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MUTUAL REGULATION OF PARENT-INFANT DYADIC INTERACTIONS: SYNCHRONY, FLEXIBILITY, AND RELATIONS WITH CONTEXTUAL FACTORS

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Abstract

Parent-infant interactions provide essential contexts in which infants learn strategies for social functioning and regulating arousal. This study explored two structural qualities of parent-infant interactions, dyadic synchrony and flexibility, thought to reflect mutual regulation. The study further explored relations among these structural constructs and contextual factors including marital satisfaction, parental depressive symptoms, parenting stress, and parent and infant affect in the interaction. Mothers, fathers, and their 6-month old male and female infants (N = 164) took part in the Still Face Paradigm. Parents provided self-report of marital satisfaction, depressive symptoms, and parenting stress. Results suggest that synchrony and flexibility represent related but independent constructs. Flexibility and synchrony were associated with parent and infant affect in the interaction; results differed slightly depending on the interactional context (mother/father, face-to-face/reunion). Mother-infant flexibility in the reunion episode was related to maternal depressive symptoms and report of parenting stress. Maternal positive affect in the reunion interaction was associated with maternal report of marital satisfaction; whereas infant negative affect expressed in father-child reunion interactions was associated with paternal marital satisfaction. Results illuminate the distinctions and similarities between flexibility and synchrony, and the relations among flexibility in parent-infant interactions and contextual factors.

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Introduction

Developing effective emotion regulation skills is an essential objective of infancy and early childhood. Although infants are born with rudimentary regulatory skills, parents provide an essential external resource, helping manage much of their infants' early stimulation and episodes of dysregulation (Cole, Michel, & Teti, 1994). The parent-infant interaction is the primary context for infant affective communication, and it is within these dyadic interactions that the infant's emergent social-communicative and self-regulatory abilities develop (Brazelton, Koslowski, & Main, 1974; Moore, Cohn & Campbell, 2001; Stern, 1985; Tronick, 1989). Through a dynamic combination of parental modeling of appropriate emotional responses for the situation, and sensitively responding to and helping children to regulate their expressed emotions, parents facilitate the growth of their children's own regulatory capacities (Morris, Silk, Steinberg, Myers, & Robinson, 2007). Kopp (1989) maintains that infant-caregiver interactions in which the two work to manage positive and negative states serve to socialize different regulatory and social skills. Parent-infant regulation of positive emotions maintains the social interaction, through which children learn social skills and rules for communicative interchanges. Within the joint regulation of negative emotional states children learn strategies for alleviating arousal and managing distress. Thus, within early dyadic interactions infants and young children learn skills for social and emotional functioning later in life.

Very young infants follow the lead of their parents, but by 6 months are able to engage in turn-taking in dyadic interactions (Cole et al., 1994; Harrist & Waugh, 2002; Tronick & Cohn, 1989). Within the Mutual Regulation Model (Tronick & Cohn, 1989), an infant's emotion regulation strategy is theorized to be shaped by the parent's response to his behaviors. An infant who experiences sensitive parenting in response to his affective cues, in which the parent

attentively and accurately responds to the infant's expression and modifies the interaction to regain the infant's attention and interest to promote positive engagement, is likely to experience more positive emotions in the interaction, to gain a sense of efficacy in his ability to control his environment, and to become more adaptive and effective in his developing self-regulatory behaviors over time. The infant whose parent does not respond sensitively is likely to experience more negative emotions and frustration, reducing the experience of efficacy in the interaction, and with time may have more difficulty developing effective strategies for maintaining dyadic interaction and self-regulation (Cole et al., 1994). Lollis and Kuczynski (1997, as cited in Hsu & Fogel, 2003) suggest that moment-to-moment parent-infant interactions are influenced by prior patterns of interaction and provide the building blocks for future relational functioning.

Much of the previous research on the development infant emotion regulation within face-to-face interactions focuses on specific behaviors of the individuals such as the affect expressed in the interaction by parent or infant, the regulatory tactics infants tend to use such as gaze aversion and self-soothing behaviors, or the quality of techniques parents use to engage their children, such as the oft-cited construct of parenting sensitivity. This approach explores ***what*** is happening in the dyadic context at the level of the behaviors of individuals (e.g., Crockenberg & Leerkes, 2004; Stifter & Braungart, 1995). Conclusions about the quality of the parent-child interaction are therefore derived from observations and assessments of individual behaviors. Other research focuses on the *processes* of regulation within the dyadic context, exploring ***how*** mutual regulation occurs, for example how moment by moment emotional expressions on the part of one individual in the dyad systematically influence the emotions and behavior of the other partner (e.g., Beebe, 2003; Feldman, 2003; Thomas & Martin, 1976). An important aspect of this dyadic moment-by-moment interaction and bidirectional influence is recognition of the co-

occurrence of both directions of influence – that of the parent to her child, but also from the child to the parent (e.g., Bell, 1968; De Mol & Buysse, 2008). Explorations of the relative efficacy of regulation strategies of parent-infant dyads are made stronger by taking into account the relative contributions of both partners to the interaction, not just by identifying the strengths or weaknesses of strategies employed by individual partners in the interaction (Beebe, 2003). At the level of the dyad, both partners are mutually influential in establishing regulatory patterns in the interaction.

This dynamic and unfolding balance of mutually regulating dyadic behaviors over time is traditionally studied in face-to-face interactions utilizing observational techniques that document moment-to-moment changes in both partners. Utilizing this microanalytic strategy, elements of contingent responsivity, of the concurrent and reciprocal processes at play, may be explored (Beebe, 2003; Cole, Martin, & Dennis, 2004). Interactive, *dyadic* regulation is a bidirectional process in which players make continual and at times subtle adjustments in response to the actions of their partners. Therefore, the level of analysis must be specific and refined enough to capture these moment-by-moment changes and to allow for exploration of the patterns and processes of dyadic regulation over time.

Given the transactional nature of mutual emotion regulation and the importance of recognizing that the behavior of the *dyad* as a unit of analysis may offer insight into the processes at play in mutual regulation in a way not captured by separate explorations of each individual's behavior in the interaction, the current study utilizes and compares two methods of exploring the structure of dyadic processes in interaction: that of *dyadic synchrony* and *dyadic flexibility*. The construct of dyadic synchrony provides an index of the degree to which both individuals move together, in a coordinated linear fashion, among varying affective states over

time. Dyadic flexibility illustrates the range of affective states expressed by the dyad in a given interaction, and the amount of movement among varying affective states occupied by the dyad, irrespective of the temporal affective coordination between the partners. Instead, dyadic flexibility explores how much a dyad moved among a variety of dyadic states within a given timeframe. While dyadic synchrony is a construct that has been used widely to examine parent-infant interactions, exploring the structure of these interactions through the lens of dyadic flexibility has been less addressed in the literature. This study will utilize both methods to explore the quality and structure of dyadic interactions, as each may offer independent and distinct insights into the processes at play in mutual regulation.

Although the behavior of the dyad is the primary focus of analysis in this study, it is likely that contextual factors that have been shown to have an impact on the responsivity and affect expression for individuals will therefore also influence the dynamics in the dyadic interaction. For example, factors such as parental depression, marital conflict, and parenting stress, that alter a parent's ability to be responsive to her child's needs and to model and be receptive to a variety of expressed emotions, may shape the resulting quality of the dyadic parent-infant interaction. Similarly factors such as infant engagement or emotional reactivity would be hypothesized to have an influence on the behaviors of the dyad. In addition to parent and infant individual factors, situational factors such as the emotional tone of the interactional context in which the dyad is engaged (e.g., conflictual, stressed interactions or mutually enjoyable interactions), or the partner with which the infant is engaged (father or mother), may have an influence on the structural quality of the interaction. In this study, contextual factors affecting individuals in the family will be examined with respect to their potential influence on the behaviors of the dyad as indexed by the constructs of dyadic synchrony and flexibility.

The underlying theoretical model for this study maintains that the foundations of infant and toddler emotion regulatory skills are laid within the context of mutual regulation of early parent-infant interactions. Within this mutually regulated interaction, both partners are active co-constructors of the interaction, and methods exploring the structure of dyadic behavior will illuminate the processes at play in the interaction. Factors influencing an individual's expression of emotion, sensitive responding to the emotions of another, and ability to adapt to situational demands will likely influence the structure of that dyadic interaction. Additionally, aspects of the interactional context, such as the emotional demands of the situation, and the partners involved in the interaction may also influence the quality and structure of the dyadic interaction. Dyadic, mutual regulatory processes involve a dynamic balance of individual actions and responses to the partner, influenced by factors within the individuals and in the interactional context.

Mutual Regulation and Dyadic Synchrony

Historically, the dyadic patterns of infant action and parent response, and the ensuing mutually regulating behaviors have been referred to in the literature as mutual reciprocity, reciprocal responsiveness, contingent responsivity, mutuality, social contingency, and dyadic synchrony, with the key element in all being the importance of matching affective and behavioral states and dyadic attunement within an interaction (see review by Harrist & Waugh, 2002). Synchrony in the young infant and caregiver interaction requires maintained shared focus of attention, temporal coordination (matching rhythm and pacing of activity level in interactions), and contingency (one event has probabilistic relationship to following event). Tronick's Mutual Regulation Model (e.g., Tronick & Cohn, 1989) describes the processes by which a dyad becomes coordinated over time by matching affective and behavioral states and works to achieve dyadic synchrony within an interaction. *Matched affect* occurs when both individuals are

behaviorally expressing the same affective state at the same time. *Dyadic synchrony* refers to the co-construction of the interaction and the dynamic adaptation on the part of both partners over time, how they respond to each others' affective states, and how they change their behaviors with respect to the other, thereby facilitating positive arousal and subsequent regulation (Feldman, 2003; Tronick & Cohn, 1989). Synchrony, as conceptualized under this model, does not depend on the valence of affect expressed by either partner at any given time, nor does it imply an exact match in affective state between the two partners, instead indexing the degree to which *changes* in an individual's affect or behavior are linked to changes in their partners' behaviors. Sometimes characterized as a "dance" between two partners in the interaction, synchrony provides an index of the joint coordination of the two individual's behaviors over time.

Recent research suggests that early transactional interactions in which mother and infant coordinate behavioral and affective states may reflect developmental and biological underpinnings or antecedents in the infant, such as those associated with sleep-wake cyclicity and cardiac rhythms (Feldman, 2006; 2007). In a study of preterm and full-term infants, Feldman explored synchrony as measured by time series analysis of second-by-second mother and infant affective behaviors. She found that mother-infant synchrony in face-to-face interactions at three months of age was predicted by sleep-wake cycles, vagal tone, and orientation and arousal modulation prenatally and in the early weeks and months after birth (Feldman, 2006). Infants with more disorganized or delayed biological rhythms displayed lower levels of mother-infant synchrony. Feldman (2007) maintains that biological rhythms may be considered the foundations of social rhythms. Moore and Calkins (2004) similarly found associations between synchrony and vagal reactivity. In a study of 3-month-old infants and their mothers, lower dyadic synchrony and matched affect in mother-infant dyads was associated with greater infant physiological

reactivity and higher vagal withdrawal in face-to-face interactions. This research suggests that the important construct of dyadic synchrony, especially in early infancy, may be influenced by and reflected in physiological processes.

Synchrony and closely related dyadic constructs in parent-infant and parent-child interactions have also been associated with a variety of concurrent and later predictors. Concurrent associations between synchrony and related constructs highlight the influence of individual characteristics of each partner on dyadic interactions. Decreased synchrony has been found to be associated with insecure parental attachment representations (Feldman, 2003), difficult infant temperament (Feldman, Greenbaum, & Yirmiya, 1999), and maternal depression (Field, Healy, Goldstein, & Guthertz, 1990). Higher synchrony has been found to be correlated with higher infant soothability, greater infant positive affect, and increased parenting stress (Moore, Powers, & Bass, 2007). Parent-infant synchrony has been shown to predict self-regulation and compliance in later childhood, fewer behavior problems, and better social-emotional adjustment in toddlerhood (Feldman, 2007; Feldman & Eidelman, 2004; Feldman & Greenbaum, 1997).

