Developmental Psychology
2006, Vol. 42, No. 6, 1077–1088

0012-1649/06/$12.00 DOI: 10.1037/0012-1649.42.6.1077

Contextual Basis of Maternal Perceptions of Infant Temperament

Amie Ashley Hane, Nathan A. Fox, Cindy Polak-Toste, Melissa M. Ghera, and Bella M. Guner
University of Maryland, College Park

To elucidate the differential saliency of infant emotions to mothers across interactive contexts, the authors examined the moderating role of observed infant affect during interactions with mother in the relation between maternal and laboratory-based ratings of infant temperament. Fifty-nine developmentally healthy 9-month-old infants were judged for degree of infant positive, infant negative, and mother–infant mutually positive affect during the course of object-focused and routine home-based activities with mother. Mothers completed the Infant Behavior Questionnaire (M. K. Rothbart, 1981), and infants underwent the Laboratory Temperament Assessment Battery (H. H. Goldsmith & M. K. Rothbart, 1999). Results revealed that maternal and observer ratings of infant negativity converged when infants manifested high degrees of negative affect during routine home-based activities. Maternal and observer ratings of infant positivity converged when infants experienced low mutually positive affect during play. These findings support the hypothesis that maternal perceptions are based on mothers' experiences with their infants but that the salience of infant temperamental characteristics to mothers varies across emotion and interactive context.

Keywords: infant temperament, mother–infant interaction, maternal perceptions

Research has demonstrated that maternal perceptions of infant temperament are related to quality of mother–infant interactive behavior (Crockenberg & Acredolo, 1983; Mangelsdorf, Gunnar, Kestenbaum, Lang, & Andreas, 1990; Nuttall, Stollak, Fitzgerald, & Messe, 1985; van den Boom & Hoeksma, 1994), behavior problems in preschool (Oberklaid, Sanson, Pedlow, & Prior, 1993), and social adjustment in early childhood (Olson, Bates, & Bayles, 1989). Further, maternal perceptions of infant and child temperament interact with quality of parenting in the prediction of behavior problems in early (Rubin, Cheah, & Fox, 2001) and middle (Hane, Rubin, Cheah, & Fox, 2006) childhood. Indeed, such evidence indicates that maternal perceptions of their children's temperament may have significant developmental relevance, inasmuch as these perceptions affect maternal behavior, dyadic behavior, and child behavior. The present work marks an effort to elucidate the basis of maternal perceptions of infant temperament by examining the degree to which the affective quality of infant behavior during the course of home-based interactions with their mothers moderates the relation between maternal report and observer ratings of infant temperament. We sought to explicate the salience of infant emotions to mothers by examining the degree to which infant interactive affect during routine home-based activities (RHA) and object-focused play activities influences the association between maternal and observer ratings. Recent evidence suggests that individual differences in infant behavior, quality of maternal interactive behavior, and their interrelation are variable across interactive contexts (Miller, McDonough, Rosenblum, & Sameroff, 2002). Understanding the situations in which mothers are most likely to be influenced by their infant's expression of emotions would serve to elucidate the processes by which individual differences in infant temperament affect the quality of mother–child interactive behavior.

Basis of Maternal Reports

Several studies have examined the relation between maternal report and home-based (Bates, Freeland, & Lounsbury, 1979; Crockenberg & Acredolo, 1983; Isabella, Ward, & Belsky, 1985; Vaughn, Taraldson, Cuchton, & Egeland, 2002) and laboratory-based (Andersson, Bohlin, & Hagekull, 1999; Bridges, Palmer, Morales, Hurtado, & Tsai, 1993; Carranza-Carnicero, Perez-Lopez, Gonzalez-Salinas, & Martinez-Fuentes, 2000; Matheny, Wilson, & Thoben, 1987; Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996) behavioral indices of infant temperament, and the findings have led to a general consensus that there is only modest convergence between maternal and independent observer ratings (Bates, 1980; Hubert, Wachs, Peters-Martin, & Gandour, 1982). The lack of strong relations between maternal and observer ratings may be a function of maternal bias, as there is evidence to suggest that maternal report of infant behavior reflects characteristics of the infant as well as maternal characteristics, including personality, parity, and sensitivity (Bates & Bayles, 1984; Crockenberg & Acredolo, 1983; Matheny et al., 1987; Leerkes & Crockenberg, 2003).

Amie Ashley Hane, Nathan A. Fox, Cindy Polak-Toste, Melissa M. Ghera, and Bella M. Guner, Department of Human Development, University of Maryland, College Park.

This research was supported by National Institute of Health Grant HD 17899 to Nathan A. Fox. We thank Stacey Barton, Sarah Bong, and Laura Driscoll for their assistance in data collection and Ian Hitchcock and Allison Schlenger for their assistance with coding of mother–infant interactive affect. We are deeply indebted to the families who have participated and continue to participate in this research.

Correspondence concerning this article should be addressed to Amie Ashley Hane, who is now at the Department of Psychology, Bronfman Science Center, Williams College, 18 Hoxsey Street, Williamstown, MA 01267. E-mail: ahane@williams.edu

The lack of convergence between maternal and observational measures of infant temperament may also be a function of the context in which observed infant behavior has been measured. Rothbart (1982) has suggested that all measurement of infant temperament is influenced by context and has described both maternal report and home-based observer ratings of temperament as reflective of a characteristic that is "within-the-infant-within-the home" (p. 36). Given that both measures share a common contextual foundation, one would expect robust relations between maternal report and home-based observations if mother's descriptions of her infant are based on her experiences with the infant, but this literature has yielded mixed findings. Vaughn et al. (2002) revealed that maternal report of temperament related more strongly to earlier assessments of maternal personality and attitudes than to contemporaneous estimates of infant behavior during the course of home-based mother–infant interaction. Similarly, Isabella, Ward, and Belsky (1985) found no significant relation between maternal reports of infant temperament and observed infant behavior during home-based naturalistic interactions with mother (dyadic) and father (triadic).

Studies that have examined relations between maternal report of infant temperament and infant interactive behavior based on very extensive or carefully constructed home-based observations have found evidence supporting the validity of maternal report (Bates, Olson, Pettit, & Bayles, 1982; Crockenberg & Acredolo, 1983; Rothbart, 1986). Crockenberg and Acredolo (1983) found that maternal report of infant distress on the Infant Behavior Questionnaire (IBQ) was significantly positively related to degree of infant fussing and crying and negatively related to maternal involved contact during both caretaking and noncaretaking interactions during two 3.5-hr semistructured home observations. Bates et al. (1982) showed that degree of infant fussing during two 3-hr home observations related to maternal report of the degree of infant difficulty. Rothbart (1986) showed that maternal report of infant temperament on the IBQ, which asks mothers to judge infant behavior during feeding, bathing, and play, related to infant behavior during repeated episodes of the same in the home. Such findings suggest that mothers are at least partly basing their ratings of infant behavior on their own experiences with their infants, but this relation is evident only when home-based observations are representative of mothers' experiences with their infants. However, exactly which caregiver experiences are most relevant, and for which emotions, remains uncertain. We suspected that maternal perceptions of infant temperament are indeed based on their experiences with their infants but that explication of the source of maternal perceptions necessitates careful consideration of context. We expected that concordance between laboratory and maternal report measures is most evident under conditions in which the emotion in question is particularly salient to the mother and explored the degree to which infant negativity, infant positivity, and mother–infant mutual positivity are differentially salient to mothers across play and RHA.

