affect tend to be neutral when reading a book together. Thus, interactional synchrony in gaze and affect between mother and toddler may also need to be examined in situations with less contextual constraints such as free play.
Third, zero-order correlations between mothers’ and infants’ affective-expressive behaviors have been used as the indices of structure-focused synchrony. Compared to mother-infant interaction, the pace of mother-toddler interaction is slower and the cyclic pattern in the temporal rhythmic is less pronounced. Perhaps other statistical methods such as state space grid analysis (SSG) may be more effective in detecting the affective dynamics in the interaction between mothers and older children (Lewis, Lamey, & Douglas, 1999). The SSG is a technique tracking dyadic trajectories as mother and child moving together in real time on a two-dimensional space by plotting one partner’s state against the other’s on their respective \( \chi \) and \( \gamma \) axis. In addition to the amount of state matching, the trajectories of the dyadic state movements can inform about the flexibility or rigidity of the dyadic interaction (clusters in some state regions and not others), the duration of time remaining in a certain state, how quickly a dyad shifts from one state to another, or how quickly it stabilizes in one particular state (Granic & Hollenstein, 2003). Thus, meaningful temporal dynamics within mother-toddler dyads may be revealed with this approach.

Fourth, Fletcher and Reese (2005) reviewed empirical studies on book reading and highlighted three distinct units of analysis: the mother, the child, and the book. They suggested that each unit and its interaction with other units exert a unique influence on the quality of book reading. This study illustrates the dyadic nature of book reading activity by examining interactional synchrony between mother and child.

In this study, the dyadic nature of interactional synchrony was operationalized as the co-movement (coordination) or co-occurrence (state matching) of two individuals’ behavior within the dyad (e.g., mother’s and toddler’s affect) with the goal to capture the higher-order phenomenon that is beyond individual behavior. However, it has been argued that this
“individual” approach to dyadic phenomenon may not be sufficient to explain a phenomenon that develops within dynamic social interactions (Aksan, Kochanska & Ortmann, 2006). This is simply because the whole is not the sum of its parts. Thus, taking a “relational” approach and using the dyad as the basic unit for direct observation (e.g., ratings of dyadic synchrony and mutual responsiveness) may also be another method to capture mother-toddler interactional synchrony.

Finally, regardless of how interactional synchrony is operationalized, this dyadic construct can potentially be a fruitful research area for our understanding of the precursors of development in early childhood. For example, taking a social-constructive approach to social cognition, Carpendale and Lewis (2006) proposed that young children develop social understanding through cooperative interactions with others. Mother-toddler synchrony may present a context for young children to develop an understanding of other people’s intentions, feelings, beliefs, and desires.
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Appendix A

Mothers’ Social-Affective Behaviors

1. Gaze:

0=Looking away from book and child,
1=Exhibiting a functional look to direct the child to the couch and/or to attend to book reading,
2=Looking at the book,
3=Glancing at the child once (for less then 2.5 sec.),
4=Glancing at the child more than once (each less then 2.5 sec.),
5=Looking at the child (for at least 2.5 sec.).

2. Affective Expression:

0=Moderate negative affect expressed facially (e.g., frowning) and/or vocally (e.g., stern voice),
1=Mild negative affect expressed by raising eye brows, pausing, and/or calling child’s name,
2=Expression of boredom or detachment from the book reading (e.g., mono-tone reading),
3=Flat affect with neutral facial and vocal expression,
4=Animated voice or facial expressions, and/or physical imitations (e.g., whispering, talking in high pitched voice, mimicking eating or drinking sounds and/or actions such as flapping arms as flying birds), or
5=Positive affect (smile or laughter).
Appendix B

Toddlers’ Social-Affective Behaviors

1. Gaze:

0=Looking away from book or mother,
1=Glancing at the book one or more times (less then 2.5 sec.),
2=Looking at the book (for at least 2.5 sec. or more),
3=Glancing at the mother one or more times (less then 2.5.),
4=Looking at the mother (for at least 2.5 sec. or more).

2. Affective Expression:

0=Expression of intense negative (e.g., kicking, stumping feet, and/or flapping arms), vocal (e.g., screaming), and facial (e.g., anger) behaviors,
1=Expression of moderate negative affect in physical (e.g., pushing away from mother, getting off the couch) in combination with facial (frowning) and/or vocal,
2=Fussing, pouting,
3=Expression of neutral affect,
4=Expression of high concentration on the story with slightly wrinkled brows and relaxed mouth,
5=Expression of animated/pretend facial expressions (e.g., mimicking the feelings of the characters),
6=Expression of genuine positive with a small smile (only corners of mouth are slightly up-turned),
7=Expression of positive affect with a large smile (narrowed eyes, bulging occurs under eyes, raised cheeks and upturned mouth corners),
8=Expression of more intense positive affect with a laugh.