Although much of the mutual regulation literature emphasizes synchronous interactions, other researchers suggest that the periods of mis-coordination and the processes by which parents and infants work together to achieve affective stabilization are key. Tronick and Cohn (1989) suggest that mothers and infants spend roughly 30% of a given interactional period in coordinated co-regulated interaction; the rest of that time is spent in an uncoordinated state. They assert that the periods of dysregulation are essential to understanding a child's developing coping skills and self regulation. Hsu and Fogel (2003), exploring mother-infant interactions from 4 to 24 weeks, found that mothers and infants spent the majority of their time in mis-matched dyadic

states in which the parent was actively engaged with an inattentive infant. Indeed, Bell and Chapman (1986) suggest that "the most significant socialization occurs at times of destabilization" (p. 596). When one member of the dyad breaches the other's limits of tolerance in the interaction, for example through becoming over-aroused or becoming disinterested and turning away from the interaction, the other member of the dyad may adjust his behaviors to return the system to a state of balance, and a jointly-coordinated behavioral state. It is in the system's movement from nonequilibrium to equilibrium that socialization of regulatory skills takes place. Some suggest that when these episodes of dysregulation are not managed effectively by a caregiver, development is compromised (Cole et al., 1994). Children thus learn emotion regulation skills through repeated dyadic interactions characterized by movement between periods of greater and lesser synchrony.

Given that the dyadic construct of synchrony provides an index of the relative coordination of the dyad's behaviors over time, and that theory suggests that it is in the mis-coordinated times and the joint action on the part of both partners to change their behaviors to resume coordinated and mutually satisfying interaction that the development of regulatory skills occurs, the study of face-to-face interactions may benefit from an approach that documents the range of possible states (regardless of degree of coordination) and number of transitions between dyadic behavioral states. Although the construct of dyadic synchrony represents one option for exploring mutual dyadic regulation, the index provides a measurement of the degree to which the dyad was successful in mutually regulating, when the system was working optimally in a coordinated fashion to support mutual enjoyment, and for the infant to feel efficacious in regulatory skills, as the parent adaptively responds to his changes in behavior. Synchrony does little to account for the processes that may be in play in those times when the dyad is not

coordinated. The theoretical construct of dyadic flexibility, and methodology of state-space grid mapping, informed by a dynamic systems approach, may offer an opportunity to explore dyadic processes in the mis-coordinated times as well as the periods of synchronous coordination.

Mutual Regulation and Flexibility

Mutual regulation of parent-infant interactions involves important recurring patterns of periods of coordination and mis-coordination, which lend themselves well to scrutiny from a dynamic systems perspective. The construct of flexibility as measured in this study is theoretically based in dynamic systems perspectives. Utilizing moment-by-moment behavioral data, dyadic measures of flexibility can be derived including the range of affective dyadic states experienced by the dyad, and the number of transitions or amount of movement among varying states occupied by the dyad. According to a dynamic systems perspective, the moment-by-moment interactions (micro-structure) that occur in real time become the building blocks for patterns and habits that over an extended period of time may form stable, self-organizing traits that are difficult to disrupt (deWeerth & van Geert, 2000; Granic, 2005; Granic & Hollenstein, 2003). Dynamic systems principles suggest that non-equilibrium in the system is necessary for the emergence of new forms of interaction, and to allow self-organizing systems to adapt flexibly to changes in the environment (Granic, 2000). Self-organization begins in moment-to-moment time scales and restricted patterns of interaction in those moments, when repeated, become ingrained, thereby limiting the range of possible alternative interactional patterns over time, constraining the options for self-organization at the developmental scale (Granic, 2000; Granic & Hollenstein, 2003). Thus, developmental patterns of parent-child interaction arise from real-time interactions that tend to recur.

Historically, inflexibility (rigidity) has been a common construct in many domains of psychology when exploring established patterns and behaviors in individuals, such as practiced response patterns, personality traits, or cognitive styles (Hollenstein et al., 2004). Werner (1946, as cited in Hollenstein et al., 2004) highlighted a lack of adaptability and variability in responses as definitive of rigidity in an individual; stability in functioning reflected flexibility in response that preserves equilibrium in a variety of situations. When applied at the level of dyadic interactions (or more complex interactional patterns, such as family systems), the concept of flexibility remains the same, but the unit of analysis is broader, reflecting the relative contributions of each individual, and providing an index of the adaptability and variability in *dyadic* responses.

Stability occurs when behaviors self-organize into recurrent patterns over time (Granic, 2000). Some stable parent-child patterns of interactions can be seen in the functional development of turn-taking patterns of speech. Less optimal stable patterns are evident in Patterson's (1982) conceptualization of "coercive cycles" in parent-child interactions. Stabilized parent-child interaction patterns that are less flexible are characterized by a diminished behavioral repertoire with fewer emotional states available to the dyad regardless of environmental demands, a limited capacity to change behaviors in response to changes in the environment, and a tendency to perseverate in a particular behavior (Hollenstein, Granic, Stoolmiller, & Snyder, 2004). De Weerth and van Geert (2000) posit that there may be an optimal level of flexibility in the parent-infant interactional system. Too little flexibility may result in a restricted range of emotional expression and a limited (albeit potentially stable and predictable) repertoire of adaptational responses regulating the dyadic interaction. Too much

flexibility may result in unpredictable and varied emotional expressions and dyadic responses, potentially reflecting little mutual regulation.

This restricted range of emotional expression and limited repertoire of regulatory responses is in line with Tomkin's theory of the socialization of affect and personality development (Tomkins, 1962, 1963 as cited in Malatesta, Culver, Tesman, & Shepard, 1989). Broadly, Tomkins highlights that individuals who as children receive help from parents and others to learn strategies to maintain positive affective states, and to reduce negative states, but not to *avoid* negative states are the most balanced with respect to affect and personality development. He suggests that there are some distinct innate emotions, but that more subtle forms of emotion expression require maturation and socialization to be developed. In being exposed to and being able to express a broad range of emotions, and in learning how to effectively tolerate negative emotions, and utilize strategies to maintain positive emotions, children are being equipped to develop and integrative affective and personality style.

When patterns in parent-child relationships are less optimal it is likely not only the *content* of the interaction (negativity, flattened affect) but also the *structure* of parent-child behavior over time, that that influences child adjustment. Structurally, if a parent-child dyad develops patterns that are fixed in a particular pattern of responding (whether too flexible, or too rigid, or just not appropriate to the demands of the situation), the child is less likely learn the regulatory skills necessary for responding to a variety of emotional and cognitive demands. Hollenstein and colleagues (Hollenstein et al., 2004) suggest that getting "stuck," or remaining in a rigid (inflexible) pattern of dyadic behavior, is problematic, both in negative and positive states. A dyad that is "stuck" is likely to be over-arousing - parents may not modulate positive or

negative states when necessary, and the dyad may not be able to adapt to shifting demands of tasks, or learn to accommodate and regulate a range of emotions.

Olson (2000) explored the concept of flexibility in a family context in his circumplex model of family systems. His model broke down flexibility in family systems into four levels: rigid – very low flexibility, structured – low to moderately flexibility, flexible – moderate to high flexibility, and chaotic – very high flexibility. In his model, he suggested that mid range flexibility (structured and flexible) was conducive of good marital and family functioning, and that the extremes were more problematic. Although Olson's concept of flexibility highlights leadership, negotiation styles, role relationships, and relationship rules, as opposed to the current construct of flexibility as reflecting affective and behavioral responses of the dyad, his model nonetheless highlights the importance of an optimal level of stability and change. Systems should be able to change when appropriate and necessary, such as in times where negotiation is necessary, when the family system may change in response to a crisis, or when adaptability is necessary in periods of stress.

The few studies specifically exploring the dyadic construct of flexibility with respect to parent-child relations have looked at both in-the-moment patterns of flexibility in the interaction, and at the development of these patterns over time. Hollenstein and Lewis (2006) explored flexibility and affective expression in interactions between mothers and their adolescent daughters. They found that dyads were more flexible in positive interactions, and that flexibility decreased during conflictual interactions in which more negative emotion was expressed by both partners. Additionally, dyads in which the adolescents reported more stressful events in the family showed lower flexibility in positive discussions, and had reduced emotional expression in general across the interactions. In an exploration of parent-child interactions during the transition

to adolescence, Granic and colleagues (Granic, Hollenstein, Dishion, & Patterson, 2003) explored developmental changes in the dynamics of interactions during problem-solving tasks with parents and their sons, at age 9-10, and every two years until the boys turned 18. They found that flexibility in the interaction peaked when the boys were 13-14 years old, around the same time that adolescent behavior problems reached peak levels. Although these studies looked at parent-adolescent relationships, rather than parent-infant dyads, results illustrate the importance of considering flexibility in an interaction in the moment, and developmentally over time. More flexible dyadic interactions are likely to be more positive, and in conflictual interactions (or developmental periods in which dyadic conflict is likely to be heightened), dyadic flexibility is likely to decrease, perhaps as the dyad becomes "stuck" in negative, conflictual patterns of responding.

In a study of parents and their kindergarten children, Hollenstein and colleagues (Hollenstein, et al., 2004) explored the concurrent and predictive associations between measures of dyadic flexibility and child internalizing and externalizing problems. Parent-child interactions that were less flexible were associated with high levels of child externalizing problems, both concurrently and in 1st grade, with growth in the problem behaviors over time. These associations between parent-child rigidity in interaction and the development of psychopathology remained even when controlling for the specific behavioral and affective content of the interactions. Additionally, inflexibility in the interaction was associated with concurrent and chronic internalizing problems. These studies highlight the utility of looking at flexibility in the parent-child interaction with respect to current behavioral and affective functioning, as well as recognizing the dynamic processes of stability and change in interactional patterns over time.

Research and theory suggest that dyadic flexibility in interaction is built of important elements of the range of emotional and behavioral states the dyad occupies and the movement between states and ability to respond to stressors. Flexibility represents a dynamic interplay between the infant's and mother's response styles, and variability provides a wide range of emotional and behavioral options that enables the dyad to establish a relationship that meets both of their needs (de Weerth & van Geert, 2000). Inflexibility may be associated with behavior problems, stress in the dyad, and lack of successful adaptation to changing demands, either in-the-moment or over time. Similarly, high levels of flexibility may also be an indication of a stressed response to environmental demands, one that cannot utilize a stable and adaptive pattern of responding. It may be that moderate flexibility is the most adaptive response, being not too rigid or not too variable, for responding to stressors while maintaining a balance of stable interactive patterns. Whereas synchrony was described as a "dance" between dyadic partners, flexibility might be thought of as the "choreography", indexing the range of behaviors available to the dyad (how many steps do they use, how many dances are known) and the movement among dyadic states (what is the pace or tempo). Optimal dyadic "choreography" will be flexible in order to adapt to multiple song styles or beats (contexts and stressors), reflecting a dyad that can improvise, and does not get "stuck" in one particular pattern of responding, dancing a waltz when the music calls for a salsa.

Relations Between Synchrony and Flexibility

Previous research exploring mutual regulation of parent-infant dyadic interactions has explored affective expressions of the individuals (e.g. "*behavior state matching,"* Field et al., 1990), and the temporal qualities of changes in parent and infant affective states in response to the partner (e.g. "*contingent responsivity*," Clarke-Stewart, 1973). Looking at parent-child

dyadic interactions from the two frameworks of *synchrony* and *flexibility* may illuminate distinct characteristics of the interactions independent of the affect expressed or the match between the two partners. As opposed to other constructs exploring the parent-child relationship that are often driven from an analysis of the behaviors of one individual and the contingent responses of another, synchrony and flexibility take into account both the parent's and infant's responsivity, emotional availability, and expression, to provide an index of the unique qualities of the structure of the interaction between the two. "Because synchrony is built on the parents' moment-to-moment attention to the infant's patterns, it may be more susceptible to parental overload than global aspects of parenting, such as sensitivity or responsiveness (Feldman & Eidelman, 2004, p. 1134)." Synchrony and flexibility as constructs highlight the *processes* at play, and the structure of the dyadic interactions; synchrony captures the correspondence between partners over time, the degree to which the dyad moves in tandem among various behavioral and affective states or is uncoordinated. Flexibility provides an index of the variability and range of the dyadic states the pair occupies, and the movement among various states, highlighting the variability in the ways in which the dyad tends to function in the interaction.

Flexible interactions are not necessarily synchronous ones, nor do synchronous interactions always appear flexible. For example, one might observe an interaction in which each member of the dyad moved frequently among affective states (positive, negative, neutral), but never in coordinated movement (when the infant was becoming more negative, the mother stayed in the same affective state, when she moved the baby remained stable). This interaction might look flexible, but not synchronous. Similarly, an interaction might look highly synchronous if the mother and infant were both primarily positive throughout the interaction, but moved in tandem to brief periods of neutrality before moving back to a mutually positive state.

