

MOTHER-TODDLER INTERSUBJECTIVITY AS A CONTRIBUTOR TO EMOTION
UNDERSTANDING AT AGE 4

by

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ABSTRACT

Intersubjectivity is a process of shared understanding between mother and child expressed through both verbal and nonverbal channels. Verbal and nonverbal intersubjective processes can be better understood in terms of their structures and contents. Emotion understanding plays a critical role in their social and emotional adjustment. Developmental literature emphasizes caregiver-child relationships as an essential element in the development of emotion understanding. However, the underlying mechanisms by which caregiver-child relationships contribute to individual differences in emotion understanding have not been adequately addressed. The present study was an attempt to examine the contribution of mother-toddler nonverbal and verbal intersubjectivity to children's emotion understanding.

Seventy-nine children and their mothers participated in the present study. At age 2½, mothers and their toddlers read two wordless books depicting emotional themes. The book reading interaction was videotaped and used to derive indices of nonverbal and verbal intersubjectivity. Nonverbal and verbal intersubjectivity was measured in terms of the structure (i.e., affective synchrony and verbal alignment) and the content (i.e., positive and negative affective matching, and shared emotional semantics and experiences of positive and negative

valence). At age 4, children were tested on emotion recognition and emotion knowledge test. Child gender and age served as the covariates in all analyses.

Results confirmed the two main hypotheses that both nonverbal and verbal intersubjectivity contributed to children's emotion understanding. Affective synchrony was the significant nonverbal predictor of emotion understanding. This relationship was nonlinear, with a U-shaped quadratic pattern. Specifically, lower and higher affective synchrony scores were likely to be associated with greater emotion recognition in children. Shared emotional semantics emerged as the significant predictor of overall emotion understanding. Verbal alignment equally contributed to emotion knowledge of negative and positive valence. Furthermore, shared semantics of positive and negative valence equally predicted emotion knowledge of negative and positive valence. However, shared semantics of positive valence had a stronger contribution to overall emotion knowledge. The present study highlights both nonverbal and verbal processes of communication between mother and child and their unique role in the development of emotion understanding.

INDEX WORDS: Intersubjectivity, Affective Synchrony, Affective Matching, Verbal Alignment, Shared Semantics, Shared Experiences, Mother-Toddler Book Reading, Emotion Understanding

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DEDICATION

I dedicate this dissertation to my sons, Harris and Mason Moorer. Boys, everyday you give me so much love, joy, inspiration, and motivation to work hard and to become the best I can be. This journey had not been easy, but I would not want it any other way! You make my life meaningful in so many ways! I love you!

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CHAPTER 1

INTRODUCTION

Emotion understanding, the earliest form of social understanding (e.g., Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Gergely & Watson, 1996), can be broken down into two main components: (1) emotion recognition, recognizing different types (Shaver, Schwartz, Kirson, & O'Connor, 1987) and intensities of facial expressions (Wintre & Vallance, 1994; Wintre, Polivy, & Murray, 1990), and (2) emotion knowledge, understanding the causal connection between the situations and evoked emotions (Russell, 2003). Both elements begin to emerge in infancy and reach a relatively sophisticated level of development by the time children enter preschool age. Given that normally developing children acquire the ability to recognize and infer emotions in such a short period of time points to its developmental significance.

Research suggests that being able to read other people's emotions plays a significant role in one's social life. For example, children's emotion understanding is positively correlated with better social adjustment and emotional well-being measured concurrently and longitudinally (e.g., Cassidy, Werner, Rourke, Zubernis, & Balaraman, 2003; Dunn & Herrera, 1997; Dunn, Maguire, Brown, 1995; Fenning, Baker, & Juvonen, 2011; Lindsey & Colwell, 2003). Children who demonstrate better emotion understanding also exhibit more prosocial behavior (e.g., Cassidy et al., 2003; Ensor & Hughes, 2005; Fenning, et al., 2011), greater creativity and longer episodes of pretend play with peers (e.g., Lindsey & Colwell, 2003; Slomkowski & Dunn, 1996; Taylor & Carlson, 1997), better skills at conflict resolution (e.g., requesting clarification of the other's point of view, compromising) (Dunn & Herrera, 1997), and higher moral orientation

(Dunn et al., 1995). In light of these findings, it is critical to understand the factors contributing to individual differences in young children's emotion understanding.

Various individual and relational factors are related to young children's understanding of emotions. The two common frameworks used to explain the linkage of individual and relationship factors to emotion understanding in children are parental emotion socialization and child attachment. Whereas parental socialization literature has focused on individual characteristics of the caregiver (e.g., emotional expressiveness) (Denham, Zoller, & Couchoud, 1994) and the child (e.g., temperament and gender) as the contributors (Casey, 1993; Chaplin, Cole, & Zahn-Waxler, 2005; Martin & Green, 2005; Trentacosta, Izard, Mostow, & Fine; Valiente et al., 2004), attachment literature has emphasized the quality of early caregiver-child relationship (see Harris, 1999). Mothers' expressed negative emotions have been shown to be negatively correlated with children's emotion understanding. Children's effortful control is found to be linked to better understanding of emotions (e.g., Denham et al., 1994; Laible, 2004; Martin & Green, 2005). In general, preschool-aged girls demonstrate better understanding of emotions than boys (e.g., Martin & Green, 2005). Finally, children who are securely attached to their mothers are more skilled in emotion understanding measured concurrently and longitudinally (e.g., Ontai & Thompson, 2002; Steele, Steele, Croft, & Fonagy, 1999).

Although both frameworks have significantly added to our knowledge about individual differences in emotion understanding among children, neither has addressed the underlying mechanisms involved in mother-child relationships that are associated with the development of emotion understanding. Vygotsky believed that cognitive capacities, particularly the ones that are unique to humans, first take form within social interactions; it was referred as the inter-psychological plane (between minds) of activity (Adams & Bullock, 1986). Based on this

proposition, the development of emotion understanding needs to be examined as a product of social interaction, which begins initially in dyadic interaction between a caregiver and a child. The primary goal of the present study, thus, is to examine the interpersonal processes occurring between mother and child and their associations with the development of emotion understanding. Specifically, this study addresses the underlying mechanisms of mother-child interaction observed in toddlerhood and their contribution to later individual differences in emotion understanding among children at preschool age. Socialization and attachment literature suggests that young children learn about emotions not only verbally in conversations about feelings (see Harris, 1999), but also nonverbally through social interactions (e.g., Denham et al., 1994). Intersubjectivity is a process of shared understanding between two or more individuals expressed through both *verbal* and *nonverbal* channels (Clark & Schaefer, 1989; Doherty-Sneddon et al., 1997). Intersubjective processes that underlie both verbal and nonverbal aspects of mother-toddler interaction are expected to contribute to individual differences in emotion understanding at preschool age. Because book reading is an age appropriate activity where mothers introduce to their toddlers new concepts, words, and emotional information, the present study focuses on the verbal and nonverbal intersubjective processes occurring between mothers and their toddlers in this social context.

Both verbal and nonverbal intersubjective processes have been conceptualized as attunement, mutual responsiveness, reciprocity, and alignment, which can be better understood in terms of their *structures* and *contents*. Research by Trevarthen (Trevarthen & Hubley, 1978), Stern (1974, 1977, 1985) and Beebe (1985; Beebe & Lachmann, 1988) on mother-infant communication was among the first to explore the concept of nonverbal intersubjectivity. Structure-focused nonverbal processes describe how consistently mother-infant dyads coordinate

their behavioral cycles in affect and gaze across time regardless of the content of their behaviors (e.g., Brazelton, Koslowski, & Main, 1974). *Affective synchrony* (i.e., dyadic coordination) between mother and child in their affect and gaze can help organize mother-child interactions and promote young child's sense of autonomy and agency, which in turn, may lead to a greater appreciation of emotional experiences (Braten, 1998, p. 380). By contrast, the content-focused process of nonverbal intersubjectivity examines 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 and intensity. *Affective matching* between mother and child, such as mutual positive affect, validates the child's feelings.

Nonverbal intersubjective processes of affective synchrony and affective matching (in both positive and negative valences) can carry meaningful emotional information for toddlers, who still heavily rely on emotional signals to make sense of people's behavior. Children who experience high levels of synchrony and share positive affect with their mothers are likely to form close psychological connection and engage in frequent and high quality emotion conversations with them. Structure- and content-focused nonverbal intersubjective processes tap distinctly different aspects of mother-child interaction. Each may differentially contribute to different elements of emotion understanding in early childhood (see discussion below). Thus, the first goal of the present study is to examine the structure and content of *nonverbal intersubjectivity* observed in mother-toddler book reading interaction and their associations with later children's emotion recognition and emotion knowledge at age 4. To achieve this goal, mothers' and their toddlers' gaze and facial affect exhibited during book reading interaction at age 2½ will be coded to derive nonverbal intersubjective indices of affective synchrony and affective matching as contributors to later children's emotion recognition and emotion

knowledge assessed at age 4. Similar to nonverbal processes, verbal intersubjectivity reflecting *common ground* in discourse can also be conceptualized with two distinctive dimensions: structure and content. Common ground as the structure of the verbal intersubjectivity (Clark & Wilkes-Gibbs, 1986; Garrod & Pickering, 2004) focuses on the verbal strategies (e.g., repetition, elaboration, and/or expansion) that people use to align one's own perspective with that of the partner's during conversations. *Verbal alignment* represents the sensitivity and skills of the caregiver and the child establish shared common ground. Because it taps into sensitivity and appropriateness to development, mother-toddler verbal alignment is expected to be associated with children's better grasps of new emotional information. Common ground as the content of verbal intersubjectivity (Clark & Wilkes-Gibbs, 1986) focuses on the substantive information shared between conversational partners. Emotional semantics and emotional information shared by conversational partners are thought to best reflect the content of verbal intersubjectivity. *Shared emotional semantics* refers to the mutual understanding between mother and toddler about the meaning of each other's emotional language used in the dialogue. Sharing and understanding emotional semantics is expected to not only improve communication effectiveness and dialogue coherence between mother and toddler, but also insure that explanations or elaborations are well understood by the young child. *Shared emotional experiences* refer to the act of making references to emotional experiences that are shared by mother and toddler in the past, present, or future. Relating and making references to a child's own personal experiences may help him/her understand how and why another person may feel in a certain situation.

Children learn about emotions through everyday conversations with their parents. How parents structure conversations and convey new information can have an effect on the extent to which children learn and formulate emotion understanding. Verbal alignment, use of shared

emotional semantics, and references to shared emotional experiences by mother and toddler reflect different aspects of verbal intersubjective processes, which are expected to contribute differentially to the development of children's emotion recognition and emotion knowledge. Thus, the second goal of the present study is to examine the structure and content of mother-toddler *verbal intersubjectivity* observed during mother-toddler book reading and their associations with later children's emotion recognition and emotion knowledge assessed at age 4. To accomplish this goal, the conversation between mothers and their toddlers during book reading at age 2½ are transcribed verbatim. Based on conversation units and speech acts, measures of verbal alignment, shared emotional semantics, and shared emotional experiences are derived as contributors to later children's emotion recognition and emotion knowledge at age 4.

CHAPTER 2

REVIEW OF THE LITERATURE

Emotions are not only an important source of information for young children, but also a primary means of their communication. Through reading and expressing emotions, children learn the rules of their social environment (Izard, 2002). Emotion understanding, the earliest form of social understanding, has a strong impact on a child's social and emotional life (Harris, 2008). For example, studies show that children's emotion understanding is associated with prosocial behavior (e.g., Ensor & Hughes, 2005), moral orientation (Dunn et al., 1995), conflict resolution skills (e.g., compromising and requesting clarification) (Dunn & Herrera, 1997). Better emotion understanding is also correlated with children's greater creativity and longer episodes of pretend play with peers (e.g., Lindsey & Colwell, 2003; Slomkowski & Dunn, 1996; Taylor & Carlson, 1997). Finally, children who show better understanding of emotions tend to be socially and emotionally well adjusted (e.g., Cassidy et al., 2003; Dunn, & Herrera, 1997; Dunn et al., 1995; Lindsey & Colwell, 2003; Miller et al., 2005).

Emotion understanding is believed to be a critical skill for children to understand the social and psychological world (Carpendale & Lewis, 2004). Recognition of emotions begins in infancy (for a review, see Nelson, 1987). Infants are capable of recognizing different types (Shaver, et al., 1987) and intensities of facial expressions (Wintre & Vallance, 1994; Wintre, et al., 1990). Emotion knowledge, an understanding of the link between expressed emotions and external causes, desires, and beliefs, begins to develop during toddlerhood and continues throughout preschool age (see Pons, Harris, & de Rosnay, 2004), during which considerable individual differences become particularly noticeable.

Development of Emotion Understanding

Perceptual studies reported that by 3 to 5 months of age infants can discriminate facial expressions of positive (e.g., happiness) and negative valence (e.g., anger, fear, and disgust) (e.g., Barrera & Maurer, 1981; Caron, Caron, & MacLean, 1988; Kuchuck, Vibbert, & Bornstein, 1986). By 5 months, infants can discriminate different emotional vocal expressions with a matched facial expression (e.g., Walker-Andrews & Grolnick, 1983). Furthermore, naturalistic observations of mother-infant face-to-face interaction suggest that by 3 months infants are also able to extract the meaning of emotion expressions by responding appropriately (e.g., matching) to their mothers' expressions of joy, anger, and sadness (Haviland & Lelwica, 1987). Kahana-Kalman and Walker-Andrews (2001) suggest that infants between 3- to 5-months of age are able to understand the meaning of emotional expressions, at least in familiar settings and/or with familiar persons (e.g., caregivers).

By the end of the first year, there is a developmental shift from simple recognition of emotional expressions to a more advanced understanding of the link between facial expressions and situations that may be the cause or consequence of an expressed emotion (e.g., Klinnert, Emde, Butterfield, & Campos, 1986). Infants are capable of seeking emotional information from other people to resolve ambiguity and using others' emotional response to regulate their own behavior (i.e., social referencing). For example, in the study by Hornik and Gunnar (1988), 12- and 18-month-olds were observed exploring a novel animal (i.e., a rabbit) with their mothers. Infants increased visual referencing to their mothers when emotional information was actively offered. An important developmental change is worth noting. Whereas both 12- and 18-month-olds sought emotional information from their mothers, only 18-month-olds responded with positive affect to their mothers' positive affect. This suggests that older infants are able to

represent emotional events in a sequential order, reflecting a rudimentary understanding of the links between emotions and situations that precede or follow them. Infants also display social referencing behavior with familiar adults such as daycare caretakers who are expressive during natural interactions (Camras & Sachs, 1991). These findings suggest that infants begin to treat people as social agents who communicate important emotional information and that individual differences in caregivers' behaviors may shape infants' understanding of emotional information.

Starting at 14 months, infants show an understanding that people can have different emotional attitudes toward different objects (Meltzoff, Gopnik, & Repacholi, 1999). For example, after witnessing an experimenter expressed the emotion of joy or disgust toward an object in a box, infants were more likely to open the box containing the "happy" object than the "disgust" one. By 18 months, they can read people's intentions and understand that people can have different desires that are different from their own (Repacholi & Gopnik, 1997). With more advanced language skills, toddlers are able to label their inner states and emotional events that they observe in others. By 20 months, toddlers begin to use emotion-descriptive terms in their everyday activities with their family members (e.g., Dunn, Bretherton, & Munn, 1987). The use of inner-state terms increases even more dramatically during the third year of life (Ridgeway, Waters, & Kuczaj, 1985).

By 36 months, toddlers demonstrate an understanding of the links between desire, intention, action, and emotional reaction (Meltzoff et al., 1999). To demonstrate this developmental milestone, Meltzoff (1996) conducted an experiment where 18-, 24-, and 36-month-olds observed an adult performing an ambiguous action (i.e., putting a toy unstably on top of a shelf and letting it fall with a banging sound). Another adult expressed an emotional reaction of either happy/satisfied or unhappy/dissatisfied immediately as a response to the first

adult's action. After witnessing the sequenced event, objects were then given to the child. Results showed that the behavior of 18- and 24-month-olds did not change systematically as a function of the second adult's emotional reaction to the event. However, 36-month-old children showed differential response according to the emotional reaction of the second adult, either put the objects back in the unhappy/dissatisfied condition, or knocked the objects off the shelf in the happy/satisfied condition.

By preschool age children already understand the links between feelings felt by people and the situations evoking different kinds of affective responses (Borke, 1971). At this age, children begin to recognize that different people may experience different emotions at a given situation due to differences in their desires or beliefs (Denham & Couchoud, 1990; Pons et al., 2004). In the literature, it is commonly referred to affective false-belief understanding (Dunn et al., 1991). Preschoolers continue to expand their emotion understanding by learning about mixed emotions and different rules of emotional expressions (Pons et al., 2004).

Finally, emotions are typically defined and theorized by different valences. For example, positive emotions are usually categorized along a dimension of pleasure and associated with goal achievement (Fredrickson, 1998). In contrast, negative emotions are categorized along a dimension of displeasure and usually associated with failure of goal achievement (Ortony & Turner, 1990). The development of emotion understanding begins with discriminating emotions of positive from negative valence and understanding their differential meanings and causes (O'Rourke & Ortony, 1994; Ortony & Turner, 1990). Not only do preschoolers and their parents conceptualize and react to negative emotions differently from positive emotions, they also express greater interest in discussing the causes of negative than positive emotions (Lagattuta & Wellman, 2002). More attention and efforts are devoted to recognize, understand, and regulate

negative than positive emotions. As such it is critical to differentiate emotions of positive from negative valence when investigating the development of emotion recognition and emotion knowledge during early childhood.

Individual Differences in Emotion Understanding

Individual differences in emotion understanding begin to emerge in infancy (e.g., Montague & Walker-Andrews, 2002) and become markedly evident during preschool years (for a review, see Harris, 2000). For example, Pons, Lawson, Harris, and de Rosnay (2003) found that some 4- to 5-year-olds showed a better emotion understanding than some 10- to 11-year-olds. Individual differences are also relatively stable over time during early childhood (Pons et al., 2004). Individual differences in children's understanding of emotions are associated not only with personal characteristics of the mother (e.g., emotional expressiveness) and the child (e.g., gender and temperament), but also with relational factors such as the security of child attachment (Harris, 1999) and the quality of caregiver-child social interactions (Denham et al., 1994). Several theoretical approaches have attempted to identify the contributors to individual differences in preschoolers' emotion understanding, including parental emotion socialization, child attachment security, mother-child discourse, and social-cognitive constructive perspectives. Each perspective will be discussed as follows.

Parental Emotion Socialization

The emotion socialization perspective focuses solely on the effect of parental verbal and nonverbal actions on children's learning about emotions. Parents can influence children's emotion recognition and knowledge by ways of providing a model, contingent responsiveness, and coaching. Children can model parental emotional expressivity for when, what, and how to express emotions in a given situation (Denham & Kochanoff, 2002). Parental contingent

emotional expressions upon children's emotional display may serve either as a reward (e.g., reacting positively to children's anger/sadness) or as a punishment (e.g., reacting with anger to children's sadness/anger). It is believed that by rewarding emotional expressions, parents may promote children's exploration of emotional world, and by punishing children's emotional expressions parents may disrupt the process of their learning about own and other's emotions (Denham & Kochanoff, 2002). Finally, parents may coach their children by explicitly talking and explaining emotional situations to help them understand and manage emotional events (e.g., Denham & Kochanoff, 2002).

