ATTENTION AS A MODERATOR OF THE EFFECTS OF NEGATIVE EMOTIONALITY ON MOTHER-CHILD INTERACTIONS DURING INFANCY

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Abstract

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Research suggests that attention and regulatory abilities may act as a buffer, protecting individuals from the effects of negative emotionality, although this hypothesis has not been previously examined during infancy. The present study examines this claim by investigating the impact of attention/regulation, negative emotionality, and their interaction on mother-child interactions during the first year of life. It was hypothesized that infants high in negative emotionality would have less effective interactions with their mother, infants high in attention/regulation would have more effective interactions, and that attention would moderate the impact of negative emotionality in mother-child interactions. Mothers completed the Infant Behavior Questionnaire-Revised, as well as participating in the Temperament Laboratory Assessment with their infant. Hierarchical multiple regression was utilized and indicated that the data did not provide support for the hypotheses.

TABLE OF CONTENTS

Page

LIST OF TABLES

Dedication

Dedicated to my teachers –

Particularly my parents and grandparents, who have provided unending support,

and my first statistics teacher, Mr. Grimm, who somehow made the subject interesting and accessible.

CHAPTER ONE

INTRODUCTION

Face-to-face interactions

An infant's face-to-face interactions with his/her caregivers are amongst the first social exchanges in life, setting the stage for the development of enduring, long-term relationships (Hsu & Fogel, 2003). From the building blocks provided by these moment-to-moment interactions an entire social repertoire emerges. Over time, a relationship forms between the parent and infant as they accumulate a history of interactions; this history, in turn, influences the dynamics of each current interaction (Lollis & Kuczynski, 1997).

Face-to-face interactions between infants and their caregivers expose the infants to large amounts of social and cognitive information (Feldman, Greenbaum, & Yirmiya, 1999). These interactions are arousing and tend to cause a great deal of positive affect in the infant (Cohn & Tronick, 1988). In order to regulate this high arousal, which may otherwise be overwhelming to the infant, parents often adjust the pace and intensity of their own affect and behavior. For instance, mothers and their infants have been shown to synchronize the intensity of their affective behavior within lags of split seconds (Cohn & Tronick, 1988). Researchers have used a number of terms to describe this mutual temporal coordination of affect, including: reciprocity (Brazelton, Koslowski, & Main, 1974), reciprocal responsiveness (Ainsworth, Bell, & Stayton, 1974), dialogue (Bakeman & Brown, 1977), synchrony (Karger, 1979), attunement (Stern, Hofer, Haft, & Dore, 1985), coordination (Tronick & Cohn, 1989), and interpersonal contingency (Jaffe, Beebe, Feldstein, Crown, & Jason, 2001).

The synchrony observed in face-to-face parent/child interactions has been linked to a number of important developmental processes, including infant attachment. Attachment may be

defined as the "child's specific affective bond with the mother, father, and other primary caregivers that impels the child to turn preferentially to these figures for safety and protection in situations of uncertainty, danger, and fear" (Lieberman et al., 2004). The central principle of attachment theory is that the quality of the infant's attachment reflects the parent-infant interaction history (Ainsworth, Blehar, Waters & Wall, 1978). Thus, individual differences in infant attachment may be the result of differences in the mother-child interaction history. Indeed, infants experiencing more synchronous interactions with their mothers tend to develop secure attachments, while infants experiencing higher levels of asynchronous interactions with their mothers tend to become insecurely attached (Isabella, Belsky, & von Eye, 1989; Isabella & Belsky, 1991). Further, in a meta-analysis of studies relating dyadic and parental behaviors to later attachment status the two largest effect sizes were for synchrony, defined as "reciprocal, mutually rewarding, responsive interactions," and mutuality, defined as "mutually focused, positive, maintained engagement," (Harrist & Waugh, 2002).

Synchrony in face-to-face interactions has also been theorized to be related to the development of self-regulation. Face-to-face synchrony allows infants their first opportunity to practice "interpersonal coordination of biological rhythms", experience the mutual regulation of positive arousal, and build to the lead-lag structure typical of adult communication (Feldman, Greenbaum, & Yirmiya, 1999). As parents adjust their own affect so that the infant does not become overwhelmed or distressed, the infant's tolerance for stimulation gradually increases. Synchronous interactions thus lead to a sense of control in the infant and to the promotion of interactive skills (Weinberg et al, 1999). Evidence for this conjecture exists; both maternal synchrony with the infant's affect and shorter lags to maternal responsiveness during the synchronizing process at three months were related to later self-control during the toddler years

(Feldman, Greenbaum, & Yirmiya, 1999). As synchrony has been shown to be related to self-regulation, it has also been theorized to be related to moral development (Emde, 1992). It provides the first setting for the integration of self-regulation and social fittedness, two constructs believed to be necessary for later moral development (Feldman, Greenbaum, & Yirmiya, 1999).

Face-to-face interactions between infants and parents emerge when infants are approximately 2 months of age (Cohn & Tronick, 1988). Although mothers, rather than infants, typically initiate face-to-face interactions before 9 months of age, research shows that probably by the infant's third month, and definitely by the middle of the first year, the organization of face-to-face interactions is actively influenced by both partners (Hsu & Fogel, 2003; Adamson & Bakeman, 1991). Thus, the influence between the infant and mother is bi-directional and flexible; interactions are not influenced solely by the infant's "endogenous, rhythmic processes" or the mother's desires (Adamson & Bakeman, 1991). Rather, both participants bring qualitatively different contributions to the interaction. Although infants use both vocalizations and facial expressions to interact with others (Yale, Messinger, Cobo-Lewis, Delgado, 2003), the infant's main contribution to the interaction is his/her ability to modulate gaze duration and direction (Adamson & Bakeman, 1991; Yale, Messinger, Cobo-Lewis, Delgado, 2003). The caregiver's main contribution is his/her ability to provide attention-maintaining and responsive stimulation (Adamson & Bakeman, 1991).

According to Tronick's mutual regulation model, infant affective organization during the interaction is dependent on two factors, the infant's internal regulatory capacity and the caregiver's ability to provide regulatory scaffolding for the infant (Weinberg et al., 1999). Within this model, the caregiver's behavior is guided by the infant's affective displays, which are in turn affected by the affective displays of the caregiver. Thus, the quality of the interaction is

determined by the abilities of both the infant and caregiver to regulate their own emotional state, express communicative messages, and respond to their partner's affective communication and regulatory needs (Weinberg et al., 1999).

This process of mutual regulation of affect leads to moments of mismatch and moments of synchrony, both of which are important in the development of mutual regulation. Hsu and Fogel (2003) found that mothers and their infants under six months of age spent about 18% of their time in symmetrical interactions, consistent with the range of 15% to 24% reported by Silven (2001), while Tronick and Cohn (1989) reported that mothers and their infants under six months of age spent 30% of their time in synchronous interaction. What research does consistently demonstrate, however, is that periods of affective matching and synchrony are less common than periods of mismatching and dissynchrony (Tronick & Cohn, 1989). Further, interactions frequently move from coordinated to less coordinated states (Tronick & Cohn, 1989). Thus, low levels of synchrony alone should not be taken as cause for alarm, rather, the caregiver-infant dyad's ability to repair their interactive errors and move from miscoordinated states to coordinated states is most important (Tronick & Cohn, 1989). Overall, dyadic synchrony and matching increase as infants mature. Indeed, Tronick & Cohn (1989) report that coordination increases from infants' third to ninth months of life. However, the relative amount of synchrony remains low.

A number of factors, including both infant and maternal individual differences and demographic characteristics, have been shown to influence synchrony in mother-infant face-to-face interactions. Infant characteristics related to observed levels of synchrony include infant temperament and sex. Specifically, high levels of infant negative emotionality have been linked to lower levels of mother-child synchrony (Feldman, Greenbaum, & Yirmiya, 1999).