Negativity in Context

We expected that infant negativity is most salient to mothers when it is expressed in the context of RHA. Indeed, the majority of the time that mothers spend with their infants involves engagement in tasks centered on routine activities such as meal preparation, feeding, and changing. High degrees of infant negativity during such daily tasks are likely to be noticed by mothers because of the frequent, repeated exposure to infant negativity, the inability to avoid the negativity given that these basic chores are requisite, and/or because the negativity itself requires mothers to exert more effort to accomplish their goals. Hence, mothers may be more likely to notice, and hence report, temperamentally negative behaviors when their infants manifest high degrees of negative affect during routine activities in the home.

Negativity during the course of object-focused play may not be as salient to mothers as it is in the routine home-based context. There is evidence to suggest that the unstructured object-focused play situation may not present sufficient emotional challenge to infants or their mothers to be a particularly meaningful context for the assessment of infant (or maternal) negativity (Miller et al., 2002; Pederson et al., 1990). The opportunity to explore novel toys in the presence of an undistracted caregiver may not lend itself to the expression of negativity simply because it is too pleasure focused to evoke negative reactions.

Positivity in Context

Although object-focused play may not evoke enough negativity to alter maternal impressions accordingly, such contexts may be ideal situations for mothers to build impressions about their infant's temperamental positivity. Although dyadic play occurs with less frequency than other types of caregiver–infant interactions (Carew, 1980; Green, Gustafson, & West, 1980), the play situation affords caregivers the chance to share a common experience with the infant that is centered on the pursuit of pleasure and is less burdened by the competing demands that saturate RHA. Indeed, if an infant smiles while being dressed, a mother may overlook the affective display simply because she is focused on the task at hand, which may further involve the presence of other family members who present with their own competing demands (such as an older sibling who needs support while changing clothes). However, infant smiles during the course of one-on-one play with mother should be quite noticeable, in part because mothers are not distracted and perhaps because mothers may use the play situation itself as a forum for the socialization of positive emotions (Malatesta & Haviland, 1982). As such, expression of infant positivity during play may be more influential in the formation of maternal impressions of infant temperamental positivity than is expression of positive affect during routine home-based tasks.

Further evidence suggests that the expression of positive emotions is socialized in infancy via the modeling of display rules during play encounters with caregivers (Malatesta & Haviland, 1982). Mothers shape the expression of positive affect via their own expression of positivity, which is reflected by similar patterns of positive expressiveness for both interactants (Malatesta & Haviland, 1982). Hence, mothers may base their perceptions of temperamental positivity on their experiences of infant positivity that are shared. Mothers who are sharing in their infant's pleasure, either because they are actively striving to socialize such expressions or simply because they themselves are both enjoying (and hence noticing) the infant's positive displays, may build such experiences into their global impressions of their infants accordingly and may be more likely to report their infant's positive affective displays than mothers who are not so affectively attuned.

Given such evidence, we examined the moderating role of mother–infant mutually positive affect in the relation between maternal and observer ratings of infant temperamental positivity.

The Case for Convergence

The best evidence for convergence between subjective and objective measures of temperament is derived from studies that have used maternal reports and observer ratings that are congruent in content (Bridges et al., 1993; Seifer, Sameroff, Barrett, & Krafchuk, 1994). Hence, the present work examines relations between affectively based ratings of temperament that are conceptually congruent. Maternal report of infant distress (IBQ Distress to Limits and Distress to Novelty) was expected to relate to laboratory-based assessments of the same (e.g., Laboratory Temperament Assessment Battery [Lab-TAB] Fear and Anger). Maternal report of infant positivity (IBQ Smile/Laughter) was expected to relate to laboratory-based ratings of the same (Lab-TAB Joy). It is imperative to specify that just as maternal reports are subject to bias and measurement error, so too are laboratory-based indices of infant behavior (Rothbart & Bates, 1998). As indicated by Kraemer and colleagues (Kraemer et al., 2003), no one informant of child behavior should be treated as more valid than another. Instead, they suggest that a robust index of child behavior is ideally derived by isolating the shared variance from multiple sources gathered across multiple contexts. The present study considers the role of infant interactive behavior in the home during routine home-based and play activities as contributing factors to the convergence of maternal and observer ratings. Such an approach to explaining convergence does not assume nor require that any one method, source, or measure is a gold standard to which all other measures should conform. The identification of the contexts in which the expression of specific infant emotions yields convergence across two other independent measures of the same emotion would illustrate the contextual influences that give rise to converging data, which captures the salience of the behavior to mothers given that mothers are involved in two of the three settings, one as the source (i.e., informant) of behavior and the other as a participating observer of infant behavior. If convergence across measures is achieved only when infant behavior occurs in certain mother–infant interactive contexts, then the manifestation of the infant behavior in those contexts can be interpreted as particularly influential to the objective portion of variance in maternal perceptions.

Summary and Hypothesis

We sought to illustrate that the relations between maternal and observer-based ratings of infant temperamental positivity and negativity are moderated by the infant's affective state during routine home-based interactions with mother. We further explored the extent to which such moderation is context specific in order to understand the circumstances in which temperamental positivity and negativity are most salient to mothers. Three hypotheses guided our analyses:

Hypothesis 1: Maternal and observer ratings of high infant negativity converge when infants manifest high degrees of negative affect during the course of RHA with mother.

Hypothesis 2: Maternal and observer ratings of high degrees of infant temperamental positivity converge when infants manifest high degrees of positive affect during home-based object-focused play interactions with mother.

Hypothesis 3: Maternal and observer ratings of high degrees of infant positivity converge when mothers and infants manifest high degrees of mutually positive affect during home-based object-focused play interactions with mother.