Empirical studies provide support to parental emotional socialization perspective. For example, caregivers' positive, contingent, and empathetic responsiveness to children's expressed emotions (e.g., positive affect and distress) is positively correlated with preschoolers' emotion understanding, (e.g., Denham et al., 1994; Denham & Kochanoff, 2002; Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997), empathetic response to others' distress (Zhou et al., 2002), and recognition of other's distress and negative emotion, as well as school-aged children's prosocial responding (Davidov & Grusec, 2006). By contrast, caregivers' negative reinforcement (e.g., verbal discouragement of emotional display, distracting, punishing, escaping to "get away" from the emotion) and anger response to children's emotional expressions were found to be negatively related to preschoolers' emotion understanding (Denham et al., 1997). Furthermore, despite its adverse effects, parental negative affect may be necessary to facilitate children's emotion understanding. For example, Denham and Kochanoff (2002) found that parents' contingent reactions to child misbehavior with negative affect in a low duration, intensity, and frequency within the context of a positive background affect was related to 5-year-olds' understanding of hidden feelings.

Parental emotion socialization literature also suggests that individual characteristics of the caregiver and the child are likely to shape how caregivers socialize their children's emotion understanding. For example, mothers' emotional expressiveness and attitudes not only reflect how they express emotions on a daily basis, but also how they react to children's expression of emotions (e.g., Denham & Kochanoff, 2002; Gottman, Katz, & Hooven, 1997). Mothers who express a moderate level of positive and negative emotion tend to provide children with specific information about the nature of various emotions and encourage them to talk about emotions and their causes. Child gender also plays a role in parental emotion socialization. Parents not only tend to talk more with girls about emotion than with boys, but also talk with girls about emotions differently from boys (e.g., Brown & Dunn, 1996; Cervantes & Callanan, 1998; Kuebli & Fivush, 1992). For example, studies found that mothers and fathers tend to use a greater variety of emotional words when speaking with girls than with boys (Kuebli & Fivush, 1992). Cervantes and Callanan (1998) reported that mothers tend to elicit more causal explanations from girls than from boys. Differences in the quantity and the quality of emotional talk with parents may explain why girls show more advanced emotion understanding than boys (Denham et al., 1994).

Studies taking the socialization perspective tend to emphasize the active role of parents as socializing agents and view children as passive recipients of parental socialization. During early childhood, in addition to passive observations, children learn about emotions through active participations in social interactions. The unidirectional conceptualization and the focus on caregiver and child personal characteristics do not adequately address the question of *how* emotional information is conveyed by parents and understood by children during social encounters. A bidirectional conceptualization of socialization would suggest that meaningful

emotional information is jointly created and shared between parents and their children. Understanding nonverbal and verbal processes of intersubjective communications between a mother and a child may be of particular importance. Through affective sharing of and open discussion about emotions, children and mothers may experience close psychological connection and mutual understanding. Investigation of mother-child intersubjective nonverbal and verbal processes in emotional communication can provide a useful framework to examine the active role of children in the development of emotion understanding.

Attachment Security

According to attachment perspective, children's secure attachment to a caregiver is a necessary step for acquiring better emotion understanding. Central to this theory is the view that children perceive, attend to, and appraise experiences through internal working model (Bowlby, 1982). Internal working model serves as an affective-cognitive filter directly affecting children's ability to attend to, remember, and understand emotional information (Belsky, Spritz, & Crnic, 1996). Secure attachment provides a sensitive and secure environment for children to express and explore emotions. Within a secure attachment relationship, children not only are more flexible and open about discussing both negative and positive emotions, but also tend to engage in rich discourse about emotions and causality and competently connect verbal labeling with implicit feeling states (Bretherton, 1987; Cassidy, 1994).

Empirical studies have provided support to the link between children's attachment security and levels of emotion understanding both concurrently and longitudinally. For example, Steele et al. (1999) found that children who were securely attached at 12 months had a more advanced understanding of mixed emotions at age 6. Results from a study by De Rosnay and Harris (2002) revealed that 3- to 6-year-olds with secure representations of parent-child

relationship performed consistently better on all emotion understanding tasks than those with insecure representations, even after controlling for verbal mental age, chronological age, and gender. Ontai and Thompson (2002) also found that securely attached 5-year-olds demonstrated greater emotion knowledge concurrently.

At first glance, it seems that a linear, positive pattern summarizes the relationship between young children's attachment security and emotion understanding development. Further research, however, indicates that the relationship between attachment and emotion understanding may not be as straightforward as it was originally thought. For example, in a study by Belsky et al. (1996), 3-year-old children who were securely attached at 12 months remembered positive affective events more accurately than negative affective events. In contrast, insecurely attached children remembered negative affective events more accurately than positive ones. However, Laible and Thompson (1998) found that preschoolers' concurrent secure attachment representation was predictive of their understanding of emotions with negative valence (e.g., sadness). Despite some mixed results, the overall findings suggest that secure mother-child attachment contributes to better understanding of emotions in children. One study using neuroimaging technique also supports this view. Carver and Vaccaro (2007) reported a concurrent link between the pattern of mother-infant interaction and infants' emotion recognition indexed by EEG response patterns. They found that infants who referenced their mothers faster in a novel toy situation had better emotion recognition scores, and that those who engaged in more interaction with their mothers after encountering a novel object also had better emotion recognition scores.

Fonagy (2001), who has done extensive work in relating attachment security to emotion understanding, considers that one of the primary evolutionary functions of attachment is

generating mind capable of inferring other people's minds, thoughts, ideas, motivations, and intentions. It is argued that attachment is the process whereby an interpersonal interpretive mechanism is generated. Similar to Bowlby's internal working model for relationships, this is a representational system for mental states including emotion understanding. According to Fonagy, an interpersonal interpretive mechanism develops out of intersubjective processes between a primary caregiver and an infant through psycho-feedback. During mother-infant affective engagement when the mother matches her infant's emotional expressions (i.e., affect mirroring), the infant develops an understanding of his/her own internal states, which is an intermediate step in developing an understanding of others as psychological entities with thoughts, beliefs, desires, and emotions. Thus, Fonagy's (2001) theory implicates the interactive process of mother-infant intersubjectivity as a contributor to emotion understanding. In support of his ideas, Fonagy (2001) presents studies with children raised by harsh or abusive parents. These studies reveal that children who have been abused or endured harsh parenting show biases and distortions in how they interpret social cues and behavior (e.g., Camras, Grow, & Ribordy, 1983; Pollak, Cicchetti, Hornung, & Reed, 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002). For example, maltreated preschoolers show less accuracy (During & McMahon, 1991) and more bias towards identifying the facial display of anger than non-maltreated children (e.g., Camras et al., 1983).

Attachment literature places primary caregivers at the center of attachment security. Their individual characteristics (e.g., affective state and personality) are expected to play a significant role in the development of attachment security and emotion understanding in young children. For example, depressed mothers are less responsive to their infants' distress signals (e.g., Milgrom, Westley, & Gemmill, 2004), express less positive and more negative affect

during interaction (e.g., Campell, Cohn, & Meyers, 1995; Field, 2002), lack response contingency, respond with less exaggeration in intonation contours in verbal response to infant vocalizations (Bettes, 1988). Greig and Howe (2001) reported that children of depressed mothers were more likely to be insecurely attached and have less advanced emotion knowledge as compared to children of nondepressed mothers. Children's individual characteristics also contribute to the development of attachment. For example, infants with low birth weight (Mangelsdorf et al., 1996) and difficult temperament (e.g., fussy, irritable) (e.g., Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996) are more likely to be insecurely attached to their mothers as compared to their counterparts. A negative concurrent relationship was also found between preschoolers' negative emotionality and their understanding of the linkage between emotions and the contexts (Bennett, Bendersky, & Lewis, 2005).

To summarize, although Fonagy (2001) theorizes that the development of emotion understanding is intersubjective or relational in nature and that it is a gradual process continuing throughout childhood, no details are provided for the role of parent-child interpersonal processes in emotion understanding development beyond infancy. Examination of the verbal and nonverbal interactive processes between parents and children during toddlerhood and their links to the development of emotion understanding in early childhood is much needed. Furthermore, proponents of attachment security as the contributor to emotion understanding highlight the active role of children in acquiring social cognition. They believe that the link comes from a mental representational system, internal working model, or interpersonal interpretive mechanism, through which children come to interpret and understand people's intentions and behaviors. Within the attachment framework, even though the importance of mother-child intersubjectivity

is acknowledged, it focuses mainly on the role of intrapersonal processes in the child, rather than on interactional processes between mother and child.

Mother-Child Discourse

Thompson (2001) suggests that parent-child conversation about everyday emotional experiences contributes to the development of understanding of self, emotions, morality, and relationships. Parent-child discourse is thought to be the developmental antecedence of secure attachment and emotion understanding. Research also shows that preschoolers' secure attachment is associated with high quality of mother-child emotional discourse characterized by elaborative, coherent, and open discussions (Leibowitz, Ramos-Marcuse, & Arsenio, 2002). This raises the question about whether it is attachment security or emotional discourse that contributes to emotion understanding. Harris (1999) proposes two different models in linking attachment and mother-child discourse to explain individual differences in children's emotion understanding. As discussed above, based on the attachment perspective, the first model suggests that variations in maternal sensitivity are responsible for individual differences in children's attachment status. Variations in children's attachment quality, in turn, lead to stable individual differences in their understanding of emotions. The second model suggests that conversations about emotionally charged events provide children with a format for organizing and retrieving such events and serve a reminder to children that a given situation can be appraised in different ways depending on the circumstances. Hence, it is elaborated and rich emotional discourse between mother and child that contributes to children's more advanced understanding of emotions. Secure attachment is simply a by-product of quality parent-child discourse. Caregivers who are skilled at translating psychological experiences into a coherent dialogue are likely to foster secure attachment in children. In short, whereas the attachment model emphasizes the quality of

children's emotional relationships with their primary caregivers, the discourse model emphasizes the imperative role of parental cognitive and linguistic input.

Empirical evidence supports the discourse model. For example, the frequency of mothers' use of emotional terms (e.g., Dunn et al., 1991; Dunn et al., 1987; Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003; Taumoepeau & Ruffman, 2006) and the elaborativeness of maternal verbal input (e.g., Cervantes & Callanan, 1998; Fenning, et al., 2011; Laible, 2004; Martin & Green, 2005) during conversations with their children are linked to children's advanced emotion understanding. It was also found that deaf children of hearing parents show a significant delay in emotion understanding as compared to deaf children of deaf parents (Peterson & Siegal, 1995, 1997). Such difference can be attributed to a lack of quality emotional conversations between hearing parents and their deaf children as compared to between deaf parents and their deaf children who can engage in conversations via shared (i.e., sign) language.

There are also inconsistent findings that cannot be solely explained by parental discourse input. For example, Ontai and Thompson (2002) found maternal elaborative style alone did not predict individual differences in preschoolers' emotion understanding. Its effect was contingent on the attachment security of children. Whereas maternal elaborativeness at age 3 predicted understanding of positive emotions in 5-year-olds who were securely attached at age 3, maternal elaborativeness was also related to less understanding of positive emotions in those who were insecurely attached. This finding suggests that the one-way discourse model focusing on maternal style of verbal input does not capture the complexity of mother-child intersubjective processes through which verbal dialogues contribute to emotion understanding in children. It may be that securely attached dyads are better at establishing mutual understanding and sharing emotional information than insecurely attached dyads. For example, a study by Leibowitz et al.

(2002) demonstrated that secure dyads engage in emotionally more open and coherent discussions as compared to insecurely attached dyads. Thus, as discussed above, attachment status may be an indication of the quality of interpersonal communication between caregivers and children. Put differently, it is not simply what and how caregivers talk to their children about emotions, but rather how together they co-create shared understanding and consider each other's perspectives. A bi-directional, interactive, and process-oriented conceptualization of parent-child discourse that reflect how parent and child create and share discussions about emotions may reveal the underlying mechanisms linking parent-child discourse to emotion understanding development.

Social-Cognitive Constructive Perspective

Emotion understanding can be viewed as children's understanding of their social and psychological world. Focusing on developmental processes taking place within the child, theories that fall under the rubric of "Theory of Mind" explain how an individual child constructs his/her own theories about people's mental states. Three most prominent theories on theory of mind development are modularity theory, simulation, and theory-theory. In brief, modularity theory suggests that children have an innate module to understand the mind, which is present at birth but gradually matures as the child develops (Baron-Cohen, 1995; German & Leslie, 2001). Simulation theory states that children come to understand emotions of another person by simulating or imagining oneself in the other person's situation (Gordon, 1992; Harris, 1991; Wellman, 2002). Finally, according to the theory-theory, a child constructs theories about mental states similar to theories in science. When new evidence is presented the child modifies or changes his theory to accommodate new information (Flavell, 1999; Perner, 1991; Gopnik, & Wellman, 1994).

As an alternative to the within-the-child perspectives described above, social constructive theory proposed by Carpendale and Lewis (2004) suggests that the development of social understanding is a gradual process constructed within social interactions. It is believed that children's social and emotional knowledge is not theoretical formed on the basis of observing others, but practical constructed from interactions with others. According to this theory, construction of social understanding begins in infancy developing in a dyadic (caregiver and infant) context and then a triadic (mother, child, and an object) context. Central to Carpendale and Lewis' (2004) social constructive theory is the contribution of cooperative parent-child interaction to children's social understanding. Collaborative conversation between mother and child allows open communication, which facilitates the child's understanding of other people's points of view and supports the construction of social understanding. Specifically, collaborative conversations about emotions or other mental states give the child an opportunity to reflect on or to think about people in psychological terms. Thus, social constructive perspective emphasizes both verbal and nonverbal aspects of caregiver-child communication as the contributing factors to the development of social and emotion understanding. However, in an attempt to provide a broader framework explaining the role of collaborative interpersonal relationships in children's construction of social understanding, this theory fails to specify the processes that take place during mental state talks and cooperative parent-child interactions.

To summarize, the above literature review provides strong theoretical foundations and empirical evidence that parent-child interpersonal relationships play an essential role in the development of emotion understanding in early childhood. Rather than seeing emotion understanding as a static, trait-like competence within the child, these perspectives view emotion understanding as emergent properties arising from children's social interactions with their

caregivers, family members, and friends. However, there are notable gaps in these theoretical conceptualizations. Specifically, the perspectives of parental emotion socialization and mother-child discourse have consistently ignored the role that a child plays in emotion understanding development. Attachment and social-constructive perspectives have failed to adequately address the underlying mechanisms by which interpersonal relationships contribute to children's understanding of emotions.

The verbal and nonverbal processes by which parent-child social interactions contribute to children's emotion understanding are relatively unknown. To address this gap, this study seeks to understand the contribution of mother-child nonverbal and verbal intersubjective communication observed at age 2½ to later individual differences in children's emotion understanding assessed at age 4. The assumption guiding the study is that through verbal and nonverbal co-constructions with their caregivers, young children learn the emotional world around them. Both the structural and the content aspects of verbal and nonverbal intersubjective communication between mothers and their toddlers are investigated, which may provide a better explanation for *how* social interactions between mothers and children contribute to later individual differences in children's emotion understanding at preschool age.

Book Reading as the Context for Investigating Intersubjective Processes

Book reading is not only a cognitively stimulating activity for young children. It also involves social and emotional exchanges between mothers and their young children. Some argue that joint reading between parents and their young children is a book-sharing event (van Kleeck, 2003) and a social context created by both participants (Pellegrini & Galda, 2003). Both participants actively create shared understanding via verbal and nonverbal exchanges. The significance of parent-child nonverbal behavior during book reading is reflected in its link to

children's attachment security. In the study by Bus and van IJzendoorn (1994), 44- to 63-week-old securely attached infants were less likely to be distracted and more likely to stay on their mothers' laps as compared to the insecurely attached infants. In addition, compared to mothers of insecurely attached infants, mothers of securely attached infants were less likely to display physical force in controlling their infants' behavior, to restrict their infants' movement, and to keep the book out of reach. Similarly, Frosch, Cox, and Goldman (2001) found that during book reading interaction, mothers of toddlers who were securely attached as infants were warmer, more supportive, and less detached, hostile, and intrusive than mothers of toddlers with a history of insecure attachment. Moreover, toddlers who were securely attached to their mothers as infants showed a greater involvement in book reading: they were more enthusiastic, showed more positive mood, and were more focused than toddlers who were insecurely attached to their mothers as infants. Individual differences in the social and emotional nonverbal behavior between mothers and toddlers during book sharing may be a reflection of differential levels of shared intersubjectivity between the two partners. Gaze and affect are the two modalities by which mother and child can connect with one another for establishing common interests (Devescovi & Baumgartner, 1993). During book sharing, both partners can jointly attend to the same picture, look at each other, or share positive affect while discussing a topic.

Another goal of book reading is to create shared understanding and interpretation of the book characters and stories generated by mother and child. Through verbal communication, parents and their children use words to create their shared world and the knowledge that these words evoke (Devescovi & Baumgartner, 1993). For example, Danis, Bernard, and Leproux (2000) demonstrated that both mothers and young children tend to follow their partner's focus of attention by verbally adjusting to the cognitive level of their partner in order to stay on the same

topic. Bruner (1983) found that by adhering to a sequential structure in which the child's response is elicited and followed by the maternal feedback, the mother is able to establish and maintain mutual understanding between them.

Finally, book reading interaction provides a rich environment for parents and children to learn and discuss emotions. Book stories are usually saturated with age-appropriate emotional themes provoking thoughts and conversations. Even without being explicitly asked to do so, caregivers and children tend to discuss (e.g., elaborate, ask questions) emotional themes as they read the books. For example, Sabbagh and Callanan (1998) found that children as young as 3- and 4- years of age contrasted different mental states during book reading with their mothers. Their mothers also responded to their children's mental talk in mentalistic terms. In Cervantes and Callanan's (1998) study, almost all mothers and majority of the children ages 2 to 4, used emotion words during book reading. Whereas children were more likely to label emotions, their mothers tended to explain the causes of emotions. Moreover, Symons, Peterson, Slaughter, Roche, and Doyle (2005) discovered that both mothers and children made elaborations beyond the actual story line by relating personal events to the emotional themes in the books (e.g., reference to child's own feelings). Book reading interaction between mothers and their toddlers not only generates shared understanding, but also encourages emotional dialogues. It can be considered an ideal context for investigating the developmental linkage of mother-toddler verbal and nonverbal intersubjective processes to later children's emotion understanding at preschool age.

Mother-Child Intersubjectivity

Emotional information is expressed and shared during interactions between children and other people through actions, expressive behaviors, and verbal communication. In this process,

both children and their partners strive to achieve mutual understanding or intersubjectivity. Trevarthen (1998) defines intersubjectivity as being able to recognize one another's impulses, intuitively, with or without cognitive or symbolic elaborations. Intersubjectivity entails sharing knowledge via verbal and nonverbal channels, such as gestures, facial expressions, and words for learning about what the other person intends to mean. Intersubjective process has been viewed as an underlying mechanism in the development of social and emotion understanding (Beebe & Lachmann, 1988). Starting in infancy, through coordinating and sharing gaze, affective and expressive behaviors infants become sensitized to emotional information during the process of establishing intersubjectivity with others. During toddlerhood, when children begin to use symbols such as words and gestures (Bates, O'Connell, & Shore, 1987), mother-child intersubjectivity transforms from simply being in a nonverbal mutual emotional state to sharing emotional states via verbal exchanges, thus, adding a symbolic layer to children's implicit emotion understanding (Feldman, 2007).