Additionally, mother-son dyads experience higher levels of coordination and matching than mother-daughter dyads (Malatesta & Haviland, 1982; Tronick & Cohn, 1989) although it is thought to be more difficult for mother-son dyads to achieve such a state (Hsu & Fogel, 2003; Weinberg, Tronick, Cohn, & Olson, 1999). Maternal depression is related to lower levels of synchrony (Field, Healy, Goldstein, & Guthertz, 1990). Further, mothers who are more experienced in caring for infants are both more sensitive and more positive in response to infant signals suggesting higher levels of synchrony in face-to-face interactions (Belsky, Taylor, & Rovine, 1984; Freeburg & Lippman, 1986; Moore, Cohn, & Campbell, 1997). However, "the extent to which the establishment, maintenance, and termination of synchrony in parent-child interaction is influenced by characteristics of the individuals involved and/or by the dyadic history that emerges between them has not been clearly established" (Hsu & Fogel, 2003).

Development of visual and social attention

Attention plays an important role in the achievement and maintenance of synchrony and develops rapidly during infancy. Over the course of development, an infant's early reactive forms of attention are gradually replaced by the individual's growing abilities to use effortful and voluntary forms of attention (Derryberry & Rothbart, 1996). Because of the immaturity of infants' regulatory abilities, parents and other caregivers are often involved in the early development of attention by helping them sustain calm, alert states conducive to attention (Ruff & Rothbart, 1996). As attention and regulation mature, the need for adult interventions decreases and they become less prominent (Gartstein & Rothbart, 2003).

During the first two months of life, the infant's alert state can be seen as his/her primary expression of attention. The alert state is not attained until late in gestation, and is a relatively uncommon event, even at birth (Colombo, 2000). Less than 20% of the newborn's time is spent

in an alert state, while 75% is spent sleeping (Colombo, 2000). Over the first three months, an increasing amount of time is spent in alert states, until, by the twelfth week, periods of alertness have become consolidated and are fairly well coordinated with the light-dark cycle (Colombo, 2000). At this point, the infant can attain longer periods of alertness (Colombo, 2000).

During periods of alertness, newborn infants' looking can be described as both organized and selective (Ruff & Rothbart, 1996). For example, newborn infants exhibit preferential looking, maintaining attention to patterned stimuli longer than plain fields of color (Fantz 1963, 1964). Newborns also show the ability to track moving objects with their eyes, although this tracking is not smooth and tends to lag behind the object's movement (Aslin, 1981). Once both the alert state and selective attention have been attained, infants may demonstrate difficulty disengaging their attention from a highly salient attentional object and these periods of looking may end in distress, a phenomenon known as sticky fixation or obligatory looking (Tennes, Emde, Kesley, and Metcalf, 1972).

During the period between the second and third months of life, in which meaningful face-to-face interactions emerge, an important transition takes place. At this point in development, infants spend an increased amount of time awake and alert, they are able to visually follow objects more easily, and their duration of looking increases (Wolff, 1987; Ruff, Lawson, Kurtzberg, McCarton, & Vaughan, 1982). In keeping with these changes, the infants' duration of social looking increases and, perhaps most importantly, ability to achieve eye contact appears (Lamb, Morrison, & Malkin, 1987). From this time on, "infants are capable of shared attention with partners" in face-to-face interactions marking "the beginning of a period of developing attachment and mutual regulation of attention in face-to-face interaction" (Ruff & Rothbart, 1996; Schaffer, 1984).

It is argued that during this time period, the alert state is more readily brought about by exogenous events or lower-level mechanisms of arousal than by more endogenous or volitional sources. Thus, the emergence of the alert state in young infants may be "thought of in terms of the ascending influence of subcortical pathways on cortical targets" (Colombo, 2000). Additionally, the noradrenergic system is thought to be most closely linked to the notion of alertness (Colombo, 2000). The locus coeruleus is the primary brainstem locus for this system (Colombo, 2000).

During the period from three to nine months, infants gain more control over their attention. They are able to allocate their attention more easily, to disengage visual attention more quickly, and begin to "develop expectations based on the repetition of simple events" (Ruff & Rothbart, 1996). At about five months, infants begin to manipulate objects that engage their attention and by nine months they become proficient at manipulating and exploring these objects (Ruff & Rothbart, 1996).

Attention is highly influenced by novelty and exploration between three and nine months. This preference is likely most influenced by the posterior attention network described by Posner (1990; from Rothbart, Ahadi, & Evans, 2000). The posterior attention network allows attention to disengage from one location, move to another location, and engage at that location (Derryberry & Rothbart, 1997). This system includes portions of the parietal cortex, pulvinar and reticular nuclei, and parts of the superior colliculus. It is "modulated by noradrenergic input and influenced by state of alertness" (Rothbart, Ahadi, & Evans, 2000).

From nine to twelve months, a transition in the infant's attention begins to take place reflecting greater intentionality and control. A number of changes in visual attention can be observed during this period. In general, a decline in the duration of looking at repetitious stimuli

is observed, in part due to an increase in speed of learning and habituation (Ruff & Rothbart, 1996). However, an increase in duration of looking can be observed when several objects are given to infants (Ruff & Salterelli, 1993; Adamson & Bakeman, 1992).

During this period, social referencing emerges, as infants begin looking toward their mothers' faces and attend to their expressions and behaviors when they are at a distance (Sorce, Emde, Campos, & Klinnert, 1985; Ruff & Rothbart, 1996). As social referencing occurs, infants begin to share attention to toys and other objects with the adults who interact with them (Ruff & Rothbart, 1996). Between nine and eleven months infants become "more likely to comply with their mother's instructions during play, to imitate her actions, and to attract the mother's attention to a toy of their own choosing," (Hubley & Trevarthen, 1979 in Ruff & Rothbart, 1996). With these changes, the infant's behaviors become more flexible and coordinated with those with whom they interact and "a more symmetrical relationship with the caretaker, based on reciprocity and characterized by intentionality, can thus be established around this age," (Schaffer, 1984).

The changes in attention taking place between nine and twelve months are thought to be related to the emergence of a second, higher level attentional system (Ruff & Rothbart, 1996). This second system may be observed in the development of some early executive function, exhibited in the infant's greater inhibitory control, ability to anticipate outcomes and ability to plan actions (Diamond, 1991). These changes are thought to be related to the development of the prefrontal cortex. EEG research (Bell & Fox, 1994) and PET studies with infants (Chugani, 1994), as well as research with brain-lesioned monkeys (Diamond & Goldman-Rakic, 1989), all suggest that parts of the frontal lobe begin functioning during these months (Ruff & Rothbart, 1996). Additionally, Posner's anterior attention network probably first comes on line during this

period, although it continues to develop during the following years (Derryberry & Rothbart, 1997; Ruff & Cappozzoli, 2003). Related to executive functioning and planning, this network is thought to underlie "the conscious, effortful control of behavior through which the individual can regulate more reactive motivational functions" (Derryberry & Rothbart, 1997) and allows "the child to rely on an increasing range of conscious representational content, to more flexibly coordinate this content, and to generate behaviors aimed at future states of affairs" (Posner & Rothbart, 1992).This network involves portions of the midprefrontal cortex, including the anterior cingulate gyrus and parts of the supplementary motor cortex (Posner & Raichle, 1994; Posner & Rothbart, 1998).

Development of attention continues long after 12 months. In general, there seems to be a "direct relationship between age and how long a child sustains visual attention" (Ruff & Rothbart, 1996). Further, children between 18 and 24 months of age become more active in controlling the attention of others through both vocalizations and pointing, and are more aware of others' reactions to this direction, checking to see whether others are following their lead (Blake, McConnell, Horton, & Benson, 1992). Children's distractibility decreases from 10 to 42 months (Ruff & Capazzoli, 2003) and older children have been observed to be better than infants in managing the distraction of being given more than one toy to play with simultaneously (Ruff & Lawson, 1990).