Although highly synchronous, this interaction may not be very flexible as the range of affect expressed and the transitions among dyadic states were limited. Taken in isolation, these patterns simply highlight the possibilities for relatedness and independence among the constructs. However, when brought back to the theoretical framework of developing emotion regulatory skills, their patterning may become more informative. If a child is consistently exposed to synchronous positive yet inflexible interactions, he may not be exposed to opportunities to try to regulate negative emotions. Similarly, if exposed to consistently flexible, but non-synchronous interactions, the child may not gain the important sense of self-efficacy in his ability to change the emotional climate of his environment by modifying his behavior.

In two recent explorations of the nature of these constructs from separate samples, flexibility and synchrony were found to be low to moderately correlated, but to represent independent constructs (Bass & Moore, 2007; Moore, Powers, & Bass, 2007). In one analysis, greater flexibility was associated with lower levels of infant distress, arousal and dysregulation, both behaviorally and physiologically, and with lower levels of parent conflict in the home (Bass & Moore, 2007). Similarly, in analysis of another dataset, it was found that greater flexibility in the dyad was correlated with greater infant positivity and with higher levels of conflict resolution in the marital relationship (Moore, Powers, & Bass, 2007). Higher synchrony was found to be correlated with higher infant soothability, greater positive affect, and more parenting stress. This previous research suggests that the construct of flexibility may tap into aspects of the dyadic interaction that are associated with contextual factors, such as an interactional style in the parent that is replicated across contexts (marital relationship, parenting role), whereas the construct of synchrony may be illuminating the role of the infant (affect, reactivity) in the dyadic interaction. This distinction may be supported by the research suggesting that parent-infant synchrony is

inflenced by physiological processes in the infant, (e.g. Feldman, 2007, Moore & Calkins, 2004), and that flexibility may be reduced in periods in which there is increased conflict in the family system (e.g. Granic et al., 2003, Hollenstein & Lewis, 2006).

Family Contexts and Dynamic Systems Principles

Flexibility and synchrony represent indices of the structure of dyadic interactions, thought to reflect mutual regulation. Theories of mutual emotion regulation highlight the bidirectional influences of both partners, of the individual characteristics of an infant's reactivity influencing the parent's responses, or of a parent's own emotional expressions and abilities to self-regulate influencing her ability to respond sensitively to her infant. Similarly, research exploring the structure of dyadic interactions highlights the contextual factors influencing the interaction at the level of the dyad, such as the quality and degree of outside stressors and perturbations (e.g. still face paradigm, having the dyad discuss a conflict situation). Synchrony and flexibility are dyadic constructs created from child and parent characteristics, thus contributions of the parent (responsivity, affect expressed) are likely to be influenced by parent and family characteristics that are related to caregiving (Skuban, Shaw, Gardner, Supplee, & Nichols, 2006). Parents' psychological well-being and social support likely contributes to their abilities to interact synchronously with their infant (Belsky, 1984).

The aforementioned research on mutual regulation within the parent-infant dyad recognizes the individual roles of each partner in influencing the interaction. However, dynamic systems principles simultaneously highlight macro- and micro-structure hierarchies (Granic, 2005). The macro-structure hierarchical element of this theoretical orientation maintains that an individual is nested within a family and that family within a culture; thus recognition of the multiple reciprocal dyadic interactions that are hierarchically nested and mutually influential, the

context in which the dyadic system is embedded, will be beneficial to understanding the system's behavior (Granic, 2005; Granic, & Hollenstein, 2003).

These contextual forces affecting the mutual regulation of parent-infant interactions may occur at multiple levels: those aspects of the *individual* (parent, infant) that may influence relationships with others, relationships *among* family members that may affect dyadic interactions with others (e.g. marital dyads influencing parent-infant dyads), and aspects of interactions among multiple levels (individual and dyadic) that influence the whole system. Each of these levels may be explored at the individual micro-structural level, but also may provide important *contexts* that may be explored to examine macro-structural dynamic influences on behaviors. For example, at the level of dyadic interactions, father-infant and mother-infant interactions may provide separate contexts in which children are exposed to varying degrees of flexibility in interaction, and therefore learn different regulatory skills. Similarly, the affective valence of the interaction, whether the dyad is engaging in a pleasing or challenging task, may influence the synchrony and flexibility of the interaction. Additionally, the marital relationship represents a separate dyadic context influential in the family system; the quality and structure of marital interactions may have an indirect influence on individual parent-infant interactions.

Dyadic Contexts: Exploring Interactional Styles of Mothers and Fathers

Each parent-infant dyad provides a distinct interactional context in which the infant experiences and learns to regulate emotion. Although less research has been conducted with fathers than with mothers, much of the research has shown that fathers are just as sensitive, highly involved, and attuned to their infants as mothers, and that infants develop attachments to fathers that are independent of their relationships formed with mothers (Belsky, Gilstrap, & Rovine, 1984; Braungart-Rieker, Garwood, Powers, & Notaro, 1998; Lewis & Lamb, 2003;

Parke & Tinsley, 1981). However, research also indicates that despite these similarities, and the capability of both parents to achieve synchronous dyadic relationships with their children, fathers and mothers may interact in different ways with their children and may foster different regulatory skills by virtue of these differences in interactive style.

In a study with 5-month-old infants, Feldman (2003) found that fathers and mothers were equally able to engage in second-by-second synchrony with their infants, however they offered different experiences in these interactions. Mother-infant play was characterized by stable regulated turns and a mutual focus on attention; play primarily consisted of coordinated social interaction, and the affective valence of the interaction oscillated fluidly between low and medium states of arousal. With fathers, play was characterized by the sudden buildup of high intensity emotional peaks that became more frequent as play progressed.

Others have noted similar qualities in the style of play between fathers and infants, describing unpredictable play comprised of high intensity, often physical or emotional sudden "staccato" peaks (Braungart-Rieker et al., 1998; Clarke-Stewart, 1978; Yogman, 1981, as cited in Lewis & Lamb, 2003). Fathers thereby provided their infants opportunities for the management of high-intensity positive arousal. Thus fathers and mothers offer different levels of positive orientation and rhythms in their interactions with infants, affording their children different opportunities to practice modes of arousal regulation (Feldman, 2003). Garcia-Sellers and Church (2000, as cited in Harrist & Waugh, 2002) found no differences in the average level of synchrony between mothers and fathers, but found that mother-child synchrony predicted child self-regulation, whereas father-child synchrony did not. Similarly, Braungart-Rieker and colleagues (1998) found different predictors for mother-infant and father-infant dyads; maternal sensitivity and mutual engagement were predictive of infant affect with mothers, but a similar

association between sensitivity and mutual engagement and infant affect was not found for fathers.

Additional studies have examined the effects of parent- and child- sex on synchrony, sensitivity, and parental engagement, finding that the match or mis-match of parent and infant sex represents another distinct contextual factor. Wienberg, Tronick, Cohn, and Olson (1999), in a study of 6-month-olds and their mothers, found that mother-son dyads exhibited higher synchrony than mother-daughter dyads. However, interactive repair of non-synchronous states was slower for mother-son than mother-daughter dyads. In her study of 5-month-old infants, Feldman (2003) found that father-son pairs showed the highest degree of synchrony of all parent-child pairs. She maintained that co-regulation of sex-matched pairs may be important, as they may have similar modes of arousal regulation, facilitating self-regulatory capacities through affective matching.

Braungart-Rieker and colleagues also recognized links between married couples in parenting (Braungart-Rieker et al., 1998). In a study of 4 month olds and their parents, mothers and fathers were found to have similar mean levels of sensitivity and mutual engagement, and infants exhibited similar amounts of positive affect with each parent. In addition, mothers who exhibited greater levels of sensitivity and mutual engagement with their infants were likely to have partners who showed similarly greater levels of these characteristics relative to other fathers. Resemblance between mothers and fathers may reflect characteristics of the infant that elicit similar behaviors from both parents, or a familial style of dyadic interaction. Thus, there may be characteristics of the dyadic context of the marital relationship (affect expression, flexibility, synchrony) that are mirrored in dyadic parent-infant interactions, reflecting dynamic systems principles of mutually influential contextual forces occurring at different dyadic levels.

These studies suggest that there may be important differences in the structural quality of interaction for infants with their fathers and mothers. Although the "dance" may be similarly coordinated for mothers and fathers, the affective valence expressed in that dance may vary, with fathers expressing greater periods of positive arousal. It may be that fathers and mothers are better dance partners with same or opposite sex infants, may be better able to coordinate their steps. The "choreography" of the dance may vary depending on whether the infant is interacting with his father or mother. Infants may be generally exposed to a fast-paced polka with fathers, characterized by rapid movement toward high intensity positive peaks, whereas with mothers they learn to dance the waltz, moving fluidly among a variety of affective states with a rolling, predictable, and gentle pace.

Family Contexts: The Influences of Marital Conflict, Stress, and Depression on Parenting

As fathers and mothers bring different interactional styles to dyadic interactions with their infants, there may be factors of their environments that influence their parenting styles and abilities to be responsive to their children in the context of parent-infant interactions. The influence of the marital relationship on parent-infant interactions has been described in the *spillover hypothesis*, whereby aspects of the marital relationship are expressed in the parent-child relationship (Easterbrooks & Emde, 1988). The spillover theory suggests that a positive marital relationship will be associated with positive parent-child interactions characterized by parental sensitivity to the child's needs, while negative marital quality may engender negative parent-child relationship quality as evidenced by less attentive and sensitive parenting. Marital hostility spills over to parental hostility and negative affect when interacting with children (e.g. Gottman & Katz, 1989; Kerig, Cowan, & Cowan, 1993). This association between the marital and parent-child subsystems may reflect various contextual pathways of influence. As mentioned above,

there may be characteristic styles of dyadic interaction, potentially inflexible, conflictual interactions, that are expressed in both marital and parent-child contexts. Alternately, it may be that an individual's experience of stress in the marital relationship has an effect on the ability to parent sensitively and be responsive and flexibly adapt to an infant's needs.

There is evidence to indicate that the quality of the marital relationship may have a differential impact on the parenting behaviors of fathers and mothers. Research suggests that men are more consistently involved in parenting and exhibit more responsive, sensitive and positive behaviors with their children when the marital relationship is supportive; marital dissatisfaction adversely affects paternal sensitivity and paternal attachment and marital distress is associated with father withdrawal from their children (Belsky et al., 1984; Belsky, Youngblade, Rovine, & Volling, 1991; Howes & Markman, 1989; Lewis & Lamb, 2003; Volling & Belsky, 1991). In contrast, others found that associations between marital discord and parental hostility did not differ for mothers and fathers (Stocker, Richmond, Low, Alexander, & Elias, 2003; Erel & Burman, 1995). In their research, Belsky and colleagues (Belsky et al., 1984) found differences between father involvement and mother involvement related to the marital interaction. High levels of father involvement in parenting was associated with high levels of marital communication, but this was not the case for mothers, suggesting that fathers' parenting roles are linked with their satisfaction with the marital relationship whereas mothers are more likely to separate their parenting and marital roles.

Parenting stress may disrupt parenting behaviors, resulting in strained parent-child dyads and less positive interactions (Crouter, Bumpus, Head, & McHale, 2001; Fagan, Bernd, & Whiteman, 2007; Gyamfi, Brooks-Gunn, & Jackson, 2001). Margolin (1981) asserts that the stresses of parenting are linked to a strain or decline in marital quality, and that these stressors

and influences may be exacerbated when parents experience strained parent-child relationships. Research exploring the interconnections of these familial stressors suggests that negative mood states often are found to carry across settings (workplace to home, marital interaction to parenting role), and has even shown that men may be more susceptible than women to the spillover of negative moods from one setting to another (Gottman & Levenson, 1986, as cited in Fagan et al., 2007; Williams & Alliger, 1994, as cited in Fagan et al., 2007). Parental stressors may be bidirectional: parents may experience stress in their work and marital roles that spillover into their sense of efficacy in their role as a parent, and they may experience difficulties in parenting that spillover into their marital relationships.

One contextual factor likely to affect parent-child relationships, parenting stress, and marital quality is parental depression. In the large body of research on parental depression and parent-child relationships, depression has been linked to less positive parent-child relationships, characterized by negative parenting behaviors, more withdrawn and fewer positive behaviors, flat affect and less contingent responsivity with infants, and more conflictual interactions (Ballard & Davies, 1996; Bronte-Tinkew, Moore, Matthews, & Carrano, 2007; Cohn, Campbell, Matias, & Hopkins, 1990; Cohn & Tronick, 1983; Cummings & Davies, 1994; Downey & Coyne, 1990; Field, 1984; Pleck, 1997). Parental depression may have an impact on reducing synchrony, as it may reduce contingent responsiveness, the parent may not "dance," and the infant may have already learned already not to move too much, or may have developed patterns to exacerbate his movements in order to induce movement in his dancing partner. With respect to flexibility, parental depression may result in an inflexible interaction, characterized by a restricted range of affect and few movements among dyadic states, or perhaps an overly-flexible interaction (reflecting the lack of contingent responsiveness), in which the dyad moves widely

among a variety of dyadic states, reflecting emotional lability and a lack of consistent correspondence between parent's and baby's affect. Specific to the mother-child dyadic interaction, synchrony has been found to be reduced under conditions of maternal depression (Field et al., 1990). Additionally, Jameson and colleagues found that depressed mother-toddler dyads exhibited less interactive coordination, fewer maintenance behaviors in the interaction, and less interactive repair than their non-depressed counterparts (Jameson, Gelfand, Kulcsar, & Teti, 1997).