Method

Participants

Fifty-nine mothers and their developmentally healthy infants (26 boys, 33 girls) participated in this study when the infants were 9 months old ($M = 9.50$, $SD = 0.27$). Participants were seen as part of a larger, longitudinal investigation that explores the role of temperament in the growth of social competence from ages 4 months to 5 years. Families were initially contacted by mail using commercial lists of names and addresses. Families who agreed to participate were invited to partake in a 4-month laboratory temperament screening.[1] At age 9 months, 59 randomly selected infants who previously participated in the 4-month laboratory visit but who were not selected on the basis of temperament participated in both laboratory and home visits. Between the 4- and 9-month assessments, 6 families dropped out, for an overall attrition rate of 10%. Of the mothers, 67.8% were Caucasian, 20.3% were African American, 8.5% were Hispanic, 1.7% were Asian, and 1.7% were of mixed ethnicity. The mothers were well educated: Of the sample, 16.9% had completed high school, 35.6% had earned a college degree, 39% had completed a graduate degree, and 8.5% had attained a professional or trade certificate.

As indicated in Table 1, 17 infants were missing a Lab-TAB Negativity score. These infants had insufficient data for the derivation of a Lab-TAB Negativity composite because they were too distressed to begin at least one of the three negativity paradigms (*masks, unpredictable toy,* or *toy behind the barrier*). These 17 children who were missing Lab-TAB Negativity scores were compared with those who participated in all three negativity paradigms on other indices of negativity, including infant negative reactivity at 4 months (see Marshall, Hardin, & Fox, 2006), IBQ Distress to Limits, IBQ Distress to Novelty, the IBQ Distress composite, and degree of infant negativity expressed during RHA and object-focused play. No significant differences were found (ts < 1; ps ranged from .72 to .88). Hence, there is no evidence to indicate that infants with missing negativity data were substantially more negative than the other infants in the sample. Because of missing data, the sample size for the tests of the hypotheses involving infant negativity varied. Thirty-nine infants had sufficient data to enter the equation regarding the moderating role of infant negative affect during object-focused play in the relation between maternal and observer ratings of infant negativity; 37 infants had sufficient data to enter the equation to test the moderating role of infant negativity during RHA in the relation between maternal and observer ratings of infant negativity.

Procedure

Families were recruited to participate in a larger study of infant temperament over time via mailings. Mothers and developmentally healthy infants who participated in a previous laboratory visit were invited to participate in

[1] To obtain a sample consisting of temperamentally extreme and random children, we screened 847 infants for temperamental reactivity at age 4 months. Of these, 250 children were selected to participate in the 9-month portion of the project, a portion of whom served as random controls and were not selected on the basis of temperament. Data presented here were derived from the subsample of random control infants who participated in the home visit.

Table 1
Summary of Measures

Variable	*N*	*M*	*SD*
IBQ Smile/Laughter	57	5.04	0.79
IBQ Distress to Novelty	57	2.64	0.65
IBQ Distress to Limits	57	3.58	0.74
IBQ Distress	57	3.12	0.60
Mother–Infant mutual positive affect: RHA	57	0.72	0.18
Mother–Infant mutual positive affect: play	59	0.82	0.12
Infant positive affect: play	59	0.28	0.20
Infant positive affect: RHA	57	0.22	0.15
Infant negative affect: RHA	57	0.17	0.15
Infant negative affect: play	59	0.11	0.11
Lab-TAB Anger	46	−0.06	0.61
Lab-TAB Fear	54	−0.07	0.83
Lab-TAB Negativity	42	−0.16	0.46
Lab-TAB Joy	57	−0.31	1.94

Note. The 17 children who were missing Lab-TAB negativity scores were compared with those who participated in all three negativity paradigms (masks, unpredictable toy, and toy behind the barrier) on other indices of negativity, and no significant differences were yielded. IBQ = Infant Behavior Questionnaire (Rothbart, 1981); RHA = routine home-based activities; Lab-TAB = Laboratory Temperament Assessment Battery (Goldsmith & Rothbart, 1999).

a laboratory and home visit when the infants were 9 months old. During the laboratory visit, infants underwent the *puppets*, *toy-behind-the-barrier*, *unpredictable toy,* and *masks* Lab-TAB paradigms. In its entirety, the Lab-TAB assessment lasted approximately 15 min. Following the 9-month laboratory visit, mothers were instructed to complete the IBQ at home prior to the home visit.

Within 2 weeks of the laboratory visit, mother and infant were scheduled for a home visit. During this visit, infants and their mothers were videotaped as they interacted in a series of interactive contexts. Three of these episodes captured mother–infant behavior during the course of RHA, including *mother busy in the kitchen*, *snack,* and *caregiving/changing*. During mother busy in the kitchen (8 min), mother was instructed to be occupied, either by preparing a snack for the infant, washing dishes, loading the dishwasher, or doing other similar household chores she is typically engaged in while in the kitchen. Mothers were instructed to do whatever they typically do with their infants while working in the kitchen. During snack (5 min), mother was instructed to spoon-feed the infant a soft food, such as yogurt or applesauce. Last, during caregiving/changing, mothers were asked to remove the baby's outfit, apply lotion, and re-dress the infant (5 min). Also included in the home visit were three episodes involving play with objects, including *free play*, *model building,* and *unpredictable toy*. For free play (10 min), mother and infant were seated on a blanket on the floor and presented with an attractive set of age-appropriate toys. Mothers were then instructed to play with their infant as they normally do. During model building (3 min), mother and infant were presented with Fisher Price stacking rings, and mother was asked to build a tower with the infant. During unpredictable toy (3 min), mother and infant were presented with a sound- and touch-activated robotic barking dog. Mothers were directed to play with the toy with the infant.

Two experimenters who were trained to be nonintrusive during the mother–infant interactions completed all home visits. Following the home visit, mothers were thanked and debriefed, and the IBQ was collected.

Measures

Maternal report of infant temperament. Maternal report of infant temperament was based on three subscales from the IBQ (Rothbart, 1981). In its entirety, the IBQ consists of 87 items that require mothers to assess the frequency of the occurrence of temperamentally salient infant behaviors along a 7-point Likert-type scale across a number of temperamental dimensions, including *activity, soothability, distress to limits, distress to novelty,* and *smiling/laughter.* The IBQ has demonstrated sound internal consistency and construct validity when compared with other methods of evaluating infant temperament (Rothbart & Goldsmith, 1985).

Three of the IBQ subscales were used for the current study because of their consistency with the Lab-TAB temperament indices, including Distress to Novelty, Distress to Limits, and Smile/Laughter. The Distress to Novelty subscale is an index of distress and extended latency to approach intense or novel stimuli and includes items such as "When given a new food, how often did the baby reject it by spitting out, closing mouth, etc.?"; "How often during the last week did the baby cry or show distress at a loud noise?"; and "When face was washed, how often did the baby fuss or cry?" The Distress to Limits subscale is an index of individual differences in reactions to frustrating situations and includes items such as "When having to wait for food or liquids during the last week, how often did the baby cry loudly?"; "After sleeping, how often did the baby fuss or cry immediately?"; and "When the baby wanted to do something, how often did s/he become upset when s/he could not get what s/he wanted?" The Smile/Laughter subscale assesses the tendency for the infant to express smiling or laughter across situations and includes items such as "When being dressed or undressed during the last week, how often did the baby smile or laugh?"; "When tossed around playfully, how often did the baby smile?"; and "When introduced to a strange person, how often did the baby smile or laugh?"