Development of negative emotionality

Negative emotionality, as a temperamental characteristic, may be thought of as "individual differences in the experience and expression of negative emotions, including both reactive and regulatory components" (Rothbart & Bates, 1998). It is often conceptualized as a general emotional dimension including "fear, anticipatory anxiety, sadness, frustration/anger,

[and] guilt" (Derryberry & Rothbart, 2001). Researchers have traditionally differentiated between two types of negative emotionality elicited by different stimuli; distress evoked by novel stimuli and/or experiences is thought to represent fear, while distress to limitations is thought to represent anger and frustration (Crockenberg & Leerkes, 2003).

Like other dimensions of temperament, negative emotionality develops rapidly during the first year and each basic emotion subsumed in this category follows a different developmental trajectory. During the first several months of life, negative emotionality is generally characterized by early irritable forms of distress (Rothbart & Derryberry, 2001). This undifferentiated distress may result from both external and internal sources (Rothbart & Derryberry, 2001). The ability to express anger also develops sometime between the first and fourth month (Plutchik, 2002). Following this emergence, researchers report a "U-shaped tendency for the developmental trajectory of anger reactions" during infancy (Carranza et al, 2000). Anger responses have been shown to decrease between 2 to 6 months; this decrease is believed to be related to "greater flexibility in attention shifting" (Johnson, Posner, Rothbart, 1994).

During the period between four to eight months, as the infant begins to interact with his/her environment, fear and irritability become differentiated from the early irritable distress (Rothbart, Chew, & Gartstein, 2001). Fear generally increases during the remaining months of the first year (Carranza et al., 2000). This increase is related to "inhibited approach behavior to unfamiliar and intense stimuli," which emerges late in the first year (Rothbart & Derryberry, 2001).

Research indicates that fear is associated with the right frontal lobe, while anger/frustration are associated with the left frontal lobe (Dawson, 1994). Infants' facial

expressions of anger have been associated with relative left frontal activation while facial expressions of sadness have been associated with relative right frontal activation (Dawson, 1994). The intensity of both emotions seems to be related to the activation of both frontal lobes, as infants who became more distressed more quickly during maternal separation show greater levels of "generalized frontal activation" (Dawson, 1994).

The neural circuits related to fear have been "referred to as a "fear system" by Panksepp (1988) and as part of a general "fight/flight" system by Gray (1994; Gray & McNaughton, 1996)" (Derryberry & Rothbart, 2001). The periaquaductal grey seems to be involved in "explosive forms of escape given unconditioned pain and imminent threat" (Derryberry & Rothbart, 2001), while the medial and anterior hypothalamus seem to be involved in "more directed forms of escape given more distant threats" (Derryberry & Rothbart, 2001). A rage system is thought to underlie frustration and anger (Derryberry & Rothbart, 2001). This system, combined with the fear system, "orchestrates defensive aggression in the face of threat" (Derryberry & Rothbart, 2001).

Higher levels of negative emotionality have been linked to a number of negative outcomes in children. These include both externalizing (e.g., Rothbart et al., 1994; Eisenberg, Fabes, et al., 1997; Stice & Gonzales, 1998) and internalizing (e.g., Clark, Watson, & Mineka, 1994; Teglasi & MacMahon, 1990) problem behaviors, poorer social interactions (Eisenberg et al., 1993, 1995), and lower levels of synchrony in mother/infant interactions (Feldman, Greenbaum, & Yirmiya, 1999). High negative emotionality has also been linked to higher levels of aggression (Rothbart et al., 1994).

Interaction of attention & negative emotionality

It is thought that a great deal of self-regulation may be achieved through attentional processes. While attention may initially be oriented toward motivationally relevant stimuli by affective-motivational systems (e.g., fear, anger, anxiety, positive anticipation), attentional self-regulation can be used to supersede the more automatic initial response through the use of self-distraction, reframing the meaning of events, and coping with stress (Derryberry & Rothbart, 1988; Ahadi & Rothbart, 1994). Thus, attention and self-regulation play an important role in helping individuals cope with negative events and emotions. A growing body of literature suggests that people who are better able to shift their attentional focus and maintain it are better able to modulate their negative affect than people with lower levels of attentional control (Rothbart, 1989). This modulation is thought to be accomplished by turning attention away from stimuli generating negative feelings; thus, people with greater control over their attention are able to experience and manifest less negative emotionality (Rothbart, 1989).

Support for this hypothesis has been found throughout the lifespan. Self-report data from both adolescents & adults have demonstrated a negative relationship between degree of attentional control and the experience and expression of negative affect (Capaldi & Rothbart, 1992; Derryberry & Rothbart, 1988). Thus, adults high in attentional control are often low in negative affect (Rothbart, Ahadi, & Evans, 2000, p. 130).

The inverse relationship between regulatory ability and negative emotionality can also be observed during childhood. Parent and teacher report questionnaire data indicate that children high in effortful control tend to exhibit low levels of negative emotionality (Ahadi et al., 1993; Eisenberg et al., 1993, 1995). Similarly Mischel observed that early ability to delay gratification,

an indicator of effortful control, was related to a later tendency to remain calm in stressful situations (1983).

As previously discussed, regulation of both attention and emotion is in part dependent on the caregiver during infancy. However, it has been observed that infants may also work toward regulating their own distress by moving their attentional focus from one stimulus to another (Ahadi & Rothbart, 1994). Additionally, a number of studies demonstrate the concurrent relationship between early attentional capacities and lower levels of negative affect. In general, infants' early attention abilities have been "associated with enhanced regulation of arousal that coincided with negative emotions or lower susceptibility to distress" (Rothbart, Ziaie, and O'Boyle, 1992). This relationship between attention and emotionality has been observed as early as 4 months. In a study during this period, infants who more readily disengaged visual attention to a central event when a peripheral event occurred were reported to be more easily soothed and less distressed according to their mothers (Johnson et al., 1991). At 9 months, infants who showed high levels of focused and sustained attention were reported to be more able to regulate negative affect than their peers (Matheny, Riese, and Wilson, 1985). Similar results were reported in samples of 12-month-olds (Wilson & Matheny, 1983) and toddlers (Matheny, Wilson, & Nuss, 1984).

Additionally, infants who showed longer periods of orienting were observed to reach the peak intensity of their responses less rapidly and were generally less labile in state (Strauss & Rourke, 1978). Further, "infants' ability to shift attention away from highly arousing stimuli" at 13.5 months was modestly related to lower levels of negative affect (Rothbart et al., 1992), while modest relationships between infants' sustained attention and ability to modulate negative emotions have been observed (Kochanska, Coy, Tjebkes, and Husarek, 1998). Longitudinal

studies also provide support for this hypothesis, as infants who showed higher levels of negative emotionality and lower levels of attentional control during an arm-restraint/frustration task were most defiant during follow-up laboratory tasks (e.g., clean-up) at 30 months (Stifter, Spinrad, and Braungart-Rieker, 1999).

It has been hypothesized that when people high in negative emotionality lack the ability to modulate their negative affect through attentional control they are more likely to experience the negative outcomes associated with high levels of negative emotionality (e.g., internalizing and externalizing behavior problems, poorer social interactions) (Belsky, Friedman, & Hsieh; 2001). Research with both preschool and school-age children supports this hypothesis. For instance, preschoolers high in negativity and low in attentional control were rated significantly lower on sociometric status and social skills than all other children, including those children who were high in negative emotionality but not low in attentional control (Eisenberg, Fabes, et al., 1993). In a follow-up study two years later, the high negative emotionality/low attention group was found to have higher levels of mother reported negativity, poorer behavioral control, and was more likely to score highly on mother-reported problem behavior (Eisenberg, Fabes, et al., 1995). Further, in a longitudinal study of the relations between negative emotionality, attentional regulation, and externalizing behavior in school-age children, attentional regulation was found to predict externalizing behavior primarily for children high in negative emotionality (Eisenberg et al., 2000).