The contextual factors of strained marital relations, parenting stress, and parental depressive symptoms are theoretically and empirically associated with affective expression, parenting sensitivity and responsiveness and aspects of dyadic interaction such as flexibility and synchrony. Synchrony in the dyad, or parent-infant coordination of affective states, is likely to be affected by outside influences that may modify the parents' emotional availability, attention to the infant's cues and capacity to change his own actions in a coordinated fashion with his infant. Flexibility, or the movement among and range of expressed affective states, may either be heightened or reduced in response to a parent's outside stressors, and may disrupt a dyad's ability to fall into stable, well-regulated moderate patterns of dyadic interaction. The influence of parental depression or parenting stress on the parent-child relationship may have a more direct effect on the dyadic qualities of parent-infant interactions apart from the quality of the marital interaction. Thus, consistent with the spillover hypothesis, the relative flexibility and synchrony in patterns of interaction and range of emotion expressed in the family at individual, dyadic, and triadic levels may be interconnected and exert influence on the qualities of interactions in separate subsystems.

Manipulating Interactive Contexts: Situational Demands of the Interaction

In addition to the individual and dyadic factors that may affect the synchrony and flexibility of the interaction, a final added layer to influence the dyadic system includes the demands of the situation in which the parent and infant are interacting. Previous research suggests that synchrony is often characteristic of mutually regulated, and jointly positive interactions, and is reduced in periods dysregulation. Similarly, dyadic flexibility has been shown to be reduced in periods of conflict or mutual negative emotion. A widely used paradigm for manipulating parent-infant interactions to observe emerging infant regulatory skills, especially with respect to the infant's attempts to be an active partner in the interaction, is the Still Face Paradigm (SFP: Tronick, Als, Adamson, Wise, & Brazelton, 1978). The typical manipulation involves allowing parent and infant to play naturally for a period of time, then for the parent to adopt an unresponsive "still face," followed by a reunion period in which the parent re-engages naturally with the baby and attempts to facilitate the repair of the dyadic interaction that was disrupted by the still face.

While much research focuses on the infant's behavior in the unresponsive period, exploring his emerging strategies for both engaging a parent and self-soothing when met with frustration, the face-to-face and reunion episodes are of most interest to the exploration of dyadic interaction in the current study (see Adamson & Frick, 2003 for a review of the SFP). In the face-to-face episode, we might observe the parent and infant engaging in a fairly typical face-to-face interaction, presumably infused with mutual positivity, and characterized by mutual regulation of the interaction. After the disruption of the still face, the setting is ripe to observe the interactive repair of mis-matching states highlighted in the literature as essential for the development of regulatory skills. In the reunion, we might expect to see a mix of negative and positive emotions in the infant, an increase in fussiness and pouting, or a spillover of the negative

emotions from the still face, and later rebound to a synchronous, more positive interaction, as the parent and infant work together to return the system to a well-regulated state (e.g., Moore & Calkins, 2004; Weinberg & Tronick, 1996). It is in the face-to-face interaction that we might see the dyad at its optimal level of coordiation, and in the reunion that we might expect to see them struggle to regain a mutually beneficial and pleasing state. Thus, through the manipulation of the interactive context, we may see how the dyad functions typically, and how they adjust to a minor stressor that disrupts the typical bidirectional flow of the dyadic interaction.

Current Study and Associated Hypotheses

The current study expands upon prior research investigating the role of *synchrony* in parent-infant interactions and the potential differences between mothers and fathers interactional styles by utilizing dynamic systems techniques to explore face-to-face parent-infant interactions in terms of the relative dyadic *flexibility* of the interaction. Flexibility in parent-child interactions has been explored in work with older children and adolescents (e.g. Hollenstein et al., 2004), but little work has been done to explore early parent-infant interactions utilizing this framework. In this study, the relations among contextual factors and the dyadic constructs of synchrony and flexibility are examined, exploring contextual influences at multiple levels, consistent with a dynamic systems perspective highlighting the importance of nested, mutually influential contextual influences: that of the parent-infant interaction, that of the interactional setting, that of the characteristics of the individual parent, and that of the marital relationship. Specifically, the constructs of marital satisfaction, parental depressive symptoms, and parenting stress will be explored in relation to the processes of mutual regulation in parent-child interactions, as operationalized in terms of dyadic synchrony and flexibility within a typical (face-to-face) and more challenging (reunion) interaction. Given evidence suggesting these contextual influences

may operate in different ways for mothers and fathers, the potential role of parent sex and the match or mis-match between parent and infant sex on these relations are also explored.

Questions and hypotheses addressed in this study are as follows:

Question 1: Given that dyadic synchrony and flexibility represent methods of indexing the structural qualities of interactions, but have different theoretical emphases with respect to the relative correspondence between partners, and the range and movement within behavioral states, how are dynamic qualities of dyadic synchrony and flexibility related to each other, how stable are these qualities across interactive contexts and settings, and how are they related to affective qualities of parent-infant interaction?

Hypothesis 1a: Consistent with theoretical associations, and prior explorations of synchrony and flexibility utilizing the same methods as are proposed in this study (Bass & Moore, 2007; Moore, Powers, & Bass, 2007), synchrony and flexibility will show low to modest correlation within interactional contexts (face-to-face and reunion episodes) and will be moderately stable across interactional contexts.

Hypothesis 1b: As found in prior explorations of synchrony in the Still Face Paradigm (SFP: Tronick et al., 1978) utilizing the same methods as proposed here (Moore & Calkins, 2004), mean levels of synchrony and flexibility of dyadic interaction may differ between face-to-face and reunion episodes of the SFP, as these represent differing interactional contexts and regulatory demands placed on the dyad. Consistent with Moore & Calkins (2004), it is predicted that mean levels of synchrony will be greater in the reunion episode than in the face-to-face episode, as this dyadic context pulls for greater mutual regulation of the interaction as the dyad works to repair after the interactive break of the still-face episode. Consistent with

findings of Hollenstein and Lewis (2006), it is predicted that flexibility may be reduced in the reunion episode as the dyad is stressed and expressing more negative affect, and as the implicit goal of the interaction is to return the dyad to a more mutually-regulated and coordinated state, thereby potentially appearing less flexible.

Hypothesis 1c: Although the constructs of synchrony and flexibility may be independent of the affective valence of the interaction (synchronous or flexible interactions may not necessarily be mutually positive) there may nonetheless be correlations between parent and infant affect and measurements of dyadic synchrony and flexibility, given that measures of synchrony and flexibility are derived from affective behaviors. Consistent with theoretical conceptualizations of the constructs, and prior explorations (Bass & Moore, 2007; Moore, Powers & Bass, 2007), it is predicted that synchrony will be modestly positively correlated with infant positive affect in face-to-face and reunion episodes, and modestly negatively correlated with infant negative affect in the reunion episode. Flexibility is predicted to be positively associated with parent and infant positive affect across episodes, consistent with prior explorations of flexibility and affective expression (Hollenstein & Lewis, 2006).

Question 2: Consistent with the theory and evidence that mothers and fathers have differing interactional styles with their infant, and yet interactional styles within families between mothers and fathers and their infant are often similar, are there similarities and differences in the dyadic qualities of interactions of mothers and fathers and their infant as indexed by dyadic synchrony and flexibility?

Hypothesis 2: The dyadic quality (measured in terms of synchrony and flexibility) of mother-infant and father-infant interactions (in the two different contexts – face-to-face

and reunion) will be similar across parents, but may differ depending on the sex of the infant.

2a: Mother-infant and father-infant interactions on average will be similar in their degree of synchrony and flexibility.

2b: Same-sex dyads and mixed-sex dyads will exhibit different patterns of synchrony and flexibility, although given mixed evidence in prior research no specific predictions will be made at this time.

Question 3: Consistent with the theory that contextual factors may influence an individual's affective expression and ability to be responsive in an interaction, are contextual factors in the family environment (the quality of the marital relationship, parenting stress, and parental depressive symptoms) related to dyadic qualities of parent-infant interactions?

Hypothesis 3: The quality of the family environment as indexed by parent report of marital satisfaction, parenting stress, and parental depressive symptoms will be related to qualities of parent-infant interaction as indexed by synchrony and flexibility.

3a: Based on prior research (Bass & Moore, 2007; Moore, Powers, & Bass, 2007), and theory that suggests flexibility and synchrony are reduced in negative and conflictual situations, it is expected that families with higher marital dissatisfaction will have less flexible parent-infant interactions, reflecting systemic behavioral rigidity and a spillover of negative affect from the marital to parenting relationships.

3b: Based on prior research (Field et al., 1990; Jameson et al., 1997), and theory that suggests that depression and parenting stress are characterized by a decrease in positive emotions expressed, and a reduction in responsivity in dyadic situations,

parental depressive symptoms and parenting stress will be associated with reduced synchrony and reduced flexibility in the interaction.

Question 4: Assuming that associations are found for question three, how might parent sex or the match between parent and infant sex moderate these associations between contextual factors and dyadic qualities?

Hypothesis 4: Parent sex, infant sex, or the parent-infant match, may moderate the relations between contextual factors (marital quality, parenting stress or parental depressive symptoms) and structural qualities (synchrony, flexibility) of the parent-infant interaction. Specifically, based on prior research (e.g. Belsky et al., 1984), the quality of the marital relationship will be more highly associated with the qualities of father-infant interactions than mother-infant interactions, as theory suggests that fathers may have a more difficult time compartmentalizing their parenting and marital or work roles, and experience greater spillover of affect than mothers.

Method

Participants

Participants for the current study were two-parent families with their six-month old infants (N = 164), who were part of a study exploring the influence of a parental history of depression on infant development (Infant Development Study (IDS): P.I.s Lewinsohn, Cohn, & Allen). Families in the IDS were recruited from a sample of adults who were participants in a longitudinal study conducted in urban and rural Western Oregon investigating the developmental course of adolescent-onset depression. In the IDS one parent in each family was a proband or control from the original adolescent sample. The current study included families for which there

were questionnaire and face-to-face interaction data for mothers, fathers, and their infants at the 6-month visit (N = 164).

Participants in this study included primarily Caucasian parents (94% of mothers and 87% of fathers). The average age of mothers was 26 years (SD=2.42) and fathers were 28 years old on average (SD = 3.33). At the time of the study, 88% of parents were married. Over half of the participants had a high school degree (53% of mothers and 52%) of fathers, and 33% of mothers and 30% of fathers had a 2- or 4-year college degree. There was a broad range of family income level, and sixty percent of families had an annual household income of $30,000 or greater.

Procedure

Parents and their infants took part in a laboratory assessment when the infants were 6 months old. Face-to-face interactions and parental questionnaires were completed by mothers and fathers separately as part of a broader assessment battery. Parental questionnaires consisted of a number of measures designed to assess current parental depression and mood state, marital functioning, and parenting stress.

Face-to-face Interactions: Observational Procedures, Data Coding, and Analyses

Observational procedures. The face-to-face interactions were completed separately with both parent-child dyads. The order of father-child and mother-child interactions was counterbalanced to control for potential order effects, and whenever possible both parents were observed with their infant on the same day. During each parent-infant interaction, the other parent left the room so as not to observe his or her spouse's interaction. Each parent participated in a modified Still Face Paradigm (Tronick, et al., 1978) with his/her infant that contained four conditions designed to elicit a broad range of infant emotions: face-to-face play, peek-a-boo game, parent still face, and reunion. The infant was seated in an infant seat secured to the table

with the parent sitting in a chair in a face-to-face position at eye level in front of the infant. During the 3-minute free play condition parents were instructed to play with the infant as they normally would. Peek-a-boo lasted for 40 seconds and represented a structured version of the game. Parents then presented a still face to the infant for 2 minutes and were given 2 minutes of unstructured reunion play following the still face condition. Two cameras were trained on the parent's and infant's faces and video feeds were synchronized to allow for coding of behaviors at the same point in time.

