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Gender Differences in Emotional Expressivity and Self-Regulation During Early Infancy

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Eighty-one 6-month-old infants and their mothers were videotaped in Tronick's face-to-face still-face paradigm to evaluate gender differences in infant and maternal emotional expressivity and regulation. Male infants had greater difficulty than female infants in maintaining affective regulation during each episode, including the still face. Mother–son dyads had higher synchrony scores than mother–daughter dyads but took longer in repairing interactive errors. In addition, maternal affect, matching, rate of change between matching and mismatching states, and synchrony in the play preceding the still face differentially mediated male and female infants' responses to the still face and reunion play. The developmental implications of these gender differences are discussed.

In their 1974 literature review, Maccoby and Jacklin concluded that few gender differences are evident before the age of 2 years. Although subsequent research indicates that this conclusion may have been premature, the literature on infant gender differences during the 1st year of life remains sparse and inconsistent, especially when contrasted with the more extensive documentation of gender differences later in development (for reviews, see Beal, 1994; Brody & Hall, 1993; Golombok & Fivush, 1994; Robinson & Biringen, 1995). Few investigators have specifically examined gender differences during the 1st year, and it must be assumed that many did not report negative findings. In addition, most studies have not been hypothesis-driven but have simply looked at gender as an analytic factor. Furthermore, studies vary in their use of type and precision of measurement, and almost none have been replicated, making it difficult to determine whether observed gender differences in the 1st year of life are valid.

The primary aims of this study were to evaluate (a) gender differences in socioemotional expressivity and self-regulation in infants under 1 year of age during Tronick's face-to-face still-face paradigm, (b) gender-related differences in maternal expressive behavior, (c) differences in the coordination (e.g., matching, rate of change, and synchrony) of mother–son and mother–daughter interactions (in partial replication of the findings of Tronick & Cohn, 1989), (d) the stability of infant expressive behavior and measures of coordination for boys and girls, and (e) the relations between maternal affect, matching, rate of change, and synchrony during the play preceding the still face and male and female infants' expressive behavior in the still face and reunion play. The study derived its set of hypotheses from a review of the literature and Tronick's (1989) mutual regulation model (MRM).

Despite the paucity of studies, the literature suggests that there are gender differences in infant expressive and self-regulatory behavior in the 1st year of life and that some of these differences are already present in newborns. Gender differences in social responsiveness have been documented within hours of delivery. For instance, male newborns are less responsive to auditory and social stimuli and less able to maintain eye contact than female newborns (Hittelman & Dickes, 1979; Osofsky & O'Connell, 1977). Male newborns also experience greater difficulties in maintaining affective regulation than female newborns. Studies using the Neonatal Behavioral Assessment Scale (Brazelton, 1984) or naturalistic observations have shown that male infants smile less than female infants and display more irritability, crying, facial grimacing, and lability of emotional states (Call, 1978; Feldman, Brody, & Miller, 1980; Korner, 1969; Osofsky & O'Connell, 1977; Phillips, King, & DuBois, 1978). Male neonates also show a more rapid buildup of arousal and a quicker peak of excitement (Osofsky & O'Connell, 1977). These differences are corroborated by the finding that, in comparison with female newborns, male newborns engage in less self-comforting, a behavior that functions to regulate periods of arousal, tension, excitement, or distress (Brazelton, Koslowski, & Main, 1974; Feldman et al., 1980; Korner, 1974).

Evidence for gender differences in socioemotional expressivity and self-regulatory capacity after the neonatal period and up until 1 year of age is inconsistent. Some studies have found no differences in infants ranging in age from 3 to 9 months (Cohn & Tronick, 1987; Lewis, 1972; Tronick & Cohn, 1989). Others have found differences that are similar to the socioemotional and self-

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regulatory differences observed during the newborn period. Moss (1967), for example, reported that 3-week-old and 3-month-old male infants cry and fuss more and are more irritable than female infants. When mother–infant interaction is disturbed or stressed, however, girls appear more emotionally negative than boys. Stoller and Field (1982) found that 8- and 12-week-old girls show more distress brow behavior and more crying than boys when their mothers maintain a still face (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Similarly, Mayes and Carter (1990) found that 3-month-old girls were more likely to evidence intense negative affect and to be more "disorganized" than boys during the still face.

When evaluating gender differences in infant behavior, it is necessary to take into account gender-related differences in parental behavior. Several studies have reported that parents hold different expectations and stereotypes about girls than about boys (Rubin, Provenzano, & Luria, 1974; Stern & Karaker, 1989) and that they interact differently with male and female infants. For example, some evidence suggests that mothers are more likely to talk to (Goldberg & Lewis, 1969; Lewis, 1972; Moss, 1967) and to engage in face-to-face interaction with their daughters than their sons (Parke, 1981; Parke & Sawin, 1980; Power & Parke, 1982) and to hold and touch their male infants longer than their female infants (Lewis, 1972; Moss, 1967), possibly in an attempt to soothe them (Golombok & Fivush, 1994).

Several studies have also evaluated gender differences in coordination in mother–son and mother–daughter interactions. Coordination generally refers to the extent mothers and infants respond to each other's affective and behavioral displays. Robinson (Robinson, Little, & Biringen, 1993) and Tronick (Tronick & Cohn, 1989; Tronick & Gianino, 1986) have argued that coordination serves an important developmental function because it leads, when successful, to a sense of control and effectance in the infant and to the promotion of interactive skills. However, there is no single agreed-on definition of coordination, and studies have used different empirical definitions. Nonetheless, studies have generally found greater coordination of behavior between mothers and sons than between mothers and daughters. Malatesta and Haviland (1982) defined coordination as mothers matching the same facial expression of their infants. They found that mothers tend to match their sons' facial expressions but respond with dissimilar expressions to their daughters' facial displays. Tronick and Cohn defined coordination as the mother and infant matching or sharing joint states, such as looking at one another (social match) or sharing attention to objects (object match). They found that, at 3, 6, and 9 months, mother–son dyads were more likely than mother–daughter dyads to be in matching states. Tronick and Cohn also evaluated synchrony in mother–infant interactions. They defined synchrony as how consistently mothers and infants moved together affectively over time and found that mother–son dyads had higher synchrony scores than mother–daughter dyads at 6 and 9 months. These findings suggest that there is a different form of mutual regulation between mothers and sons than between mothers and daughters, which may have important consequences for the infants' emotional responsiveness and formation of the self (Carter, Mayes, & Pajer, 1990; Chodorow, 1978; Robinson et al., 1993; Tronick & Cohn, 1989).

No study, to our knowledge, has evaluated the short-term stability of boys' and girls' expressive behavior and mother–son and mother–daughter coordination during the face-to-face still-face paradigm. One study, however, has found that maternal behavior in the play preceding the still face differentially mediates male and female infants' responses in the still face. Carter et al. (1990) found that infants' reactions to the still face varied depending on their mothers' affective responsiveness during the play preceding the still face. Girls of more affectively positive mothers were more likely to remain neutral during the still face, whereas boys of more affectively positive mothers were more likely to protest and to display negative affect. Studies such as that of Carter et al. highlight factors that facilitate male and female infants' coping with challenging interactive contexts such as the still face. The research also suggests that differences in maternal affect have differing consequences for boys and girls. Differences in the dyadic characteristics of mother–infant interactions are also likely to differentially affect the socioemotional development of boys and girls, although this remains an unexamined issue.