In an attempt to study whether attention would buffer the effects of negative emotionality at an earlier age, Belsky et al. (2001) assessed both attention and negative emotionality using laboratory measures at 15 months. Following this sample up at age three, a moderating effect of attention on negative emotionality was found for social competence, so that children classified

low in attentional persistence were rated as less socially competent. A moderating effect was also found for school readiness such that high levels of negativity predicted increased school readiness at age three only for children classified as high in attentional persistence. No effect was found in predicting problem behaviors at age three in this sample.

Measurement of parent-child interaction & infant temperament

Research on each of the variables previously discussed has utilized a variety of measurement techniques, including observational measures, questionnaires, and physiological measures. Each of these methods has inherent advantages and disadvantages and some variables more easily lend themselves to measurement with a specific technique.

Observational measures are often used in examining both infant temperament and parent-child interactions. These observations most frequently take place in a laboratory setting, although home observations may also be used. Laboratory observations offer a great degree of control in that they enable researchers to manage the "context and/or elicitors of the child's behavior" (Rothbart & Bates, 1998). At the same time, however, the types of behaviors that can be elicited may be limited due to the constraints of the laboratory situation (Rothbart & Bates, 1998). Laboratory observations typically utilize videotapes of the participants which are then coded at a later date. Because of this, "strict controls on reliability are possible" and the information processing capacities of the coder are not overly taxed as is sometimes the case in *in vivo* coding (Rothbart, Chew, & Gartstein, 2001). However, this approach may still lead to problems in "detecting low intensity or ambiguous reactions of the child" (Rothbart, Chew, & Gartstein, 2001). Further, repeated testing and observations may be impractical or result in carryover effects (Rothbart & Bates, 1998).

Observational measures have been the primary method of measurement in studies of synchrony in parent-child interaction. The parent-child dyad is generally observed during a play interaction and this interaction is later coded. Most researchers have focused on examining the "temporal sequencing of individual behaviors of the two partners," (Hsu & Fogel, 2003). As a result, interactions between mother and infant have been studied and understood at an individual level, as opposed to a truly dyadic level. Some researchers take exception to this method, arguing that dyadic interactions are co-constructed and involve co-regulatory processes, thus the dyad as a whole, rather than each individual in the dyad, should be the principle unit of analysis (Hsu & Fogel, 2003).

Observational measures are also often used in studies of attention. Looking, observing responses, facial expressions, and motor activity have all been coded as indices of attention. Looking has been described as a "key measure of visual attention directed toward external events" and can be easily and systematically observed across a variety of situations (Ruff & Rothbart, 1996). In many studies looking has been measured by having an observer record whether the infant looks at a stimulus, and if so, for how long (Ruff & Rothbart, 1996). This is a relatively simple coding technique and can be a very reliable index of attention (Ruff & Rothbart, 1996). However, inference is required to link looking to attention and without the use of additional indices of attention, level of engagement may be difficult to establish (Ruff & Rothbart, 1996).

Observing responses are "actions the subject uses to bring a stimulus event into view", such as reaching toward an object and manipulating it (Ruff & Rothbart, 1996) and may also be observed and coded. Like looking, observing responses are relatively simple to observe and

code reliably, but still require that an inference linking observing responses and attention be made (Ruff & Rothbart, 1996).

Facial expression has not been coded as widely as looking or observing responses in studies of attention. However, Izard described two expressions, interest and hypothesized interest, which are thought to be indicative of attention (Ruff and Rothbart, 1996). The interest expression is defined as "brows drawn together but neither raised nor lowered…there is no movement in the eye or cheek region. The mouth is open and relaxed," (Izard, Dougherty, and Hembree, 1989). Hypothesized interest is defined as an expression in which "no movements can be coded in any region of the face, but looking is clearly directed at a single target" (Izard, Dougherty, and Hembree, 1989). An advantage of using facial expression as an index of attention is that it seems to allow researchers to differentiate between "qualitatively different levels of attention," as the interest expression seems to reflect a more intense level of attention than hypothesized interest (Ruff & Rothbart, 1996).

Although not used as frequently, level of motor activity may also be coded in conjunction with other indicators of attention, as irrelevant motor activity is typically reduced during periods of attention (Ruff & Rothbart, 1996).

Negative emotionality may also be assessed using observational methods. In this case, the reactive components of negative emotionality are typically measured as a "combination of vocal, facial, motor, and physiological indices of distress" (Crockenberg & Leerkes, 2003). Temperament researchers are interested not just in the qualitative nature of these responses, but also in their intensity and fluctuation (Derryberry & Rothbart, 2001). The regulatory components of negative emotionality are often "operationalized in terms of the timing and/or degree of reductions in the same measures" (Crockenberg & Leerkes, 2003). Thus, given a

fearful response, researchers may be interested in how quickly the infant demonstrates the reaction, the peak intensity of fear, how quickly this peak is achieved, how long the peak intensity is maintained, and how quickly the infant recovers from the fearful state (Derryberry & Rothbart, 2001).

Questionnaires represent another method of measuring attention and negative emotionality, this time relying upon parent's extensive experience with their child rather than observational or physiological data. As with any parent-report measure, concerns about measurement error due to social desirability, the parents' knowledge of other infants' behavior, and/or the parents' possibly inaccurate memory of events involving their child have been raised (Gartstein & Rothbart, 2002). However, parent-report measures have established a "fair degree of objective validity," (Rothbart & Bates, 1998). Additionally, concerns about the possibility of perceptual and reporting biases occurring in parent-report measures may be partially offset by the advantages that this method of data collection offers. Questionnaires are often the most convenient method of collecting information about participants, as they are relatively easy to administer and analyze. Further, parents can observe and report on a wider range of their child's behaviors than may be elicited or observed in the laboratory, particularly those behaviors that occur infrequently.

Observational and questionnaire methods involve inherently different assessment criteria; observers generally assess individual behaviors during a relatively short, finite period, while parent-report questionnaires request parents to remember and report aggregated or global perceptions about their children (Carranza et al., 2000). Each of these methods has considerable strengths and limitations. While each can independently and reliably indicate the presence, and in some cases, the level, of a variable, "more confident inferences can be made when multiple

measures at different levels converge in some theoretically meaningful manner," (Ruff & Rothbart, 1996). Thus, employing multiple methods may help minimize measurement error. Additionally, measurements taken at several points across the rapid development of the first year can provide a better assessment of social, emotional, and cognitive development during infancy than measurements at a single point.

Physiological measures, often including heart rate, may also be used to measure attention. Decrements in heart rate are thought to be indicative of attention to external events, while heart rate acceleration is considered indicative of attention directed inward, as in problem solving (Ruff & Rothbart, 1996). Thus a decrease in a measure of heart rate variability, such as respiratory sinus arrhythmia, is a physiological measure which includes sustained attention to both internal and external events (Ruff & Rothbart, 1996).

Electroencephalographs (EEGs) have also been used as physiological measurements of attention and negative emotionality, allowing researchers to investigate the distribution of activity across the cortex during a variety of events or activities (Ruff & Rothbart, 1996; Dawson, 1994). EEGs have the advantage of being noninvasive and thus, can be obtained from alert, awake subjects who are actively engaged in a cognitive task or emotion-eliciting event (Ruff & Rothbart, 1996). Positron emission tomography (PET) enables researchers to relate performance on particular tasks to patterns of metabolic activity in the brain, enabling them to map the distribution of activity within the brain during specific tasks (Ruff & Rothbart, 1996). This technique can be quite time consuming and expensive however, and thus, is generally not used in studies with large numbers of subjects (Ruff & Rothbart, 1996). Additionally, as an invasive technique, it is generally not used in studies of children unless it has been clinically indicated (Ruff & Rothbart, 1996).