Nonverbal Intersubjectivity

The construct of nonverbal intersubjectivity has been extensively studied in the context of mother-infant face-to-face communication (e.g., Trevarthen & Hubley, 1978). However, it remains a matter of debate what constitutes caregiver-infant nonverbal intersubjectivity. Affective matching, attunement, mutual responsiveness, and reciprocity are some of the terms used to describe this phenomenon. Meltzoff (Meltzoff & Moore, 1998), for example, focuses on the process of an infant's cross-modal matching with the partner's actions, and argues that this competence reflects an infant's recognition of another as a psychological agent with emotions, intentions, and desires, or what he calls 'the other's psychological mind' (p. 48). Stern (1985) believes that attunement, a dynamic process of 'changing with' another person, is a central

element of intersubjective process during caregiver-infant interaction (for a review, see Beebe, Rustin, Sorter, & Knoblauch, 2003). Trevarthen (Trevarthen & Hubley, 1978) conceptualizes two types of intersubjectivity: primary and secondary. Whereas primary intersubjectivity highlights the synchronous and coordinated feature of dyadic mother-infant communication in early infancy, secondary intersubjectivity focuses on the triadic interaction of an infant's coordination of attention between a social partner and an object beginning at around 9 months of age (Bakeman & Adamson, 1984). Joint attention (e.g., Bruner, 1983; Butterworth & Cochran, 1980) and social referencing (e.g., Campos & Stenberg, 1981) are examples of secondary intersubjectivity.

Researchers also differ in how they view individual differences in nonverbal intersubjectivity. Some view it as an all-or-none phenomenon; either it is shared between social partners or it is not (e.g., Trevarthen, 1979; Meltzoff, 1998). By contrast, Beebe and her colleagues (Beebe et al., 2003) expanded the all-or-none concept of nonverbal intersubjectivity into graded differences between dyads, focusing on qualitative differences in how primary caregiver and infant affectively relate to each other. In this conceptualization, intersubjectivity is viewed as a continuum with two polars of affective valence, ranging from high to low levels of negative and positive affective sharing. Evidence from empirical studies supports Beebe et al.'s theorization. For example, during the first year of life, mothers and their infants frequently move from a matched to a mismatched state, ranging from none to 30% or 40% of the time among different dyads (Tronick & Cohn, 1989). Dyads also differ in the proportion of time they spend sharing positive, negative, and neutral affect with each other (e.g., Moore & Calkins, 2004). There are also individual differences in how flexible and/or predictable dyadic patterns are, which may be attributable to developmental maturity (Cohn & Tronick, 1987), relationship type

(e.g., Gottman, 1979), and/or individual characteristics of the mother (e.g., depression; Field, 1984) and the infant (e.g., prematurity; Lester, Hoffman, Brazelton, 1985).

It has been argued that to fully understand actions and/or emotions of other people, their behaviors have to be placed in time and in a context (Edelman, 1989). Nonverbal intersubjectivity is a time- and context-based relational process between interacting individuals, during which both partners co-create shared meaning (Feldman, 2007a). Starting from infancy, nonverbal intersubjectivity provides a schema, derived from perceptual and temporal patterns of nonverbal dyadic communication of ‘being with other’. This presymbolic capacity allows an infant to detect contingencies between his/her own behavior and the behavior of others (e.g., caregiver), and to form expectations about people’s actions (see Beebe & Lachmann, 1988). Such interactional contingency is an essential experience for the development of emotion understanding (Feldman, 2007a). Studies show that nonverbal intersubjectivity between a mother and an infant is characterized by unique temporal and affective qualities reflected not only in the timing structure in the mother’s and the infant’s gaze, affect and tactile coordination with respect to each other, but also in the content of emotional tone, such as positive/negative affective sharing. Both the temporal structure and the affective content in mother-infant intersubjective interaction provide important information about *how* a mother and a child share mutual understanding through affective and expressive behaviors bound in time and in a situation through meaningfully connected events (Feldman, 2007b).

Affective Synchrony as Structure of Nonverbal Intersubjectivity

Research on mother-infant face-to-face interaction demonstrates that during dyadic communication a mother and her infant’s gaze, facial affect, and body posture are temporally synchronized (Cohn & Tronick, 1987). Both partners systematically change their behavior with

respect to the change of the other's behavior (Tronick & Cohn, 1987). Temporal congruency and coordination between mother and infant as they cycle from one emotional state (e.g., neutral) to the next (e.g., positive) reflects the structural aspect of nonverbal intersubjectivity (Tronick & Cohn, 1987). The structural property of behavioral timing in dyadic communication lays the foundation on which the substantive content of emotional information is exchanged.

An important aspect of dyadic synchrony involves coordination of facial affect. For example, during mother-infant face-to-face interaction, when one partner originates positive affect, the other tends to follow with a positive affect (Cohn & Tronick, 1987). On the other hand, expression of negative affect by one another (e.g., mother) is usually followed by a sign of distress in facial affect of the other (e.g., infant) (e.g., Field, 1984). To further differentiate the intensity level of affective engagement, facial expression and attentional dimensions are often considered simultaneously. For example, one of the widely used and empirically tested behavioral coding systems for mother-infant affective synchrony during face-to-face communication is the Monadic Phases (Tronick, Als, & Brazelton, 1980), in which the levels of negative and positive affective expressions displayed by both the mother and the infant in relation to one another are based on a combination of their gaze, affect, and posture. The phase of infant positive engagement, such as play and talk, almost always occurs when the infant's gaze is directed at the mother, which is typically reciprocated by the mother's positive affect signified by a configuration of smiling, vocalization, gentle touch, and/or looking to the infant (Cohn & Tronick, 1988). Similarly, a study by Moore and Calkins (2004) identified the co-occurrence of smiling and looking at mother as a high level of infant positive affect, and the co-occurrence of negative affective display (e.g., anger, irritation) and looking away from mother as a high level of infant negative affect.

Few studies have examined nonverbal intersubjectivity between caregiver and child in relation to the development of emotion understanding. Yet, a link has been suggested. For example, Ereky-Stevens (2008) found that when 10-month-olds experienced higher levels of nonverbal intersubjective interaction with their mothers, indexed by a composite score of mindful facilitation (i.e., appropriate scaffolding of infant engagement and activity), shared attention, appropriate pacing (i.e., synchronizing with infant arousal), affect catching (i.e., matching infant affect), they were likely to demonstrate greater emotion understanding (a composite score of emotion recognition and emotion knowledge) at 54 months of age. In another study by Colwell and Hart (2006), preschoolers who interacted with their mothers synchronously with greater mutuality and dyadic balance were more advanced in emotion labeling and affective perspective taking. Clarke and Ladd (2000) reported that mother-child connectedness, reflecting dyadic positive engagement, mutual warmth, reciprocity, happy emotional tone, and intimacy, was positively associated with children's empathetic understanding and socioemotional orientation. In a longitudinal study by Feldman (2007c), mother-infant synchrony (i.e., affective coordination) across the first year predicted later empathy and moral orientation in adolescence.

Affective Matching as Content of Nonverbal Intersubjectivity

Embedded within the structural property (i.e., affective synchrony) of nonverbal intersubjectivity, affective matching carries emotional information, for example, about how interactive partners feel in a given moment and how this affective state relates to the situation at that moment. Focusing on the congruence between two partners' affective and expressive behaviors, behavioral matching is considered as the content-focused process of caregiver-infant interaction (Tronick & Cohn, 1989). Affective matching between a caregiver and an infant can also be understood as a "match" both within and across behavioral modalities. For example, a

positive match can be considered when the mother responds to her infant's positive vocalizations with infant-directed speech or when the mother touches the infant affectionately in response to her infant's look (Feldman & Eidelman, 2004).

Affective matching has received some empirical attention in studies with toddlers and preschoolers. For example, socialization literature has commonly referred to affective matching between a parent and a child as mutual affect sharing (e.g., Healey, Gopin, Grossman, Campbell, & Halperin, 2010; Kochanska & Aksan, 1995) or as contingent responsiveness. These studies showed the link between caregiver-child mutual positive affect and children's understanding of emotion. For example, Denham and Kochanoff (2002) found that maternal positive contingent responsiveness to their 3- and 4-year-olds' expressed emotions was associated with children's better understanding of mixed emotions at age 5. Maternal expression of negative affect towards a preschooler's expression of any emotions is generally associated with low level of emotion understanding in preschoolers (e.g., Denham et al., 1997). Yet, in some cases expression of low intensity of negative affect in response to child's expression of negative affect (e.g., misbehavior) can positively contribute to preschooler's emotion understanding (e.g., understanding of hidden feelings) (Denham & Kochanoff, 2002). These findings highlight the importance of affective matching not only in emotional valence (e.g., neutral, positive, or negative) between caregivers and their children but also in the intensity of their emotional expressions. In a study by Moore and Calkins (2004) the high and low affective behaviors of infants and mothers were determined by the co-occurrence of facial affect, gaze direction, and/or body movements. An affective match was considered when mother and infant shared the same affective state with the same intensity.

Taken together, despite the paucity of empirical studies, the literature suggests that both the structure and the content of mother-child nonverbal intersubjectivity relate to children's understanding of emotions. The first goal of the present study, thus, is to examine the link between mother-toddler nonverbal intersubjectivity to later children's emotion recognition and emotion knowledge at age 4. Overall, it is expected that greater affective synchrony and positive affective matching between mother and toddler during book reading contributes to children's more advanced emotion understanding at age 4. In all but one study (Feldman, 2007d), affective synchrony and affective matching have been rated globally, which leaves out great details and may not be sensitive enough to capture the temporal structure and affective quality of mother-child intersubjectivity. The present study fills this gap by applying a microanalytic coding strategy to capture nuanced variations in affective synchrony and affective matching between mothers and their toddlers. In this study affective synchrony and affective matching between mother and toddler are determined on the basis of their gaze direction together with the valence and intensity of their facial displays.

Relative Contribution of Structure- and Content-Focused Nonverbal Intersubjectivity to Emotion Understanding

Affective synchrony and affective matching respectively reflect the structural property and the emotional content of nonverbal exchanges between mothers and their young children. Each may also represent a different functional aspect of caregiver-child nonverbal intersubjectivity. Whereas affective synchrony may represent an active process of emotional regulation in maintaining an optimal interaction between mother and infant, affective matching may reflect the global quality of their relationship (Moore & Calkins, 2004). This difference

may suggest that affective synchrony and affective matching have differential contribution to the development of emotion recognition and emotion knowledge.

Linking affective synchrony to emotion knowledge. Synchrony is thought to be biologically rooted and related to the patterns of biological systems such as sleep-wake cycles and brain activity (Feldman, 2007a; Stratton, 1982). Furthermore, the micro-level of moment-by-moment adaptation during mother-infant synchrony is believed to represent the process of integration of biological and social rhythms (Feldman, 2007a). It has also been suggested that a combination of the perceptual, affective, and motor experiences offered by the repetitive and interrelated nature of mother-infant synchrony contributes to the organization of perception and action into coherent structures (Bloom, 1970; Nelson, 1985), and, therefore, cognitive and affective experiences (Lewis & Goldberg, 1969; Stern, Beebe, Jaffe, & Bennett, 1977). Because emotion knowledge reflects an understanding of the link between emotions and people's beliefs and desires or different situations that evoke them, the temporal sequence in antecedent-consequent thinking is required. The interrelatedness of mother-infant synchrony sensitizes the child from an early age to see oneself and the other as intentional agents whose actions and emotions are linked and bound by time and within a given context. In addition, affective synchrony between a mother and a child allows some experience of unpredictability and variability, which is important for understanding how people can have different intentions and emotions and expecting some level of variability in people's expression of emotions.

Empirical evidence supports the specific link of dyadic synchrony to emotion knowledge. For example, Feldman (2007c) reported a longitudinal association of mother-infant and father-infant synchrony at 3 months with children's test performance on emotion knowledge at age 5. In another study by Feldman and Greenbaum (1997), they reported a link of mother-infant

synchrony at 3 and 9 months to symbolic play and internal state talk at age 2 (Feldman & Greenbaum, 1997). Long-term associations have been also found between mother-infant synchrony and children's symbolic development, empathy, and moral orientation in adolescence (Feldman, 2007b). These studies by Feldman and her colleagues have only focused on the main effect of synchrony (i.e., the structural aspect of mother-child nonverbal intersubjectivity). Its relative contribution to that of affective matching (i.e., the content aspect of mother-child nonverbal intersubjectivity) is unknown. The majority of previous studies combined the content and structure of nonverbal intersubjectivity in analysis, thus, ignoring possible differential functional effects of affective synchrony and affective matching on the development of emotion understanding. Thus, this study investigates the relative contribution of affective synchrony and affective matching to the development of emotion knowledge. It is expected that the contribution of the structure-focused affective synchrony in mother-toddler nonverbal communication to later individual differences in children's emotion knowledge (Stern & Gibbon, 1978) is above and beyond that of the content-focused affective matching (see Figure 1). Given that synchrony is viewed as an important modulator of infant negative emotions (e.g., Moore & Calkins, 2004) and that negative emotions are particularly salient for young children and their parents (Lagattuta & Wellman, 2002), it is hypothesized that the contribution of affective synchrony to emotion knowledge is specific to negative emotions.

Linking affective matching to emotion recognition. Affective matching between primary caregiver and infant is characterized by highly aroused affective exchanges (Cohn & Tronick, 1987). Gergely and Watson (1996) proposed a biofeedback theory suggesting that infants learn to understand their internal states through mother-infant affect mirroring (i.e., affective matching). Specifically, in the process of mother-infant face-to-face interaction, a mother

matches her infant's affective expressions and mirrors her infant's emotional state. After repeated exposure to the external presentations of internal states, the infant gradually becomes sensitized to his or her own internal state cues and learns to identify correct internal stimuli corresponding to specific emotional category that he/she experiences. In this process, emotions become consciously accessible and meaningful to the infant. Fonagy (2001) extended this theory and further suggested that mother-infant affective matching and mirroring contributes to the recognition of internal states/emotions in others. Specifically, he proposed that the understanding of one's own internal states is an 'intermediate step' in the development of understanding of others as psychological entities, which is essential to the reading other people's emotions. Fonagy further outlined four developmental stages of emotion understanding or, what he called, levels of awareness about one's own emotional state in relation to others' psychological and emotional states. During the first year of life, an infant has only primary awareness of being in an emotional state. In the next level, functional awareness allows the child to infer others' emotions or signals of an action. With the development of reflective awareness, the child is then able to reflect on the mind or mental states as a concept that might be separate from physical reality/actions. The final level is autobiographical in nature, during which the child can place life experiences infused with emotions into a coherent sequence.

To date, the only existing empirical evidence that supports the link between affective matching and emotion recognition comes from studies with atypical children who suffered maltreatment, social deprivation, and/or sensory deprivation. Maltreated children experience more affective mismatching in interaction with their mothers as compared to control dyads of nonmaltreated children. In a study by Sachs-Alter (1989) maltreating mothers displayed less positive affect to their children's positive emotions. In addition, they produced more negative

affect when their children demonstrated difficulty accomplishing a task. The study by Camras et al. (1988) found that abused children and their mothers expressed less recognizable emotions and that abused children performed less accurately on the emotion recognition task. As preschoolers, maltreated children show less accuracy (During & McMahon, 1991) and more bias in facial display recognition (i.e., anger expression) than nonmaltreated children (Camras et al., 1983; Pollak et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002).

When children are separated from their primary caregivers and placed in multiple foster cares, emotion recognition is equally or even more compromised. In addition to experiencing emotional and/or physical abuse from their primary caregivers, these children are less likely to form a meaningful relationship with any caregiver when forced to move to different foster cares. As a result of deprivation in affective matching, studies show that these children tend to be delayed or impaired in emotion recognition (Pears & Fisher, 2005). In a similar vein, institutionalized children experiencing early emotional deprivation also have difficulty in emotion recognition. For example, Fries and Pollak (2004) found that post-institutionalized preschoolers were less accurate at identifying simple facial expressions. The longer the children lived in institutionalized settings, the worse they became in emotion recognition. However, post-institutionalized children demonstrated improvements in emotion understanding after entering adopted homes (Fries & Pollak, 2004). This suggests that experiences with affective matching in new relationships allow institutionalized children to catch up with their competence in emotion recognition.

Children with a sensory (hearing and vision) disability are likely to experience impoverished quality of social interaction as well, including low levels of affective matching with caregivers (Loots, Devise, & Jacquet, 2005), which may be associated with their difficulty

in emotional competence. For example, Roch-Levecq (2006) found that 4- to 12-year-old children with congenital blindness were less skilled at facially expressing basic emotions as compared to sighted children. In a study by Dyck, Farrugia, Shochet, and Holmes-Brown (2004), they found that compared to age-peers without sensory impairment, both hearing- and vision-impaired school-aged children were significantly delayed in emotion recognition.

Taken together, studies with atypical children provide strong evidence that inadequate affective matching experience with primary caregivers or lack thereof is associated with their deficits in emotion recognition. Given the theoretical and empirical evidence, it is hypothesized that the contribution of the content-focused affective matching in mother-toddler communication to later individual differences in children's emotion recognition is above and beyond that of the structure-focused affective synchrony (see Figure 1). Furthermore, valence specificity is expected for mother-toddler positive and negative affective matching in their relation to later children's recognition of positive and negative emotions at preschool age. Specifically, it is expected that toddlers who show more positive matching with their mothers would be better at recognizing positive emotion (i.e., happiness) at age 4, whereas toddlers who display more negative matching with their mothers would later be better at recognizing negative emotions (i.e., anger, sadness, and fear) (see Figure 1).

Verbal Intersubjectivity

During toddlerhood, the development of symbolic representation enables children to use symbols and language to explicitly express their thoughts and feelings and to reflect on the thoughts and feelings of others. Interpersonal intimacy and intersubjectivity between child and parent can now be negotiated through verbal sharing (Stern, 1985), which is likely to give boost to further development of emotion understanding.

The construct of verbal intersubjectivity, commonly referred to as shared understanding, has been mainly researched in adult discourse literature. This body of literature has been generally concerned with the question of how a speaking person selects expressions/words to convey what is intended and how a listening person selects interpretations for those expressions in the hope that they capture the intended meaning. Given the complexity of language, intersubjectivity during adult conversation is simply about how two (or more) communicating individuals understand each other. Although researchers vary in what they think the process is for people to achieve verbal intersubjectivity, they all emphasize a bidirectional influence. Conversational partners have to work together to establish a mutual understanding of what they talk about (Garrod & Pickering, 2004).