In this study, gender differences in infant and maternal socioemotional expressivity and self-regulation during Tronick's face-to-face still-face paradigm were evaluated. Several specific hypotheses were advanced on the basis of the literature and Tronick's MRM (Beeghly & Tronick, 1994; Tronick, 1989; Weinberg & Tronick, 1997). Briefly, the MRM argues that infant affective organization is simultaneously dependent on both the infant's regulatory capacities and the regulatory scaffolding provided by the caregiver. The caregiver's behavior is guided by the infant's expressive displays (e.g., gaze, facial expressions, gestures, and vocalizations). In turn, the infant's states are affected by the expressive displays of the caregiver. From this perspective, the quality of the interaction is determined by the ability of each participant to regulate his or her emotional states, express communicative messages, and respond to his or her partner's affective communications and regulatory needs. Thus, characteristics of the interaction observed for a particular dyad (e.g., matching and synchrony) depend on both the infant's and the adult's interactive and regulatory capacities.

It was hypothesized, first, that boys would show greater difficulty than girls in maintaining affective regulation, such that boys would display more negative affect than girls during the episodes of the face-to-face still-face paradigm, including the still face. Second, it was expected that boys, because of their greater difficulty in maintaining affective regulation, would be more dependent on their mothers to help them regulate their affective states. Thus, it was hypothesized that mothers would use different and more frequent strategies designed to help boys as opposed to girls regulate affective states. Third, based on the findings of Tronick and Cohn (1989), greater coordination in the interactions of mother–son dyads than in the interactions of mother–daughter dyads was expected. Thus, it was hypothesized that mother–son as compared with mother–daughter dyads would be more likely to be in social matching states and receive higher synchrony scores. It also was expected that mother–son dyads would have a slower rate of change from mismatching to matching states because boys' greater difficulties in maintaining affective regulation may make it more difficult for mother–son dyads to repair interactive errors (i.e., moments when mothers and infants are not in joint social or object matching states).

Finally, several hypotheses regarding stability and individual differences were advanced. It was predicted that male and female

infants would show a similar amount of stability in their expressive behavior but that the pattern of correlations would be somewhat different for boys and girls. On the basis of Carter et al.'s (1990) work, it also was hypothesized that positive maternal affect in the play preceding the still face would be associated with negative affective displays in boys and with interest expressions and object exploration in girls during the still face and reunion play. Hypotheses regarding the measures of coordination were more difficult to frame because of a lack of precedent in the literature. On the one hand, higher coordination (e.g., synchrony) during the first play might be expected to be associated with more disruption and negative expressivity during the still face when regulatory support is abruptly withdrawn and during the reunion play when the mother and infant must renegotiate the interaction after the stress of the still face. This disruption may be particularly evident for boys if they, as hypothesized, have more difficulty than girls in regulating their affective states. On the other hand, greater coordination during the first play may be associated with greater ability to cope with the stresses of the still face and the reunion play because effective coordination has been argued to lead to a sense of control and effectance in the infant (Robinson et al., 1993; Tronick & Gianino, 1986).

Method

Participants

Eighty-one 6-month-old infants (43 girls and 38 boys) and their mothers participated in the study. The infants ranged in age from 5 months 3 weeks to 6 months 1 week. Infants were studied at 6 months because this age represents a time when infants have at their disposal a wide range of expressive behaviors. In particular, it is a period characterized by a shift in the infant to an enhanced interest in and capacity to engage objects and to use object engagement as a regulatory strategy (Trevarthen, 1979). Furthermore, infants were studied at 6 months because there is extensive research using the face-to-face still-face paradigm at this age (Cohn & Tronick, 1987; Gusella, Muir, & Tronick, 1988; Toda & Fogel, 1993; Weinberg & Tronick, 1994, 1996) and because 6 months was one of the ages in Tronick and Cohn's (1989) article, whose findings this study was designed to partially replicate.

Mothers and infants were at low social and medical risk. All infants were full-term and healthy at birth and at the time of assessment. Mothers were married and Caucasian, had at least a high school degree (mean education level = 14.5 years), were middle class (average Hollingshead four-factor socioeconomic status index = 2.15), and ranged in age from 20 to 39 years (M = 29.5 years). Forty-four percent of the mothers were primiparous. Analyses (t tests) revealed no significant differences in demographics between mothers of boys and mothers of girls.

Participants were recruited through birth announcements published in local newspapers. Potential participants were sent a letter describing the study and were then telephoned. Mothers who expressed interest in participating in the study were scheduled to bring their infant to the laboratory at a time when they thought their infant would be alert. Agreement to participate in the study was high (85%). However, 13 mothers who had been scheduled were no-shows (1 mother experienced a death in the family, and 12 mothers changed their mind in regard to participation). An additional 4 mothers could not be scheduled within the time span needed to see the infant, and 2 dyads were dropped from the sample because of a technical problem with the video-recording equipment. No infant was dropped from the sample as a result of crying during the face-to-face still-face paradigm. There were more boys (n = 12) than girls (n = 7) in the group of infants who were not part of the final sample. Among these nonparticipants, dyads with female infants did not differ from dyads with male infants in terms of social, medical, or demographic variables.

Laboratory Setting and Procedure

The laboratory setting and procedures, based on those originally developed by Tronick (Tronick et al., 1978), have been described in detail elsewhere (Weinberg & Tronick, 1994). The video room was equipped with an infant seat mounted on a table, an adjustable swivel stool for the mother, two cameras (one focused on the infant and the other on the mother), a microphone, and an intercom through which mothers were given procedural instructions.

Mothers and infants were videotaped in Tronick's face-to-face still-face paradigm (Tronick et al., 1978). The paradigm included (a) a 2-min face-to-face play interaction for which the mother was instructed to play with the infant, (b) a subsequent 2-min still-face interaction for which the mother was instructed to keep a still face and to look at the infant but not smile, talk, or touch the infant, and (c) a second 2-min reunion play interaction. Each of these episodes was separated by a 15-s intertrial interval during which the mother turned her back to the infant. The signals from the two cameras were transmitted through a digital timer and split-screen generator into a video recorder to produce a single image with a simultaneous frontal view of the mother's face, hands, and torso and the infant's entire body.

Coding of Data

Coding of infant behavior and facial expressions. The infants' behavior was coded second by second using the Infant Regulatory Scoring System (IRSS; for details, see Tronick & Weinberg, 1990a; Weinberg & Tronick, 1994). This system codes the infant's direction of gaze (looks at mother, looks at objects, and scans), vocalizations (neutral–positive, fussy, and crying), pick-me-up gestures, other gestures (one hand pointing or reaching toward the mother, leaning toward the mother, and touching the mother), self-comforting (mouthing a body part or object), distancing (escaping by turning and twisting in seat), and autonomic stress indicators (spitting up or hiccuping). The gaze and vocalization codes are mutually exclusive, whereas the other codes within a category can co-occur. Because mothers are instructed not to use toys or pacifying objects during the face-to-face still-face paradigm, the looks-at-objects code refers to the infant looking at things inherent to the face-to-face setting, such as the infant chair or strap or the infant's or mother's clothing. Looking at objects was coded if the infant looked at an object for 2 s or more. This coding criterion was used to distinguish between sustained object engagement and scanning of the environment, which was defined as looking at something for less than 2 s.