Purpose of Study

The purpose of this study is two-fold. The first goal is to develop multi-method constructs for infant attention/regulation and infant negative emotionality. The second goal is to then examine the impact of these temperament domains on parent-child interactions during infancy.

Within this study infant temperament was assessed using two measures, the Infant Behavior Questionnaire – Revised (IBQ-R) and the Temperament Laboratory Assessment (TLA). Given the relative strengths and weaknesses of both parent-report and laboratory-based assessments, if sufficient convergence is found between the two methods, using both in tandem as in the multi-trait multi-method matrix approach may maximize the reliability and validity of temperament measurement. Previous research has yielded significant, albeit low to moderate, agreement between parent-report and other methods of assessing infant temperament (e.g., Carter, Little, Briggs, and Kagan, 1999; Field and Greenberg, 1982). Thus, it is hypothesized that temperament data collected during the laboratory assessment and data from the parent-report questionnaire will converge to a significant extent, enabling the construction of multi-method constructs for both infant negative emotionality and attention/regulatory capacity.

The impact of these domains on mother-infant interactions will also be investigated. First, it is hypothesized that dyads in which the infant is high in negative emotionality will demonstrate less effective interactions, as evidenced by lower levels of synchrony/reciprocity and responsivity/sensitivity. Second, it is expected that more effective interactions will be found within dyads in which the infant is high in attention and regulation. Finally, it is believed that infant attention will moderate the effect of infant negative emotionality on parent-child

Interactions, such that higher levels of attention will be associated with more effective mother-child interactions, even in the context of elevated child negativity, thus playing a protective role.

CHAPTER TWO

METHOD

Participants

Participants were recruited amongst parents of infants in the San Francisco Bay Area. Parents whose infants were 6, 9, or 12 months of age (plus or minus two weeks) were invited to take part in the study. Possible participants were identified through birth announcements released by hospitals and published in the local San Francisco Bay Area newspapers. Because these announcements were released by hospitals rather than parents, they are thought to comprise a relatively representative sample of births in the Bay Area. Eligible families were contacted by telephone approximately two weeks before their infants were eligible to participate in the study.

A sample of 68 families was recruited in this manner. Infants were approximately equally distributed across age groups and by gender: (1) 6 months of age (N = 19; 10 males and 9 females); (2) 9 months of age (N = 25; 14 males and 11 females); (3) 12 months of age (N = 24; 12 males and 12 females). All data were collected between 3/1/2000 and 9/1/2001.

The majority of participating parents were mothers (97%), with fathers comprising the remaining respondents (3%); most participants were married (95.5%). In terms of ethnicity, the majority of respondents were Caucasian/European American (82.1%), followed by Asian/Asian American (9.0%), Hispanic/Latino(a) (4.4%), Filipino (3.0%), and African American/Black (1.5%).

Procedures

Participating parents were asked to complete a measure of infant temperament, the Infant Behavior Questionnaire – Revised (IBQ-R; Gartstein & Rothbart, 2003). The families also participated in a laboratory measure of infant temperament, the Temperament Laboratory

Assessment (TLA; Gonzalez et al., 2002). Parents were told that their participation would take about an hour and a half for questionnaire measures, and about one hour for the TLA. Participants were also informed of the fact that all assessments had to be completed within 2 weeks of their child turning 6, 9, or 12 months of age, depending on the infant's age group. Participants were reimbursed $25.00 for taking part in this research.

Measures

Infant Behavior Questionnaire (IBQ-R; Gartstein & Rothbart, 2002). The IBQ-R is a rationally derived, fine-grained, psychobiologically oriented assessment designed as a parent report measure of infant temperament. Items and scales constructed for the IBQ-R were based on the definition of temperament proposed by Rothbart & Derryberry (1981), as well as work with the Child Behavior Questionnaire (Rothbart, Ahadi, & Hershey, 1994), comparative studies, and other developmental research identifying significant dimensions and associated behavioral tendencies.

The IBQ-R is comprised of three overarching factors which are in turn composed of 14 scales: (1) Positive Affectivity/Surgency - Smiling and Laughter, High Intensity Pleasure, Activity Level, Approach, Perceptual Sensitivity, and Vocal Reactivity; (2) Negative Emotionality - Fear, Distress to Limitations, Sadness, and Falling Reactivity (negatively loading); (3) Orienting/Regulatory Capacity - Duration of Orienting, Soothability, Cuddliness/Affiliation , and Low Intensity Pleasure (Gartstein & Rothbart, 2003). In terms of psychometric properties, the reliability and validity of this questionnaire have been documented, with Cronbach's alphas ranging from .77 to .96 (Gartstein & Rothbart, 2003; Gartstein, Slobodskaya & Kinsht, 2003).

Temperament Laboratory Assessment (TLA; Gonzalez, Gartstein, Carranza, & Rothbart, 2001). The TLA was designed in order to elicit both the reactive and regulatory aspects of temperament in children aged 6 to 12 months. This assessment, based on the Laboratory Temperament Assessment Battery (LAB-TAB; Goldsmith & Rothbart, 1996), consists of 10 episodes: warm-up, play with toys, toy retraction, embrace with examiner, parent-child interaction, visual perceptual sensitivity, separation, peek-a-boo, auditory perceptual sensitivity, and presentation of masks. Each task targets specific aspects of infant temperament, including negative emotionality, positive emotionality, and regulatory capacity. All laboratory sessions were recorded on video to be coded and analyzed at a later date.

Coding of the TLA provides indices of threshold, latency, intensity, time to peak intensity, and recovery time for reactions involving arousability of affect, motor activity, and related responses. LAB-TAB, which served as a model for the TLA, has been widely used and consistently described as reliable and valid, with inter-rater agreement ranging from 87% to 100% (Goldsmith & Rothbart, 1991). Convergence between latency, intensity, and duration parameters of positive affectivity, fear, and anger was demonstrated with an average intercorrelation of .68 (Goldsmith & Rothbart, 1991). Additionally, preliminary analyses of the TLA have provided satisfactory inter-rater reliability estimates, with correlations between raters ranging from .64 to 1.00.

Aspects of negative emotionality are expected to be elicited during a variety of TLA tasks. Fearful reactions are expected during warm-up and presentation of masks, while toy retraction is expected to elicit frustration/anger. The warm-up task is the first activity for the infant in the unfamiliar lab setting. During this task, the experimenter told the infant's parent "I'm going to talk to [child's name] for a minute, then we'll play with Pooh for a minute, and

then you and [child's name] can play together." The experimenter then played with the infant without any props for one minute and introduced a stuffed Winnie the Pooh in the second minute of play. Following this period, the parent was told "Play with [child's name] however you like. I will come back soon," and the experimenter left the room for a period of two minutes. In the presentation of masks task, the experimenter told the infant's parent "Now I will show you child some masks. Please don't react to them yourself or comment on them, but if [child's name] needs soothing, please go ahead." The experimenter then positioned herself behind a wooden board with a window covered by a curtain. The experimenter knocked on the board to gain the child's attention, lifted the curtain, and showed each mask for 10 seconds before proceeding to the next mask. The masks worn were a witch, an old man, a vampire, and a gas mask. Latency to fear, intensity and duration of facial and bodily fear, and intensity and frequency of distress vocalizations were coded for both the warm-up and masks segments. Within the toy retraction task, mothers were told "I'm going to give [child's name] these keys. After 15 seconds I'll ask you to take them away and place them out of his/her reach (experimenter indicates a place outside infant's reach but within sight). After 15 seconds you can give it back. We'll repeat this three times." Latencies to anger and sadness, as well as presence and intensity of bodily and facial anger, sadness, and distress vocalizations are coded in this episode.