In the developmental literature, discourse between a caregiver and a child about emotion has been linked to children's emotion understanding (e.g., Fenning et al., 2011). In addition to coaching and formal teaching of emotions (Camras et al., 1996), parent-child everyday conversation about emotion can shape emotion understanding development. Conversations with their parents provide children with the context in which they are introduced to emotional events; they are compelled to ask questions and to understand the causes of these events (Ensor & Hughes, 2008). Both the quantity and the quality of parental verbal input during conversation have been the focus of previous investigations. The role a child plays in the bidirectional process of conversation, however, has been largely ignored. Based on the conceptualization that conversation is a coordinated activity between interacting individuals, during which all participants are actively involved to achieve intersubjectivity, the failure of recognizing a child's contribution to emotion conversation is a significant gap in the literature.

Despite the fact that toddlers do not have mature linguistic and communicative skills,

mothers often treat their children as equal-partnership conversational partners. Caregivers ask their opinions, respond to their vocalizations as conversational turns, and provide openings for equal dialogic exchanges (Rogoff, Mistry, Goncu, & Mosier, 1993). In addition, caregivers facilitate and motivate their toddlers' participation in conversations through mocked excitement and praise of their efforts and performances. Toddlers interact reciprocally by responding, initiating, and trying to make sense of their partner's messages (Rogoff et al., 1993). Thus, similar to conversation between adults, both mother and child make sure that they are attended to, heard, and understood by the other, and both try to let the other know whether she/he has succeeded in doing so (Clark & Schaefer, 1989). Mothers and toddlers must work together in order to exchange messages and achieve mutual understanding. Intersubjective verbal exchanges between mother and toddler involve not only the substantive content of conversation, but also the structural procedures of conversation.

Verbal Alignment as Structure of Verbal Intersubjectivity

A conversation is not possible unless participating individuals share mutual understanding, or common ground (Turnbull & Carpendale, 1999). Achievement and maintenance of common ground is essential for passing new information and facilitating further understanding between partners. Common ground is viewed by some as a by-product of a collaborative effort between conversing partners (Clark & Wilkes-Gibbs, 1986; Turnbull & Carpendale, 1999). During conversation individuals create shared understanding by way of aligning one's language (e.g., grammar, semantics, syntax) and perspective with that of their partner (e.g., Garrod & Pickering, 2004; Pickering & Garrod, 2004).

The process of alignment language and perspectives allows people to communicate without constant interruptions, to coordinate their activities, to create social and personal

relationships, and to serve as background on which emotional information can be built on (Turnbull & Carpendale, 1999). When investigating a structural process of verbal intersubjectivity, Turnbull and Carpendale (1999) argued that common ground is achieved on the basis of a highly ordered practice of turn-taking, negotiation, and responding to the partner's contribution to the discourse. Others emphasize that common ground is achieved via the sequence of presenting and accepting/following up on the message. For example, Clark and Schaefer (1989) represent the process of creating common ground as a two-phase sequence: presentation of information (e.g., utterance) and acceptance (evidence of understanding the meaning of presented utterance). Such pattern is also found in a sequence of conversational turns between Japanese mothers and their toddlers when discussing emotions (Clancy, 1999). Typically, an emotional term is first introduced, which is followed by a feedback of acceptance or rejection. During mother-child communication, such sequence is usually terminated after a response to or further elaboration of the feedback.

To achieve and maintain common ground, conversants must show sensitivity to their partner's prior knowledge, level of competence, and perspective. The other's needs and competence level must be taken into account. In other words, conversing individuals need to be vigilant and willing to align their perspective in order to establish shared common ground. To verify that one appropriately adjusts and aligns one's perspective to the partner's level and beliefs, it is necessary to demonstrate that the person who receives the information actually understands the intended meaning (Clark & Schaefer, 1989). In other words, successful verbal alignments should result in agreement or reconciliation of the differences in perspectives. When conversants differ in their perspectives, efforts are exhibited by both partners to reconcile their differences (e.g., Kruger, 1993). Conversants routinely express either their agreement,

disagreement, or not understanding verbally and/or nonverbally (e.g., head nodding) (Bavelas, Coates, & Johnson, 2000) in order to let their partner know that they understand and accept presented information (Clark & Wilkes-Gibbs, 1986) or need more feedback. Indeed, adults routinely align verbally according to their conversational partner (e.g., Ervin-Tipp, 1968; Labov, 1972). It is well documented that mothers modify their language when they talk with infants and young children (Brown & Bellugi, 1964). They construct well-formed utterances (e.g., Brown & Bellugi, 1964) that are short and syntactically simple (e.g., Snow, 1972; Phillips, 1973), commonly referred to as *motherese*. Even young children demonstrate verbal alignment when necessary. For example, in a study by Gelman and Shatz (1977) showed that 4-year-olds appropriately adjusted their speech when asked to explain a toy to an adult versus to a 2-year-old child. Preschoolers treated their partners differently in terms of the range of topics introduced, the style of speech, and the request of their partner's response. With their 2-year-old partners, 4-year-olds used short and repetitive utterances, as well as a variety of demonstrative and attentional devices; they did not offer their young partners the option to change or to ignore the topic and did not challenge their responses. By contrast, when the conversational partner was an adult, 4-year-olds introduced a wide range of topics, sought information from their knowledgeable partner, called into question about adult's statements, and modulated their assertion.

The strategies for verbal alignment are typically expressed in speech acts (e.g., Goncu, 1993). Speech acts that operate on the reasoning or ideas of the partner are likely to increase alignment with the partner's perspective (e.g., Kruger, 1993) and facilitate the negotiation process of verbal exchange. Speech acts considered to be high quality in achieving and maintaining common ground include repetition (or rephrasing), expanding (or elaborating),

challenging (or questioning). By contrast, speech acts such as diversion (providing irrelevant information), assertion (emphasizing one's own idea), and negation without explanation are considered to be low quality. The function of each speech act is discussed below.

Repetition or paraphrasing of utterances by a conversation partner indicates that one is attending to and has picked up on what the other is trying to say (Clark & Bernicott, 2008). Utterances by one conversational partner are often based on his/her assumption about the knowledge that is shared with the partner (Horton & Gerrig, 2005). Pickering and Garrod (2004) believe that by repeating the partner's choices of words, sounds, and grammatical forms, people align one's own perspective with that of the other. This theoretical argument rests on the idea that conversants need to share representation of the topic under discussion on multiple levels (e.g., space, time, causality) in order to share mutual understanding. By hearing and repeating each other's utterances, conversants activate the same representation of the situation under discussion (e.g., place, characters, time). Studies show that very young children do not repeat what they know best or entirely new material (Bloom, Hood, & Lightbown, 1974). They often repeat adult's prior utterances when they are in the process of learning the meaning and structures that they just heard (Ninio, 1983) or when they would like to continue the topic of conversation (Bloom, Rocissano, & Hood, 1976). Producing completely new information is more resource-demanding for young children than using and expanding words uttered by their mothers (Hoff-Ginsberg, 1998). When young children do not understand the presented information, they are more likely to ignore the message, attend to something else, or change the topic of conversation (Bloom et al., 1976). Clark and Bernicott (2008) found that during conversation between mothers and their 2½ year-olds, both mothers and children tended to repeat each other's words, phrases, and sentences.

By repeating what the other has said, both mother and child acknowledge the received message and place it in common ground.

Expanding (i.e., adding information about the topic of a prior utterance), *providing alternatives* (i.e., adding information by opposing an aspect of the topic in the prior utterance), and *expatiating* (i.e., adding information to the prior utterance and introduced another related topic) (Bloom et al., 1976) are other ways to align one's perspective with that of the partner so that children and mothers can share the topic of conversation and maintain it over an extended time. In a study with preschool-aged children, Goncu (1993) examined specific verbal and nonverbal play acts that are associated with intersubjectivity during pretend play. Three- and 4-year-olds maintained mutual understanding by expanding on their partner's ideas. Older children were more skilled at verbally sharing intersubjectivity with play partners; they demonstrated more instances of expansion of the partner's ideas.

Giving clues or *defining* what the partner has said reveals that one is conscious of the other's state of mind (e.g., Devescovi, 1982). The speech act of *challenging* or *questioning* the partner's statement has the quality of extending conversation and negotiating on the subject of conversation (Kaye, 1982), which can facilitate the achievement of common ground between partners. The speech acts of defining, giving clues, or challenging do not simply dismiss the other's perspective. Rather, they are used to acknowledge ignorance or unawareness and to correct misunderstanding in order to come to mutual agreement. These speech acts reflect one's attempts to connect to the partner's perspective even when the two do not initially agree or share the same representation of the subject under discussion. Speech acts expressed in a form of information question (e.g., "What did the boy do after?") tend to serve multiple functions in conversation (Sinclair & Van Gessel, 1990). In addition to requesting to fill in unknown

information, these questions request for verbal response of the partner that will contribute something new to conversation (e.g., opinion). Finally, questions that solicit agreement from the partner to the speaker's descriptive statement (e.g., He is happy now, isn't he?) should be considered to be high quality as they explicitly seek feedback from the partner to verbally align their perspectives. Speech acts such as *irrelevant acts* (providing irrelevant information), *assertion* (emphasizing one's own idea), *negation without explanation*, and *simple response* are considered to be low quality as they do not facilitate building common ground. These speech acts tend to emphasize one's own idea without consideration of or reference to the partner's perspective. For example, Goncu (1993) showed that 3-year-olds, who were less skilled at sharing common ground during pretend play, performed more irrelevant acts, rejected their partner's ideas more often, and emphasized their own ideas more often than 4-year-olds. People do not know what the other knows unless they talk about it (Wells, 2007). When one person asks a question, the partner is presented with an opportunity to connect with the perspective of the other by responding and expanding on the partner's question, thus to build, maintain, and extend dialogue (Kaye, 1982). Although a simple response accomplishes the task of answering the question, it does not expand conversation or connect with the partner on a more meaningful level (Wells, 2007). Therefore, simple responses do not serve well in enhancing intersubjectivity. Finally, a plain question of incomprehension (e.g., "what?") serves a limited function of requesting for repetition and thus is considered to be a low quality speech act.

Shared Emotional Semantics and Experiences as Content of Verbal Intersubjectivity

Common ground has been also described as a baggage of prior beliefs, assumptions, and other information that is constantly being updated throughout conversation (Clark & Schaefer, 1989).

Thus, the content-focused verbal intersubjectivity focuses on the substantive information shared between conversation partners.

Shared emotional semantics. Sharing and understanding the meaning of language is critical for achieving and maintaining common ground between conversing individuals (e.g., Wittenbaum & Park, 2001). For example, the word ‘mouse’ can refer to an animal or to an object (i.e., computer mouse). Conversational partners must share the meaning of their language in order to understand each other. The importance of sharing the meaning of spoken language or semantics has been demonstrated by experimental studies. In a study by Garrod and Anderson (1987), two players seated in different rooms were requested to collaborate on a novel maze by sharing their mental representations of the spatial and functional organization. During the task, the players created mutually shared language when referring to the location descriptions. For example, they would reserve the term ‘row’ exclusively for describing vertical arrangements of the maze. Results from this study also demonstrated that mutually shared background knowledge acquired from previous collaborative games helped the players establish new semantics for the novel game. Establishing shared semantics that both players could understand was shown to increase mutual understanding and communication effectiveness.

Using semantics (e.g., words or phrases) that are mutually shared and understood becomes particularly important in conversation with young children whose linguistic and conversational skills are still limited. For example, successful pretend play requires that the players create new meaning for an object/situation and share it with the partner. The following excerpt of verbal exchange between two preschoolers (Gottman & Parker, 1986, pp. 156) illustrates a situation where two friends, who do not initially agree with each other, share the semantics of two play objects referred to as ‘this and that thing’:

E: How about you will pretend that *this thing*...

N: No, *this is* the same thing...

E: OK, you can pretend that *that's* the same thing.

Researchers have suggested shared semantics serve an important vehicle for children to effectively communicate and resolve their concerns. Glucksberg, Krauss, and Weisberg (1966) found that linguistically immature young children often rely on privately shared language established with people close to them (e.g., mother) when conveying their ideas. For example, when attempting to describe a novel form that conventionally can be referred to as a “boot”, 33- to 49-month-olds would use descriptors such as “mommy’s hat” in their communication with an experimenter. Take the previous example of ‘mouse,’ a college student should have no problem understanding what the other meant when he/she said ‘use your mouse’. Both would know that an object rather than an animal was referred to. However, a toddler is likely to misunderstand the meaning of the word ‘mouse.’ In sum, the above reviewed studies support the idea that mutually shared semantics between conversational partners is an indication of intimate connection that is essential for intersubjective communication.

Research on mother-child emotional discourse found strong concurrent and developmental links of mothers’ and children’s use of emotional language to children’s emotion understanding. Specifically, frequent use of emotional language by mother and child during discourse is associated with children’s better emotion understanding (e.g., Dunn, Brown, & Beardsall, 1991; Dunn, Brown, Slomkowski, 1991). Wareham and Salomon (2006) found a positive association between mothers’ discussion about causes of emotions with their children during reminiscing and children’s emotion understanding. The content of emotional conversation such as maternal discussion of causes and consequences of emotions and feelings

of others contributed more to children's emotion understanding than did the frequency of emotional terms used by children and mothers (e.g., Garner et al., 1997). Furthermore, connection between conversation turns between mother and child plays a critical role in social understanding (Ensor & Hughes, 2008). Together, these findings suggest that children are not merely passive participants of emotional conversations; they understand and share the meaning of emotional language conveyed by mothers. It appears that using emotional words and phrases in a way that both child and mother can mutually understand is important for emotion understanding development. Due to variations in toddlers' language competence, individual differences in mother-toddler shared emotional semantics during discourse perhaps can explain some inconsistent and mixed findings. For example, Ontai and Thompson (2002) reported that it was maternal pragmatic style of emotional language (e.g., repeating, confirming), not elaborative style (e.g., requesting for emotion-related information, making references to the emotional causes), contributed to the 3-year-olds' emotion understanding. This highlights the importance of conveying emotional information in a way that children can understand and relate to. From the perspective of intersubjectivity, shared emotional semantics between mothers and their children may serve as the foundation for their elaborative discussion on the causes and consequences of emotions.

Shared emotional experiences. Interpersonal attraction literature provides evidence that shared knowledge acquired through mutual experiences, close proximity, or similar cultural background helps people understand each other and share common ground (e.g., Nahemow & Lawton, 1975; Thomas & Fletcher, 2003). Intimacy is expressed through disclosing and sharing personal information (e.g., Gaebelin, 1976; Jourard, 1971; Morton, 1978). Intimate partners tend to discuss private information, express emotions and personal feelings, and personalize

nonintimate or mundane topics (e.g., Morton, 1978). Individuals who are in the process of forming a relationship tend to exchange more information with each other as compared to individuals who are already in a relationship, suggesting that mutually shared information forms a connection between individuals (e.g., Altman, 1973). Indeed, people in close relationships share more common ground as compared to strangers or acquaintances (e.g., Fletcher, 2002). For example, compared to strangers, married couples communicate more intimacy and private information with and without personal feelings (Morton, 1978). Furthermore, shared private and non-private information accumulated over the course of relationship helps partners identify the other's thoughts and feelings. By contrast, strangers can only rely on on-line behavioral data obtained from interaction (Thomas & Fletcher, 2003).

Shared background knowledge between people improves communication effectiveness. Experimental studies have demonstrated that individuals who share more background information about the topic under discussion (e.g., city landmarks) come to mutual understanding with fewer words and conversational turns (Isaacs & Clark, 1987). Personal (e.g., attitudes) and background (e.g., geographic or culture) similarities between people have also been shown to increase the likelihood of forming an intimate or close relationship (e.g., Nahemow & Lawton, 1975). When people share more knowledge because of their relational history (e.g., friends) or because of shared geographical/cultural background, they can understand more of what the other refers to, which makes communication easier and more enjoyable (e.g., Duck, 1994).

Similar to findings reported in adult literature, children also tend to gravitate to other children who are like them (e.g., age, sex, preferences for leisure activities) (Berndt, 1982; Kandel, 1978). When two unacquainted children meet, they usually begin by exchanging

information in order to establish their common attitudes and orientations (Furman & Childs, 1981). Research also shows that friends connect through mutually shared and enjoyed activities (e.g., Furman & Childs, 1981). Because common ground or shared information is built over a history of intimate and close interactions between play partners, young friends tend to engage in more connected, complex, and nonliteral (e.g., pretend) play and show more agreement as compared to interaction between non-friends (Gottman, 1983). An important indicator of intimacy in childhood friendship is the ability to verbally express thoughts and feelings with a peer (Parker & Herrera, 1996). Abused children experience difficulty in forming and sustaining intimate relationships with other children, which has been attributed specifically to their inability to express emotions and personal feelings (Parker & Herrera, 1996). Securely attached mother-child dyads tend to provide and discuss more details about past events; they remember and share more personal information than insecurely attached dyads (e.g., Laible, 2004). Frequent references to shared emotional experiences are thus expected to reflect greater intersubjectivity between mother and child.

In sum, literature on mother-child discourse suggests that the quantity and the quality of emotional conversation contribute to children's emotion understanding. While conversation between caregiver and child is shaped by both participants, the focus of empirical investigations has been predominantly on the quality of parental input. The role of the child and the bidirectional process of conversation have been largely ignored. To fill this gap, the second goal of the present study is to examine the association of the structure and content of mother-toddler verbal intersubjectivity with later children's emotion understanding at age 4. Overall, it is expected that high quality in the structure (indexed by greater verbal alignment) and the content (indexed by greater shared emotional semantics and shared emotional experiences) of verbal

intersubjectivity between mothers and their toddlers during book reading interaction contributes to later children's more advanced emotion understanding at age 4.

Relative Contribution of Structure- and Content-Focused Verbal Intersubjectivity to Emotion Understanding

Verbal intersubjectivity is a multi-dimensional phenomenon. Specifically, its structural aspect (i.e., verbal alignment) focuses on how mother and child relate to one another as conversational partners, whereas its content aspect focuses on the substance of their conversation (i.e., shared emotional semantics and emotional experiences). Similarly, emotion understanding is a multifaceted social cognition. Although both emotion recognition and emotion knowledge reflect children's understanding of emotion, each represents a distinct dimension of emotion understanding. Whereas emotion recognition requires the ability of processing and labeling of facial expressions and recognizing their emotional meanings, emotion knowledge requires an understanding of antecedent-consequence relationship between emotional-charged events and feeling states. The structure- and content-focused mother-child verbal intersubjectivity is expected to be differentially linked to the development of emotion recognition and emotion knowledge.

Linking verbal alignment to emotion knowledge. Slomkowski and Dunn (1996) found that the length of episodes with logically connected turns between preschoolers' conversation was positively related to their emotion knowledge. Denham and colleagues (Denham & Auerbach, 1995; Denham et al., 1997) found that children who scored higher on emotion understanding tasks engaged in more frequent reciprocal conversation with their mothers, during which mothers questioned, explained to, and guided their children, and children tended to actively respond and share ideas with their mothers. Literature on conflict resolution provides

additional evidence for the contribution of verbal alignment to emotion understanding. For example, Laible and Thompson (2003) reported that maternal verbal alignment to children's perspective in successful resolution of conflict at 30 months predicted greater emotion understanding in children 6 months later. It is important to point out that the majority of previous studies combined emotion recognition and emotion knowledge tests into one composite score. Thus, less is known about the differential contribution of verbal alignment to children's emotion knowledge and emotion recognition.