Data coding. Coding of parent-infant interactions was done by separately coding the affect and behaviors of the infants and parents in 1-second time frames. The coding system developed was an adaptation of Tronick's manualized monadic phases coding system (Cohn & Tronick, 1987; Tronick, Als, & Brazelton, 1980) and Izard's Affex system (Izard, Dougherty, & Hembree, 1983). Infant behavior was coded during all four conditions, while parent behavior was coded during face-to-face and reunion play. Infant facial expression was coded as negative, neutral, or positive. Parent facial expression was coded utilizing a 7-point scale that included the categories of anger, sadness, neutral, low positive, high positive, surprise, and empathy. In addition, direction of gaze (toward or away from the partner) was coded for both parent and infant. Prior to analysis, parent facial expression codes were recoded to a 3 category system to mirror infant affect codes of negative (anger, sadness), neutral (neutral), and positive (low positive, empathy, high positive, surprise).

Coding of videotapes was conducted by observers trained to a minimum reliability of $\underline{\kappa}$ =.70 and 80% agreement. Separate coding teams coded infant and parent behaviors and within each team the same person never coded both mother and father of the same infant or the infant with both of his/her parents. In addition, 20% of the parent tapes and 20% of the infant tapes

were coded by more than one coder to ensure inter-coder reliability and to reduce coder drift. For this subset of observations, parent kappas were .82 for facial expression, and infant affect and gaze kappas ranged from .71-.83.

Dyadic Synchrony. To measure the relative coordination of parent and infant behaviors over time, parent-infant synchrony during free-play and reunion phases of the SFP was calculated according to procedures established by previous research (e.g., Moore & Calkins, 2004). First, social engagement scores were created for parents and infants separately utilizing information from both the affect and gaze codes to create an index of engagement on a 6-point scale whereby a "1" represents the lowest level of engagement with the partner (negative affect and gaze away) and follows through increasing levels of engagement and positive affectivity (i.e., "2" represents negative affect with gaze towards the partners, "3" is neutral affect with gaze away) to a "6" being the most engaged (positive affect and gaze towards) with the partner. Pearson correlation coefficients were computed between parent and infant engagement scores on a second-by-second basis, thereby creating an index of dyadic synchrony with a theoretical range of -1 to 1. Separate synchrony scores were created for each parent-infant dyad in each interactional context (face-to-face and reunion episodes). Synchrony scores were transformed prior to analysis utilizing Fisher's R to Z transformation.

Flexibility. To measure the range of affect expressed in the interaction, and the number of transitions among states expressed by the dyad, parent and infant affective states in second-by-second behavioral observations were further explored utilizing GridWare software (Gridware 1.1; Lamey, Hollenstein, Lewis, & Granic, 2004). The GridWare program allows for exploration of dyadic time-series data utilizing dynamic systems principles by creating a grid of all possible state spaces that a dyad can inhabit. In this case the grid included 36 possible states made up of

combinations of the six possible infant levels of engagement (discussed above) and the six corresponding parental affective states (see Figure 1). The GridWare program provides measures of flexibility by identifying the *range* of affective states that a dyad exhibits (theoretically 1-36 with this dataset), the *transitions* among the various possible states across the course of an interaction (the number of transitions a dyad made in a given interaction divided by the total valid interaction length, thereby accounting for variety in length of interaction, and representing the percentage of time the dyad changed states within the interaction, theoretically 0-1), and a measure of the *dispersion*, or how evenly the data points are spread across the state-space grid for a given episode (the sum of the squared proportional duration of time spent across all cells, corrected for the number of cells visited, and inverted (following Hollenstein et al., 2004), theoretically ranging from 0-1) . Fewer states visited and fewer transitions among states, and lower dispersion values suggests an interaction that is "stuck" and less flexible with a restricted range of affect. Associations among the various indices of flexibility were explored using correlations. As they were expected to be fairly highly correlated based on analyses in previous research (correlations ranging from .52 to .65), scores were standardized and summed to create a composite variable of *flexibility* for use in analyses. The composite flexibility scores (for mothers and for fathers and in face-to-face play and reunion episodes) had alphas ranging between .73 to .83.

Questionnaire Measures: Parental Depression, Parenting Stress, and Marital Functioning

Parental depression. The Center for Epidemiological Studies – Depression Scale (CES-D), a standardized self-report measure of depression severity widely used in research to screen for depression, was used to assess current parental depressive symptoms (CES-D; Radloff, 1977). The 20-item CES-D scale assesses an individual’s current levels of depressive symptoms.

Items are rated on a 4-point scale based on the frequency with which the item has been experienced in the previous week. Scores are then summed to create an overall depression rating. A score of 16 or higher signifies the risk of clinical depression. The CES-D has good established reliability and validity, with an alpha of .85 in a general community sample.

Parenting stress. Parenting stress was assessed through the Parenting Stress Index (PSI; Abidin, 1986). The PSI is a parent-report measure that assesses elements of child behavior and sources of stress for parents. The 101-item assessment consists of 13 subscales that make up two broadband domains: the Child Domain and the Parent Domain. The Child Domain includes the following subscales: Child Adaptability, Child Demandingness, Acceptability of Child, Child Mood, Child Distractability, and Reinforces Parent. The Parent Domain subscales include: Depression, Parental Attachment, Restriction of Role, Social Isolation, Health, Relationship with Spouse, and Sense of Competence. The PSI has been well-validated and is a stable measure of parenting stress for use with infants and older children. It has a demonstrated ability to discriminate between normal and stressed family systems (Haskett, Ahern, Ward, & Allaire, 2006). The current study used the two broadband domains of Parenting Stress –Child, and Parenting Stress – Parent for analyses. In this study, the scores of the final scales were reversed such that higher scores indicated less parenting stress, so as to remain consistent with other measures of family functioning (such as the DAS mentioned below), and to facilitate ease of interpretation.

Marital functioning. Martial quality was assessed using the Dyadic Adjustment Scale (DAS: Spanier, 1976). The DAS assesses the quality of spouses and other similar dyads. It is made up of 32 items comprising four subscales: dyadic consensus, dyadic satisfaction, dyadic cohesion, and affectional expression. The reliability estimates for the four subscales range from

.73 to .94. A total adjustment score is calculated and will be used in the current study, with a possible range of 0-151, with higher scores indicating better adjustment; clinical cutoff of below 107 has been used to classify couples as "maritally dissatisfied." The total scale has excellent reliability (α = .96) and validity.

Results

Descriptive Analyses

Prior to examining study hypotheses, descriptive analyses were conducted of study variables. Means and standard deviations for mothers and fathers are presented in Table 1. As described in Forbes et al. (2004), results of a one-way ANOVA indicated a significant difference between mothers' and fathers' positive affect in the face-to-face episode, $F(1,264) = 5.03$, $p = .026$, with mothers expressing significantly more positive affect (M = .57 , SD = .22) than fathers (M = .51, SD = .23). Additionally, significant differences in depressive symptoms were found between mothers and fathers, $F(1,311) = 9.38$, $p = .002$, with mothers endorsing significantly more depressive symptoms (M = 8.53, SD = 7.94) than fathers (M = 6.03, SD = 6.29). No differences were found between parents for the other variables (e.g. parenting stress, marital satisfaction, infant affect).

Analyses for study hypotheses were initially conducted using the whole sample (mothers and fathers data combined) when applicable to explore the relations between study variables and the structural constructs of flexibility and synchrony. However, results indicated that patterns of association consistently differed for mothers and fathers, consistent with the theory that mothers and fathers may engage in different styles of dyadic interaction with their infants, and their parenting may be differentially influenced by contextual factors. Therefore, results discussed below are separated by parent.

Hypothesis 1a: Synchrony and flexibility will be moderately correlated within context (face-to-face and reunion episodes) and stable across contexts.

Synchrony and flexibility in the mother-infant dyad was modestly correlated in the face-to-face and reunion episodes, and modestly stable across episodes (see Table 2). In father-infant dyads, only synchrony remained stable across episodes, and flexibility and synchrony were not correlated (see Table 3).

Hypothesis 1b: Mean levels of synchrony and flexibility of dyadic interaction may differ between face-to-face and reunion episodes of the SFP.

Repeated measures ANOVAs of synchrony and flexibility with parent (mother, father) as the between subjects variable and episode (face-to-face, reunion) as the within subjects variable were conducted. Results indicated that mean levels of synchrony did not differ between face-to-face and reunion episodes $F(1, 249) = 0.173$, $p = .678$. Similarly, mean levels of flexibility did not differ between face-to-face and reunion episodes $F(1, 240) = 0.299$, $p = 585$. No interactions were found between episode and parent for either variable, indicating that levels of synchrony and flexibility did not differ depending on which parent was interacting with the infant.

Hypothesis 1c: There may be correlations between parent positive and infant positive and negative affect and measurements of dyadic synchrony and flexibility.

Mother-infant synchrony and flexibility in the face-to-face episode was correlated with maternal positive affect, and infant positive and negative affect in the episode (see Table 2). In the reunion episode, only mother-infant synchrony was correlated with maternal positive affect expressed in the interaction. Father-infant synchrony and flexibility in the face-to-face episode was correlated with infant positive affect expressed (see Table 3). Father-infant synchrony and flexibility in the reunion episode was correlated with infant positive affect expressed in the

interaction, and synchrony was also correlated with infant negative affect expressed in the interaction.

Separate multiple regression models were analyzed for mother-infant and father-infant synchrony and flexibility to explore the relative contributions of parent and infant affect in predicting dyadic synchrony and flexibility (see Table 4). The model predicting mother-infant synchrony in the face-to-face interaction from mother and infant affect was significant, R = .55, adj. R^2 = .29, F(3,136) = 19.17, *p* =.000. Mother and infant positive affect, and infant negative affect independently predicted synchrony. In the reunion episode, mother-infant synchrony was also predicted by parent and infant affect R = .26, adj. R^2 = .04, F(3,117) = 2.78, *p* =.044, with mother and infant positive affect independently predicting synchrony. The model predicting mother-infant flexibility in the face-to-face episode was significant, R = .48, adj. R^2 = .22, F(3,137) = 13.65, *p* =.000, with parent and infant positive affect and infant negative affect independently predicting flexibility. Mother-infant flexibility in the reunion episode was not predicted by parent or infant affect in the interaction.

The model predicting father-infant synchrony in the face-to-face interaction from father and infant affect was significant, R = .35, adj. R^2 = .10, F(3,120) = 5.28, *p* =.002. Father and infant positive affect independently predicted synchrony. In the reunion episode, father-infant synchrony was also predicted by parent and infant affect, R = .32, adj. R^2 = .07, F(3,101) = 3.60, *p* =.016, with infant positive affect independently predicting synchrony. The model predicting father-infant flexibility in the face-to-face episode was significant, R = .29, adj. R^2 = .06, F(3,120) = 3.50, *p* =.018, with infant positive affect independently predicting flexibility. Father-infant flexibility in the reunion episode was predicted by parent or infant affect in the interaction,

$R = .31$, adj. $R^2 = .07$, $F(3,101) = 3.54$, $p = .018$, but neither infant or parent positive affect, nor infant negative affect expressed in the interaction independently predicted flexibility.

Hypothesis 2a: Mother-infant and father-infant interactions will be similar on average in their degree of synchrony and flexibility.

One-way ANOVAs to examine mean differences in synchrony and flexibility by parent revealed that mean levels of synchrony and flexibility were not significantly different between mothers and fathers.

Hypothesis 2b: Same-sex dyads and mixed-sex dyads will exhibit different patterns of synchrony and flexibility.

One-way ANOVAS to examine mean differences in synchrony and flexibility by parent-infant "match" revealed that mean levels of synchrony and flexibility were not significantly different between same-sex and mixed-sex dyads.

Hypothesis 3: The quality of the family environment as indexed by parent report of marital satisfaction, parenting stress, and parental depressive symptoms, will be related to the quality of the parent-infant interaction as indexed by synchrony and flexibility.

Separate regressions were performed exploring relations among interactive qualities (the dyadic constructs of synchrony and flexibility, and parent and infant affect expressed in the interaction), and contextual factors (parental depressive symptoms, marital satisfaction, and parenting stress). For example, the relative contributions of parent and infant affect and synchrony and flexibility in predicting marital satisfaction were explored. It is important to note that these regressions explored the relative contributions of dyadic qualities in relation to various contextual factors, and do not propose (for example) that flexibility *causes* depression or parenting stress, just that there may be independent associations among these factors. Eight

separate regressions were performed predicting maternal and paternal depressive symptoms, marital satisfaction, and parenting stress (parent and child domains) from study affect variables and synchrony and flexibility variables. None of the full models were significant, but some individual predictors were found.