Aspects of regulation/attention are exhibited during the arc of toys task in the TLA. During the arc of toys the infant is shown a rubber duck, a rattle, a stuffed pig, a stuffed ball, and nesting cups. The mother is told "We want to see how [child's name] will play with these toys by him/her self. Please do not interact with him/her unless it is necessary. If a toy falls out of reach please put it back but do not play with [child's name]." The experimenter then left the

room for a period of three minutes. Latencies to approach the toys and to look away are coded for this task, as well as facial interest and toy manipulations.

Coding of Maternal Interactional Behavior

The TLA also includes a two minute parent-child interaction episode. Mothers were given the instructions "Here is a phone that you can use to play with your baby. You can interact/play however you would like, just try not to get [baby's name] too excited. I will be back when it's time for the next activity." The experimenter then left the room and the interaction was videotaped through a one-way mirror using a camera monitored by an experimenter in the adjoining room.

Global ratings of synchrony/reciprocity in parent-child interactions and maternal responsivity/sensitivity were provided using a 7-point Likert scales (1 = extremely asynchronous/non-reciprocal, insensitive/non-responsive; 4 = moderately synchronous/reciprocal, sensitive/responsive; 7 = extremely synchronous/reciprocal, sensitive/responsive). Ten variables identified as components of responsiveness were used to assess individual aspects of maternal interactional sensitivity (e.g., initiatives to motivate play, emotional attunement, enjoyment of joint activity) (Laasko et al., 1999). Considering these aspects deemed relevant to responsive parental behavior aided the raters in generating an appropriate responsivity code. Thus, based on observation of a two-minute video segment of play, the coder assigned a global rating from one to seven to the mother's behavior based on examination of these 10 responsivity-related variables.

Maternal synchrony/reciprocity was coded in a similar manner, using a 7-point Likert scale based on the research of Bernieri, Reznick, and Rosenthal (1988). Coders were guided in their ratings of reciprocity by considering three demonstrated aspects of synchrony: simultaneous

movement, tempo similarity, and coordination and smoothness. Again, a global rating from one to seven was assigned to the parent-child interactional behavior following observation of the two-minute play episode.

Three raters, all graduate students in psychology, coded maternal interactional behavior and participated in training and reliability checks in order to ensure understanding of the categories and specific criteria used in coding, as well as agreement between raters. Interobserver reliability was assessed by having the three coders independently code the same training cases, with the correlation coefficients ranging from .47 to .93 (Kappa = .86).

Analytic Strategy

The first steps in analysis involve building multi-method constructs of both infant attention/regulation and negative emotionality. The attention/regulation construct will use the Orienting/Regulatory Capacity factor score from the IBQ-R which is comprised of the Duration of Orienting, Low-Intensity Pleasure, Soothability, Cuddliness, and Smiling and Laughter scales, as well as indicators of attention from the TLA. Similarly, the multi-method construct of infant negative emotionality will use the Negative Emotionality factor score from the IBQ-R, including the Distress to Limitations, Fear, Sadness, and, Falling Reactivity (negatively loading) scales, as well as indicators of negative emotionality from the TLA. Bivariate correlations will first be computed in order to examine patterns of association among these items. Indicators that demonstrate generally significant correlations will be included in an evaluation of internal consistency conducted by computing Cronbach's alphas.

Once multi-method constructs for attention/regulation and negative emotionality have been built, hierarchical multiple regression will be used to evaluate the impact of each, and their interaction, on parent-child interactions factors, with synchrony/reciprocity and

responsivity/sensitivity as the dependent variables. In the first step of the regressions, demographic variables will be entered, including child age and gender, parent age, education, and SES. In the next step, negative emotionality and attention/regulation constructs will be entered in order to examine their main effects. Finally, the interaction term will be entered in order to examine the moderator effects of attention/regulation of the relationship between negative emotionality and parent-child interactions. If the interaction is found to be significant, further testing will follow the procedures outlined by Aiken and West (1991).

CHAPTER THREE

RESULTS

Attention/Regulation Construct

In order to create the attention/regulation construct, bivariate correlations between the IBQ-R Orienting/Regulatory Control factor score and TLA indices of attention/regulation were computed to determine which variables were significantly correlated, using an alpha level of .05 to determine statistical significance (Table 1). Internal consistency of correlated variables was then examined by calculating Cronbach's alpha. In order to ensure sufficient internal consistency, an alpha of .70 or greater was the goal, although slightly lower threshold values have also been deemed acceptable (Nunally, 1978). Unfortunately, it was not possible to create a multi-method construct with sufficient internal consistency. That is, combining laboratory-based and parent report data into a single scale did not result in a measure with adequate internal consistency, even after considerable manipulation of content (i.e., eliminating certain items, while retaining others). The highest level of internal consistency achieved was an alpha of -.07 in a scale including the IBQ-R Orienting/Regulatory Control factor score and facial interest, duration of looking, number of manipulations, and changing toys as laboratory indicators.

Table 1

	1	2	3	4	5	6
1. IBQ-R O/RC		-.12	-.08	-.27*	-.18	-.16
2. Toys – facial interest	-.12		.50*	.48*	-.02	.15
3. Toys – duration of looking	-.08	.50*		.63*	-.38*	.26*
4. Toys – number of manipulations	-.27*	.48*	.63*		-.20	.30*
5. Toys – change toys	-.18	-.02	-.38*	-.20		-.15
6. Toys – change actions	-.16	.15	.26*	.30*	-.15	

Correlations between laboratory and questionnaire indicators of attention/regulation, $p \leq .05$

As laboratory-based and parent-report questionnaire indicators of attention/regulation did not combine to provide a scale with sufficient internal consistency, a construct based on laboratory indicators of attention/regulation was developed. A scale with sufficient internal consistency combined facial interest, duration of looking, and number of manipulations, producing an alpha of .69. This construct's internal consistency was slightly lower than the desired level; however, it was decided to retain all three indicators of attention and regulation in order to provide a broader measure, conveying a greater amount of information regarding each child's regulatory and attentional abilities.

Negative Emotionality Construct

The negative emotionality construct was developed in the same manner, correlating the IBQ-R Negative Emotionality factor score and TLA indices of negative emotionality. The correlations are shown in Table 2. Again, a Cronbach's alpha of at least .70 was the goal in order to ensure sufficient internal consistency. A scale of sufficient internal consistency (alpha = .71) was obtained, combining laboratory-based and parent-report questionnaire indicators of negative emotionality. Included in this scale were the IBQ-R Negative Emotionality factor score, intensity of fear, frequency of fear, intensity of distress vocalizations, frequency of distress vocalizations, intensity of bodily fear, frequency of bodily fear, intensity of escape, frequency of escape, and duration of escape from the masks segment. Also included were intensity of bodily fear, frequency of bodily fear, presence of escape behaviors, and intensity of escape behaviors from the warm-up episode and the presence of struggle, intensity of struggle, reaching for toy, presence of bodily anger, and presence of bodily sadness from the toy retraction episode.