The links of perspective alignment to children's emotion knowledge can be also drawn from research on preschoolers' pretend play. Pretend play requires children aligning their perspectives and negotiating the meaning of characters, objects, and events. Dunn and Cutting (1999) found that cooperative play between preschool friends, indexed by discussing joint pretend activity, taking a role as part of a joint pretend activity, or following a pretend suggestion of the partner, was positively correlated with children's understanding of emotional causes. In a study by Connolly and Doyle (1984), the frequency and complexity of pretend play was significantly correlated with children's more advanced understanding of emotional causes. Studies also found that when preschoolers were trained to engage in pretend play, they showed an improvement in emotion knowledge (e.g., Burns & Brainerd, 1979; Shultz & Johnson, 1974). This suggests that encouraging and helping preschoolers to engage in make-believe role playing, that requires high degree of shared perspectives, directly contributes to emotion knowledge development.

To date, only one study attempted to tease apart the relative contribution of the structure and the content of mother-child conversation to social understanding in children. Ensor and Hughes (2008) examined the association of mothers' references to cognitive terms (i.e., content)

and their semantically related utterances to children's prior utterances (i.e., structural connectedness) observed during mother-toddler conversation with children's social understanding (a composite score of false belief, emotion understanding, and deception tasks). Results showed that mothers made most of their cognitive references when they semantically related to their child's prior utterances. However, mothers' connected utterances without cognitive references predicted children's social understanding above and beyond their cognitive references made outside connected episodes. As the authors pointed out, aligning one's perspective with that of the partner makes children to be more aware of the similarities and/or differences in their thinking, which may serve an even more critical function in children's social understanding than that of simple cognitive references (Ensor & Hughes, 2008). This study will explore the relative contribution of the structure of verbal intersubjectivity indexed by verbal alignment and the content of verbal intersubjectivity indexed by shared emotional semantics and experiences to emotion knowledge. Based on available evidence, it is hypothesized that the contribution of verbal alignment to children's emotion knowledge at age 4 is above and beyond that of the content of verbal intersubjectivity (see Figure 1). Given that it is more critical to maintain alignment with the partner's perspective in conflictual than non-conflictual situations (cf. Dunn et al., 1991) and that parent-child conversations about negative emotions involve more explanation, elaboration, and reflective thinking than positive emotions (Lagattuta & Wellman, 2002), it is hypothesized that the contribution of verbal alignment is specific to negative emotions (see Figure 1).

Linking shared emotional semantics and experiences to emotion recognition. Children begin to recognize emotions in infancy (e.g., Barrera & Maurer, 1981). As they master language, emotion recognition becomes increasingly explicit and verbal (e.g., Bretherton &

Beeghly, 1982). Children as young as 2 years of age begin to speak of their own and of others' inner states. In a study by Bretherton et al. (1981), 30 percent of 20-month-olds used verbal labels for pain, disgust, distress, affection, and moral conformity in appropriate contexts. The process of labeling one's own and other's emotional expressions is likely to sensitize the child to emotional facial displays and to become more efficient at processing and understanding their meaning. Labeling of emotions is important for a child to move from implicit emotion recognition, which is based mainly on perception and discrimination of emotional expressions, to explicit emotion recognition, which is based on an array of skills, including perception, discrimination, and understanding the meaning of emotional expression (e.g., Walker-Andrews, 1997). Explicit expression or labeling of emotions is likely to make a direct contribution to children's emotion recognition.

The literature on mother-child discourse provides a strong support to the idea that the emotional content of mother-child conversation contributes to children's emotion recognition from a very early age. For example, Dunn and colleagues (Dunn et al., 1991) found a developmental link between the quality of emotional conversation between children and their mothers at 36 months and individual differences in children emotion recognition at age 6. Children who used more emotional words and discussed more emotional topics with their mothers during toddlerhood performed better on emotion recognition task than their counterparts. Studies by Denham and colleagues (e.g., Denham et al., 1992; Denham et al., 1994) found that mothers' frequent use of emotional language was related to children's emotion recognition. Moreover, when mothers used emotion labels combined with discussion of causes of emotion, their children showed better emotion recognition a year later.

However, some studies found mixed results. For example, when examining the

contribution of different types of maternal emotional language to children's emotion recognition, Martin and Green (2005) found no significant relationship between maternal labeling or emotional explanations and children's emotion recognition. In another study, Garner et al. (1997) found that emotion description used by low-income mothers during conversation with their preschoolers was not related to children's emotion recognition. As discussed above, these findings suggest that simple emotional labeling by individual conversation partners may not be sufficient to enhance children's emotion recognition. In addition to the use of emotional terms, both the mother and the child need to mutually share and agree on emotional expressions being labeled. As such, emotional language expressed in the context of mutual understanding creates meaningful intersubjective information for the child, and, which, in turn, better contributes to emotion recognition development.

With respect to shared emotional experiences, their link to children's emotion understanding can be drawn from research on mother-child reminiscing of the past. Reminiscing about past experiences requires that conversing partners share not only semantics of words or phrases for description and recollection, but also emotional information. When caregivers engaged in a highly elaborative reminiscing style, their children demonstrated more advanced emotion understanding (a composite score of emotion recognition and emotion knowledge) (Laible, 2004). Finally, there is evidence that therapy that encourages children to verbalize their own emotional experiences and adults (e.g., mothers or therapist) to give feedback on those emotional experiences improves children's emotional competence (see Kempler, 2007).

Given the available evidence, it is expected that the contribution of the content of the mother-toddler verbal intersubjectivity indexed by shared emotional semantics and experiences contributes to later children's emotion recognition at age 4, which is above and beyond that of

verbal alignment, the structure of verbal intersubjectivity (see Figure 1). To date, no empirical study has examined a possible link between the valence of parent-child discourse theme and children's recognition of negative and positive emotions. Studies with abused children or children who had a traumatic experience provide some clues for the plausible links, which suggest that children's recognition of negative emotions can be affected by their negative experiences. Specifically, maltreated children and/or children who had a traumatic experience exhibit heightened sensitivity to fearful/angry facial expressions and perform better at the recognition of negative emotions (e.g., anger) (Masten et al., 2008; Scrimin, Moscardino, Capello, Altoe, & Axia, 2009). However, it is less clear if conversation about negative or positive emotions between low-risk mothers and their young children would potentially heighten children's sensitivity or vigilance toward negative or positive emotions. Thus, another goal of the present study is to examine the specificity of emotional valence in the developmental associations of shared emotional semantics and experiences with preschoolers' recognition of positive and negative emotions, respectively. Specifically, it is hypothesized that toddlers and their mothers who share more positive emotional semantics and experiences would later better at recognize positive emotion (i.e., happiness) at age 4, whereas toddlers and their mothers who share more negative emotional semantics and experiences would later better recognize negative emotions (i.e., anger, sadness, and fear) (see Figure 1).

In sum, this study is an attempt to understand the contribution of nonverbal and verbal intersubjectivity between mothers and their toddlers observed during book reading to later children's emotion recognition and emotion knowledge at age 4. The specific hypotheses are summarized below:

1. Greater nonverbal intersubjectivity, indexed by greater affective synchrony and positive affective matching as well as lower negative affective matching, between mother and toddler during book reading interaction contributes to children's more advanced emotion understanding at 4.
 - a. The contribution of structure-focused affective synchrony to emotion knowledge is above and beyond that of content-focused affective matching.
 - b. Greater affective synchrony is associated with better knowledge about negative emotions (i.e., anger, sadness, and fear) valence, not positive emotion (i.e., happiness).
 - c. The contribution of content-focused affective matching to emotion recognition is above and beyond that of structure-focused affective synchrony.
 - d. Greater positive affective matching is associated with better recognition of positive emotion, whereas greater negative affective matching is associated with better recognition of negative emotions.
2. Greater verbal intersubjectivity, indexed by verbal alignment, shared emotional semantics and shared emotional experiences, between mothers and their toddlers during book reading interaction contributes to later children's more advanced emotion understanding at age 4.
 - a. The contribution of structure-focused verbal alignment to emotion knowledge is above and beyond that of content-focused shared emotional semantics and emotional experiences.
 - b. Greater verbal alignment is associated with better knowledge about negative emotions, not positive emotion.

- c. The contribution of content-focused shared emotional semantics and emotional experiences to emotion recognition is above and beyond that of structure-focused verbal alignment.
- d. Greater shared emotional semantics and emotional experiences with positive valence are associated with better recognition of positive emotion, whereas greater shared emotional semantics and emotional experiences with negative valence are associated with better recognition of negative emotions.

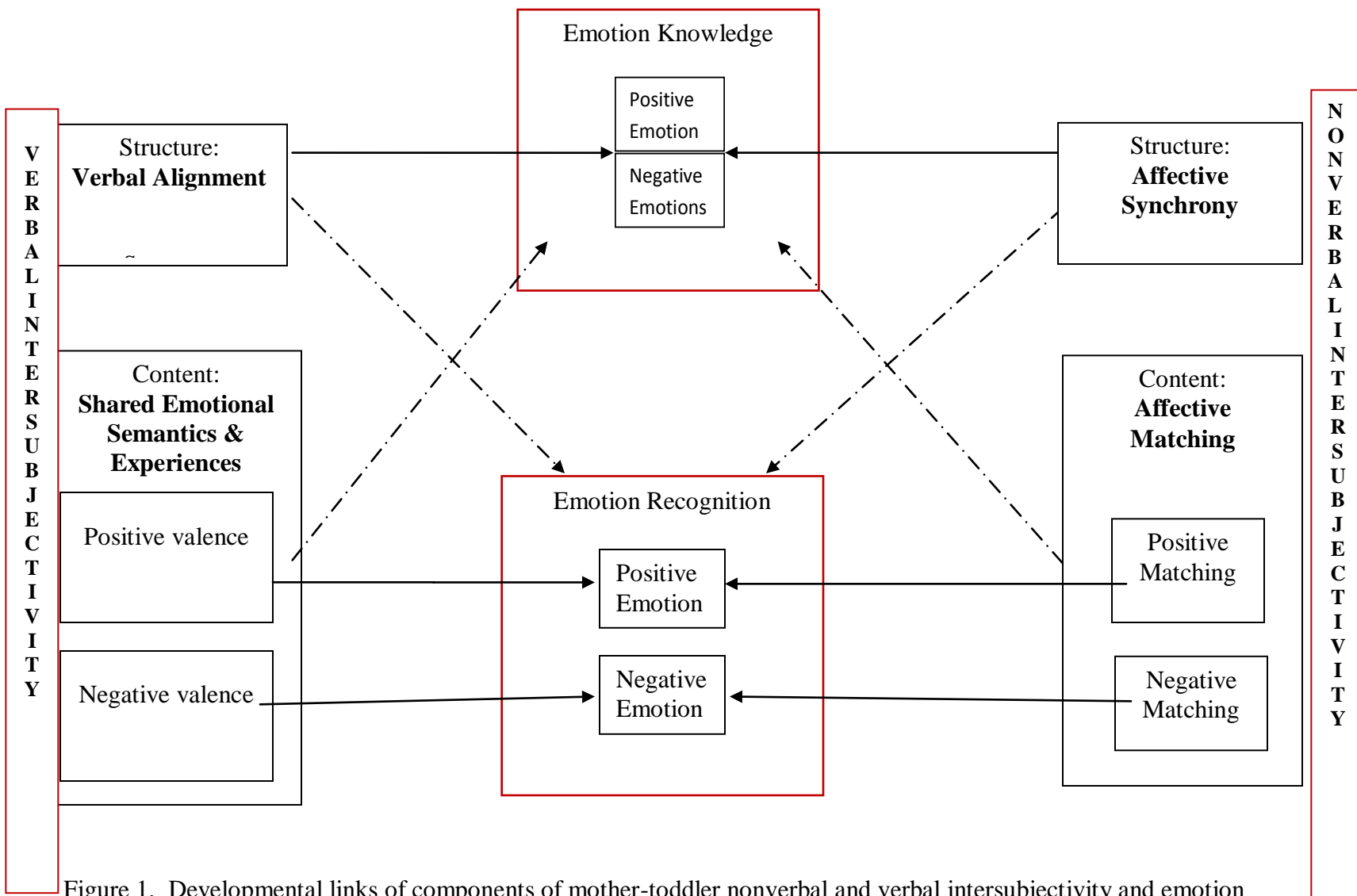


Figure 1. Developmental links of components of mother-toddler nonverbal and verbal intersubjectivity and emotion recognition and emotion knowledge. Relative strength of the relationship between variables is indicated by the solid and dotted lines, respectively. Whereas a solid line represents a stronger relationship, a dotted line represents a weaker relationship.

CHAPTER 3

METHODS

Research Design

The data is drawn from a larger longitudinal sample. At age 2½ (± 2 weeks, time 1), children and their mothers visited the lab where they were observed during a book reading activity. At age 4 (time 2), children were tested individually for emotion understanding.

Participants

Seventy-nine mothers and their 2½-year-olds participated in this study. About 59% of the toddlers were males and 50% were first-borns. The majority of the mothers were European Americans (82%) who were married (79%) and had some college education (90%). This current sample represents families from middle-class socioeconomic backgrounds. About 34% of the mothers were full-time employed when their children were 2½ years of age. Parents received \$30 and a free video of the visit for their participation in the study.

Procedures

Visit at Age 2½

Book Reading Interaction

As part of a larger longitudinal project, the mothers and their children were invited to visit the laboratory playroom for approximately two hours. 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 elicit more variability in mothers' reading with an 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-aged 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 coding use.

Mother-Toddler Intersubjectivity

Book reading between mother and toddler requires some level of intersubjectivity, such as sharing object of attention, emotional involvement, mutual understanding about the story, and an on-going dialogue, particularly, when some clarification or explanation is needed. Given these characteristics, the book reading interaction between mothers and toddlers is expected to capture shared verbal and nonverbal intersubjectivity.

Nonverbal Intersubjectivity. The nonverbal intersubjectivity between mother and toddler during book reading interaction is indexed by affective synchrony and affective matching. To derive these measures, a microanalytic 5-second time sampling strategy is employed to record mothers' and toddlers' social-affective behavior in two modalities: gaze and affective expression. Each behavioral modality is coded in a separate pass for the mother and the toddler separately.

For each 5-second coding interval, child or maternal behavior is classified as one of the hierarchically structured states that reflect the degree to which mother and child are each socially and emotionally involved in the interaction with one another (see Appendix A and Appendix B for details). The codes for maternal gaze range from 0 (i.e., looking away from child and book) to 5 (i.e., looking at child). The codes for child gaze range from 0 (i.e., looking away from mother and book) to 4 (i.e., looking at mother). The codes for maternal affective expression range from 0 (i.e., moderate negative affect) to 9 (i.e., intense positive affect). The codes for child affective expression range from 0 (i.e., intense negative affect) to 8 (i.e., intense positive affect). About 15 % of the sample 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.

Affective synchrony, an index of the structure-focused process, emphasizes the degree to which the mother's and the toddler's affective states change together over time. First, data from gaze and facial affect are combined to create 8 mutually exclusive affective state ranging from -4 (high negative) to disengaged (-1), 0 (neutral), and +1 (low positive) to +3 (high positive). An affective state is assigned to each of the 5-second coding intervals for the mother and the toddler separately (see Appendix C and Appendix D for details).

To derive the measure of affective synchrony, time series analysis is applied to compute the degree of coordination between the mother's and the toddler's affective states across the 120 coding blocks for each dyad separately.

Affective synchrony is indexed by the cross correlation function (CCF) with the largest coefficient on the CCF plot, ranging from 0 (no association) to 1 (perfect match).

Affective matching, an index of the content-focused process, measures the degree of how mother and toddler match the valence and intensity of their affect in a given moment across time. To derive the measure of affective matching, the proportion of the total coding intervals in which the toddler and the mother display the same type of affective states (i.e., negative, and positive) is computed for each dyad. The indices of positive and negative affective matching are used in subsequent analysis.

Verbal Intersubjectivity. Mother-toddler verbal intersubjectivity is indexed by verbal alignment, shared emotional semantics, and shared emotional experiences. *Verbal alignment* underscores the structural process through which mother and toddler achieve common ground, whereas *shared emotional semantics and experiences* emphasize the substantive emotional content information communicated between mothers and their toddlers. To derive these measures, speech utterances produced by mother and toddler are first transcribed verbatim. Nonverbal speech acts such as nodding are also noted. Each transcript was first segmented into message units, which are individual speech acts or utterances bounded by their intonation contour (Leaper, Tenenbaum, & Shaffer, 1999). These message units represent a complete thought. Given the nature of book reading, some message units generated by mothers are monologues made to narrate stories, which are not part of mother-toddler conversation. Thus, maternal narration units are excluded, and only conversation units are further analyzed. Interrater reliability agreement on coding conversational units indexed by Kappas is .94.

Maternal and toddler conversation units are further identified as emotion-related when they contain one or more emotion-related terms, phrases, or expletives that connote a feeling

state (e.g., ‘yuck’ [disgust]) (see Appendix E for a complete list). Conversation units that are moral or evaluative in nature are considered as emotion-related only if they denoted or connoted a feeling state (e.g., ‘that was disgusting!’). Conversation units that include the word ‘nice’ are classified as emotion-related only if they are used to express liking, not ‘goodness’.

Conversation units that include the word ‘like’ are coded as emotion-related if they are used to express enjoyment or dislike (e.g., ‘the boy liked his cat’) (Dunn et al., 1991). The valence of each emotion-related conversation unit is further identified as positive, negative, neutral/unclear, or mixed. Following Lagattuta and Wellman’s (2002) criteria, emotion-related words or phrases that refer to or describe favorable or desirable emotional states (e.g., happy), facial expressions (e.g., smiling), enjoyment (e.g., like), or emotional evaluations (e.g., fun) are deemed to be positive in valence. In contrast, emotion-related words or phrases that refer to or describe unfavorable or undesirable emotional states (e.g., afraid, embarrassment), facial expressions (e.g., crying), attitudes (e.g., hate), or evaluations (e.g., scary) are coded as negative in valence. If the valence is not clear, a neutral/unclear valence will be assigned. The last category of mixed emotion is added to account for conversational units that include two opposing emotional valences (e.g., “Is he happy or sad?”). An example of conversation unit coding is shown in Table 1.

Mean length of utterance (MLU) is an indicator of expressive language development, reflecting grammatical complexity and syntactic growth (Brown, 1973; Klee, Schaffer, May, Membrino, & Mougey, 1989; Rondal, Ghiotto, Bredart, & Bachelet, 1987). It is positively correlated with child age until about 48 months. To compute MLU, the number of individual morphemes in each utterance produced by the toddler are counted first (Brown, 1973; MacWhinney, 2000) and then averaged across all utterances from the entire sample of book

reading. The Child Language Data Exchange System (CHILDES; MacWhinney, 2000) is used to derive MLU.