The infants' facial expressions were scored second by second using the AFFEX system (Izard & Dougherty, 1980), which identifies 10 facial expressions (i.e., joy, interest, sadness, anger, surprise, contempt, fear, shame–shyness–guilt, distress, and disgust) as well as blends of facial expressions. AFFEX codes label facial expressions with emotion terms such as *joy* or *anger* and equate facial expressions with discrete emotions (Izard, 1977; Izard & Malatesta, 1987). The perspective in this study, however, was that infant affect is expressed facially, vocally, and bodily (Fogel et al., 1992; Weinberg & Tronick, 1994).

Coding of maternal behavior and facial expressions. The mothers' behavior was coded second by second with the Maternal Regulatory Scoring System (MRSS; Tronick & Weinberg, 1990b). The system codes six dimensions of maternal behavior: direction of gaze, proximity to infant, caregiving behavior, vocalizations, touch, and eliciting behavior. Table 1 presents a summary description of the major codes included in the MRSS.

The mothers' facial expressions were coded second by second using a slightly modified version of the Overall Mood Rating Scale from the Hedonic Tone Scales (Easterbrooks & Emde, 1983). This system rates

Table 1
Summary Definitions of the Major Codes of the Maternal Regulatory Scoring System

Dimension	Definition
Proximity	Caregiver's proximity to or physical distance from the infant: (a) nose to nose (76%), (b) looming (86%), or (c) average (94%)
Caregiving	Caregiver engages in a caretaking activity (75%), such as wiping the infant's face or readjusting the chair strap
Gaze	Caregiver (a) looks at the infant's face (98%), (b) looks at the same object the infant is looking at (90%), or (c) averts (89%; i.e., does not look at the infant or at the same object as the infant)
Vocalization	Caregiver vocalizes to the infant (96%); specific vocalizations include calling the infant's name (79%), directing attention to self (75%), and making mouth noises (84%)
Touch	Caregiver touches the infant; touches include strokes (93%), rhythmic movement of limbs (93%), kisses (91%), sucking on infant's fingers or toes (97%), pinches (100%), pokes or jabs (83%), tickles (91%), pulls (80%), and holding or containing the infant's limbs (e.g., holding both hands; 92%)
Elicits	Caregiver attempts to elicit the infant's attention by making noise (93%; i.e., clapping hands), waving (87%), repositioning self in infant's line of vision (85%), or blowing on infant (77%)

Note. Mean percentage agreement rates for each code are presented in parentheses. The complete system is available from M. Katherine Weinberg.

maternal facial expressions on a 7-point scale: high positive (e.g., exaggerated play faces), moderate positive (e.g., smiles), low positive (e.g., facial expressions of interest), neutral (e.g., bland expressions with no animation), low negative (e.g., sober and serious expressions), moderate negative (e.g., frowns and sadness), and high negative (e.g., anger expressions, distress, and disgust). The scale was applied on a second-by-second basis rather than as an overall rating of the mothers' facial expressions for each episode. Thus, although this coding was more coarse than the facial affect coding done for the infants, it provided a detailed, second-by-second description of maternal facial affect and was appropriate for analyses of matching and synchrony.

Infant and maternal coding was done by several coders from the videotapes. In terms of infant coding, one coder scored the infants' direction of gaze, another coded vocalizations, a third coded gestures and distancing, and a fourth coded self-comforting and autonomic stress indicators. In addition, two coders who had been trained with Izard's (Izard & Dougherty, 1980) training tapes and manuals coded the infants' AFFEX facial expressions independently of IRSS codes. In terms of maternal coding, one coder scored the mothers' direction of gaze, another coded vocalizations, a third coded the mothers' proximity to the infant, and a fourth coded touch, caregiving, and eliciting behaviors. Two additional coders scored the mothers' facial expressions independently of the MRSS codes.

A digital time display was used to track time intervals. This produced an absolute frequency count of the behaviors and facial expressions and maintained their temporal sequence to within a 1-s interval. Each coder used the same onset time for starting the coding of each episode. Tapes were run at normal speed, although they were frequently stopped or run in slow motion to accurately determine the beginning and end of shifts in infant and maternal behavior or facial expressions.

Reliability. As a means of assessing interobserver reliability, 20% of the first play, still-face, and reunion play episodes (60 episodes) were selected randomly and recorded independently by different coders. Reliabilities for the IRSS, MRSS, AFFEX, and Maternal Mood Rating Scale codes were determined through both percentage agreement and kappa values. Percentage agreement involved the procedures established by Cohn and Tronick (1987). Percentage agreement was not defined, as it often is, as the overall proportion of time a code was scored during an episode; rather, it was defined more stringently as the proportion of time two coders scored the same code in the same 1-s interval using the following formula: agreements/(agreements + disagreements). Lack of agreement could occur because two coders coded different behaviors or facial expressions in the same second or because they chose the same code but disagreed as to the second in which it occurred. The number of times both coders agreed that a code did not occur was not considered in this calculation because of its likelihood of inflating the agreement.

Reliability was calculated for each IRSS code and for the AFFEX codes of joy, interest, sadness, anger, and uncodable–unscorable. The AFFEX-coded facial expressions of surprise, fear, disgust, distress, contempt, and positive and negative blends occurred 1% of the time or less. Because these codes were so infrequent, they were excluded from the analyses of variance (ANOVAs) evaluating differences in infant expressive behavior. However, these codes were needed for the time-series analysis evaluating synchrony in infant and maternal behavior. Mean percentage agreement rates for each IRSS and AFFEX code are presented in Table 2.

Reliability was calculated for each MRSS and Maternal Mood Rating Scale code. The negative Maternal Mood Rating Scale codes (i.e., low, moderate, and high negative), which accounted for slightly more than 1% of all facial expressions, were excluded from the analysis evaluating differences in maternal expressive behavior but not from the time-series analysis of synchrony. The low incidence of maternal negative affect was consistent with previous research indicating that mothers at low social, medical, and psychiatric risk rarely display negative expressions to young infants (Carter et al., 1990; Malatesta & Haviland, 1982; Robinson et al., 1993; Tronick & Cohn, 1989). Mean percentage agreement rates for the Maternal Mood Rating Scale codes of high positive, moderate positive, low positive, and neutral were 89%, 82%, 80%, and 78%, respectively. Mean percentage agreement rates for each MRSS code are presented in Table 1.