However, as a sufficiently internally consistent scale could not be constructed for regulation/attention, a laboratory-based construct was also developed incorporating indicators

Table 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. IBQ-R Negative Emotionality		.10	.16	.06	.16	.03	.15	.16	.13	.20	-.07	-.07	-.10	-.11	.10	-.09	.12	.22
2. Mask – intensity fear	.10		.81*	.68*	.64*	.65*	.38*	.33*	.23	.29*	.25*	.25*	.13	.15	.07	.22	.01	.13
3. Mask – frequency of facial fear	.16	.81*		.32*	.31*	.38*	.37*	.17	.17	.16	.13	.13	-.12	-.10	.10	.11	-.15	.11
4. Mask – intensity of distress vocalizations	.06	.68*	.32*		.87*	.59*	.28*	.49*	.33*	.47*	.24	.24	.06	.04	-.14	.08	-.05	.01
5. Mask – frequency of distress vocalizations	.16	.64*	.31*	.87*		.49*	.13	.42*	.33*	.40*	.20	.20	.12	.12	-.04	.11	.05	.01
6. Mask – intensity of bodily fear	.03	.65*	.38*	.59*	.49*		.72*	.17*	.04	.14	.20	.20	.30*	.318	.11	.288	.12	.05
7. Mask – frequency of bodily fear	.15	.38*	.37*	.28*	.13	.72*		.08	.00	.09	.12	.12	.04	.04	.18	.29*	-.07	-.05
8. Mask – intensity of escape behaviors	.16	.33*	.17	.49	.42*	.17*	.08		.93*	.97*	.22	.22	.11	.12	.15	.08	.06	-.01
9. Mask – frequency of escape behaviors	.13	.23	.17	.33*	.33*	.04	.00	.93*		.92*	.04	.04	.05	.06	.24	.06	.04	-.02
10. Mask – duration of escape behaviors	.20	.29*	.16	.47*	.40*	.14	.09	.97*	.92*		.01	.01	.04	.04	.14	.02	.05	.00
11. Warm-up – intensity of bodily fear	-.07	.25*	.13	.24	.20	.20	.12	.22	.04	.01		1.0	.20	.18	-.06	.23	.06	-.03
12. Warm-up – frequency of bodily fear	-.07	.25*	.13	.24	.20	.20	.12	.22	.04	.01	1.0		.20	.18	-.06	.23	.06	-.03
13. Warm-up – .presence of escape behaviors	-.10	.13	-.12	.06	.12	.12	.04	.11	.05	.04	.20	.20		1.0*	.33*	.31*	.22	-.09
14. Warm-up – intensity of escape behaviors	-.11	.15	-.10	.04	.12	.12	.04	.12	.06	.04	.18	.18	1.0*		.38*	.32*	.22	-.09
15. Toy Retraction – intensity of struggle	.10	.07	.10	-.14	-.04	-.04	.18	.15	.24	.14	-.06	-.06	.33*	.38*		.20	.16	-.08
16. Toy Retraction – attempts to reach toy	-.09	.22	.11	.08	.11	.11	.29*	.08	.06	.02	.23	.23	.31*	.32	.20		.11	-.07
17. Toy Retraction – bodily anger	.12	.01	-.15	-.05	.05	.05	-.07	.06	.04	.05	.06	.06	.22	.22	.16	.11		-.04
18. Toy Retraction – bodily sadness	.22	.13	.11	.01	.01	.01	-.05	-.01	-.02	.00	-.03	-.03	-.09	-.09	-.08	-.07	-.04	

*Correlations between laboratory and questionnaire indicators of negative emotionality, *p≤.05*

from all three episodes designed to address infant Negative Emotionality in order to maintain consistency between constructs. From the masks episode, intensity of fear, frequency of facial fear, intensity of distress vocalizations, frequency of distress vocalizations, intensity of bodily fear, frequency of bodily fear, intensity of escape behaviors, frequency of escape behaviors, and duration of escape behaviors were included. Intensity of bodily fear, frequency of bodily fear, presence of escape behaviors, and intensity of escape behaviors were included from the warm-up episode. Finally, intensity of struggle, attempts to reach toy, bodily anger, and bodily sadness from the toy retraction episode were included. These indicators resulted in a construct with sufficient internal consistency (alpha = .72).

Impact of Attention/Regulation, Negative Emotionality, and their Interaction

Because it was not possible to create sufficiently internally consistent multi-method constructs, it was decided to complete two sets of Multiple Regression Procedures to test the hypotheses, one set using the questionnaire data and one using the laboratory data to predict both synchrony/reciprocity and responsivity/sensitivity, as dependent variables. Initial regressions, in which demographic variables, including child age and gender, parent age, education, and SES, were entered in the first step revealed that these did not account for significant variance. As a result, demographic variables were omitted to provide greater power in subsequent analyses and the "trimmed" equations (i.e., excluding these ultimately non-significant predictors) are presented here. Additionally, the multi-method construct for negative emotionality was evaluated, but provided results consistent with those obtained using the separate parent report or laboratory constructs. Thus, in all cases, negative emotionality and attention/regulation were

entered in the first step of the regression. In the second step, the interaction of attention/regulation and negative emotionality was entered.

In predicting synchrony/reciprocity, the overall model did not reach statistical significance, utilizing laboratory constructs of attention and negative emotionality, F = 1.57, p=.21 (see Table 3). Further, the overall model was not significant using questionnaire Orienting/Regulatory Control and Negative Emotionality factors, F = .16, p=.93 (see Table 4). Similarly, the overall model predicting responsivity/sensitivity was not significant using laboratory constructs, F = .46, p=.71 (see Table 5), or questionnaire factor scores, F = 1.04, p=.38 (see Table 6).

Table 3 – Predicting Synchrony/Reciprocity from Laboratory Observation

	R	R^2	R^2 Change	β
Overall Model	.27	.07	.04	
Variables				
Negative Emotionality Lab Construct				.07
Attention/Regulation Lab Construct				.07
Interaction				-.23

Table 4 – Predicting Synchrony/Reciprocity from IBQ-R Data

	R	R^2	R^2 Change	β
Overall Model	.04	.00	.00	
Variables				
Negative Emotionality Factor Score				.02
Attention/Regulation Factor Score				-.01
Interaction				-.03

Table 5 – Predicting Responsivity/Sensitivity from Laboratory Observation

	R	R^2	R^2 Change	β
Overall Model	.15	.02	.02	
Variables				
Negative Emotionality Lab Construct				.00
Attention/Regulation Lab Construct				.01
Interaction				.15

Table 6 – Predicting Responsivity/Sensitivity from IBQ-R Data

	R	R^2	R^2 Change	β
Overall Model	.21	.05	.02	
Variables				
Negative Emotionality Factor Score				1.22
Attention/Regulation Factor Score				.41
Interaction				-1.22

CHAPTER FIVE

DISCUSSION

The goals of this study were to build multi-method constructs combining laboratory and questionnaire temperament data for both infant Negative Emotionality and Attention/Regulation and to test a set of hypotheses derived from the literature regarding the interaction of negative emotionality and attention, being relevant in predicting multiple important child outcomes throughout development. In the case of infant negative emotionality, laboratory and questionnaire data did significantly converge and it was possible to build a multi-method construct for this factor. However, laboratory and questionnaire data were not found to converge to a significant degree for infant attention/regulation; thus, it was impossible to build a multi-method construct with sufficient internal consistency.

The hypothesis that dyads in which the infant exhibited higher levels of negative emotionality would show lower levels of synchrony/reciprocity and responsivity/sensitivity in mother-child interactions was not supported. Further, the hypothesis that dyads in which the infant showed high levels of attention/regulation would have more effective mother-child interactions was also not supported. Contrary to our hypothesis, results did not provide support for the hypothesis that attention would moderate the effect of negative emotionality on parent-child interactions during infancy.

One possible explanation for this pattern of findings lies in the rapidly changing development of attention over the first year of life. Within the sample used in this study, the mean age of infants was 40.18 weeks, or at the beginning of the tenth month. Additionally, with data collection points at 6, 9, and 12 months of age, the majority of infants in the study were within the period during which the anterior attention network appears to come on line. Once this

system becomes active, greater flexibility in attention shifting, greater inhibition, and initial signs of executive control become apparent. It is possible that these elements of attention/regulation account for its protective function in relation to the impact of negative emotionality on social outcomes. Thus, the considerable number of infants in the study who likely had not yet reached this developmental milestone may account for the nonsignificant findings. Unfortunately, due to the relatively small sample size, it is impossible to look at the 12-month-old infants in isolation in order to definitively address this potential explanation.