An infant distress composite was created by taking the mean of the IBQ Distress to Novelty and Distress to Limits subscales, such that higher scores indicate more distress. The Smile/Laughter subscale was used as the index of infant smiling and laughter.

Observational ratings of infant temperament. To examine individual differences in expressed affect in the laboratory, we used the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith and Rothbart, 1999). The Lab-TAB consists of 20 standardized paradigms that are designed to elicit anger, fear, interest, pleasure, and activity level. The episodes included in this study were attractive toy behind the barrier, masks, puppets, and unpredictable toy and were carried out in accordance with Lab-TAB guidelines. As per the Lab-TAB manual, the order of the episodes was the same for each infant. For all of the episodes, the infant was sitting in a highchair with a table directly in front of him or her on which all of the stimuli were presented. During each of the episodes, the mother remained in the room with her infant and was instructed to sit behind the child and to remain neutral. Each episode began with the infant in a neutral state. Episodes were terminated if the infant became too upset or if the mother indicated that she thought the infant was becoming too upset to continue.

To assess expression of distress to limits, we administered the infant toy-behind-the-barrier paradigm. The infant was given an attractive toy with which to play. Once the infant was engaged with the toy, the experimenter gently took the toy from the infant and placed it behind a clear plastic barrier situated approximately 30 cm in front of the infant, where it remained for 30 s or until the infant reached a maximum distress level. This procedure was repeated two more times for a total of three trials.

An Anger score was obtained by rating the intensity of facial anger (0–2) intensity of vocal distress (0–3), and intensity of struggle (0–3). A higher score indicates more anger. Prior to coding, interrater reliability was achieved by two independent observers who were blind to all other data in the study. Reliabilities were achieved separately for each of the four scales entering into the Anger composite, with kappas ranging from .73 to .87; average kappa = .81.

Two Lab-TAB paradigms were used to assess fear, including masks and unpredictable toy. During masks, a large cardboard screen with a door was placed in front of the infant. Two masks, an old man mask and a clown mask, were presented to the infant through this door. The duration of

presentation of each mask lasted 10 s. Each mask was presented only once. During the unpredictable toy episode, a long track, approximately 1.5 m in length, was placed on the table in front of the infant. The track was used to guide a noisy and unpredictable remote-controlled dog toward the infant. One trial would consist of the dog walking down to the end of the track, approximately 15 cm in front of the infant, and sitting down and barking. This was repeated across a total of three trials. Each trial was approximately 10 s.

A Fear score was obtained by rating the intensity of vocal distress (0–3) and intensity of escape (0–3) from the masks and unpredictable toy paradigms. A higher score indicated more fear. Prior to coding, interrater reliability was achieved by two independent observers who were blind to all other data in the study. Reliabilities were achieved separately for each of the scales entering into the Fear composite, with kappas ranging from .74 to .97 for the masks paradigm and from .59 to .98 for the unpredictable toy paradigm. Mean kappa values for masks and unpredictable toy were .85 and .80, respectively.

The Fear and Anger scores were converted to *z* scores for normalization and then summed to obtain a nonspecific and robust marker of Lab-TAB Negativity. To ensure that the negativity composite was robust and consisted of negativity expressed during both the anger and fear paradigms, we required that all infants with negativity scores reported here successfully complete at least one trial during the masks, unpredictable toy, and toy-behind-the-barrier paradigms.

The puppet paradigm was used to assess joy. For this paradigm, the infant was seated in a highchair as an experimenter manipulated two colorful puppets engaged in a scripted and standard dialogue. During the puppet show, the infant was tickled three times by the puppets; first by one, next by the other, and finally by both puppets simultaneously. One trial was equal to the time between tickles, for a total of four trials. After the puppet show, the experimenter placed the puppets on the table in front of the child for 30 s.

For the joy episode, the intensity of smiling (0–2), intensity of positive motor activity (0–2), and the presence or absence of laugher and approach were averaged to obtain a joy composite. Higher scores represent higher degrees of joy. Reliabilities were achieved separately for each of the scales entering into the joy composite, with kappas ranging from .75 to .87 and an average of .77.

Interactive affect. To assess degree of mother–infant affect during home-based interactions, we used Kochanska's (1997, 1998) scales for rating the affective quality of mother–infant interaction. Kochanska's affect scales involve rating the mother and infant separately in 30-s segments according to signs of tenderness/affection, joy, neutral positive, neutral negative, or discrete negative affect. Each 30-s segment can be coded for multiple discrete affects, including tenderness/affection (hugging, kissing), joy (smiling, laughing), and discrete negativity (frowning, fussing, or crying). In the absence of a single discrete event (in a given 30-s segment), a general mood code is assigned. A positive mood code was given when the interactant being judged manifested a state of contentment, and a negative mood code was given if the interactant manifested signs of distress, fear, fatigue, or disinterest. For each member of the dyad, a negative affect score was derived by summing instances of negative discrete affect and negative mood and dividing it by the total number of coded segments in a given interactive episode. An index of positive affect was obtained by summing the instances of positive discrete affect (tenderness/affection + joy) divided by the total number of coded segments in a given episode. A score for mutually positive affect was obtained by summing the frequency of segments during which both mother and infant manifested a positive mood or a positive discrete event (tenderness or joy) and neither manifested negativity (affect or discrete), divided by the total number of coded segments in a given episode. Because we were interested in the extent to which the nature of the situation in which mothers and infants were coengaged influenced maternal perceptions of infant temperament, we created aggregates that were based on the type of activity in which mothers and infants interacted—that is, tasks centered on RHA and tasks involving object-focused play. For each index of affect, a RHA composite was obtained by taking the mean of the proportions of affect derived from mother busy in the kitchen, snack, and caregiving/changing. A set of object-focused play composites was obtained by computing the mean of the proportions of each type of affect during the free play, model building, and unpredictable toy episodes. Each RHA and object-focused play composite was converted to a *z* score prior to analysis. Table 2 depicts the interrelations among the degree of mutually positive affect across the home visit episodes. Mutually positive affect during mother busy in the kitchen is significantly related to the same during snack, and degree of mutually positive affect during free play is significantly associated with mutually positive affect in both model building and unpredictable toy.

Two independent raters who were blind to all infant temperament data coded home-based affect. Each rater first achieved training reliability with the first author, with kappa values ranging from .89 to .98 across 18 cases. The affect raters achieved sound interrater reliability with each other, achieving a kappa value of .78 for the quality of infant affect and a kappa value of .84 for the quality of maternal affect.

Results

Preliminary Analyses

Table 1 provides the descriptive statistics for maternal report and observer ratings of infant temperament and home-based interactive affect.