As a second measure of reliability, Cohen's kappas (Cohen, 1960; see also Cicchetti & Feinstein, 1990) were calculated for categories with mutually exclusive codes (i.e., AFFEX facial expressions, IRSS gaze, IRSS vocalizations, MRSS gaze, MRSS proximity, and Maternal Mood Rating Scale codes). Mean kappa values for AFFEX facial expressions, IRSS gaze, and IRSS vocalizations were .77, .82, and .76, respectively. These values are similar to those reported by other researchers (Toda & Fogel, 1993). Mean kappa values for MRSS gaze, MRSS proximity, and the Maternal Mood Rating Scale scores were .79, .85, and .78, respectively.

Coder unawareness. Maintaining coders' unawareness is difficult in a study on infant gender. Mothers refer to the infant by name and often dress the infant in a manner suggestive of the infant's gender. Although it is possible to ask mothers to dress their infant in gender-neutral clothing and to refrain from referring to the infant by name, Melson and Fogel (1982) noted that even with such precautions, it is virtually impossible to remain masked to infant gender. Furthermore, asking mothers to modify their normal routines with their infant may produce reactive effects in the mothers. Therefore, as a means of preventing distortion in the mothers' behavior and maintaining the coders' unawareness, mothers and coders were not told that one objective of the study was to evaluate gender issues but that the study was concerned with infant interactive and communicative behavior with mothers. Furthermore, as described earlier, coding was done by several independent coders. As noted by Melson and Fogel, the inde-

Table 2

Proportion of Time Male and Female Infants Displayed AFFEX-Coded Facial Expressions and IRSS-Coded Behaviors During the Episodes of the Face-to-Face Still-Face Paradigm

Facial expression or behavior	Play 1		Still face		Reunion		All episodes		Gender		Episode	Wilks's
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(1, 79)	r^2	*F*(2, 78)	λ
Joy (89%)												
Boys	.35	.26	.09	.12	.32	.28	.26	.18	7.34**	.08		
Girls	.20	.19	.04	.07	.26	.21	.16	.12				
Both	$.27_a$	.24	$.06_b$	.10	$.29_a$	.25					48.41**	.45
Interest (95%)												
Boys	.55	.26	.64	.27	.45	.27	.55	.22	9.93**	.11		
Girls	.67	.20	.76	.22	.61	.22	.68	.17				
Both	$.61_a$	.23	$.71_b$	.25	$.53_c$	.26					16.09**	.71
Sadness (82%)												
Boys	.01	.01	.05	.12	.04	.07	.03	.06	0.39	.00		
Girls	.01	.01	.04	.11	.02	.05	.02	.04				
Both	$.01_a$	.01	$.05_b$	.11	$.03_b$	.06					8.56**	.82
Anger (89%)												
Boys	.02	.08	.11	.20	.09	.17	.07	.12	4.35*	.05		
Girls	.01	.05	.04	.09	.04	.11	.03	.06				
Both	$.02_a$	.07	$.07_b$	.15	$.07_b$	.14					7.80**	.83
Looking at mother (87%)												
Boys	.46	.27	.26	.14	.55	.25	.42	.17	4.11*	.05		
Girls	.36	.23	.21	.14	.48	.27	.35	.16				
Both	$.40_a$	.25	$.23_b$	.14	$.51_c$	.26					43.47**	.47
Looking at objects (96%)												
Boys	.35	.23	.45	.20	.26	.22	.35	.17	8.24**	.09		
Girls	.44	.23	.56	.18	.36	.23	.45	.16				
Both	$.40_a$	.24	$.51_b$	.20	$.31_c$	.23					23.99**	.62
Scans (92%)												
Boys	.20	.12	.29	.15	.19	.15	.23	.12	1.56	.02		
Girls	.20	.12	.23	.12	.17	.13	.20	.09				
Both	$.20_a$	.12	$.26_b$	.14	$.18_a$	.14					18.66**	.68
Neutral–positive vocalizations (75%)												
Boys	.11	.16	.07	.08	.20	.21	.13	.12	9.72**	.10		
Girls	.04	.05	.04	.04	.11	.11	.06	.05				
Both	$.07_a$	.12	$.05_a$	.06	$.15_b$	.17					19.49**	.67
Fussy vocalizations (81%)												
Boys	.05	.13	.09	.13	.13	.20	.09	.12	6.70**	.07		
Girls	.02	.03	.03	.07	.07	.11	.04	.05				
Both	$.03_a$	.09	$.06_a$	.11	$.10_b$	.16					6.99**	.85
Crying (77%)												
Boys	.00	.01	.02	.09	.09	.24	.04	.10	3.54†	.04		
Girls	.00	.00	.01	.05	.02	.09	.01	.04				
Both	$.00_a$	.01	$.02_a$	.07	$.05_b$	.18					3.92*	.91
Pick-me-up gestures (77%)												
Boys	.02	.06	.06	.08	.05	.12	.04	.07	5.73*	.06		
Girls	.00	.01	.02	.06	.02	.07	.01	.04				
Both	$.01_a$	.04	$.04_b$	.07	$.04_b$	.09					9.26**	.81
Gesturing signals (77%)												
Boys	.14	.20	.12	.14	.28	.21	.18	.13	2.08	.02		
Girls	.11	.12	.06	.07	.26	.24	.14	.11				
Both	$.12_a$	.16	$.09_a$	.11	$.27_b$	.23					24.74**	.62
Self-comforting (98%)												
Boys	.09	.13	.04	.07	.10	.17	.07	.09	2.27	.03		
Girls	.11	.18	.12	.20	.12	.18	.12	.16				
Both	.10	.16	.08	.16	.11	.18					1.56	.96
Distancing (91%)												
Boys	.02	.03	.05	.09	.04	.08	.03	.06	6.40*	.07		
Girls	.00	.01	.02	.05	.01	.01	.01	.02				
Both	$.01_a$	.03	$.03_b$	.07	$.02_b$	.05					4.65*	.89
Distress indicators (80%)												
Boys	.01	.02	.06	.10	.04	.15	.04	.06	0.61	.01		
Girls	.01	.02	.04	.08	.03	.05	.03	.04				
Both	$.01_a$	.02	$.05_b$	.09	$.04_b$	.11					8.55**	.82

Note. Means with different subscripts are significantly different from each other at $p < .05$. Mean percentage agreement rates for each code are presented in parentheses. The r^2 values represent the proportion of variance accounted for by gender and were calculated with formulas provided in Cohen (1988). Wilks's lambdas for the episode effect can be interpreted similar to a proportion of variance measure, although numbers closer to zero indicate a stronger effect. AFFEX = affect expressions by holistic judgments; IRSS = Infant Regulatory Scoring System.

† $p < .10$. * $p < .05$. ** $p < .01$.

pendent multiple-coder approach is unlikely to result in consistent bias. Furthermore, the frequent interrater reliability checks ensured that coders remained unbiased and reliable.

Data Reduction and Analyses

Differences in Infant and Maternal Expressive Behavior

Infant expressivity. To evaluate the hypothesis that boys would show greater difficulty than girls in maintaining affective regulation, particularly in the still-face and reunion play episodes, we conducted a 2 (gender) × 3 (episode) ANOVA with episodes as repeated measures. Significant episode effects were evaluated with post hoc tests in which the critical p value for significance was adjusted with the Bonferroni correction to control for multiple tests. Effect size for the between-subjects variable (gender) was evaluated using an r^2 value calculated with Cohen's (1988) d statistic. Effect size for the repeated measures variable (episode) was assessed with Wilks's lambda.