Whereas previous research demonstrates a relationship between attention and emotionality as early as four months (e.g., Johnson et al., 1991), the impact of their combined effects on other variables has not been investigated during the first year of life. In other words, the hypothesis that those individuals high in negative emotionality who are unable to modulate their negative affect through attentional control are more likely to experience negative outcomes associated with negative emotionality, has not been previously documented during the first year. The earliest age group included in research designed to evaluate how attention-based regulation moderates the expressions of negative emotionality was 15 months of age at the beginning of a longitudinal investigation extending to 3 years of age. Thus, it may also be possible that the buffering effect of attention/regulation on the effects of negative emotionality may be additive in nature, only becoming apparent after a substantial number of interactions over a longer period of time. If this is the case, the effect may not have been sufficient to enable detection in this study due to its concurrent design.

Another possible explanation for the findings in this study may relate to the method used to measure regulation. When using observational measures, research suggests that self-regulatory behaviors are most likely to occur during experimental emotion-activating conditions

rather than during conditions not designed to elicit a specific emotion (Cole, Martin, and Dennis, 2004). Additionally, previous research suggests that regulatory strategies were most likely to be observed during periods of negative emotion than during periods of neutral or positive emotion (Cole, Martin, and Dennis, 2004). However, the arc of toys task used to elicit attention and regulation within this study does not meet these optimal conditions, as the arc of toys, while generally enjoyable for the infant was not designed to elicit strong positive emotion and rarely evokes negative emotion. Further, some researchers have suggested that the most appropriate method for measuring regulation in the laboratory may be through "temporal analyses of change", first eliciting an emotion and then measuring regulatory processes and subsequent decreases in emotion (Cole, Martin, and Dennis, 2004). The coding scheme utilized in this study does not focus on these temporal sequences of events; rather, it provides codes for latencies, presence, and intensity of regulatory behaviors.

In summary, the hypotheses of this study were not supported by the data. In the case of infant negative emotionality, it was possible to build a multi-method construct using questionnaire and laboratory data. However, this was not the case for infant attention/regulation, as laboratory and questionnaire indicators of this construct did not converge. Results indicated that main effects of infant negative emotionality and attention/regulation on maternal synchrony/reciprocity and responsivity/sensitivity were non-significant, as was the interaction between negative emotionality and attention/regulation. These results may indicate that the hypothesized relationships between negative emotionality and attention/regulation and their impact on dyadic interactions may not be of significance during the first months of life. It is also possible, however, that limitations of the research design precluded the ability to detect these relationships.

Limitations of the study included the varied age of infants in the sample and possible issues related to the measurement of regulation and attention in the laboratory, as discussed above. Other limitations include the relatively small sample size, which precluded the opportunity to investigate the relationship between infant temperament variables and mother-child interactions at each measurement point (i.e., 6, 9, and 12 months) independently, and that the outcome variables of interest, maternal synchrony/reciprocity and sensitivity/responsivity, were based on a single, brief observation during the laboratory assessment. It is possible that the nature of the assessment, with mothers knowing that they were being taped and observed, provided higher-quality interactions than would be observed in a more natural setting. A longer assessment, or observation over multiple interactions, may have been a better method for assessing the parent-child interactions.

Despite non-significant results, this study does have implications for future research. As the interaction between negative emotionality and attention/regulation and parent-child interaction variables was not found to be significant at this age, while previous research has demonstrated significant relationships between the interaction and other important outcome variables, a question of interest may be at what age the interaction between negative emotionality and attention/regulation begins to have a significant impact on other outcomes. Additionally, future research may address whether the interaction of infant negative emotionality and attention/regulation is related to other concurrent outcome variables of importance, such as attachment security, parents' sense of competence, and later parenting styles. Finally, future research may focus on implementing other measurement techniques, such as physiological measures or laboratory measurements focused on temporal coding schemes of attention and

regulation, which may provide a different picture of the relationship between negative emotionality and attention at this early age.

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APPENDIX

Appendix A

Maternal Responsivity/Sensitivity Scale Definitions

1	2	3	4	5	6	7
Extremely Non-Responsive/ Sensitive			Moderately Responsive/ Sensitive			Extremely Responsive/ Sensitive

1= Extremely Non-responsive/Sensitive: The mother avoids, ignores, or reprimands the child. The mother lacks genuine interest and empathy toward the child; does not accurately interpret communication from the child. The parent (a) does not initiate/motivate child play; (b) does not reinforce child activities; (c) does not draw the child into joint activity; (d) does not use versatile motivational strategies; (e) is not emotionally available/attuned; (f) does not provide affective encouragement; (g) does not show enjoyment of joint interaction; (h) does not allow the child independent activity; (i) demonstrates no sensitivity in the guidance of child activity; (j) is not able to effectively extend child activity.

4= Moderately Responsive/Sensitive: The mother provides only perfunctory, half-hearted responses. The mother appears to be only moderately interested, demonstrates moderate levels of empathy toward the child, and periodically accurately interprets communication from the child. The parent periodically (a) initiates/motivates child play; (b) reinforces child activities; (c) draws the child into joint activity; (d) displays a moderate frequency of versatile motivational strategies; (e) is moderately emotionally available/attuned; (f) provides moderate frequency of affective encouragement; (g) shows moderate enjoyment of joint interaction; (h) periodically allows the child independent activity; (i) demonstrates moderate levels of sensitivity in guidance of child activity; and (j) is able to periodically, effectively extend child activity.

7= Extremely Responsive/Sensitive: The mother provides prompt, contingent, warm, and supportive responses. The mother appears to be genuinely interested and empathic toward the child, accurately interpreting communication. The parent (a) consistently initiates/motivates child play; (b) consistently reinforces child activities; (c) consistently draws the child into joint activity; (d) frequently uses versatile motivational strategies; (e); is highly emotionally available/attuned; (f) provides high frequency of affective encouragement; (g) shows high levels of enjoyment in joint interaction; (h) consistently allows the child independent activity; (i) demonstrates high levels of sensitivity in guidance of child activity; (j) is able to effectively extend child activity.

Maternal Synchrony/Reciprocity Scale Definitions

1	2	3	4	5	6	7
Extremely Asynchronous/ Non-reciprocal			Moderately Synchronous/ Reciprocal			Extremely Synchronous/ Reciprocal

1=Extremely Asynchronous/Non-reciprocal

a. Low Frequency of Simultaneous Movement- low quantity/degree of movement that appears to begin or end at the same moment.
b. Low Levels of Tempo Similarity- low rate/degree to which the 2 people in the clip match on this characteristic.
c. Low Levels of Coordination/Smoothness- extremely poor quality of interaction flow for the infant and the mother; poor match/fit for the patterns of interactive behavior.

4= Moderately Synchronous/Reciprocal

a. Moderate Frequency of Simultaneous Movement- moderate quantity/degree of movement that appears to begin or end at the same moment.
b. Moderate Levels of Tempo Similarity- moderately similar tempo quality to the behavior of interaction partners, or speed at which behaviors unfold. Moderate rate/degree to which the 2 people in the clip match on this characteristic.
c. Moderate Levels of Coordination/Smoothness- moderately smooth flow of behavior for the infant and the mother; average match/fit for the patterns of interactive behavior.

7= Extremely Synchronous/Reciprocal

a. High Frequency of Simultaneous Movement-high quantity/degree of movement that appears to begin or end at the same moment (e.g., if a mother begins to turn her head at the precise moment that a child lifts an arm off of a table.)
b. High Levels of Tempo Similarity- all people have a tempo quality to their behavior, or speed at which behaviors unfold, similar to a tempo or orchestra follows at a concert. High rate/degree to which the 2 people in the clip match on this characteristic.
c. High Levels of Coordination/Smoothness- extremely smooth flow of behavior for the infant and the mother; good match/fit for the patterns of interactive behavior. How smooth are the interactions of the dyad? This characteristic is similar to how a couple of dancers may be described.