To explore the data for the presence of potential covariates, we computed zero-order correlations between infant sex, maternal ethnicity, maternal education, maternal age, and the variables involved in the tests of the hypotheses. No significant relations between the demographic variables and the factors entering into the regression equations were found. Thus, no covariates were used in the tests of the hypotheses.

Table 2
Interrelations Among Indices of Mother–Infant Home-Based Affect

Variable	Snack	Caregiving/changing	Free play	Model building	Unpredictable toy
Mother busy in kitchen	(54) .302*	(54) .023	(54) −.145	(54) −.104	(51) −.003
Snack		(54) .123	(54) .081	(54) .127	(51) .269*
Caregiving/changing			(54) .189	(54) .064	(51) .139
Free play				(56) .457**	(52) .423**
Model building					(52) .225

Note. Values in the parentheses represent the valid *N* for each correlation.
* $p < .05$. ** $p < .01$, two-tailed significance.

Zero-order correlations between IBQ and Lab-TAB indices were computed and are reported in Table 3. IBQ Distress to Limits was significantly positively correlated with Distress to Novelty, such that mothers who reported their infants as distressed to novelty were significantly more likely to report them as distressed to limits as well. Lab-TAB Fear was significantly correlated with Lab-TAB Anger, such that infants who were distressed during the fear-evoking paradigms were also more likely to be distressed during the anger-evoking paradigm. A significant and negative correlation between Lab-TAB Joy and the IBQ Distress composite was yielded and indicates that infants who were more joyful during the Lab-TAB were less likely to be described as distress prone by their mothers. Lab-TAB Negativity was significantly and negatively correlated to Lab-TAB Joy, such that infants who manifested high degrees of joy during the Lab-TAB were significantly less likely to manifest negative affect during the Lab-TAB Anger and Fear paradigms. The Lab-TAB Negativity composite was significantly associated with the Lab-Tab Fear and Anger scores that were used to construct the composite. The IBQ Distress composite was associated with each of its subcomponents, Distress to Limits and Distress to Novelty. Correlations examining the interrelations among the RHA and play affect composites were computed and are presented in Table 4. A significant relation between mother–infant mutually positive affect in RHA and infant negative affect in the same context was found. Similarly, infant negative affect during play was significantly negatively associated with mutually positive affect in the same context. In each of these relations, the manifestation of infant negativity was associated with lower degrees of mutually positive affect occurring within the same interactive context. Degree of infant positive affect during RHA was significantly and positively related to positive affect during play, such that infants who manifested high degrees of positivity during routine care were more likely to manifest high degrees of positive affect during play. No similar evidence of contextual consistency in either infant negativity or degree of mother–infant mutual positivity was revealed.

Table 5 contains the zero-order relations between the indices of home-based affect and the IBQ and Lab-TAB composites. One nonsignificant trend ($p < .10$, two-tailed significance) indicated that high degrees of infant positivity during play at home were associated with more negativity in the laboratory.

Prior to testing the hypotheses, we computed paired-samples *t* tests examining whether each index of home-based affect differed significantly across contexts. Results of these analyses show that degrees of infant negative, infant positive, and mother–infant mutually positive affect did not differ systematically across interactive contexts (all ps $> .10$).

Maternal and Observer Ratings of Infant Negative Emotionality

Prior to testing the hypotheses, we mean centered the predictors entered into the regression equations, which is consistent with the recommendations of Aiken and West (1991).

To examine the degree to which infant negative affect as expressed in the home while interacting with mother moderates relations between maternal report and observer ratings of infant negativity, we computed two hierarchical multiple regressions. In the first analysis, observer ratings of Lab-TAB Negativity were regressed onto IBQ Distress, degree of infant negative affect during RHA, and their product. No significant direct effect for maternal report or infant negative affect during RHA was found. A significant interaction effect between IBQ Distress and infant negative affect during RHA in the home on Lab-TAB Negativity was found, $F(1, 35) = 5.78$, $p < .05$, $\beta = .40$ (95% confidence interval [CI] = .05 to .61), incremental $r = .38$. To elucidate the nature of the interaction effect, we obtained graphical depiction of the effect as suggested by Cohen and Cohen (1983), such that predicted means for Lab-TAB Negativity based on "high" values (obtained by adding one standard deviation to the mean) and "low" values (obtained by subtracting one standard deviation from the mean) for each predictor were computed (See Figure 1). Post hoc regressions to examine the significance of each slope in Figure 1 were computed on the basis of guidelines suggested by Aiken and West (1991) for interaction effects involving two continuous variables. Results of two post hoc regression equations in which the Lab-TAB Negative Emotionality scores were regressed onto IBQ scores at the high and low levels of infant negative affect (+/−1 *SD*) indicated that the relation between maternal and laboratory observer ratings of infant negativity was significant and positive for infants who displayed high degrees of negative affect during RHA, $\beta = .44$ (95 % CI = −.04 to .89), $t(35) = 2.02$, $p = < .05$; and nonsignificant and negative for infants who manifested low degrees of negative affect during RHA, $\beta = -.41$ (95% CI = −.89 to .10), $t(35) = -1.63$, $p > .05$. Inspection of Figure 1 reveals that infants who manifested high degrees of negativity

Table 3
Zero-Order Relations Among IBQ and Lab-TAB Indices of Temperament

Variable	IBQ Distress to Limits	IBQ Distress to Novelty	IBQ Distress composite	Lab-TAB Joy	Lab-TAB Fear	Lab-TAB Anger	Lab-TAB Negativity
IBQ Smile/Laughter	(54) −.048	(54) −.247	(54) −.162	(54) .149	(54) −.081	(51) .014	(39) −.192
IBQ Distress to Limits		(54) .483**	(54) .883**	(54) −.163	(54) .095	(51) −.118	(39) −.036
IBQ Distress to Novelty			(54) .837**	(54) −.117	(54) .221	(51) .271	(39) .202
IBQ Distress Composite				(54) −.280*	(54) .177	(51) .073	(39) .094
Lab-TAB Joy					(54) −.181	(54) −.242	(42) −.349*
Lab-TAB Fear						(54) .382**	(42) .885**
Lab-TAB Anger							(42) .647**

Note. IBQ = Infant Behavior Questionnaire (Rothbart, 1981); Lab TAB = Laboratory Temperament Assessment Battery (Goldsmith & Rothbart, 1999). Values in the parentheses represent the valid *N* for each correlation.
* $p < .05$. ** $p < .01$, two-tailed significance.