For mothers, significant associations were found between flexibility in the reunion episode and parental depressive symptoms and parenting stress (both the parenting and child domains of this measure), controlling for affect expressed in the interaction, and synchrony and flexibility in the other episodes (see Tables 5, 6, 7). Synchrony in the face-to-face interaction was independently related to maternal ratings of parenting stress – child domain, when controlling for synchrony in the reunion, flexibility and affect variables. When only the variables associated with the reunion episode were entered into the regression (parent and infant affect, synchrony, and flexibility) predicting maternal report of marital satisfaction, the amount of parent positive affect expressed in the interaction was independently related to maternal ratings of marital satisfaction (Table 9). The above results did not change when explored in hierarchical regressions, nor when order of entry (affect variables and flexibility/synchrony) varied.

For fathers, the amount of infant negative affect expressed in the reunion independently predicted paternal ratings of marital satisfaction, controlling for affect and synchrony and flexibility in other episodes (Table 8). These associations remained significant and consistent when explored in hierarchical regressions varying order of entry. No other significant associations were found for fathers predicting contextual variables from affect and synchrony and flexibility.

Hypothesis 4: Parent sex, infant sex, or the parent-infant "match," (different-sex vs. same-sex dyads) may moderate the relations between contextual factors (marital satisfaction, parenting stress or parental depressive symptoms) and the quality of the parent-infant interaction.

The above regressions predicting contextual variables from affect and synchrony and flexibility variables were run including infant sex and "match" in the full model. Although, as mentioned above, there were clear differences between mothers and fathers with respect to the associations between contextual factors and indices of the quality of parent-infant interaction, including infant sex and match in the model did not change these associations, nor were they independent predictors of contextual variables.

Discussion

The purpose of this study was to explore the dynamic structural qualities of mutual regulation and the processes at play within parent-infant interactions through the dyadic constructs of flexibility and synchrony. As early parent-infant interactions provide the contexts in which children begin to learn regulatory skills, methodologies that illuminate the processes involved in the joint regulation of affect may provide a means for better understanding how variations in those skills are developed. Studied frequently in parenting literature, synchrony explores a parent-child dyad's coordinated movement among affective states over time. Dyadic flexibility, a construct just beginning to receive attention in the parent-child literature, examines dyadic interactions by providing an index of the range of affective states and movement among those states. To better understand the relative contributions of each construct to a theoretical understanding of the dynamic processes operating in mutual regulation of parent-infant interactions, the current study sought to compare these two constructs, as they highlight differing, yet complementary aspects of dyadic behavior. Comparison of the constructs included

examining the degree to which parents' and infants' affect drives synchrony and flexibility, and exploring contextual factors that influence individuals in the family, and through their impact on an individual's emotional expression and responsiveness, might be associated with variations in the structure of dyadic interactions. The contextual influences explored included individual factors (sex of the parent and infant, parents' depressive symptoms, parents' reports of parenting stress and marital satisfaction) and situational factors (whether the dyad engaged in face-to-face play or reunion in the SFP).

Differentiating the Constructs

Previous research exploring mutual regulation utilizing methods that illuminate the structural dynamics at the level of the dyad has looked either at the temporal coordination of affect and behavior over time through the construct of synchrony (e.g. Feldman, 2003; Skuban et al., 2006) or at the movement among and range of expressed affective states within an interaction (e.g. Granic, et al., 2003; Hollenstein, et al., 2004). Given that each approach may highlight distinct qualities of the interaction, perhaps reflecting dynamic shifts between coordinated and mis-coordinated states, mutual regulation and interactive repair, this study benefits from utilization of both constructs to explore the same dyadic interaction, thereby broadening the understanding of what each method can offer in our understanding of the structure of mutual regulation in the parent-infant dyad. Just as it may be beneficial to know how well the dyad is dancing together in an interaction (synchrony), it may be equally important to explore the choreography (flexibility) of that pairing. Consistent with prior explorations utilizing both constructs of synchrony and flexibility (Moore, et al., 2007; Moore, et al., submitted), in this study it was found that the two constructs were modestly correlated, thereby representing related, but independent constructs. Given that these two constructs are derived from analyses of the

same parent and infant behaviors during dyadic interaction, this association is to be expected. However, the lack of a stronger correlation between the two highlights the unique contributions each method of analysis may offer in exploring the structure of parent-infant interactions. As discussed previously, it is possible to have a highly synchronous interaction that is not particularly flexible and a highly flexible interaction that is only moderately synchronous.

The association between the two constructs was found only in the face-to-face interaction of the SFP, not in the reunion episode, suggesting that synchrony and flexibility may reflect different processes when the dyad is stressed, and highlighting the importance of context when measuring dyadic interaction. In face-to-face interaction, when parents and infants are positive and their behaviors relatively coordinated, synchrony and flexibility may both index the successful mutual regulation of the interaction. As predicted by previous research and theory, in face-to-face contexts where both partners are generally positive and responsive to the others' cues, the interactions are likely to be synchronous and moderately flexible, reflecting processes involved in mutual regulation (Feldman, 2003; Hollenstein & Lewis, 2006; Tronic & Cohn, 1989). However, in the reunion episode, when the individuals in the dyad are likely to be expressing more negative affect, and the coordination of the interaction has just been interrupted by the still face, the construct of flexibility may provide an index of interactive repair that is not captured by synchrony. As suggested by Tronick and Cohn (1989), this uncoordinated state is essential for the development of children's coping and self-regulatory skills, and as demonstrated by the work of Hollenstein and colleagues (Hollenstein, et al., 2004; Hollenstein & Lewis, 2006) the dysregulation and increased negativity characteristic of stressed dyadic systems can be captured by the construct of flexibility. In this study both synchrony and flexibility were stable

across the two interactional contexts and the mean levels of flexibility and synchrony did not differ significantly between episodes.

Affective Expression

Given theoretical expectations that synchronous interactions tend to be mutually positive (e.g., Lindsey, Cremeens, Colwell, & Caldera, 2009), and that flexibility is associated with more positive interactions (e.g., Hollenstein & Lewis, 2006), but can also illuminate those interactions that tend to be more conflictual and negative (e.g., Hollenstein et al., 2004) this study explored the role of positive and negative affective expressions as determinants of synchrony and flexibility. Based on the theory of bidirectional, mutually influential processes of parent infant interactions, in which both partners systematically influence the behavior of other (e.g., Beebe, 2003), and consistent with prior research exploring these dyadic indices (Bass & Moore, 2007; Moore, Powers, & Bass, 2007), it was expected that the individual associations of parental positive affect and infant negative affect would only be moderately correlated with indices of flexibility and synchrony. This association would highlight that although derived from individual scores of affect expressed, flexibility and synchrony represent *dyadic* indices and neither a parents' nor an infant's affective expression should be strongly correlated with the index as that might suggest that one or another member of the dyad was driving the interaction.

Consistent with expectations, both flexibility and synchrony were moderately correlated with infant and parent affective expression. Across interactive contexts (face-to-face and reunion), infant positive affect predicted flexibility and synchrony; greater infant positive affect in the interaction was associated with more synchronous and flexible interactions. With mothers, infant negative affect was also associated with the degree of synchrony and flexibility in the face-to-face interaction, with increased levels of infant negative affect also associated with more

synchronous and flexible interactions. Given that average levels of infant negative affect were low in the face-to-face interaction (M = 7.4%), this association possibly reflects general variability and "movement" in the interaction, rather than a strong association between infant negative affect and degree of flexibility or synchrony. In the reunion episode, in which infants were proportionately more negative than in the face-to-face episode (M = 21%), significant associations were not found between infant negative affect expressed and the flexibility or synchrony of the interaction.

Parental positive affect was related to the flexibility and synchrony of interactions, both in the face-to-face and reunion episodes. Greater parental positive affect was associated with *reduced* flexibility and synchrony. This may reflect the degree to which the constructs of flexibility and synchrony assess a parent's range of affect expressed in response to the infant, the parent's movement *with* his or her infant. Because parents in general spent much of their time in positive expressions when interacting with their infants, parents who were more consistently positive may in effect have been less contingently responsive to their infants in the interactions, and therefore appeared less flexible and synchronous. This finding highlights the importance of not assuming that more positive affect expressed in an interaction is "better," and more conducive to supporting infant development of emotion regulatory skills. Consistent with this current finding, Izard and colleagues (Izard, Haynes, Chisholm, & Baak, 1991) found that mothers who reported that they expressed more positive emotions with their children in daily life than negative, and explicitly tried to avoid showing negative emotion, actually had infants with higher levels of insecure attachment. These findings suggest that there may be a benefit for parents and children to be exposed to a balance of positive and negative affective states, both for

the development of emotion regulatory skills and a wide range of affective expression (consistent with the theories of Tomkins) and for establishing secure attachment relationships with infants.

Consistent with the findings of Izard and colleagues, in recent factor analyses of a variety of measures of parent and infant behaviors during dyadic interaction using this and another dataset than that studied in the current report (Moore, et al., 2008), parental positive affect loaded on a factor characterized by dyadic asynchrony, without the contributions (in this factor) of infant positive or negative affect. Again, with this particular factor, high levels of parent positivity seemed to indicate that the parent remained positive despite variability in the infant's affective state in the interaction, which may suggest a parent who is less attuned to his or her infant's emotional cues.

On average, parents in this study were displaying positive affect greater than 50 percent of the time in face-to-face and reunion episodes. Despite this generally positive approach with infants, variability in the amount of positive affect expressed in each interaction was nonetheless predictive of flexibility and synchrony in the interaction. Thus, an important aspect of both the constructs of flexibility and synchrony is the degree to which parents are responding and adjusting their behavior in response to the infant's affect. A parent who exhibits a higher proportion of positive affect in an interaction may not be perceived as *responsive* by the infant, and the degree to which the dyad is moving flexibly among affective states, or synchronously together within the course of the interaction may be reduced. It is in the sensitive responding to and modeling of appropriate emotional response for the infant, that a parent is thought to facilitate the development of the child's regulatory capabilities and skills (Morris et al., 2007).

These findings on the associations between parental affect and synchrony and flexibility, may illustrate the continued importance of the parent in achieving and driving mutual regulation

at this stage of infant development. Although the infant may be a more active participant in the interaction at 6-months of age, the dyadic quality of the interaction may still rest on the parents' responses to changing demands of the interactional context and to infant behavioral cues. In synchronous interactions, a mother may follow the infant's lead, or the infant may follow the mother's lead, or they may truly engage in mutual regulation and responsiveness, but this mutuality is just beginning to emerge in the second half of the first year of life (e.g., Cohn & Tronick, 1987; Feldman, 2003).

Parental Context

Given research suggesting that mothers and fathers engage in different styles of interaction with their infants (e.g., Braugart-Rieker et al., 1998; Feldman, 2003), it was hypothesized that there might be differences between indices of synchrony and flexibility in mother-infant and father-infant interactions depending on the sex of their infant. Mother-infant and father-infant dyads did not differ in the overall levels of flexibility and synchrony. Additionally, although mothers were significantly more positive with their infants in the face-to-face interaction than fathers (as reported by Forbes et al., 2004 using this same dataset), differences in the amount of positive affect expressed were not reflected in differences in synchrony and flexibility. Qualities of interaction as indexed by synchrony and flexibility were similar in mother-infant and father-infant interactions. Although affect expression, particularly variability in affect, may contribute to flexibility and synchrony, the differences in parental affective expression, in combination with the lack of mean differences in flexibility and synchrony between mothers and fathers, suggests that these dyadic constructs function independently of the predominant affective valence of the interactions. Parental positive affect

was predictive of synchrony and flexibility for both mothers and fathers in the face-to-face episode and predictive of only synchrony in the reunion episode for mothers.

Contextual Factors: Parental Depression, Marital Satisfaction, Parenting Stress

As mutual regulation involves affective expression and mutual responding on the part of both parent and infant, individual contextual factors theorized to affect a parent's ability to express a wide range of emotions and respond effectively to his or her infant, such as parental depression, marital satisfaction, and parenting stress, are likely to have an impact on the structural components (i.e., synchrony and flexibility) of the dyadic interaction. This study proposed that there would be associations between the dyadic qualities of the interaction as indexed by synchrony and flexibility and broader family contextual factors independent of the affective valence of the interaction. With respect to parental depression, prior research suggests that synchrony will be reduced in dyads in which a parent exhibits more symptoms of depression (e.g., Field et al., 1990), and that findings might vary with respect to flexibility either looking inflexible and or overly flexible, as dyads in which a parent endorses more symptoms of depression tend to show less contingent responsivity, more conflictual interactions, and reduced interactive repair (e.g., Jameson, et al., 1997). Parenting stress has also been shown to result in less positive, more strained, parent-child dyadic interactions (e.g., Crouter et al., 2001), and thereby was theorized to have resulting implications for the structure of dyadic interactions.