Table 1

Example for coding message units, valence of emotion-related conversation units, speech acts, verbal alignment, and shared semantics

Utterance Semantics	Message Unit	Emotion-Related/Valence	Speech Act	Verbal Alignment (quality)
1. Mother: momma and a boy are dancing. ---	Narration		---	---
2. Mother: oooh, and now what is happening here? ---	Conversation		---	---
3. Toddler: the momma. shared			Simple response	low
4. Mother: What is that momma doing? shared			Information question	high
5. Toddler: (no response) ---			No response	low
6. Mother: Is she hugging her baby and kissing it? ---		Emotion-related/positive	information question	high
7. Toddler: Mmhmm. shared			Simple response	low
8. Mother: Does she love that baby? shared		Emotion-related/positive	Information question	high
9. Toddler: (no response)			No response	low

Note. --- = not coded

Verbal alignment. Verbal alignment reflects mothers' and toddlers' willingness and/or ability to relate to each other during conversation. Based on the speech act expressed, each conversation unit is classified as either high quality or low quality. Speech acts operate on the reasoning or idea of the partner, such as rephrase, challenge, information question, clues, repeat, expanding, providing alternatives, expatiating and defining, are considered to be high quality (see Table 2), as they are likely to increase alignment with the partner's perspective (e.g., Kruger, 1993). On the other hand, speech acts such as simple response, no response, negation without explanation, irrelevant act, and incomprehensive question are considered low quality (see Table 2), because they place emphasis on one's own idea without consideration of or reference to the partner's idea, which are not likely to increase alignment with the other partner's perspective. Provided that verbal alignment is interpersonal in nature, the quality of speech act is determined on the basis of the partners' prior conversation unit. See Table 1 for examples of coding speech act for the quality of verbal alignment. The number of conversation units classified as low or high quality speech act will be tallied. The ratio of high to low quality conversation units will be computed as index for verbal alignment and used in subsequent analysis. Interrater reliability agreement on high and low speech acts indexed by Kappas was .95.

Table 2

Summary of Speech Acts Classified as Verbal Alignment with High and Low Quality

Quality Of Verbal Alignment	Speech act	Examples
High	Rephrase	Child: 'Boy sad.'/Mother: 'The boy is sad.'
	Challenge/request for justification	Child: 'Mother feels happy.'/Mother: 'Are you sure she feels happy?'
	Information question	Mother: 'So did the boy spill all the grapes?'
	Giving clues	Child: 'I think the boy is angry.'/Mother: 'I don't think he is, look at his eyes.'
	Repetition	Child: 'Mommy is mad.'/Mother: 'Mommy is mad.'
	Expanding/elaborating/elaborative response	Child: 'That's his mommy.'/Mother: 'She has long hair.'
	Providing alternatives	Child: 'I don't know why he is sad.'/Mother: 'Maybe because his mom sent him to time-out.'
	Expatiating	Child: 'The boy feels sad.'/Mother: 'He does feel sad. But, the cat decided to cheer him up.'
Low	Defining	Mother: 'How does he feel?'/Child: 'I don't know.'/Mother: 'He feels mad, just like when you could not go outside.'
	Simple or no response	Mother: 'Who is that?'/Child: 'A little boy.'
	Negation without Explanation/assertion	Child: 'She is sad.'/Mother: 'No, she is mad.'
	Irrelevant act	Child: 'Mommy is sad.'/Mother: 'And look at the cat.'
	Question of verbal incomprehension	Mother: 'What's wrong?'/ Child: 'What?'

Shared emotional semantics. Shared emotional semantics reflect conversational partners' mutual understanding of the meaning of emotional language (e.g., words and phrases). Each conversation unit is judged for its semantic relatedness to the partner's previous conversation unit. When conversation units are semantically related, they are deemed to be shared semantics. The two partners do not have to agree with each other to be qualified as shared semantics, but they need to demonstrate an understanding of what the other meant to say. In other words, the response unit must be semantically appropriate. The absence of verbal reply (i.e., no response) to the partner's explicit demand (e.g., a question) suggests that one does not understand or share the meaning with the partner, which is considered as an absence of shared semantics. Emotion-related conversation units, when identified as shared semantics, are deemed to be shared emotional semantics. Interrater reliability agreement on shared emotional semantics indexed by Kappas was .62. Interrater reliability agreement on the valence of shared emotional semantics indexed by Kappas was .99.

Example for coding shared semantics is presented in Table 1. Based on emotional valence, the number of shared emotional semantics is tallied separately as positive and negative. The proportion of the number of positive and negative shared emotional semantics to the total number of conversation unit is then computed to be used in subsequent analysis.

Shared emotional experiences. During conversation, the mother or the toddler relate to one another by making references to experiences that they presently share, shared in the past, or will share (Dennis, Talih, Cole, Zahn-Waxler, & Mizuta, 2007). Thus, shared emotional experiences are identified based on a conversation unit whether it refers to experiences that both mother and toddler either (a) currently share (e.g., "They are having a good time just like we are right now!"), (b) have shared in the past (e.g., "The mother sent the boy to his room and he was

sad, like you were when you had to go to your room for disobeying me.”), or (c) both know about in the future (e.g., “They are having a fun picnic and so we will when we get home!”). A conversation unit referring to shared emotional experiences that either simply repeats partner’s message or expresses an agreement or acceptance of the partner’s message is not considered as shared emotional experiences (e.g., Mother: “we had a picnic last week”/Child: “We had a picnic.”). Interrater reliability agreement on shared emotional experiences by Kappas is .60. Coders had a perfect agreement on the reliability coding for the valence of shared emotional experiences. The number of shared emotional experiences is tallied separately on the basis of positive and negative valence. Then, the proportion of positive and negative shared emotional experiences to the total number of conversation unit is computed to be used in subsequent analysis.

Visit at Age 4

Emotion Understanding

When children turned 4 years of age, they were invited back to the lab where they were individually tested for emotion recognition and emotion knowledge.

Emotion recognition. To assess children’s ability to recognize facial expressions of emotion, the Diagnostic Analysis of Nonverbal Accuracy (DANVA) developed by Nowicki and Duke (1994) was administered to the preschoolers. This instrument was designed to measure individual differences in children’s ability to accurately send and receive nonverbal emotional information. Only the discrimination of emotional information task was chosen for the present study for assessing children’s emotion recognition skills. Children were presented a total of 24 photographs of facial expressions of *happy*, *sad*, *mad*, and *scared* posed by three child actors with a high or a low intensity in random order. Children were asked to name each posed

emotion in the photo. For each correct labeling, children received 1 point. Two sum scores are derived: a positive emotion (i.e., happiness) and a negative emotion (i.e., sum of sadness, fear, and anger). The composite total of summing positive and negative emotion test scores represents an overall level of emotion recognition. The overall internal consistency and test-retest reliability estimates for the DANVA ranged from .77 to .88 (see Nowicki & Duke, 1994). The construct validity has been demonstrated by a significant correlation of emotion recognition test scores with measures of children's social competence and academic performance (see Nowicki & Duke, 1994).

Emotion knowledge. Affective perspective taking test was administered to assess children's understanding of the link between people's emotions and external and internal causes that trigger them. Children were presented with 20 emotional story vignettes about a boy/girl (the protagonist's name matches the child's sex). The presentation of each vignette was accompanied by an illustrative drawing. Children were asked how the protagonist in each story would feel. The story vignettes on the emotion of happiness, sadness, anger, and fear were selected from the review provided by Ribordy, Camras, Stefani, and Spaccarelli (1988). The discriminant validity of this task came from the studies with maltreated preschoolers who were less accurate in their performance compared to normal children (e.g., Pollak et al., 2000). For each correct answer the child receives a score of 2. When the answer is incorrect but matched with the valence of the target emotion (e.g., anger for sadness), a partial score of 1 is given. A score of 0 is given when the answer does not match the valence of the target emotion (e.g., happiness for fear). Two sum scores are derived: a positive emotion (i.e., happiness) and a negative emotion (i.e., sum of sadness, fear, and anger). The composite total of summing positive and negative emotion test scores represents an overall level of emotion recognition.

CHAPTER 4

RESULTS

Preliminary Analysis

Previous research suggests that there are age and sex differences in the development of emotion understanding during the preschool age (e.g., Denham & Couchoud, 1990; Brown & Dunn, 1996). Additionally, early language ability is associated with individual differences in preschoolers' emotion understanding (Brown & Dunn, 1996). Thus, the effect of child age, sex, and language ability (indexed by mean length of utterance assessed at toddlerhood) on emotion recognition and emotion knowledge test scores was examined. When significant associations were found, they were included in subsequent analyses as covariates. The effects of child sex, age, language ability on mother-toddler intersubjectivity and emotion understanding were explored.

Child Sex. To investigate whether child sex had an effect on verbal and nonverbal intersubjectivity, two sets of multivariate analyses of variance (MANOVAs) were conducted (see Table 1 for descriptive statistics). In the first MANOVA, where nonverbal intersubjectivity measures including positive and negative affect matching and affective synchrony served as the dependent variables, the main effect for child sex was not significant, Wilks' $\Lambda = .97$, $F(3, 75) = .86$, *ns*, partial $\eta^2 = .03$. In the second MANOVA, verbal intersubjectivity measures including verbal alignment shared semantics and shared experiences of positive and negative valence served as the dependent variables. The main effect for child sex was again not significant, Wilks' $\Lambda = .92$, $F(5, 69) = 1.16$, *ns*, partial $\eta^2 = .07$. To investigate whether child sex had an

effect on emotion recognition and emotion knowledge, three separate multivariate analyses of variance (MANOVAs) were conducted (see Table 1 for descriptive statistics). In the first MANOVA, recognition of positive and negative emotions served as the dependent variables. The main effect for child sex was approaching significance, Wilks' $\Lambda = .94$, $F(2, 76) = 2.46$, $p < .10$, partial $\eta^2 = .06$. Specifically, girls showed higher scores than the boys in recognition of positive emotion, $F(1, 77) = 4.53$, $p < .05$ (see Table 1). In the second MANOVA, knowledge of positive and negative emotions served as the dependent variables. The main effect for child sex was not significant, Wilks' $\Lambda = .97$, $F(2, 76) = 1.76$, ns , partial $\eta^2 = .03$. In the final MANOVA, the total scores of emotion recognition and emotion knowledge served as the dependent variables. The main effect for child sex was not significant, Wilks' $\Lambda = .98$, $F(2, 76) = .67$, ns , partial $\eta^2 = .02$. Given that child sex had an effect on recognition of positive emotion, it was included as a covariate in subsequent analysis.

Child Age. To examine whether child age at the time of emotional understanding assessment contributed to the individual differences in emotion understanding, bivariate correlation analyses were performed. Results showed that older children performed better on knowledge of negative emotions ($r = .25$, $p < .05$) and younger children performed better on the overall emotion recognition and recognition of negative emotions (r 's = $-.23$, p 's $< .05$). As a result, child age was included as a covariate in subsequent analysis.

Child Language. Correlational analysis was also performed to examine the association of children's language ability at age 2½ indexed by MLU (boys: $M = 2.38$, $SD = .53$; girls: $M = 2.31$, $SD = .52$) with the measures of intersubjectivity and emotion understanding. Results showed that toddlers' language ability was not significantly correlated with emotion recognition ($r = -.068$, ns) or emotion knowledge ($r = .004$, ns). Moreover, toddlers' language ability was not

significantly correlated with positive affective matching ($r = -.046, ns$), negative affective matching ($r = .021, ns$), affective synchrony ($r = -.087, ns$), verbal alignment ($r = .167, ns$), shared emotional experiences ($r = .065, ns$), or shared emotional semantics ($r = .179, ns$). Thus, child language ability was not considered in further analysis

Contribution of Mother-Toddler Nonverbal Intersubjectivity to Emotion Understanding

The first set of research hypotheses addressed the contribution of nonverbal intersubjectivity between mothers and their toddlers at age 2½ to later children's emotion understanding assessed at age 4. Scatter plots were first created to examine the bivariate associations between structure- (i.e., affective synchrony) and content-focused (i.e., positive and negative affect matching) measures of nonverbal intersubjectivity with each of the four emotion understanding outcome variables. Visual examination showed that a nonlinear relationship between emotion knowledge and affective synchrony (see Figure 2). Specifically, lower and higher affective synchrony scores were likely to be associated with greater emotion recognition in children. Thus, a second-order quadratic term of affect synchrony was added to the subsequent regression analysis

To test the first main hypothesis that greater mother-toddler nonverbal intersubjectivity would contribute to children's more advanced emotion recognition and emotion knowledge at age 4, two separate hierarchical regression analyses were computed, with the total emotion recognition and emotion knowledge scores as the dependent variable, respectively. Child age and sex were included as the covariates in each regression analysis.

Emotion Recognition. In the first hierarchical regression analysis predicting emotion recognition, child age and sex were entered in the first step, followed by the measures of nonverbal intersubjectivity in the second step, including negative and positive affect matching,

and the linear and the quadratic terms of affective synchrony. The initial model with child's age and sex was approaching significance, $F(2, 75), p = .10, R^2 = .06$, adjusted $R^2 = .04$. However, the overall model was not significant, $F(6, 71) = 1.50, ns, R^2 = .11$, adjusted $R^2 = .04$ (see Table 4). Thus, nonverbal intersubjectivity did not make a significant contribution to preschoolers' overall emotion recognition.

Emotion knowledge. In the second hierarchical regression analysis predicting emotion knowledge, child age and sex were entered in the first step, followed by negative and positive affect matching as well as the linear and the quadratic terms of affective synchrony in the second step. The initial model with child age and sex was not significant, $R^2 = .01$, adjusted $R^2 = -.01, F(2, 75) = .512, ns$. However, the addition of nonverbal intersubjectivity measures improved the model significantly. Specifically, both linear and quadratic terms of affective synchrony made a significant contribution to emotion knowledge. The overall regression model was also significant, $F(6, 71) = 2.21, p = .05, R^2 = .16$, adjusted $R^2 = .09$ (see Table 4). Thus, nonverbal intersubjectivity did make a significant contribution to preschoolers' overall emotion knowledge.

Taken together, the first main hypothesis was partially supported. Specifically, nonverbal intersubjectivity between mother and toddler contributed significantly to children's emotion knowledge, but not emotion recognition, at age 4.

Hypothesis 1a. To test the hypothesis that the contribution of affective synchrony to emotion knowledge would be above and beyond that of affective matching, a hierarchical regression analysis was performed, with the total score of emotion knowledge as the dependent variable. Child sex and age were entered in the first step, followed by measures of affective matching in the second step, and affective synchrony with linear and quadratic terms in the third step. The initial model with child sex and age was not significant, $R^2 = .01$, adjusted $R^2 = -.01, F$

(2, 75) = .512, *ns*. The addition of measures of positive and negative affective matching did not improve the model, $R^2 = .05$, adjusted $R^2 = -.01$, $F(2, 73) = 1.28$, *ns*. As predicted, the final model with the addition of affective synchrony measures improved the model significantly, $F(6, 71) = 2.21$, $p < .05$, $R^2 = .16$, adjusted $R^2 = .09$. Thus, the hypothesis that affective synchrony contributes to emotion knowledge above and beyond that of affective matching was supported (see Table 5).

Hypothesis 1b. To test the hypothesis that greater affective synchrony would be associated with knowledge about negative emotions, but not positive emotion, partial correlations controlling for child sex and age were performed to examine the association of affective synchrony with knowledge of positive and negative emotions separately. As predicted, the results showed that the partial correlation between affective synchrony and knowledge of negative emotions was approaching significance (see Table 6).

Hypothesis 1c. To test the hypothesis that the contribution of affective matching to emotion recognition would be above and beyond that of affective synchrony, a hierarchical regression analysis with the total score of emotion recognition as the dependent variable was performed. In this regression model, child sex and age were entered first as the covariates, affective synchrony with the linear and the quadratic terms were entered in the second step, followed by the measures of positive and negative affect matching in the third step. Results showed that the initial model with child sex and age was approaching significance, $F(2, 75) = 2.59$, $p < .10$, $R^2 = .06$, adjusted $R^2 = .04$. The model with the addition of linear and quadratic terms of affective synchrony was not significant, $F(4, 73) = 1.59$, *ns*, $R^2 = .08$, adjusted $R^2 = .03$. The final model with the measures of positive and negative affect matching added was not significant either, $F(6, 71) = 1.50$, *ns*, $R^2 = .11$, adjusted $R^2 = .04$. Thus, this hypothesis was not

supported. Affective matching did not make additional contribution to emotion recognition that was above and beyond affective synchrony (see Table 7).

Hypothesis 1d. To examine the hypothesis that greater positive affective matching would be associated with better recognition of positive emotion, and greater negative affective matching is associated with better recognition of negative emotions, partial correlation tests were performed. After controlling for child sex and age, no significant association was found between positive and negative mother-toddler affective matching with children's recognition of positive and negative emotions at age 4 (see Table 6). This hypothesis was not supported.

Contribution of Mother-Toddler Verbal Intersubjectivity to Emotion Understanding

To test the second main hypothesis that greater verbal intersubjectivity would contribute to children's more advanced emotion recognition and emotion knowledge at age 4, two sets of hierarchical regression analysis were computed separately.

Emotion Recognition. In the first hierarchical regression analysis, child age and sex were entered in the first step, followed by the measures of verbal intersubjectivity in the second step, including shared emotional semantics and shared emotional experiences with positive and negative valences. Although the overall model was not significant, $F(7, 66) = 1.47, ns, R^2 = .14$, adjusted $R^2 = .04$, the contributions of shared semantics with positive and negative valences approached significance after partialling out child age and sex as well as the measure of verbal alignment and shared experiences with positive and negative valences. (see Table 8).

Emotion knowledge. In the second hierarchical regression analysis, child age and sex were entered in the first step, followed by shared emotional semantics and shared emotional experiences in the second step. The first model with child sex and age was not significant, $F(2, 71) = .53, ns, R^2 = .02$, adjusted $R^2 = -.01$. However, the addition of verbal intersubjectivity

measures made a significant improvement to the model, $F(7, 66) = 3.46, p < .05, R^2 = .27$, adjusted $R^2 = .19$. Specifically, greater shared emotional semantics with positive valence between mother and toddler predicted greater emotion knowledge in children at age 4 (see Table 8).

Taken together, it was found that verbal intersubjectivity was a significant contributor to emotion knowledge, but not to emotion recognition.

Hypothesis 2a. To test the hypothesis that the contribution of verbal alignment to emotion knowledge would be above and beyond that of shared emotional semantics and shared emotional experiences, a hierarchical regression analysis with the total score of emotion knowledge as the dependent variable was performed. Child sex and age were entered as covariates in the first step, followed by the measures of shared emotional semantics and experiences in the second step, and verbal alignment in the third step. The initial model with the covariates of child sex and age was not significant, $F(2, 71) = .528, ns, R^2 = .02$, adjusted $R^2 = -.01$. The addition of shared emotional semantics and experiences improved the model significantly, $F(4, 69) = 2.99, p < .05, R^2 = .15$, adjusted $R^2 = .10$. However, verbal alignment did not make any further improvement to the model, $F(5, 68) = 2.36, p < .05, R^2 = .15$, adjusted $R^2 = .09$ (see Table 9). Thus, the hypothesis that the contribution of the structural aspect of verbal intersubjectivity to emotion knowledge is not above and beyond that of the content aspect of verbal intersubjectivity was not supported.

Hypothesis 2b. Partial correlations were performed to test the hypothesis that greater verbal alignment would be associated with better knowledge about negative emotions, not positive emotion. Results revealed that the associations of verbal alignment and with emotion knowledge of both positive and negative valence were approaching significance (see Table 6)

with equal strength (r 's=.20, p 's < .10). These results suggested that verbal alignment contributed equally to knowledge of positive and negative emotions.