Table 4
Interrelation Among the Home-Based Interactive Affect Composites

Variable	M-I MP RHA	IPA RHA	INA RHA	M-I MP play	IPA play
IPA RHA	(54) .152				
INA RHA	(54) −.779**	(54) −.020			
M-I MP play	(54) .108	(54) .118	(54) −.020		
IPA play	(54) .201	(54) .588**	(54) −.006	(56) −.050	
INA play	(54) −.156	(54) −.020	(54) .187	(56) −.726**	(56) −.083

Note. IPA = infant positive affect, INA = infant negative affect, M-I MP = mother–infant mutually positive affect; RHA = routine home-based activities. Values in the parentheses represent the valid *N* for each correlation.
** $p < .01$, two-tailed significance.

during RHA with their mothers and who their mothers rated as highly distress prone largely carry this interaction effect. The average predicted Lab-TAB Negativity value for these infants is greater than one and a half standard deviations from the sample mean, whereas the predicted mean Lab-TAB Negativity scores for infants who manifested high degrees of negativity in the home but who were rated as low on distress by their mothers and those who did not manifest high degrees of negativity during RHA are all within one standard deviation of the sample mean.

To explore the moderating role of infant negative affect during object-focused play, we computed a similar analysis by regressing Lab-TAB Negativity onto IBQ Distress, infant negative affect during object-focused play, and their product. No significant direct effect for IBQ Distress or infant negative affect during play was yielded. The interaction term also did not approach significance, $F(1, 35) < 1.00$, $p = .56$, incremental $r = .10$.

Maternal and Observer Ratings of Positive Emotionality

To examine the degree to which positive affect in the home moderates relations between maternal report and observer ratings of infant positivity, we computed a series of hierarchical multiple regressions. In the first regression, observer ratings of Lab-TAB Joy were regressed onto IBQ Smile/Laughter, degree of infant positive affect during RHA, and their product. No significant direct effect for IBQ Smile/Laughter or infant positive affect during RHA was yielded. The interaction of IBQ Smile/Laughter and infant positive affect in RHA was also nonsignificant, $F(1, 48) < 1.00$, $p = .38$, incremental $r = .12$. To explore the moderating role of infant positive affect during object-focused play, we computed a similar regression analysis, regressing Lab-TAB Joy onto IBQ Smile/Laughter, infant positive affect during object-focused play, and their product. No significant direct effects for maternal report of smiling and laughter or infant positivity during object-focused play were yielded. The interaction term was also nonsignficant, $F(1, 50) < 1.00$, $p = .44$, incremental $r = .11$.

To test the third hypothesis regarding mutually positive affect, we computed a set of analyses examining the moderating role of mother–infant mutually positive affect during both RHA and object-focused play in the relation between maternal and observer report of positive emotionality. The Lab-TAB Joy scores were regressed onto IBQ Smile/Laughter, degree of mother–infant mutually positive affect during RHA, and their product. No significant direct effect for IBQ Smile/Laughter or mutually positive affect during RHA was yielded. The interaction term was also nonsignificant, $F(1, 48) = 2.56$, $p = .12$, incremental $r = .23$. To explore the moderating role of infant positive affect during object-focused play, we computed a similar regression analysis, regressing the Lab-TAB Joy scores onto IBQ Smile, mother–infant mu-

Table 5
Relations Between Home-Based Affect and Maternal and Observer Ratings of Temperament

Home-based affect variable	IBQ Smile/Laughter	IBQ Distress	Lab-TAB Negativity	Lab-TAB Joy
		RHA		
Infant negative affect	(52) −.075	(52) .029	(39) .226	(54) −.133
Infant positive affect	(52) .055	(52) .003	(39) .220	(54) .142
Mutually positive affect	(52) −.027	(52) −.055	(39) −.061	(54) .181
		Object-focused play		
Infant negative affect	(54) .119	(54) −.029	(41) .016	(56) −.121
Infant positive affect	(54) .114	(54) .035	(41) .299[a]	(56) .094
Mutually positive affect	(53) −.211	(54) .079	(41) .037	(56) −.037

Note. IBQ = Infant Behavior Questionnaire (Rothbart, 1981); Lab-TAB = Laboratory Temperament Assessment Battery (Goldsmith & Rothbart, 1999); RHA = routine home-based activities. Values in the parentheses represent the valid *N* for each correlation.
[a] $p < .10$, two-tailed significance.

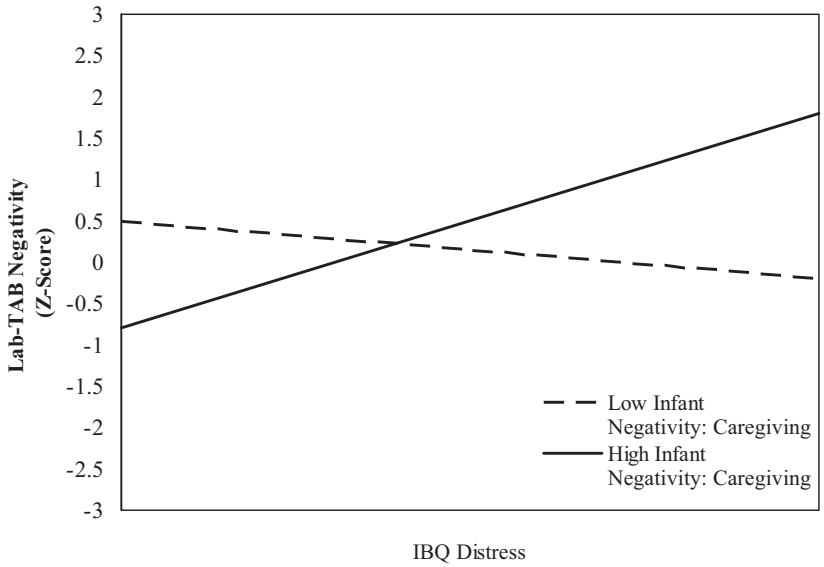

Figure 1. Infant Behavior Questionnaire (IBQ) Distress by infant negative affect during routine home-based activities on Laboratory Temperament Assessment Battery (Lab-TAB) Negativity.

tually positive affect during object-focused play, and their product. The interaction term yielded significance, indicating that mother–infant mutually positive affect during object-focused play moderates the relation between IBQ Smile/Laughter and Lab-TAB Joy, $F(1, 52) = 12.10$, $p < .01$, $\beta = -.64$ (CI = $-.85$ to $-.23$), incremental $r = .44$. To elucidate the nature of this interaction effect, graphical depiction of the effect was obtained as suggested by Cohen and Cohen (1983), such that predicted means for Lab-TAB Joy based on "high" values (obtained by adding one standard deviation to the mean) and "low" values (obtained by subtracting one standard deviation from the mean) for each predictor were computed (see Figure 2). Post hoc regressions to examine the significance of each slope in Figure 2 were computed on the basis of guidelines suggested by Aiken and West (1991) for interaction effects involving two continuous variables. Results of two post hoc regression equations in which the Lab-TAB Positive Emotionality scores were regressed onto IBQ scores at the high and low levels of mother–infant mutually positive affect ($+/-1$ *SD*) indicated