Current findings support the hypothesis that mother-infant dyadic flexibility is associated with broader family contextual factors. Specifically, mother-infant flexibility in the reunion interaction was predictive of maternal report of depressive symptoms and parenting stress. Greater flexibility was associated with more depressive symptoms and increased parenting stress. The finding that mother-infant flexibility in the reunion was associated with maternal depressive

symptoms is consistent with study hypotheses, as the expectation was that a pattern of functioning in one context would spillover onto other contexts. More flexible reunion interactions predicted greater depressive symptoms in mothers. It may be that the dyadic context of the reunion episode, a context requiring interactive repair, in which the infant is likely to be more distressed or more affectively labile and the mother must help her infant to regain a positive affective state, a flexible interaction is actually one in which the dyad exhibits a greater range of affect, both positive and negative affect, exhibiting emotional lability. This emotional lability on a dyadic level may be consistent with, and reflective of, individual variable and labile mood states associated with depression.

In a review of the associations between depressive symptoms and parenting competence, Dix and Meunier (2008) highlight an increase in negative affect and reduction in positive affect, a reduced ability to pay attention to child affective signals and to engage in child-oriented goals, and an increase in negative appraisals of parenting competence as ways in which symptoms of depression have an impact on parenting competence. In the reunion episode, a parent must be sensitive to his or her child's needs to regulate, and able to appropriately modify his or her own affect expression to encourage positive emotions and mutual, coordinated affective expression in the interaction, in order to recover from the disruption of the still face. A parent who is struggling with some of the difficulties noted above may not have the cognitive and emotional resources to accomplish such a goal. Additionally, flexibility in the dyadic interaction may reflect a pattern of interaction that has developed between parent and infant in which the interaction is unpredictable, failing to settle into stable patterns. As suggested by the current findings, greater flexibility in the reunion interaction may not be optimal if that range of dyadic

states expressed by parent and infant and the transitions among varying states highlights a lack of synchrony, of mutual emotional regulation to recover from a stressful event (the still face).

Greater maternal flexibility in the reunion was also associated with increased reports of parenting stress, both with respect to the parent and child domains. Additionally, mother-infant synchrony in the face-to-face interaction was associated with greater parenting stress in the child domain. These results are consistent with the above findings for depression, suggesting that both depression and parenting stress have an impact on the parent's ability to be appropriately responsive in the interaction. Although associations between parental affect expressed in the interaction and parenting stress were not found (as may have been predicted by prior research, e.g. Crouter et al., 2001), current results suggest that flexibility as an index of dyadic interaction taps into processes that may not be elucidated by exploring affect alone. Maternal stress in a parenting role, both with respect to individual factors and difficult child factors, was associated with the flexibility and synchrony of the mother-infant interaction following a stressor. Maternal experiences of stressors broadly may limit the ability to effectively adapt interaction patterns to the behaviors of distressed infants in the moment, thereby resulting in an interaction that is more flexible and unpredictable, and fails to settle into a stable mutually-regulated pattern. When stressed, she may not have the cognitive or emotional resources available to regulate her own behavior and to help her child recover from the stressful still-face, thereby engaging in a more flexible dyadic interaction, expressing a broad range and many changes in affective expression.

Consistent with the theory of spillover in which aspects of the marital relationship are expressed in parent child relationships (Easterbrooks & Emde, 1988), marital satisfaction was associated not with the structural constructs of synchrony and flexibility, but was associated with affective variables. Previous research exploring strained marital relationships and parenting

quality has highlighted the carryover of mood states from one relationship to another (e.g. Ragan, Bernd, & Whiteman, 2007), thus the current results may be expected, as flexibility and synchrony are proposed to function independently of the valence of affect expressed in the interaction. For mothers, higher marital satisfaction was moderately associated with higher amounts of positive affect expressed in the reunion episode. These results are consistent with predictions, that a mother's experience of the marital relationship is likely to spillover onto her interactions with her infant; less satisfied mothers are likely to be less positive, more satisfied mothers are likely to exhibit more positive affect in the interaction. As parents rarely express negative affect in parent-infant interaction, and the proportions of negative affect expressed were minimal in this study, analysis of whether or not marital distress was associated with maternal negative affect was not conducted.

For fathers, marital satisfaction was associated with infant negative affect expressed in the reunion episode. Fathers who had infants who expressed more negative affect in the reunion episode rated their marriages as less satisfying. This may be consistent with predictions and prior research suggesting that men are more susceptible than women to the negative spillover of negative moods from one context to another (e.g., Fagan et al., 2007) and that father involvement in parenting is related to marital satisfaction (Belsky et al., 1984). For a father, marital dissatisfaction may be related to his feelings of parenting efficacy, and having an infant who exhibits relatively greater negative affect after a stressful situation (potentially reflecting the father's inability to soothe his child), is likely to compound that stress. The differences between associations of maternal and paternal marital satisfaction and affect variables whereby maternal marital dissatisfaction is associated with maternal affect, and paternal marital dissatisfaction is associated with infant affect, highlights purported differences in how mothers and fathers deal

with marital stress in respect to their parenting role. Maternal dissatisfaction in the marriage and in the parenting role may reflect a stable trait of the mother's personality, whereby her affect in one context is consistent with her affect in another. In contrast, for fathers, the links between infant negativity and a paternal experiences of marital dissatisfaction may reflect associations between a father's efficacy in the parenting role (ability to soothe a distressed infant), and his satisfaction in the marriage.

Limitations and Further Directions

Just as the purported function of the interactive context (mutual regulation in the face-to-face play v. interactive repair in the reunion episode) may influence measures of synchrony and flexibility, it may be that the length of the observational context is also an important parameter to consider. For example, the initial part of the reunion episode when the dyad first resumes their interaction may show a structural pattern that is distinct from the remaining time. Further exploration of these constructs of synchrony and flexibility might break down the reunion episode into shorter epochs (20-30 seconds, or less), to see if there is substantial variability in the index of flexibility or synchrony when those early efforts to regulate in the first few seconds of reunion and repair are observed. It may be that individual differences in the ability to "repair" may be most striking at particular time points, before the eventual return to baseline mutual dyadic functioning.

As discussed previously, it is likely that there is an optimal level of synchrony and of flexibility, and also that there may be varying profiles of a dyad's relative flexibility and synchrony within a dyadic typical style of interacting. It could be that differences between synchrony and flexibility wash out on average, but that particular profiles of the synchrony/flexibility balance are more protective than others, or more predictive of particular

outcomes. Preliminary explorations with this dataset, creating separate flexibility/synchrony groups based on midpoint and tercile cut-offs for each construct did not reveal significant differences in those behavioral profiles with respect to contextual factors such as depression, parenting stress, or marital satisfaction, but it may be that a particular balance between flexibility and synchrony is predictive of later child outcomes. Similarly, it may be that flexibility and synchrony are curvilinear, and that high and low levels are not optimal, but that mid-range flexibility or synchrony promotes optimal development of emotion regulation and range of emotions experienced and expressed. In a study exploring flexibility (utilizing slightly different operationalizations of the construct), affect expression, and conflict in adolescent girls, Lichtwarck-Aschoff, Kunnen, and van Geert (2009) found a curvilinear aspect to flexibility, whereby there was an optimal level of emotional variability. As the number of conflicts the girls experienced in a given week increased, so too did their report of variability in emotions expressed in a given week. However, at a certain point, conflicts increased while variability in emotional expression decreased. This relationship highlights the potential relation between flexibility in emotional expression and ability to negotiate conflictual interactions with another. In unhealthy, rigid interactional patterns, often characterized by conflict, the patterns of emotional expression are likely to fall into restricted patterns (e.g., Patterson's coercive cycles). A dyadic system needs to have a certain amount of variability in responses in order to adapt to new situational demands, but in repeatedly high-conflict interactions, these response patterns are likely to become automatized and predictable, i.e., inflexible. Further exploration of the potential optimal ranges of synchrony and flexibility and their relation to parent and child outcomes may help elucidate the underlying structure of dyadic interactions and the ways in which that structure contributes to adaptive functioning and to effective emotion regulation.

Other limitations of this study have to do with the study sample, including the degree of parental impairment or distress in the sample, and potential limitations in the measurement of contextual factors. The current sample of parents did not report high levels of current depressive symptoms (CES-D: *M* =7.34), parenting stress (PSI-Parent: *M* = 61.26, PSI-Child: *M* = 89.49), or marital dissatisfaction (DAS: *M* = 109.39). Although these constructs were related to flexibility in the reunion for mothers, studying a more significantly distressed sample may have led to findings that were generalized across parental and interactional contexts, or that were associated with the affective valence in the interaction. In a study using the same dataset, Forbes et al. (2004) found that current depressive symptoms were not predictive of infant affect in interaction with parents, but that a past history of diagnosed parental depression was associated with reduced infant positive affect at the 3-month visit, but not the 6-month visit. The current dataset had few parents, mothers or fathers, exhibiting current clinical levels of depressive symptoms. Recruitment of a sample of parents in greater distress may have led to associations between parental depression and affective expression in the interaction. Campbell, Cohn, and Meyers (1995) found that chronic, current depression during the postpartum period was associated with less positive maternal and infant affect, but that remitted depression was not. As the sample for the current study was made up of parents at least one of whom had a past history of depression, but few of whom were currently experiencing clinical levels of depressive symptoms, a lack of association between depressive symptoms and parent-infant synchrony and flexibility in face-to-face contexts may be understandable.

Similarly, the lack of associations between marital satisfaction and synchrony and flexibility in the dyadic interaction may reflect the relative satisfaction of the marital dyads, and the specificity of the questionnaire measures for accessing marital conflict. Recruitment of a

sample that was more stressed in their parenting and marital roles may have highlighted associations among contextual factors and dyadic parent-infant interactions. In previous studies exploring the construct of flexibility, marital conflict, rather than marital satisfaction in general, was assessed, and found to be associated with flexibility (Bass & Moore, 2007; Moore, Powers, & Bass, 2007). It may be that the marital constructs assessed by the DAS did not access the particular factors that may play a role with respect to the spillover effect. Additionally, parent report of marital satisfaction and marital conflict may not provide the best measure of the spillover of interactional qualities in the marital dyad influencing interactional qualities in the parent-infant dyad. Further study will be needed to tease out how specific aspects of marital functioning are related to flexibility and synchrony, such as marital conflict and satisfaction in the relationship specifically with respect to co-parenting. Extended exploration of these associations might incorporate observational measures of the marital dyad engaged in a face-to-face interaction to better index the style of parental interaction and facilitate the exploration of the relative spillover of flexibility and synchrony from one dyadic context to another.

Summary

Given the importance of early parent-infant interactions for the development of an infant's abilities to experience, express, and regulate emotion, the current study sought to explore structural qualities of these interactions as indexed by the dyadic constructs of synchrony and flexibility. In particular, aspects of the interaction such as the parent with whom the child was interacting, the affect expressed by infants and parents, and family contexts such as parental depression, parenting stress, and marital conflict, were explored for their potential influences on the structural qualities of the dyadic interaction. Synchrony and flexibility were found to be modestly correlated, but to represent independent qualities of the interaction. Both dyadic

constructs were stable and consistent across interactive contexts (face-to-face play and reunion episodes), but flexibility was not associated with synchrony in the reunion episode, when the dyad worked to repair the interaction after the still face. For mother-infant dyads flexibility in the reunion episode was a significant predictor of maternal depressive symptoms and maternal reports of parenting stress. Thus, although infants did not experience different structural qualities of dyadic interaction with respect to flexibility and synchrony when interacting with their mothers and fathers, contextual influences such as parental depression, parenting stress, and marital satisfaction had an impact on the quality of the dyadic interactions with mothers in this sample, but not with fathers. In addition, it was only in the reunion episode, in which the dyad was likely engaged in interactive repair, that these associations were found. Further study will be needed to tease out specific aspects of marital functioning on flexibility and synchrony, such as the role of marital conflict, and satisfaction in the relationship with respect to co-parenting, and to explore the influence of contextual factors on synchrony and flexibility in more distressed dyads may further elucidate the potential role of the spillover effect. As the two constructs differed in their predictive power in the reunion episode, further study will be needed to refine understanding of the interactive processes at play in the course of repairing such miscoordination.