Maternal expressivity. To evaluate the hypothesis that mothers would use different and more frequent strategies designed to help boys as opposed to girls regulate their affective state, particularly in the reunion play episode, we conducted a 2 (gender) × 2 (episodes) repeated measures ANOVA. Because all mothers were instructed to behave in the same manner during the still-face episode, only the first play and reunion plays were included as repeated measures.

Differences in the Coordination of Mother–Infant Interactions

To evaluate the hypothesis that there would be greater coordination in mother–son pairs than in mother–daughter pairs, we assessed three measures of coordination: (a) matching, the extent to which mothers and infants share joint states, such as looking at one another (social match) or sharing attention to objects (object match); (b) rate of change between matching and mismatching states (i.e., rate of change between moments when mother and infant are or are not in joint social or object matching states); and (c) synchrony, the extent to which mothers and infants change their behavior in temporal coordination with respect to the other. The matching and synchrony measures differ in that matching focuses on the content of the behaviors of mothers and infants and synchrony focuses on how mothers and infants change their affective states together over time, regardless of the content of their behavior. Thus, some dyads may seldom be in matching states but may have high synchrony scores because infant and mother tend to change in the same affective direction over the course of the interaction.

For comparability with Tronick and Cohn's (1989) data, the IRSS, AFFEX, MRSS, and the Maternal Mood Rating Scale scores were converted into monadic phases (Tronick, Als, & Brazelton, 1980). The primary difference between the monadic phases scoring system and those used in the present study is that the former does not code individual expressive modalities (e.g., voice, gaze, and face) separately but combines expressive information into distinct behavioral–affective configurations referred to as phases. Although the term *phase* may imply a sequence of distinct forms, there is no sequential component to the monadic phases scoring system.

Several a priori combination rules were used on the infant and maternal data to convert the data into monadic phases. For the infant, direction of gaze, AFFEX facial expressions, and vocalizations were combined to form nine phases (see Table 3). AFFEX codes that occurred infrequently were included in the creation of the phases because of their importance in generating an index for synchrony. Surprise and positive blends were combined with AFFEX joy, whereas fear, disgust, distress, contempt, and negative blends were combined with AFFEX anger. Expressions of shame–guilt–shyness and distress did not occur in this data set. The nine phases were play, vocalize–talk, social attend, object play, object attend, positive avert, avert, wary, and protest. One of these phases was assigned to each second of infant data.

For the mother, direction of gaze, affect, and elicits were combined to form 12 phases (see Table 4). The Maternal Mood Rating Scale scores of low, moderate, and high negative, although they occurred infrequently, were included in the creation of the phases because of their importance in generating an index for synchrony. The 12 phases were play, social play, object play, positive elicit, positive away, set–interest, object attend, monitor, wary, disengaged, negative elicit, and hostile. One of these phases was assigned to each second of maternal data.

Matching. The 9 infant and 12 maternal phases were reduced to five monadic phases following the a priori rules and procedures

Table 3
Combination Rules for Construction of the Nine Infant Phases

	IRSS gaze code		
AFFEX code	Look at mom	Look at object	Look away
Joy	Play (7)	Object play (6)	Positive away (7)
Interest	Social attend (5)	Object attend (4)	Avert (2)
Sadness	Wary (3)	Avert (2)	Avert (2)
Anger	Protest (1)[a]	Protest (1)[a]	Protest (1)[a]
Obscure/noncodable	Social attend (5)	Object attend (4)	Avert (2)

Note. Vocalize–talk (8) was composed of joy or interest AFFEX codes co-occurring with both looking at mother and neutral–positive vocalizations. The scale scores assigned to each infant phase are presented in parentheses. AFFEX = affect expressions by holistic judgments; IRSS = Infant Regulatory Scoring System.
[a] Protest (1) was also composed of the IRSS cry code co-occurring with any AFFEX facial expression or IRSS gaze code.

Table 4
Combination Rules for Construction of the 12 Maternal Phases

Affect code	MRSS gaze code		
	Social attend	Object attend	Avert
High positive	Social play (8)	Object play (7)	Positive away (8)
Moderate positive	Social play (8)	Object play (7)	Positive away (8)
Low positive	Set–interest (5)	Object attend (4)	Disengaged (2)
Neutral	Monitor (5)	Object attend (4)	Disengaged (2)
Low negative	Wary (3)	Object attend (4)	Disengaged (2)
Moderate negative	Hostile (1)	Hostile (1)	Hostile (1)
High negative	Hostile (1)	Hostile (1)	Hostile (1)
Unscorable	Set–interest (5)	Object attend (4)	Disengaged (2)

Note. Positive elicits (6) was composed of the high, moderate, and low positive and neutral affect codes co-occurring with any MRSS elicit code. Negative elicits (1) was composed of the low, moderate, and high negative affect codes co-occurring with any MRSS elicit code. The scale scores assigned to each maternal phase are presented in parentheses. MRSS = Maternal Regulatory Scoring System.

used by Tronick and Cohn (1989). Following Tronick and Cohn, two types of matching states (social matches and object matches) were considered in the analyses. Social matches were defined as the proportion of time mothers and infants were in the monadic phases of social attend or social play in the same 1-s interval. Object matches were defined as the proportion of time mothers and infants were in the monadic phases of object attend or object play in the same 1-s interval. Avert–negative matches were not evaluated because mothers were in this phase only about 1% of the time. To account for differences in the base rate of social and object matches, we used the adjusted or relative percentage of social (or object) matches in the analyses. The adjusted value was calculated as the percentage of time in social (or object) match divided by the total time during which mothers or infants were in a social (or object) phase. The adjusted proportions were transformed using arcsine transformation and then analyzed in a 2 (sex) × 2 (episode) multivariate analysis of variance (MANOVA) with first play and reunion play as repeated measures.

Rate of change. The rate of change from matching to mismatching states is a measure of the rate of reparation in the mother–infant interaction. In this study, reparation referred to the ability of the mother–infant dyad to move from nonshared states to joint social or object states. The rate of change per second was arcsine transformed and analyzed in a 2 (sex) × 2 (episode) MANOVA with the first and reunion play episodes as repeated measures.

Synchrony. In preparation for the synchrony analyses, we scaled the infant and maternal phases from 1 to 8 using an affective–attentional dimension similar to that used by Tronick and Cohn (1989). For the infant, a score of 1 assigned to protest represented maximum negative involvement, and a score of 8 assigned to vocalize–talk represented maximum positive involvement. For the mother, a score of 1 assigned to hostile and negative elicits represented maximum negative involvement, and a score of 8 assigned to play, positive away, and social play represented maximum positive involvement. The particular scale scores assigned to infant and maternal phases are presented in parentheses in Tables 3 and 4. Technically, synchrony was defined as the proportion of shared variance at Lag 0, as indexed by the square of the cross-correlation between each mother's and infant's time series. Cross-correlations were calculated by means of the scaled scores and then transformed with Fisher's z transformation before analysis. The cross-correlations were then analyzed in a 2 (sex) × 2 (episode) MANOVA with the first and reunion plays as repeated measures.