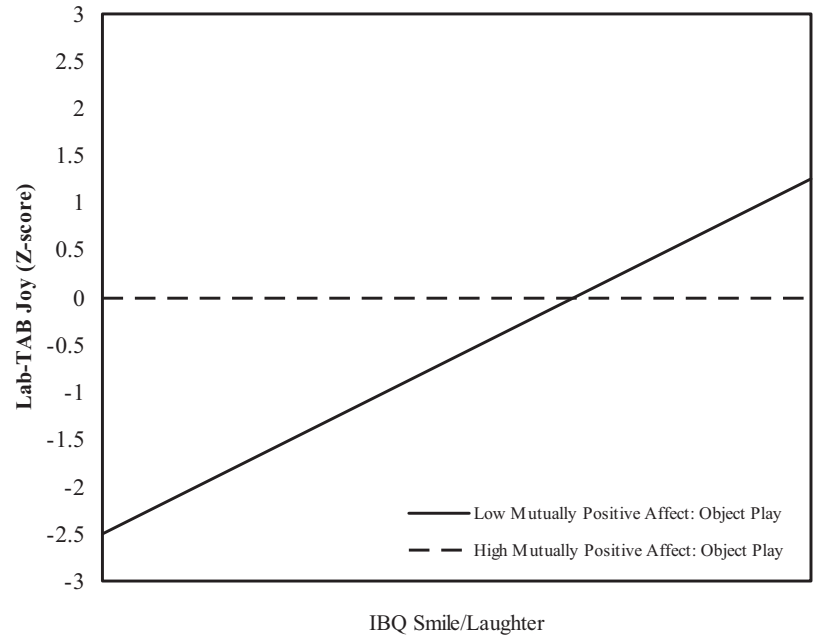

Figure 2. Infant Behavior Questionnaire (IBQ) Smile/Laughter by mother–infant mutually positive affect during object-focused play on Laboratory Temperament Assessment Battery (Lab-TAB) Joy.

that the relation between maternal and laboratory observer ratings of infant positivity is significantly positive for infants who were engaged with low degrees of mutually positive affect during object-focused play, $\beta = .65$ (CI = −.322 to 1.37), $t(50) = 3.24$, $p < .01$; and nonsignificant for infants who experienced high degrees of mutually positive affect during object-focused play, $\beta = -.17$ (CI = −.65 to .20), $t(50) = 1.05$. Inspection of Figure 2 indicates that this interaction effect is largely carried by infants who experienced low degrees of mutual positivity during object-focused play and who were rated by their mothers as low on IBQ Smile/Laughter. The average predicted Lab-TAB Joy value for these infants is less than two standard deviations from the sample mean, whereas the predicted mean Lab-TAB Joy scores for infants who experienced low degrees of mutual positivity during play but who were rated high on smiling and laughter by their mothers and those who experienced high degrees of mutual positivity during play are all within one standard deviation of the sample mean.

Discussion

To understand the differential salience of infant positive and negative emotions during the course of RHA and object-focused play, in this study we examined the roles of infant positive and negative interactive affect during home-based interactions with mother as they influence the concordance between maternal and observer reports of infant temperament. It was anticipated that maternal and observer ratings of high infant negativity would converge for infants who manifested high degrees of negative affect during the course of RHA. As well, we hypothesized that maternal and observer ratings of high infant positivity would converge for infants who manifested high degrees of positive affect and who experienced high degrees of mutually positive affect during a series of home-based object-focused play activities. Our results show that concordance between maternal and observer ratings was achieved when maternal perceptions of high distress were consistent with manifestation of infant negativity during RHA and not object-focused play. We also found that maternal and observer ratings of low infant positivity converged when mothers and infants experience low degrees of mutually positive affect during object-focused play but not RHA. Hence, the findings reported here indicate that maternal perceptions of infant temperament are informed by "emotions in situo," whereby the expression of infant positive and negative emotionality is differentially salient to mothers depending on the context in which the emotion is expressed.

Infant Negativity

Our results reveal that infants who were rated by their mothers as prone to distress and who manifested high degrees of negative affect in the home during RHA showed substantially more negative emotionality during the laboratory assessment than did infants for whom maternal report and home-based observation did not converge. This finding supports evidence indicating that there is an objective portion of variance in maternal report that is based on mothers' experiences with their infants (Bates et al., 1982; Crockenberg & Acredolo, 1983; Rothbart, 1982, 1986).

Of import, this finding also helps to elucidate the process by which infant negativity affects maternal perceptions. As we anticipated, degree of infant negativity is most salient to mothers during the course of RHA, which occupy the largest portion of mothers' day-to-day experiences with infants. The large amount of time that mothers are engaged in activities in the home that center on infant care, such as meal preparation, feeding, and changing, indicates that mothers of infants who fuss during such tasks are exposed to more negativity than mothers whose infants manifest distress in other situations. And, because such routine tasks are unavoidable, mothers with infants who express high levels of negativity during RHA are *necessarily* frequently exposed to infant negativity. Finally, infant negativity during RHA may make the home-based activities more arduous, as mothers must exert additional effort to soothe, calm, or prevent infant distress. The findings reported here reveal that negativity during RHA informs maternal impressions of infant temperamental negativity inasmuch as infants who were viewed as negative and who manifested high degrees of negativity also manifested high degrees of negativity in the Lab-TAB Anger and Fear episodes.

High degrees of infant negativity have been associated in some studies with insensitive maternal caregiving (Crockenberg & Acredolo, 1983; Ghera, Hane, Malesa, & Fox, 2006; Mangelsdorf et al., 1990; Nuttall et al., 1985; van den Boom & Hoeksma, 1994). Negative infants who receive insensitive maternal caregiving may be at risk for subsequent behavior problems, as maternal perceptions of infant temperament interact with quality of parenting in predicting poor social outcome in early (Rubin et al., 2001) and middle (Hane et al., 2006) childhood. Hence, interventions that are aimed at teaching maternal soothing techniques and coping strategies that are developed specifically for, or are easily incorporated into, the routine aspects of the infant caregiving repertoire may prove particularly efficacious for intervention programs that target distress-prone infants.

Infant Positivity

Examination of the relation between infant home-based positive affect and maternal and observer ratings of the same revealed that maternal report of low degrees of infant smiling and laughter converged with Lab-TAB Joy when infants experienced a low degree of mutually positive affect during home-based object-focused play interactions. Contrary to our expectation, convergence occurred for low (vs. high) degrees of positivity. Further, our results show that the relation between maternal and laboratory-based observer ratings of positivity was moderated by the dyadic index of home-based affect and not the more monotonic infant positive affect score. It is well established that the basis for caregiver–infant play is reciprocity in social behavior (Beebe, Jaffe, Feldstein, Mays, & Alson, 1985; Cohn & Tronick, 1987; Van Egeren, Barratt, & Roach, 2001), and additional evidence points directly to the importance of affective matching, sharing, or attunement (Stern, Hofer, Haft, & Dore, 1985) as indicators of the overall quality of playful interactions. Our data indicate that a lack of mutual pleasure during what should be reciprocal and mutually rewarding activities alters mothers' perceptions. During playful activities, mothers generally expect their infants to be delighted and to share in that delight. When this expectation is violated, mothers' perceptions are likely to be altered because the violation of this expectation is especially salient—more salient than the satisfaction of the expectation of mutual pleasure would be.