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Appendix: Tables and Figures

Table 1. Descriptive Statistics for Study Variables

	Mother				Father			
	N	M	SD	Range	N	M	SD	Range
Flex FF	153	0.03	2.63	-8.33 – 6.79	133	0.021	2.47	-8.63 – 4.60
Flex RE	131	-0.03	2.48	-7.96 – 8.30	111	-0.002	2.64	-9.96 – 6.64
Synch FF	158	0.29	0.14	-0.08 – 0.67	137	0.29	0.17	-0.27 – 0.71
Synch RE	137	0.27	0.22	-0.44 – 0.75	114	0.30	0.22	-0.32 – 0.80
CES-D	164	8.53[a]	7.94	0 – 39	149	6.03[b]	6.29	0 – 36
DAS	164	108.70	18.04	0 – 134	149	110.16	15.38	15 – 137
PSI-Parent	164	61.06	8.57	22 – 75	149	61.48	8.55	26 – 75
PSI-Child	164	89.96	10.30	32 – 103	149	88.97	9.88	33 – 104
PPosFF	142	.57[c]	.22	.06 – 1.00	124	.51[d]	.23	.02 – 0.99
PPosRE	122	.52	.24	.01 – 0.98	108	.51	.26	.00 – 1.00
IPosFF	154	.25	.21	.00 – 0.93	135	.22	.19	.00 – 0.76
INegFF	154	.07	.13	.00 – 0.78	135	.09	.18	.00 – 0.96
IPosRE	131	.22	.21	.00 – 0.89	117	.22	.22	.00 – 0.84
INegRE	131	.21	.29	.00 – 1.00	117	.18	.28	.00 – 1.00

Note. Flex FF = flexibility in face-to-face; Flex RE = flexibility in reunion; Synch FF = synchrony in face-to-face; Synch RE = synchrony in reunion; PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

[a/b] significant difference $p = .002$; **[c/d]** significant difference $p = .026$

Table 2. Intercorrelations Among **Maternal** Flexibility, Synchrony, Contextual and Affective Variables

	Flex FF (N)	Flex RE (N)	Synch FF (N)	Synch RE (N)
Flex FF	--	**.327*** (131)**	**.259*** (152)**	.158 (131)
Flex RE		--	-.082 (131)	**.210* (131)**
Synch FF			--	**.263** (137)**
CES-D	-.075 (149)	**.203* (127)**	.004 (154)	-.021 (133)
DAS	-.058 (149)	.049 (127)	**-.176* (154)**	.125 (133)
PSI-Parent	-.049 (149)	**-.216* (127)**	.000 (154)	-.141 (133)
PSI - Child	-.019 (149)	-.155 (127)	-.020 (154)	-.101 (133)
PposFF	**-.228** (138)**	.079 (119)	**-.413*** (140)**	**-.187* (122)**
PposRE	.-.161 (118)	.117 (118)	**-.340*** (121)**	-.121 (122)
IposFF	**.163* (153)**	.083 (131)	**.177* (152)**	.096 (131)
InegFF	**.382*** (153)**	.018 (131)	**.187* (152)**	.081 (131)
IposRE	.072 (131)	.116 (131)	.121 (131)	.132 (131)
InegRE	.095 (131)	.143 (131)	-.042 (131)	-.025 (131)

Note. Flex FF = flexibility in face-to-face; Flex RE = flexibility in reunion; Synch FF = synchrony in face-to-face; Synch RE = synchrony in reunion; PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 3. Intercorrelations Among **Paternal** Flexibility, Synchrony, Contextual and Affective Variables

	Flex FF (N)	Flex RE (N)	Synch FF (N)	Synch RE (N)
Flex FF	--	.119 (111)	.148 (132)	-.054 (109)
Flex RE		--	-.046 (111)	-.084 (106)
Synch FF			--	**.222* (114)**
CES-D	-.030 (129)	.056 (108)	-.115 (133)	-.014 (111)
DAS	-.119 (129)	-.099 (108)	.027 (133)	.046 (111)
PSI-Parent	-.053 (129)	-.064 (108)	-.009 (133)	-.011 (111)
PSI - Child	.032 (129)	.021 (108)	-.001 (133)	-.044 (111)
PposFF	-.015 (121)	.048 (102)	-.111 (123)	.042 (105)
PposRE	.-.035 (105)	.185 (102)	-.144 (108)	-.032 (104)
IposFF	**.296***(133)**	**.255** (111)**	**.266** (133)**	**.189* (110)**
InegFF	-.066 (133)	-.105 (111)	.032 (133)	.017 (110)
IposRE	.097 (115)	**.304*** (111)**	.145 (116)	**.261** (109)**
InegRE	.179 (115)	**-.241* (111)**	.032 (116)	-.137 (109)

Note. Flex FF = flexibility in face-to-face; Flex RE = flexibility in reunion; Synch FF = synchrony in face-to-face; Synch RE = synchrony in reunion; PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 4. Regression Analyses of Affect Variables Predicting Flexibility and Synchrony in Face-to-Face and Reunion Episodes, Split by Parent

				Mothers				
	Flexibility in Face-to-Face (*N* = 137)				Synchrony in Face-to-Face (*N* = 136)			
Predictor	B	SE B	ß	*p*	B	SE B	ß	*p*
PPos	-2.75	0.96	-.23	**.005**	-0.34	0.06	-.48	**.000**
PIpos	4.17	0.99	.34	**.000**	0.26	0.06	.35	**.000**
PIneg	7.80	1.79	.35	**.000**	0.26	0.10	.20	**.011**
	Flexibility in Reunion (*N* = 117)				Synchrony in Reunion (*N* = 117)			
PPos	1.03	1.03	.10	.318	-0.24	0.11	.22	**.027**
PIpos	1.94	1.25	.17	.124	0.31	0.13	.26	**.016**
PIneg	1.63	0.86	.19	.061	0.02	0.09	.03	.797
				Fathers				
	Flexibility in Face-to-Face (*N* = 120)				Synchrony in Face-to-Face (*N* = 120)			
Predictor	B	SE B	ß	*p*	B	SE B	ß	*p*
PPos	-1.46	1.05	-.14	.164	-0.18	0.08	-.22	**.023**
PIpos	3.69	1.25	.29	**.004**	0.34	0.09	.36	**.000**
PIneg	-0.54	1.31	-.04	.680	0.06	0.11	.06	.567
	Flexibility in Reunion (*N* = 101)				Synchrony in Reunion (*N* = 101)			
PPos	0.39	1.12	.04	.730	-0.19	0.12	-.18	.106
PIpos	2.40	1.29	.20	.066	0.35	0.13	.29	**.008**
PIneg	-1.27	1.02	-.14	.215	-0.11	0.11	-.11	.315

Note. PPpos = proportion parent positive affect expressed; PIpos = proportion infant positive affect expressed; PIneg = proportion infant negative affect expressed

Table 5. Regression Analyses of Study Variables Predicting **Maternal** Symptoms of Depression (N = 113)

Predictor	B	SE B	ß	*p*
Synchrony in face-to-face	5.97	6.87	.11	.387
Synchrony in reunion	-3.12	3.48	-.10	.373
Flexibility in face-to-face	-0.48	0.37	-.15	.194
Flexibility in reunion	1.06	0.38	.31	**.007**
PPosFF	-4.79	5.82	-.13	.413
PPosRE	0.61	5.15	.02	.906
IPosFF	1.34	5.58	.03	.811
INegFF	-5.76	11.71	-.05	.624
IPosRE	-3.57	5.54	-.09	.521
INegRE	-2.11	3.35	-.07	.530

Note. PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

Table 6. Regression Analyses of Study Variables Predicting **Maternal** Parenting Stress – Child Domain (N = 113)

Predictor	B	SE B	ß	*p*
Synchrony in face-to-face	-16.97	8.04	-.25	**.037**
Synchrony in reunion	-2.47	4.07	-.06	.545
Flexibility in face-to-face	0.56	0.43	.15	.191
Flexibility in reunion	-1.00	0.45	-.25	**.027**
PposFF	-8.17	6.80	-.18	.232
PposRE	-0.55	6.02	-.01	.927
IposFF	5.10	6.52	.11	.436
InegFF	-3.11	13.69	-.02	.821
IposRE	3.01	6.47	.07	.643
InegRE	0.94	3.92	.03	.811

Note. PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

Table 7. Regression Analyses of Study Variables Predicting **Maternal** Parenting Stress – Parent Domain (N = 113)

Predictor	B	SE B	ß	*p*
Synchrony in face-to-face	-5.40	6.70	-.10	.422
Synchrony in reunion	-1.07	3.40	-.03	.753
Flexibility in face-to-face	0.53	0.36	.17	.138
Flexibility in reunion	-1.19	0.37	-.35	**.002**
PposFF	3.57	5.67	.10	.530
PposRE	-0.52	5.02	-.02	.918
IposFF	-2.36	5.43	-.06	.665
InegFF	-4.03	11.41	-.04	.725
IposRE	2.99	5.39	.08	.581
InegRE	2.73	3.27	.09	.405

Note. PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

Table 8. Regression Analyses of Study Variables Predicting **Paternal** Marital Satisfaction (*N* = 95)

Variable	B	SE B	ß	*p*
Synchrony in face-to-face	9.30	11.59	.09	.424
Synchrony in reunion	-1.20	7.23	-.02	.868
Flexibility in face-to-face	-1.17	0.81	-.16	.154
Flexibility in reunion	-1.24	0.74	-.18	.098
PposFF	2.37	10.58	.03	.824
PposRE	-0.96	9.52	-.01	.920
IposFF	0.23	12.85	.003	.986
InegFF	17.22	16.93	.12	.312
IposRE	8.25	11.32	.11	.468
InegRE	-16.26	7.66	-.27	**.037**

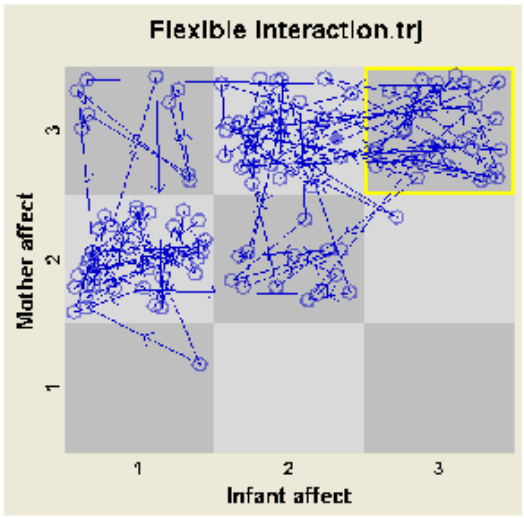
Note. PPosFF = proportion parent positive affect expressed in face-to-face; PPosRE = proportion parent positive affect expressed in reunion; IPosFF = proportion infant positive affect expressed in face-to-face; INegFF = proportion infant negative affect expressed in face-to-face; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

Table 9. Regression Analyses of Study Variables in the Reunion Episode Predicting **Maternal** Marital Satisfaction (*N* = 113)

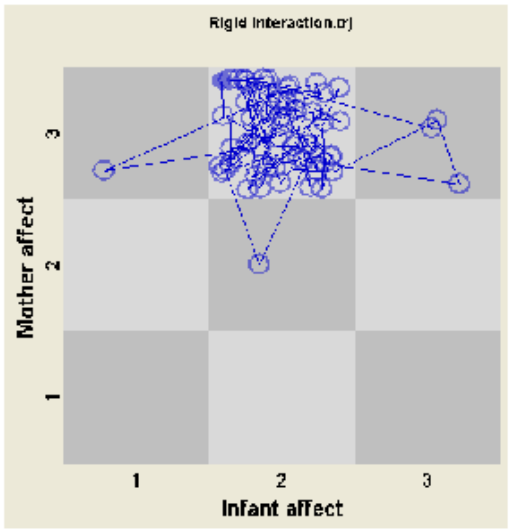
Predictor	B	SE B	ß	*p*
Synchrony in reunion	10.71	6.68	.16	.112
Flexibility in reunion	-0.12	0.69	-.02	.868
PposRE	16.44	7.55	.23	**.032**
IposRE	-10.19	9.25	-.13	.273
InegRE	-6.15	6.39	-.10	.338

Note. PPosRE = proportion parent positive affect expressed in reunion; IPosRE = proportion infant positive affect expressed in reunion; INegRE = proportion infant negative affect expressed in reunion.

Figure 1. State Space Grids showing N of cells and N of transitions.



1 = Negative 2 = Neutral 3 = Positive



1 = Negative 2 = Neutral 3 = Positive