Replication

Tronick and Cohn (1989) only included data from a mother–infant play interaction in their report. This play interaction preceded the still face and was similar to the first play interaction in this study. To replicate Tronick and Cohn's findings and to evaluate what happens in a play interaction uninfluenced by the carryover effects from the still face, we further evaluated gender differences in the three measures of coordination with two-tailed t tests using the first play interaction data only.

Stability of Infant Expressive Behavior and Measures of Coordination

To assess the stability of infant expressive behavior as well as the stability of matching, rate of change, and synchrony, we calculated Pearson correlations between the episodes of the face-to-face still-face paradigm. The correlations were calculated separately by infant gender. Infant expressive behaviors that occurred 5% or less of the time in each episode were eliminated because low frequencies distort correlation coefficients (i.e., when there is no occurrence of a behavior, zeros distort the correlation). This resulted in the exclusion of sadness, crying, pick-me-up gestures, distancing, and autonomic stress indicators from the correlational analyses.

Relation Between Maternal Affect and Measures of Coordination and Infant Expressive Behavior

Pearson correlations were also used to evaluate the relation between maternal affect (as assessed by the Maternal Mood Rating Scale) in the first play and infant expressive behavior during the still face and the reunion play. The relations between the measures of coordination in the first play (i.e., social and object matching,

rate of change, and synchrony) and infant expressive behavior during the still face and the reunion play were also evaluated.

Results

Episode Differences in Infant and Maternal Expressive Behavior and Measures of Coordination

Infant expressivity. Replicating earlier studies, the main effects of episode indicated that both male and female infants reacted with negative affect to the still face (see Table 2; see also Stack & Muir, 1992; Toda & Fogel, 1993; Weinberg & Tronick, 1996). Facial expressions of sadness and anger, scanning, pick-me-up gestures, distancing by twisting and turning in the seat, and autonomic stress indicators such as hiccuping were significantly more common during the still face than the first play episode for both male and female infants. Both sexes also displayed significantly fewer facial expressions of joy, looked less at the mother, showed more facial expressions of interest, and looked more at objects during the still face than during the first play.

The reunion episode was characterized, for both male and female infants, by a carryover of negative affect from the still face, an increase in fussiness and crying, and a rebound of positive mother-oriented behaviors (e.g., looks at mother, gestures, and neutral–positive vocalizations). These findings highlight the complexity of the affective and regulatory processes that take place during the reunion play and are consistent with previous work by Weinberg and Tronick (1996) and Kogan and Carter (1996).

Maternal expressivity. Mothers of both male and female infants were significantly more likely to keep an average distance from the baby, $F(1, 79) = 7.62$, $p < .01$, during the first play as opposed to the reunion play. Also, they were significantly more likely to try to elicit the baby's attention by calling his or her name, $F(1, 79) = 5.50$, $p < .05$; directing attention to themselves, $F(1, 79) = 3.95$, $p < .05$; or repositioning themselves in the infant's line of vision, $F(1, 97) = 13.46$, $p < .001$.

During the reunion play relative to the first play, mothers of both male and female infants were significantly more likely to display high positive affect, $F(1, 79) = 4.38$, $p < .05$; maintain a looming proximity to the infant, $F(1, 79) = 9.80$, $p < .01$; hold–contain the infant's limbs, $F(1, 79) = 5.43$, $p < .05$; blow on the infant, $F(1, 79) = 8.98$, $p < .01$; and kiss the infant, $F(1, 79) = 5.23$, $p < .05$. These findings suggest that mothers are more likely to try to elicit their infant's attention during the first play than the reunion play and that they are more likely to use a variety of arousing and soothing strategies during the reunion play when renegotiating the interaction after the still face. These findings also suggest that mothers and infants are in a heightened emotional state and motivated to resume their normal relationship.

Matching, rate of change, and synchrony. There were no main effects of episode for object matches or synchrony. However, mothers and infants were more likely to be in social matches during the reunion play than during the first play. Furthermore, the rate of change between matching and mismatching states was slower in the reunion play than in the first play. These findings suggest that mothers and infants maintained a higher level of mutual attention and had a more difficult time repairing interactive errors during the reunion play than during the first play. This may have been due to a carryover effect of negative affect from the still face as well as to the ambivalent nature of the infants' behavior during the reunion play, which alternated between positive and negative states. These findings further document the stressful and challenging nature of the reunion episode.

Gender Differences in Infant and Maternal Expressive Behavior and Measures of Coordination

Infant expressivity. There were several significant main effects of gender but no significant Gender × Episode effects. Thus, gender differences were consistent across the contexts of the face-to-face still-face paradigm, including the still face, during which mothers were instructed not to interact with the infant.

The main effects of gender supported the hypothesis that boys would have more difficulty than girls in maintaining affective regulation and would show more negative affect during the face-to-face still-face paradigm (see Table 2). Boys were more likely than girls to display facial expressions of anger, to fuss, to want to be picked up, and to attempt to get away or distance themselves from the mother by arching their back and turning and twisting in the infant seat. Boys also tended to cry more than girls.

Although boys showed more negative expressive behavior than girls, they surprisingly displayed significantly more positive affect directed toward the mother as well. Boys were more likely than girls to display facial expressions of joy, to look at the mother, and to vocalize to the mother using neutral–positive vocalizations. Girls, on the other hand, were more likely than boys to look at and explore objects and to display facial expressions of interest.

Maternal expressivity. There were few significant gender-related differences in the mothers' behavior. There was a main effect of gender for the MRSS code of make noise, $F(1, 79) = 5.19$, $p < .05$. Mothers were more likely to elicit their son's than their daughter's attention by making noises with their hands (e.g., clapping their hands or snapping their fingers). There was also a significant Gender × Episode interaction effect for the Maternal Mood Rating Scale code of low positive affect, $F(1, 79) = 5.79$, $p < .05$. Post hoc tests indicated that mothers showed more low positive affect toward sons during the first play than during the reunion play. These differences offer little support for the hypothesis that mothers use different behaviors to help boys and girls maintain affective regulation.

Matching. Table 5 presents the adjusted proportion means and standard deviations (before the arcsine transformation, for ease of interpretation) of social and object matches for boys and girls in the first and reunion play episodes. For object matches, there was no significant Gender × Episode interaction. The analysis, however, revealed that mother–daughter dyads tended to be more likely than mother–son dyads to be in object matches. For social matches, there were no significant gender or interaction effects.

To replicate Tronick and Cohn's (1989) data, we also evaluated matching using only the first play data. Two-tailed t tests revealed that mother–daughter dyads were significantly more likely than mother–son dyads to be in object matching states during the first play, $t(1, 78) = -1.99$, $p < .05$. In addition, there was a trend for mother–son dyads to be more likely than mother–daughter dyads to be in social matching states during the first play, $t(1, 75) = 1.84$, $p < .07$.