The findings revealing convergence for indices of low positivity are complimentary to an emergent body of evidence indicating that infant and maternal positivity may be as important to the study of early social development as are indices of negativity. It has been suggested that the manifestation of positivity during social engagements in particular may be related to the development of extraversion and agreeableness (Aksan & Kochanska, 2004). Further work indicates that infant positive emotionality is stable from infancy through toddlerhood (Belsky, Hsieh, & Crnic, 1996) and early childhood (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Shiner & Caspi, 2003). Additional evidence suggests that children who do not manifest high degrees of positive affect and involvement in social play settings are at risk for social withdrawal when they experience maternal behavior that is marked by the presence of negativity (Rubin et al., 2001) or the lack of maternal positivity (Hane et al., 2006). Hence, infants in the current sample who were viewed by their mothers as low on positivity, who were accordingly engaged in interactions with mothers marked by low degrees of mutual positivity, and who showed low degrees of positivity during social play with a stranger, may indeed be on a trajectory for behavioral inhibition in toddlerhood or social withdrawal in childhood.

The convergence for low positivity across sources may be a function of the relationship between the mother and infant. Kochanska (2002) has shown that mutual positivity is one component of mutually responsive orientation, itself an indicator of a "positive, close, mutually binding and cooperative relationship" (p. 192) between mother and child. Thus, the model of infant positivity reported here may be a function of the low-quality mother–infant relationship experienced by these infants. Maternal perceptions of the lack of infant positivity may be both an antecedent to and/or a consequence of an overall negative relationship with the infant, as previous research has found that mothers of insecurely attached infants tend to rate them less favorably on indices of temperament (Belsky & Rovine, 1987; Seifer et al., 1996). If these infants were experiencing a poor quality dyadic relationship, then the lack of overt joy during the Lab-TAB in this group could be reflective of excessive stranger anxiety associated with an insecure attachment or an inability to mutually regulate affect with others because of the poor interactive history with mother, a phenomenon reported in the maternal depression literature (Beebe & Lachmann, 1998; Cohn & Campbell, 1992; Field, 1989). Such a claim awaits substantiation from future research.

Additional evidence indicates that maternal reports are based on maternal characteristics (Bates & Bayles, 1984; Crockenberg & Acredolo, 1983; Leerkes & Crockenberg, 2003; Matheny et al., 1987). Given such evidence, it seems plausible that the convergence for low degrees of positivity across measures may be a function of maternal characteristics that biased reports of infant positivity and her interactive style with her infant, which in turn affected the quality of the infant's behavior in the laboratory. Future research that examines the relative contributions of infant and maternal behavior in the convergence between maternal and observer ratings of infant temperament are necessary before definitive conclusions regarding the basis of maternal reports of infant temperament can be drawn.

Contrary to our expectation, the findings reported here do not show that infants who manifested high degrees of positive affect or who were engaged with high degrees of mutual positivity during play and were perceived by their mothers to be highly positive exhibited substantially higher degrees of positivity during the laboratory paradigm. It seems plausible that the infants who were highly positive while in the care of their mothers and who were reported by their mothers as such may not have manifested high positivity during the laboratory paradigm because of the somewhat stressful nature of the laboratory situation, in which a stranger was present and the infant's access to mother was restricted. Nine-month-olds, at the peak of stranger anxiety, may have been particularly affected by this situation. One nonsignificant trend reported in Table 5 supports such an interpretation, as infants who manifested high degrees of discrete positivity with their mothers in play situations at home were slightly more likely to express negativity in the laboratory. Hence, temperamentally positive infants who usually exhibited high degrees of positivity with their mothers may not have done so simply because of the experimenter's presence and restriction to mother during the laboratory puppet play. A future replication of this work with younger infants may show stronger convergence for high degrees of positivity.

Limitations

For both our laboratory and maternal report measures of negativity, we relied on robust composites of negative emotionality that were defined by the presence of fear and frustration as determined by two dominant methods of temperament assessment. Other recently published studies have found direct (Bridges et al., 1993) and indirect effects in the relations between Rothbart's IBQ (Rothbart, 1981) and Goldsmith and Rothbart's (1999) Lab-TAB. Results of our analyses indicate that these two measures can be used in concert to obtain a robust index of negative emotionality or to examine the factors that mitigate validity of maternal reports. However, the use of nonspecific indices of negative emotionality limit the findings reported here. Because the home-based measure of infant affect was not tailored to examine fear versus anger reactions, we could not generate specific hypotheses regarding the degree to which the expression of anger or fear during interactions with mother mitigates observer and maternal ratings of the same. Leerkes and Crockenberg (2003) showed that convergence of maternal and observer ratings of fear and anger are mitigated by different maternal factors. Hence, replication in which home-based infant behaviors are rated for fear and anger reactions may provide the ability to draw specific conclusions about the basis of maternal report of anger and fear separately. Finally, the results reported here may have been affected by the substantial amount of missing data in the Lab-TAB Negativity composite. A comparison of the infants who completed all Lab-TAB Negativity episodes and those who did not on measures of observed and maternal report of temperament indicated that the infants who had insufficient data were not temperamentally different from infants who did complete the paradigm. However, the considerable reduction in the sample size for the tests involving observed negativity may have led to insufficient power to detect relations of a smaller magnitude.

The mothers in this sample completed the IBQ following the laboratory visit in which temperament was assessed. Thus, the possibility that maternal ratings were influenced by observation of the infant's response during the Lab-TAB paradigm cannot be ruled out. However, given that the IBQ asks mothers to rate their infants' behavior during home-based activities and the mothers in

this sample completed the questionnaire in the home, it seems unlikely that the infants' patterns of responding during the laboratory visit usurped maternal impressions based on repeated daily contact with her infant.

Conclusions

We have provided evidence that infant negativity is most salient to mothers during the course of routine RHA and not during periods of semistructured, object-focused play. The lack of infant positivity was salient to mothers when it occurred during activities centered on object-focused play but not on RHA. Future studies that seek to explore relations between individual differences in infant behavior, maternal perceptions, and maternal behavior should carefully consider the emotional valence of infant and maternal behavior and the context in which such behavior is manifest, as the various settings in which caregivers and children coengage may not be of equivocal developmental importance.

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Received October 15, 2004
Revision received December 8, 2005
Accepted February 3, 2006 ■