Hypothesis 2c. To test the hypothesis that the contribution of shared emotional semantics and emotional experiences to emotion recognition would be above and beyond that of verbal alignment, a hierarchical regression analysis was performed. In this regression analysis, child sex and age were entered in the first step as covariates, followed by verbal alignment in the second step, and measures of shared emotional semantics and emotional experiences in the third step. The base model with child sex and age was approaching significance, $F(2, 71) = 2.65, p < .10, R^2 = .07, \text{adjusted } R^2 = .04$. The addition of verbal alignment did not improve the model, $F(3, 70) = 1.76, ns, R^2 = .07, \text{adjusted } R^2 = .03$. The further addition of shared emotional semantics and experiences also did not improve the final model, $F(5, 68) = 1.05, ns, R^2 = .07, \text{adjusted } R^2 = .00$. Thus, the hypothesis that the contribution of shared emotional semantics and emotional experiences to emotion recognition is above and beyond that of verbal alignment was not supported (see Table 10).

Hypothesis 2d. Partial correlation tests were performed to test the hypothesis that greater shared emotional semantics and experiences with positive valence would be associated with better recognition of positive emotion, and greater shared emotional semantics and experiences with negative valence are associated with better recognition of negative emotions. Because none of the partial correlations was significant (see Table 6), this hypothesis was not supported.

Additional Williams' T_2 statistical tests (Williams, 1959) were conducted to compare the magnitude of correlations of shared semantics with positive and negative valence with knowledge of positive and negative emotions as well total emotion knowledge. Results showed that the magnitude of the correlation of the total emotion knowledge with shared semantics of

positive valence and was greater than with shared semantics of negative valence ($t = 2.34$, $df = 70$, $p < .05$).

Table 3

Descriptive Statistics for Measures of Emotion Understanding and Mother-Toddler

Intersubjectivity

Measures	Boys Mean (SD)	Girls Mean (SD)	Total Mean (SD)
Emotion Recognition			
Positive	5.07 (1.19)	5.55 (.724)	5.30 (1.01)
Negative	9.71 (2.87)	10.1 (3.45)	9.87 (3.14)
Overall	14.8 (3.07)	15.6 (3.42)	15.18 (3.25)
Emotion Knowledge			
Positive Valence	3.78 (1.62)	4.05 (1.40)	3.91 (1.15)
Negative Valence	8.56 (2.43)	7.92 (2.73)	8.27 (2.58)
Overall	12.37 (3.17)	11.97 (3.29)	12.18 (3.21)
Nonverbal Intersubjectivity			
Affective Synchrony	.253 (.060)	.242 (.072)	.247 (.065)
Positive Affective Matching	.296 (.190)	.320 (.184)	.315 (.195)
Negative Affective Matching	.015 (.045)	.004 (.016)	.010 (.033)
Verbal Intersubjectivity			
Verbal Alignment	2.03 (.964)	2.03 (.859)	2.03 (.906)
Shared Emotional Semantics	.093 (.058)	.111 (.049)	.102 (.054)
Shared Emotional Experiences	.009 (.012)	.012 (.012)	.010 (.012)

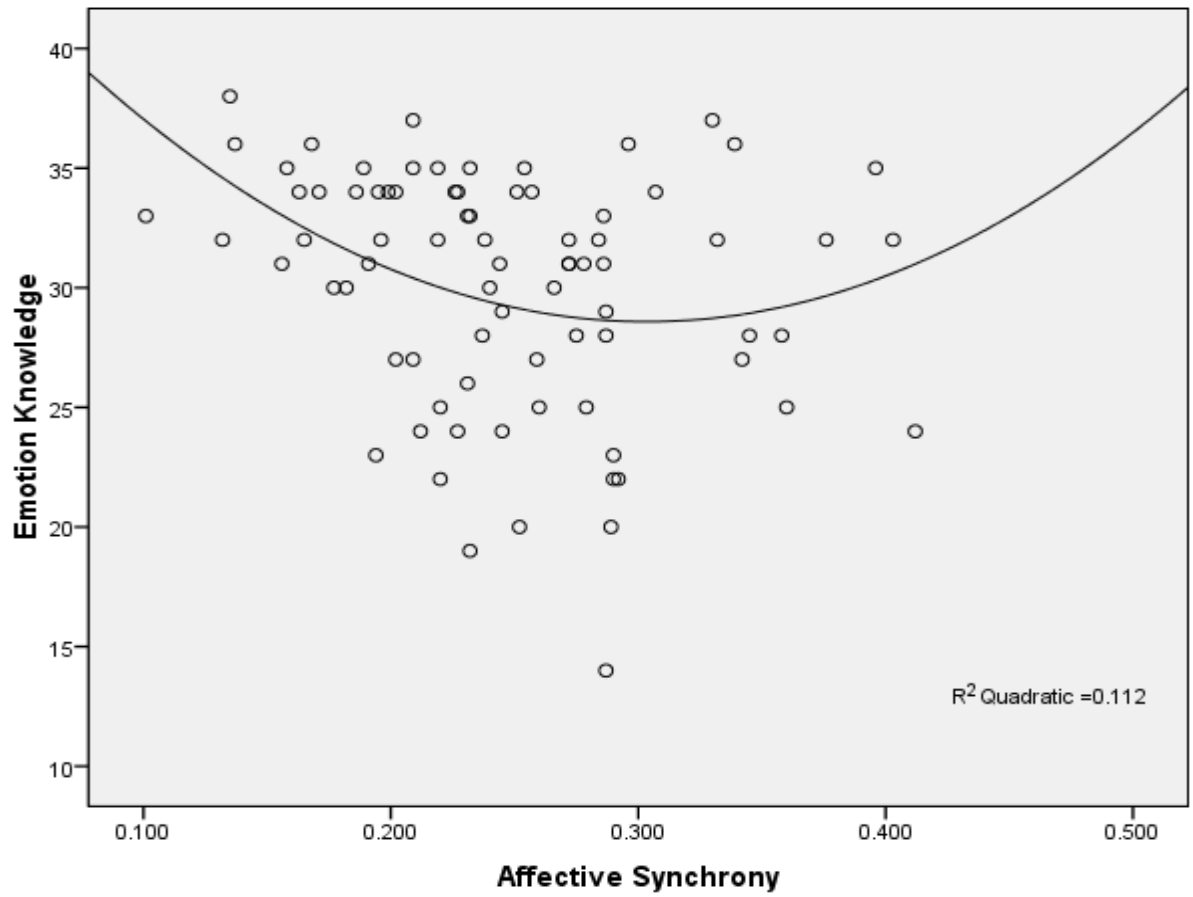


Figure 2. Scatter plot of affective synchrony and emotion knowledge.

Table 4

Hierarchical Regression: Predicting the Contribution of Nonverbal Intersubjectivity to Total Emotion Recognition and Total Emotion Knowledge

Variables	Total Emotion Recognition			Total Emotion Knowledge		
	β	ΔR^2	ΔF	β	ΔR^2	ΔF
Step 1		.06	2.59 [†]		.01	.51
Child Sex	-.68			.04		
Child Age	-.27*			.11		
Step 2		.05	.96		.14	3.03*
Child Sex	-.64			.11		
Child Age	-.29*			.09		
Positive Affective Matching	.98			.15		
Negative Affective Matching	-15.86			-.12		
Affective Synchrony	4.75			-.32*		
Affective Synchrony ²	-54.65			.24*		

[†] $p < .10$ * $p < .05$

Table 5

Hierarchical Regression: Testing the Additional Contribution of Affective Synchrony to Total Emotion Knowledge

Variables	Total Emotion Knowledge		
	B	ΔR^2	ΔF
Step 1		.01	.51
Child Sex	.036		
Child Age	.111		
Step 2		.03	1.28
Child Sex	.056		
Child Age	.099		
Positive Affective Matching	.131		
Negative Affective Matching	-.112		
Step 3		.110	4.65*
Child Sex	.110		
Child Age	.091		
Positive Affective Matching	.152		
Negative Affective Matching	-.124		
Affective Synchrony	-.324*		
Affective Synchrony ²	.238*		

[†] $p < .10$ * $p < .05$

Table 6

Partial Correlations Between Mother-Toddler Intersubjectivity and Emotion Understanding

Measures		Emotion Recognition			Emotion Knowledge		
		Negative	Positive	Total	Negative	Positive	Total
Nonverbal Intersubjectivity	Affective Synchrony	.08	.03	.08	-.22†	-.17	-.22*
	Affective Matching						
	Positive	.13	-.11	.11	.14	.10	.12
	Negative	-.15	-.11	-.15	-.16	-.04	-.14
Verbal Intersubjectivity	Verbal Alignment	.13	.16	-.07	.20†	.20†	.18
	Shared Semantics						
	Positive	.12	-.01	.17	.38**	.35*	.48**
	Negative	-.16	.08	-.07	.30*	.20†	.19†
	Shared Experiences						
	Positive	-.03	.01	.01	-.18	.06	-.02
	Negative	.09	-.06	.08	.02	-.02	.01

† $p < .10$ * $p < .05$ ** $p < .01$

Note. Effects of child age and sex were partialled out.

Table 7

*Hierarchical Regression: Testing the Additional Contribution of Affective Matching to Total**Emotion Recognition*

Variables	Total Emotion Recognition		
	β	ΔR^2	ΔF
Step 1		.07	2.59 [†]
Child Sex	-.108		
Child Age	-.233*		
Step 2		.02	.616
Child Sex	-.129		
Child Age	-.228*		
Affective Synchrony	.664		
Affective Synchrony ²	-.593		
Step 3		.032	1.30
Child Sex	-.101		
Child Age	-.252*		
Affective Synchrony	.644		
Affective Synchrony ²	-.587		
Positive Affective Matching	.061		
Negative Affective Matching	-.165		

[†] $p < .10$

* $p < .05$

Table 8

Hierarchical Regression: Predicting the Contribution of Verbal Intersubjectivity to Total

Emotion Recognition and Total Emotion Knowledge

Variables	Total Emotion Recognition			Total Emotion Knowledge		
	β	ΔR^2	ΔF	β	ΔR^2	ΔF
Step 1		.069	2.65†		.015	.258
Child Sex	-.10			.03		
Child Age	-.24*			.12		
Step 2		.066	1.01		.254	4.59**
Child Sex	-.10			.07		
Child Age	-.19			.23		
Verbal Alignment	-.05			-.03		
Shared Semantics of Positive Valence	.26†			.57**		
Shared Semantics of Negative Valence	-.23†			-.04		
Shared Experiences of Positive Valence	-.14			-.19		
Shared Experiences of Negative Valence	.11			.08		

† $p < .10$ * $p < .05$ ** $p < .001$

Table 9

Hierarchical Regression: Testing the Additional Contribution of Verbal Alignment to Total

Emotion Knowledge.

Variables	Total Emotion Knowledge		
	B	ΔR^2	ΔF
Step 1		.015	.528
Child Sex	.03		
Child Age	.12		
Step 2		.133	5.39*
Child Sex	.08		
Child Age	.15		
Shared Emotional Semantics	.37*		
Shared Emotional Experiences	-.00		
Step 3		.000	.006
Child Sex	.08		
Child Age	.15		
Shared Emotional Semantics	.37*		
Shared Emotional Experiences	-.00		
Verbal Alignment	.01		

† $p < .10$ * $p < .05$

Table 10

Hierarchical Regression: Testing the Additional Contribution of Shared Emotional Semantics and Experiences to Total Emotion Recognition

Variables	Emotion Recognition		
	B	ΔR^2	ΔF
Step 1		.069	2.65†
Child Sex	-.10		
Child Age	-.24*		
Step 2		.001	.067
Child Sex	-.10		
Child Age	-.24		
Verbal Alignment	-.03		
Step 3		.001	.049
Child Sex	-.10		
Child Age	-.24*		
Verbal Alignment	-.02		
Shared Emotional Semantics	-.03		
Shared Emotional Experiences	.02		

† $p < .10$ * $p < .05$

CHAPTER 4

DISCUSSION

The overarching goal of the present study was to understand the role of early mother-child communication, indexed by verbal and nonverbal intersubjectivity, in the development of emotion understanding at preschool age. Specifically, the main hypothesis was that mother-child intersubjectivity (i.e., shared understanding) would contribute to individual differences in development of emotion understanding at age 4.

To capture both verbal and nonverbal processes of shared understanding, intersubjectivity between mother and child was measured during toddlerhood in the context of book reading interaction. Furthermore, both nonverbal and verbal processes of intersubjectivity were examined in terms of their structure (i.e., affective synchrony and verbal alignment, respectively) and content (i.e., affective matching and shared emotional semantics and experiences, respectively). Children's understanding of emotion was assessed at age 4 by measuring emotion recognition (i.e., recognition of facial emotional expressions) and emotion knowledge (i.e., understanding the link between situations and caused emotions). The two main predictions were that nonverbal intersubjectivity and verbal intersubjectivity would separately contribute to children's emotion recognition and emotion knowledge. Details of the findings are discussed next.

Child Age, Sex, and Language as Correlates of Emotion Understanding

According to the previous literature, children's age, sex and language ability may affect their performance on emotion understanding tasks (e.g., Denham & Couchoud, 1990; Brown & Dunn, 1996). Specifically, girls, older children, and children with more advanced language skills perform better on emotion understanding tasks than their counterparts. The present study also found that children's age and sex, but not language ability, were correlates of emotion understanding. Specifically, the girls in the present study showed better recognition of positive emotion as compared to the boys. This is consistent with the findings with adults that women are better than men at correctly detecting happy faces than sad faces (Gur et al., 1992; Erwin et al., 1992; Heimberg, Gur, Erwin, Shtasel, & Gur, 1992). Furthermore, recent neural studies found different patterns of brain activation in females and males when viewing emotional displays. Lee and his colleagues (Lee et al., 2002) discovered that bilateral frontal and left parietal activation was observed in both male and female participants when responding to the presentation of happy faces. However, the female participants showed left thalamic activation as well as right occipital and temporal activation that were not observed in the male participants. Thus, different neural processes may be at work shaping how boys and girls process and respond to facial expressions. Future studies should examine a potential interplay of neural processing and gender differences in socialization to help elucidate how child sex may be linked to emotion processing.

The assessment of emotion understanding was performed at age 4, with a range from 4 years to 4 years and 11 months. Even with a variation of less than 1 year, the present results showed that older children were more advanced in emotion knowledge, specifically, better understanding of causes for negative emotions. In general, young children have greater difficulty

in understanding and inferring negative emotions such as fear or sadness as compared to happiness (e.g., Denham & Couchoud, 1990). Young children do not reliably identify causes of anger until over 5 years of age (Borke, 1971; Reichenbach & Masters, 1983) and causes of sadness until 6.5 years of age (Cnepp, 1983; Reichenbach & Masters, 1983; for a review, see Smiley & Huttenlocher, 1989). Denham and Couchoud (1990) theorized that this may be due to the fact that adults show and talk about happy expressions more often with younger children, and, that the emotions most frequently talked about by adults may be learned at earlier ages.

By contrast, it was unexpected to find that younger children showed more advanced overall emotion recognition, particularly, better recognition of negative emotions. It is possible that younger children are more attuned to and frequently rely on people's emotional expressions to better understand the daily situations and events, and thus, perhaps were more interested in and attentive to the emotion recognition task.

Finally, no link was found between language ability at age 2¹/₂ and children's performance on emotion understanding tasks. One possible explanation is the temporal distance between two assessments. It is likely that children's language skills had changed by the time they reached age 4. The measurement used in the analysis did not reflect the preschoolers' concurrent language development. Another possible reason for the lack of association is that emotion recognition and emotion knowledge tasks require little linguistic skills. For example, at least one experimental study found language ability does not affect children's performance on emotion recognition task, even though children in the experimental group were language impaired (e.g., Ford & Milosky, 2003).

Contribution of Nonverbal Intersubjectivity to Emotion Understanding

The first main hypothesis that greater mother-toddler nonverbal intersubjectivity would contribute to children's more advanced emotion recognition and emotion knowledge at age 4 was partially supported. Specifically, only affective synchrony, the structure of mother-toddler nonverbal intersubjectivity, was a significant predictor of children's emotion knowledge. On the other hand, affective matching, the content of mother-toddler nonverbal intersubjectivity, failed to predict children's emotion knowledge and emotion recognition at age 4.

Affective Synchrony

Contribution to Emotion Recognition. It was found that affective synchrony between toddler and mother was not related to individual differences in emotion recognition at age 4. It appears that the ability to recognize facial expressions is not linked to the nuances of social experiences, specifically, variations in coordinative synchronization of social interactive actions. Yet, it is still possible for a threshold effect in the effect of nonverbal aspect of interpersonal experience on children's competence in emotion recognition. For example, the effect only becomes detectable when the level of synchrony is compromised to a more extreme degree such as in neglectful or abusive relationships. Indeed, most studies that found an association between children's emotion recognition and social experiences are typically with children who experienced abuse or psychological trauma or came from an impoverished, highly stressful environment (e.g., Camras, et al., 1983; During & McMahon, 1991; Pollak et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002).

Since the mother-toddler dyads in this study were from middle-class low-risk families, the restricted range of mother-toddler affective synchrony might have prevented a clear pattern of association between affective synchrony and the development of emotion recognition at age 4.

Contribution to Emotion Knowledge. The contribution of mother-toddler affective synchrony to the development of children's emotion knowledge was a nonlinear, U-shaped quadratic pattern (see Figure 1). Toddlers who had lower and higher degrees of synchrony with their mothers demonstrated more advanced emotion knowledge at age 4. In contrast, toddlers who had a mid-range of synchrony with their mother had lower levels of emotion knowledge. Although both higher and the lower levels of affective synchrony contributed to more advanced emotion understanding, there might be different underlying mechanisms. The cyclic organization in the timing of affective synchrony characterizes the structural quality of social communication between two partners, during which each partner is attuned to the microlevel shifts in the other's affective and expressive behavior (e.g., Lester et al., 1985; Stern, 1977). This unique structural property of affective synchrony is believed to be the foundation for a child's first social-emotional learning experience of what is like "to be with other" (e.g., Lewis & Goldberg, 1969; Stern et al., 1977). Toddlers who experience higher level of synchrony with their mothers are likely to develop a more coherent scheme of 'being with other' which has been theorized to promote understanding of emotions (e.g., Feldman, 2007). On the other hand, toddlers who experience lower affective synchrony are expected to go through more erratic interactions with mothers. Presumably, such experience may expose toddlers to different types of emotional causes and situations, which may help them better understand the causal links.

When toddlers experienced a mid-range of affective synchrony with their caregivers, they were the least knowledgeable about emotions at age 4. Such finding is contradictory to infancy

research that a mid-range of interactional synchrony is optimal for development (e.g., Belsky, Rovine, & Taylor, 1984; Isabel & Belsky, 1991; Malatesta, Culver, Tesman, & Shepard, 1989). Infants maintaining a mid-range of vocal synchrony with their mothers were more likely to be securely attached at age 1 (Jaffe et al., 1991; see also Beebe & Jaffe, 1992). This optimal mid-range synchrony hypothesis was justified by a principle of dynamic homeostasis. Affective synchrony between mother and infant involves an ongoing regulation of interactions, which is central to the organization of an infant's emotional experience. Extreme responsiveness (high synchrony) and unresponsiveness (low synchrony) are likely to be disruptive to the infant's interactive experiences. The reversed pattern in direction of association between synchrony and developmental outcome found in this study with toddlers may suggest a developmental reorganization between infancy and preschool age. As infants transitioning into toddlerhood, an increase and differentiation of interconnections between limbic system and neocortex may account for qualitative differences in emotional development (Salovey & Sluyter, 1997). Developmental changes in brain processing coincide with those observed in parent-child interactions, such as a greater balance in participation and shared power between the two (for a review, see Harrist & Waugh, 2002) as well as increased competence of emotional self-regulation in children. Developmental transition and organization in the neural and social functioning may explain altered pattern in the linkage between affective synchrony and emotion understanding.