Rate of change. There was no significant Gender × Episode interaction effect for the rate of change per second between match-

Table 5
Proportion of Time for Object Match, Social Match, Rate of Change per Second Between Matching and Mismatching States, and Synchrony by Gender and Episode

Coordination measure	Play 1		Reunion		Both episodes		Gender		Episode	Wilks's
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*(1, 79)	r^2	*F*	λ
Object match (adjusted rate)										
Mother–son	.08	.14	.08	.13	.08	.10	3.02†	.04		
Mother–daughter	.13	.14	.10	.12	.12	.10				
All dyads	.11	.14	.09	.12					0.77[a]	.99
Social match (adjusted rate)										
Mother–son	.50	.26	.52	.29	.51	.25	1.55	.02		
Mother–daughter	.39	.24	.49	.27	.44	.25				
All dyads	.44	.26	.50	.28					4.91[a]*	.94
Rate of change per second										
Mother–son	.08	.04	.08	.04	.08	.03	3.74†	.05		
Mother–daughter	.10	.03	.08	.04	.09	.03				
All dyads	.09	.04	.08	.04					4.30[b]*	.95
Synchrony										
Mother–son	.10	.10	.08	.10	.08	.08	1.80	.01		
Mother–daughter	.06	.07	.07	.09	.07	.06				
All dyads	.08	.08	.07	.10					0.23[c]	1.00

Note. The r^2 values represent the proportion of variance accounted for by gender and were calculated with formulas provided in Cohen (1988). Wilks's lambdas for the episode effect can be interpreted similar to a proportion of variance measure, although numbers closer to zero indicate a stronger effect.
[a] $df = 1, 79$. [b] $df = 1, 78$. [c] $df = 1, 77$.
† $p < .10$. * $p < .05$.

ing and mismatching states. The rate of change, however, had a tendency to move more slowly from matching to mismatching states and back again for mother–son than for mother–daughter dyads (see Table 5 for the means and standard deviations before the arcsine transformation).

To replicate Tronick and Cohn's (1989) data, we also evaluated rate of change using only the first play data. A two-tailed *t*-test revealed that mother–daughter dyads moved significantly more quickly than mother–son dyads between matching and mismatching states during the first play, $t(1, 74) = -1.34, p < .02$. The rates of change between matching and mismatching states were .10 per second for mothers and daughters and .08 per second for mothers and sons. Thus, mother–son dyads took longer to repair moments when they were not in joint social and object states than mother–daughter dyads.

Synchrony. Table 5 presents the means and standard deviations before Fisher's *Z* transformation for ease of interpretation. Contrary to expectation, the analysis revealed no significant gender differences in synchrony when the first play and the reunion play data were combined. However, the synchrony measure was significant when only first play data were considered. Replicating Tronick and Cohn's (1989) finding, the analysis revealed that mother–son dyads had significantly higher synchrony scores than mother–daughter dyads during the first play, $t(1, 74) = 2.04, p < .05$.

Stability of Infant Expressive Behavior and Measures of Coordination

Infant expressivity. It was expected that male and female infants would display a similar amount of stability across episodes but that the patterns of stable behaviors would be somewhat different. The correlational analyses (see Table 6) generally supported this prediction. Boys had 17 significant correlations, as compared with 14 for girls. This finding suggests that 6-month-old boys and girls have stable ways of interacting with a social partner both in normal face-to-face interactions and in challenging contexts such as the still face. Boys and girls showed stability in similar domains in some cases and differences in other domains. For example, the correlations between the first play and the still face indicated that both boys and girls showed stability in the expression of interest and scans (see Table 6 for details). However, girls also showed stability in the expression of joy, fussy vocalizations, and self-comforting, whereas boys showed stability in the expression of anger. Few expressive behaviors were stable across all three episodes, with the exception of scanning and self-comforting. Boys showed stability in scanning and girls in self-comforting across the three episodes, attesting to the robustness of these two expressive behaviors.

Matching, rate of change, and synchrony. Stability of matching, rate of change, and synchrony was assessed between the first and the reunion plays (see Table 6). Social matching showed a high degree of stability for both boys and girls. Boys, but not girls, also showed stability in the rate of change between matching and mismatching states and in synchrony. There was no stability in object matching for either the male or female infants.

Relation Between Maternal Affect and Measures of Coordination and Infant Expressive Behavior

Maternal affect and infant expressive behavior. Analyses evaluated the relation between maternal affect, as assessed by the Maternal Mood Rating Scale scores, in the first play and the

Table 6
Stability of Infant Expressive Behaviors and Measures of Coordination

Behavior or measure	First play to still face		First play to reunion		Still face to reunion	
	Male	Female	Male	Female	Male	Female
Expressive behavior						
Joy	.23	.44**	.61**	.41**	.53**	−.12
Interest	.44**	.48**	.61**	.61**	.40*	.36*
Anger	.55**	.16	.27	−.06	.30	.63**
Look at mother	.12	.05	.63**	.58**	.39*	.05
Look at object	.10	.18	.61**	.58**	.34*	.11
Scans	.58**	.43**	.51**	.09	.72**	.18
Neutral–positive vocalizations	.25	.08	.74**	.28	.27	.12
Fussy vocalizations	.26	.49**	.22	−.07	.61**	.27
Gesturing signals	−.13	.27	.58**	.38*	.01	.18
Self-comforting	.30	.59**	.37*	.47**	.16	.64**
Coordination measures						
Social match			.61**	.53**		
Object match			.17	.17		
Rate of change			.44**	.18		
Synchrony			.35*	.21		

*$p < .05$. **$p < .01$.

infants' expressive behavior during the still face and the reunion play. Based on Carter et al.'s (1990) work, it was expected that positive maternal affect in the first play would be associated with negative expressive displays in the boys and with interest expressions and object exploration in the girls. This hypothesis was supported for the still face but not for the reunion play.

For boys, positive maternal affect during the first play was associated with an increase in fussiness ($r = .34, p < .05$) in the still face. For girls, positive maternal affect in the first play was associated with an increase in looking at objects ($r = .32, p < .05$) and a decrease in scanning ($r = -.37, p < .05$). These findings are similar to those reported by Carter et al. (1990), who found that male infants of positive mothers showed negative affect during the still face, whereas female infants of positive mothers tended to remain neutral during the still face. The pattern of correlations was different for the reunion play, during which the mothers and infants had to renegotiate the interaction after the still face. For boys, positive maternal affect in the first play was not significantly associated with infant behavior during the reunion play. For girls, positive maternal affect in the first play was correlated with a decrease in interest ($r = -.34, p < .05$) during the reunion play.

Matching, rate of change, and synchrony and infant expressive behavior. Analyses addressed the relations between matching, rate of change, and synchrony and infant expressive behavior. Two opposing hypotheses were proposed. The first hypothesis predicted that greater coordination in the first play would be associated with infant negative expressivity in the still face and reunion play. The alternative hypothesis predicted that greater coordination in the first play would be associated with greater ability on the infant's part to cope with the stresses of the still face and reunion play. Both hypotheses were supported.