Affective Matching

Contrary to the predictions, affective matching between mother and toddler was not significantly linked to children's emotion knowledge or emotion recognition. One possible explanation for this failure may be attributed to the developmental timing of observing mother-

child interaction. According to the biofeedback theory (Gergely & Watson, 1996) and Fonagy's (2001) theorization, the link between mother-child affective matching and emotion recognition is most salient during infancy. The phenomenon of affect mirroring or affective matching, where a mother matches her infant's affective expressions and mirrors her infant's emotional state, is commonly observed in early infancy. During early infancy, when face-to-face interaction reaches its peak, an infant is most sensitive to her/his mother's affective expression (e.g., Tronick et al., 1978) and most likely to reciprocate the mother's facial emotional expressions (e.g., Feldman, 2007a). Saturated with emotional vitality, the mutual and reciprocal influences are theorized to sensitize infants to their own internal state cues and to the internal and external facial cues of other people. During the second and third year of life, social interaction between mother and toddler becomes less emotionally intense. Joint or shared attention with neutral affect characterizes social interaction between mother and child. The salience of affective matching in dyadic communication fades into the background.

An alternative explanation for the lack of significance may be attributed to the context of book reading. On average, the book reading activity was a fairly neutral experience for mothers and toddlers, where most dyads displayed moderate positive affect and very few expressed negative affect. Studies reporting a wide range of positive and negative expressive behavior by mothers and young children during book reading were typically with at-risk families such as low social-economic status or insecure attachment dyads (Bus, 2008). In fact, the only evidence linking affective matching to emotion recognition comes from studies with atypical population (e.g., maltreated children; During & McMahon, 1991; Camras, et al., 1983; Pollak et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002). The restricted variations in affective matching may attenuate the relationship with emotional outcomes. To better capture the subtle differences

in the affective expressions in low-risk mother-toddler dyads, a more sensitive coding system may be necessary. For example, the classification of minute qualitative differences in core affect is based on not only its valence (ranging from feeling pleasant to feeling unpleasant), but also its arousal level (ranging from feeling passive to feeling active) (Kuppens, Oravecs, & Tuerlinck, 2010). Applying a two-dimensional approach to the identification affect can better reflect the degree of affective matching between caregiver and toddler. Even though the majority of toddlers and mothers were positive, the arousal level is likely to differ considerably, particularly, among toddlers.

Contribution of Verbal Intersubjectivity to Emotion Understanding

The second major research question of the present study was to examine the contribution of verbal intersubjectivity between mother and toddler to children's emotion understanding at age 4. Similar to the nonverbal channel of interpersonal interaction, verbal intersubjectivity was measured in terms of its structure (i.e., verbal alignment) and content (i.e., shared emotional semantics and experiences). The main hypothesis was that greater verbal intersubjectivity would contribute to children's more advanced emotion recognition and emotion knowledge at age 4. Findings from this study provided partial support for this hypothesis.

Verbal alignment, the structure of verbal intersubjectivity, was not significantly linked to overall emotion recognition or emotion knowledge, and its association with positive and negative emotion knowledge only approached significance. On the other hand, shared emotional semantics, the content of verbal intersubjectivity, significantly contributed to emotion recognition and emotion knowledge. Shared semantics of negative and positive valence were differentially linked to emotion recognition and emotion knowledge. Whereas shared semantics of negative valence were significantly associated with children's less advanced emotion

recognition, shared semantics of positive valence were significantly correlated with children's more advanced emotion recognition and emotion knowledge.

Verbal Alignment

The structural act of aligning one's own perspective with that of the partner's was expected to serve a critical function in enhancing children's understanding of emotional causes. Ensor and Hughes' (2008) study showed that the structural aspect of mother-child conversation predicted children's emotion understanding above and beyond that of the content. However, in this study, verbal alignment between mother and toddler failed to predict children's emotion knowledge or emotion recognition at age 4. One possible explanation for the null findings was due to how verbal alignment was operationalized. Different speech acts were coded and collapsed into two broad categories of verbal alignment: high and low quality. The aggregation of different speech acts perhaps may mask the linkage between verbal alignment and emotion knowledge. For example, both repeating and elaborating partner's utterances were categorized as high quality verbal alignment. Although all these alignment strategies would suggest that one is attending to the partner's view, their communication functions may not be the same. By elaborating on the partner's idea, the common ground established by two interactants can serve to maintain the shared understanding over an extended period of time. In contrast, repeating and paraphrasing may only create a superficial level of shared understanding. In a similar vein, the alignment strategies of expanding (indicating agreement) and challenging (indicating disagreement) may also differ in their communication functions. Whereas both speech acts reflect one's attentiveness to the partner's ideas and extension of mutual topic, the maintenance of common ground between the two interactants may be compromised when one partner challenges, rather than agrees with, the other's idea. Furthermore, the best way to determine

whether common ground is established is to understand the function of the speech act as it relates to not only the preceding, but also the subsequent one. Thus, a sequential pattern that takes into account of presentation of information, processing, and responding between two partners may be a more sensitive measure of verbal alignment. (e.g., Clark & Schaefer, 1989; Clancy, 1999). Finally, verbal alignment can be conceptualized from the perspective of a stylistic pattern created by mother and toddler in formulating and maintaining shared understanding. An example of such dyad-based analysis is a cross-cultural study by Choi (1992) examining cultural differences in communicative patterns between Korean and Canadian mother-child dyads. Based on the speech-turn based analysis, shared understanding between Korean dyads was achieved through explicit efforts by mothers in prompting her child to react to their initiation. Hence, the alignment process was characterized by the pattern of mother-leads-and-child-follows. By contrast, the Canadian mothers were likely to assume autonomy in their child allowing him/her to jump into conversation at will, characterizing a balanced partnership style of alignment. The development of emotion understanding in preschoolers may be sensitive to stylistic differences, as opposed to subtle differences in quality, in dyadic verbal alignment process.

Contribution to Emotion Knowledge. Although it was hypothesized that the contribution of verbal alignment to knowledge of negative emotions would be stronger than that of positive emotion, results showed that the linkage to both types of emotions approached significance with equal strength. The hypothesized link between verbal alignment and emotion knowledge of negative emotions was based on the earlier findings that parent-child conversations about negative emotions involve more explanation, elaboration, and reflective thinking than positive emotions (Lagattuta & Wellman, 2002). The current findings would suggest that aligning one's perspective with that of the partner is beneficial to children's understanding about antecedent-

cause relationship of emotions regardless of the affective valence under discussion.

Shared Emotional Semantics and Experiences

Contribution to Emotion Recognition. No significant relationship was found between the overall shared emotional semantics and emotion recognition in this study. However, when the contribution of shared emotional semantics was considered separately for negative and positive valences, their contributions approached significance, even after the effects of covariates of child characteristics, verbal alignment, and shared emotional experiences were controlled for (see Table 8). Whereas shared semantics with positive valence tended to be associated with more advanced emotion recognition in children, shared semantics with negative valence tended to be associated with less advanced emotion recognition in children.

One possible explanation for these unexpected findings is that it is natural for parents to talk about positive emotions and openly express them during verbal exchanges. Children are expected to have a greater chance to observe the co-occurrences of positive maternal facial displays with the uttered positive emotion lexicons. On the other hand, it is plausible that caregivers who share higher level of verbal intersubjectivity with their children tend to suppress their negative arousals to maintain a neutral expression when discussing with their children about negative emotions. Reduced exposure to semantically matched negative maternal expressions may decrease children's awareness about and recognition of emotions. In a similar vein, heightened exposure to semantically matched positive maternal expression may increase children's awareness and recognition of emotions. There is some support to this explanation. For example, Belsky et al. (1996) found that 3-year-olds who were securely attached at 12 months remembered positive affective events more accurately than negative ones. In contrast, insecurely attached children remembered negative affective events more accurately than positive ones.

No significant association was found between shared emotional experiences and emotion recognition. However, this null finding should not be hastily interpreted as a lack of relationship between shared emotional experiences and emotion recognition. Results from studies on mother-child reminiscing suggest that sharing and discussing emotional experiences of the past, present, and the future are beneficial to children's social cognition. Particularly, when mothers engaged in a highly elaborative reminiscing style, their children demonstrated better emotion understanding (Laible, 2004). Welch-Ross (1997) also demonstrated a link between preschoolers' (3.5- to 4.5-year-olds) social understanding and higher levels of intersubjective sharing during mother-child discussions about the past. The null finding in the present study may be attributed to the fact that during book reading mothers and toddlers rarely mentioned their shared emotional experiences. Perhaps, a context where mothers and children are explicitly asked to talk about past, present or future emotional experiences, or where prompts such as a family photo album are used, would elicit more shared emotional experiences during mother-child conversation.

Contribution to Emotion Knowledge. Shared emotional semantics not only contributed to emotion knowledge, its contribution was above and beyond that of verbal alignment. These findings point to the significance of content-focused verbal intersubjectivity in mother-toddler conversation to the development of emotion knowledge. One of the important elements of shared emotional semantics is the connectedness of mother-child emotional conversation. To be coded as *semantically shared*, the mother or the child had to appropriately respond to their partner's previous utterance. This *structural* aspect of 'connectedness' in mother-child conversation was found to be predictive of social understanding in children (Ensor & Hughes, 2008). Thus, it is possible that the index of shared emotional semantics captures not only the

content but also the structural aspects of mother-child conversation, which would explain its significant link to both emotion recognition and emotion knowledge.

Upon closer examination, results further revealed that both shared semantics of positive and negative valences contributed to knowledge of positive and negative emotions (Table 6). However, the contribution of shared semantics of positive valence to overall emotion knowledge was stronger than that of negative valence (i.e., approached statistical significance according to Williams' T_2). It can be speculated that caregiver-child dyads with secure attachment relationship are more likely to use shared emotional semantics with positive valence in their conversation. Securely attached children show a more advanced emotion understanding as compared to their counterparts (e.g., De Rosnay & Harris, 2002; Ontai & Thompson, 2002).

However, this present finding is contrary to Laible's (2010) finding that the quality of conversation between mothers and their 4-year-olds reminiscing about negative, not positive, experiences was associated with the preschoolers' better emotion understanding. Several differences between this and Laible's study may explain the differential findings. First, mothers and children in Laible's (2010) study were explicitly asked to talk about a positive and a negative emotional event experienced by the children in the past. It is possible that without an imposed content theme for mother-child conversation, as in the situation of book sharing in the current study, most mothers and children would be more inclined to focus on the positive themes. Second, shared semantics reflect a partner's sensitivity to and understanding of what the other is willing to talk about. Caregivers are likely to focus on the themes that they believe their children understand and are more willing to respond to. It is possible that mothers feel comfortable talking about both positive and negative emotions with their 4-year-olds, whereas they tend to discuss positive emotions and experiences with their toddlers. Frequent discussion of positive

emotions and experiences help children learn about the relationship between emotions and their eliciting situations. Thus, differences in the age of the participants and the context may be important factors for yielding different results.

Finally, the fact that the link between emotion knowledge and shared positive emotional semantics was stronger than those of negative ones does not rule out the value of conversations about negative emotions. On the contrary, children can gain understanding about negative emotions from conversation with their others (e.g., Lagattuta & Wellman, 2002). Factors such as timing (e.g., immediately after the event), social and cultural contexts, individual characteristics of the mother (e.g., depression) and the child (e.g., temperament) may further moderate the link between shared emotional semantics and emotion knowledge. For example, in the study by Laible (2004), children's temperament predicted their mothers' elaborative style of negative, but not positive, emotions. Specifically, mothers were likely to elaborate about negative emotions during reminiscing of child past experiences if they perceived their child to be temperamentally difficult (e.g., high in negative reactivity). In the future, it may be useful to examine mother-child verbal intersubjectivity in multiple contexts (e.g., book reading and reminiscing of the past). To further elucidate the relationship between verbal intersubjectivity and emotion understanding, it may be interesting to investigate the moderating effects of child and maternal characteristics on their linkages.

Conclusions

Overall, the results of the present study support the main thesis that mother-child intersubjectivity contributes to children's emotion understanding. Examination of the nonverbal processes between mother and toddler revealed that it was the structural aspect indexed by affective synchrony (i.e., temporal congruency in affective coordination) between mother and

toddler that contributed to children's knowledge about emotional causes. Affective synchrony in communication, which is theorized as a biologically predisposed individual adaptation to the partner's social rhythms, is expected to contribute to children's emotion knowledge directly and/or indirectly through their general cause-effect reasoning (Feldman, 2007a). Examination of the verbal intersubjectivity demonstrated that it was the content, indexed by shared semantics of positive valence, that was the most salient predictor of emotion knowledge, and, to some extent, of emotion recognition. Shared emotional semantics reflects a process of sharing experiences through emotional words, which is likely to provide children with the opportunity to directly discuss emotions and their causes. These results suggest that verbal and nonverbal processes are not only important channels of interpersonal communication, but also pathways through which children develop emotion understanding. These verbal and nonverbal processes may facilitate a positive and secure mother-child relationship and a coherent mental representational system of relationship in children (Fonagy, 2001), which are expected to help children better understand social and emotional events.

Several limitations in the study need to be pointed out. First, the sample of the study was relatively small and homogeneous. The majority of the participants were from middle-class Caucasian families representing a low-risk sample. The lack of diversity in socioeconomic status and ethnicity among mother-child dyads is likely to reduce the variability in the measures of nonverbal and verbal intersubjectivity. Moreover, this study is correlational in nature, which does not permit deriving causal conclusions about the direction of the influence. Although the results of the present study and previous findings strongly suggest that the quality of communication between primary caregiver and child contributes to the development of emotion understanding, only studies with an experimental design can provide causal inferences.

Despite the limitations, results of the current study may have implications for clinical applications. For example, differential contributions of verbal and nonverbal intersubjective processes to emotion understanding may inform clinicians formulating communication-based therapeutic strategies for parents and young children to promote children's emotion functioning.

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Appendix A

Coding of Toddlers' Affective Behavior

1. Gaze:

0=Looking away from book or mother,

1=Glancing at the book one or more times (less than 2 sec.),

2=Looking at the book (for at least 2 sec. or more),

3=Glancing at the mother one or more times (less than 2 sec.),

4=Looking at the mother (for at least 2 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 and disengaged,

4=Expression of high concentration on the story with slightly wrinkled brows and relaxed mouth, or expression of a neutral affect with relaxed eye brows and mouth and engaged

5=Expression of animated/pretend facial expressions (e.g., mimicking the feelings of the characters),

6=Expression of genuine positive affect with a small (only corners of mouth are slightly upturned),

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.

Appendix B

Coding of Mothers' Affective Behavior

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 than 2 sec.),

4=Glancing at the child more than once (each less than 2 sec.),

5=Looking at the child (for at least 2 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., monotone reading),

3=Flat affect with neutral facial and vocal expression,

4=Animated voice,

5= Animated voice and facial expressions,

6=Animated voice, facial expressions, and 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),

7= Expression of genuine positive affect with a small (only corners of mouth are slightly up-turned),

8= Expression of positive affect with a large smile (narrowed eyes, bulging occurs under eyes, raised cheeks and upturned mouth corners),

9= Expression of more intense positive affect in a form of laughter

Appendix C

Coding of Mother's Negative and Positive Affective States

To create an index of mother's *high negative* (= -4) affective state, a mother will have to display negative affect facially (e.g., frowning) and/or vocally (e.g., stern voice) with the gaze directed to or away from child. An index of mother's *moderate negative* (= -3) affective state will be derived when the mother displays negative affect by raising eye brows, pausing, and/or calling child's name with the look directed to or away from child. An index of mother's *low negative* (= -2) affective state will be derived when she expresses boredom/sadness in combination with the look directed to the child or the book. To create an index of mother's *disengaged* (= -1) affective state, the mother has to express boredom/sadness/detachment in combination with looking away from child and book. A *neutral* (=0) affective state is coded when the mother displays flat/neutral affect and looks directly to child/book or away from child/book. An index of mother's *low positive* (= 1) affective state is derived when the mother shows facial or vocal animation, exaggeration, and/or imitation with their gaze directed toward child or book. A *moderate positive* (= 2) affective state is coded when the mother smiles with gaze directed toward or away from child and/or book. Finally, mother's *high positive* (= 3) affective state is coded when the mother displays an intense smile or laugh while looking at child.

Appendix D

Coding of Toddler's Negative and Positive Affective States

To create an index of toddler's *high negative* (= -4) affective state, a toddler has to express intense negative affect and to look away from book and mother. When the toddler pushes away from mother, frowns, fusses and looks away from mother and book, *moderate negative* (= -3) affective state is coded. An index of toddler's *low negative* (= -2) affective state is derived when the expression of fussiness is combined with looking at mother or book. An index of *disengaged* (= -1) affective state is derived when the expression of neutral affect is combined with disengaged from book reading and looking away or a lack of continuous attention to mother and/or book. When toddler displays flat neutral affect and relaxed facial expression, *neutral* (= 0) affect is coded. To derive an index of toddler's *low positive* (= 1) state he/she has to display animated facial expression or expression of surprise and interest. When the toddler smiles, *moderate positive* (= 2) state is coded. Finally, when the toddler laughs or displays a big smile and looks at the mother, *high positive* (= 3) state is coded.

Appendix E

Emotion-Related Terms and Phrases

Negative Valence		Positive Valence	Neutral/Unclear
Afraid	Naughty	Be (is/are/will be)	Feeling
Aggravate	Ornery	alright	“Get him going”
Angry	Sad	Better mood	“Wound up”
Ashamed	Scare	Cheer/cheerful	
Bad mood	Scary	Enjoy	
Boring/bored	Shame	Excited/exciting	
Cranky/crabby	Sick=disgusted	Feel alright	
(Drive/go) crazy	Sorry	Feel better	
Cry	Stubborn	Feel good/fine	
Didn't have fun	Tearing	Fun/funny	
Didn't please	Trouble (to	Glad	
Disappoint	get/got in	Good humor (of)	
Don't like	trouble)	Good thing=relieved	
Don't love	Ugly	Grateful	
Embarrassed	Unhappy	Have fun	
Feelings hurt	Upset	Have good time	
Fear	Whine	Happy	
Feel bad	Worry	Hug	
Feel inhibited	(What's) wrong	Hysterical	
Feel left out	Yuck/yucky	Joy	
Feels shy		Kiss(ing)	
Frighten		Laugh	
Fuss/fussy		Like	
Not fun/not funny		Love	
Grouchy		Pleased	
Guilt/guilty		Pride/proud	
Hate		Relieved	
Hysterical		Silly	
Jealous		Smile	
Let down (disappoint)		Surprise	
Lonely		“Heck of a time”	
Mad		“Having a ball”	
Miss			
(What's the) matter			
Nervous			