Synchrony and rate of change appeared to operate differently for boys and girls depending on whether the infants were coping with the challenge of the still face or the reunion play. For boys, synchrony in the first play was associated with negative expressive displays such as fussiness ($r = .41, p < .01$) in the still face but with positive displays such as looking at the mother ($r = .33, p < .05$) and gestural signals ($r = .37, p < .05$) in the reunion play. Thus, higher mother–son synchrony in the first play was related to increased negativity in the still face and to a resumption of positive behaviors that elicited and maintained the interaction during the reunion play. Rate of change in the first play, however, did not predict male infants' behavior during the still face but was significantly associated with less joy ($r = -.38, p < .05$), fewer looks at the mother ($r = -.39, p < .05$), and more scanning ($r = .37, p < .05$) during the reunion play. This suggests that rate of change operates differently than synchrony for male infants. It is possible that higher rates of change during the first play reflect a dysregulated interaction requiring frequent repairs of mismatching states and that this is associated with increased infant negativity when the mother resumes interaction in the reunion play. For girls, synchrony did not significantly predict behavior during the still face but was associated with less scanning ($r = -.32, p < .05$) and self-comforting ($r = -.31, p < .05$) during the reunion play. Rate of change did not significantly predict behavior for girls in either the still face or the reunion play. These data suggest that, for girls, higher mother–daughter synchrony in the first play is associated with well-regulated reunion interactions, as reflected in less scanning and a decreased need to self-comfort.

The pattern of correlations for social matching indicated that, for both boys and girls, social matching in the first play was associated with positive expressive behaviors during the still face and the reunion play. For girls, social matching in the first play was correlated with neutral–positive vocalizations ($r = .33, p < .05$) during the still face. For both boys and girls, social matching in the first play was associated with increases in joy ($r = .59, p < .01$, for boys; $r = .41, p < .01$, for girls) and looking at the mother ($r = .62, p < .01$, for boys; $r = .54, p < .01$, for girls) and with decreases in looking at objects ($r = -.48, p < .01$, for boys; $r = -.53, p < .01$, for girls) and interest ($r = -.49, p < .01$, for boys;

$r = -.40, p < .01$, for girls) during the reunion play. In addition, for boys, social matching in the first play was related to an increase in neutral–positive vocalizations ($r = .37, p < .05$) and a decrease in self-comforting ($r = -.33, p < .05$) during the reunion play. Thus, higher rates of social matching during the first play were associated, for both boys and girls, with increases in behaviors that served to elicit or maintain interaction with the mother.

There were two significant correlations between object matching and the female infants' expressive behavior. For girls, object matching was positively correlated with looking at objects ($r = .38, p < .05$) in the still face and negatively correlated with looking at the mother ($r = -.37, p < .05$) in the reunion play. There were no significant correlations between object matching and the male infants' expressive behavior. Object matching therefore did not appear to be as good a predictor of male infant behavior as the other measures of coordination.

Thus, the expectation that more coordinated mother–infant first play interactions would be associated with more negative expressive displays during the still face and reunion play, particularly for boys, received some support. Higher mother–son synchrony and rate of change in the first play predicted more negative affect, less positive affect, and less social and object engagement in the subsequent episodes. The alternative hypothesis that greater coordination in the first play would be associated with greater capacity to cope with the stress of the still face and the reunion play also received support. For both boys and girls, social matching during the first play was associated with positive expressive behaviors that served to elicit or maintain interaction with the mother.

Discussion

The data supported the hypothesis that boys have greater difficulty than girls in maintaining affective regulation. As expected, boys displayed more negative affect than girls during the face-to-face still-face paradigm. They were more likely than girls to show facial expressions of anger, to fuss, to gesture to be picked up, and to try to escape or get away by turning and twisting in the infant seat. In addition, boys tended to cry more than girls. These findings are consistent with the work of other researchers (Feldman et al., 1980; Korner, 1969; Moss, 1967; Osofsky & O'Connell, 1977; Phillips et al., 1978).

Boys were also more socially oriented than girls. They were more likely than girls to look at their mother, to display facial expressions of joy, and to vocalize using neutral or positive vocalizations. Girls, in comparison with boys, spent substantially more time exploring objects and displaying facial expressions of interest. This latter finding is consistent with Malatesta's work (Malatesta & Haviland, 1982), which found that girls show more facial expressions of interest than boys when interacting with their mothers.

Of course, variation and overlap occurred in the distributions of boys' and girls' behavior. For instance, some girls were more affectively negative than some boys, and some boys were more focused on objects than some girls. This overlap must be kept in mind when evaluating the findings.

The lack of significant Gender × Episode interaction effects indicated that the gender differences were consistent across the different contexts of the face-to-face still-face paradigm. Thus, the hypothesis that boys would display more negative expressive behavior than girls during the still face was supported. This finding is inconsistent with Mayes and Carter's (1990) and Stoller and Field's (1982) research indicating that girls react more negatively than boys to the still face. This inconsistency is difficult to explain but may be the result of methodologic differences. Both Mayes and Carter's and Stoller and Field's still-face procedure differed from that originally described by Tronick et al. (1978) and used in this study. In Stoller and Field's study, a 45-s still-face episode followed a 1-min separation from the mother. In Mayes and Carter's study, the still-face episode was preceded by a 2- to 3-min break during which mothers were allowed to hold and comfort their infants. Thus, Stoller and Field's and Mayes and Carter's projects and the current study varied greatly in the level of distress that the infants experienced before the still face. Moreover, the studies differed in terms of coding (particularly in the level of detail coded) and the ages at which the infants were assessed.

It was expected that mothers would use more frequent and different strategies designed to regulate boys' as opposed to girls' affective states. This hypothesis was not strongly supported. Mothers were more likely to elicit their sons' than their daughters' attention by making noises with their hands and were more likely to express low positive affect to their sons in the first play episode. These differences do not appear, in and of themselves, sufficient to account for the gender differences in the infants' behavior. The lack of a powerful maternal effect was also supported by the finding that infant gender differences were consistent across the three episodes of the face-to-face still-face paradigm, including the still face, during which all mothers acted in the same way.

The results supported the hypothesis of greater coordination in the interactions of mothers and sons as compared with mothers and daughters. Interestingly, significant gender differences in coordination were revealed only during the play preceding the still face. It is likely that the intervening stress of the still face attenuated gender differences when both the first and the reunion play data were considered in the analyses. The results replicated Tronick and Cohn's (1989) finding of greater synchrony between mothers and sons. This finding suggests that mothers and sons more carefully tracked each other's behavior and facial expressions than mothers and daughters. This greater coordination, which takes place at a subtle microtemporal level, may function to help boys maintain self-regulation. In addition, probably because of the larger sample size in this study than in Tronick and Cohn's project, we found gender differences in matching and the rate of change between matching and mismatching states that were not found in Tronick and Cohn's study. Thus, mother–son dyads tended to be in social matching states more frequently than mother–daughter dyads whereas mother–daughter dyads were more likely to be in object matching states. Furthermore, the rate at which mismatching states were repaired to matching states was slower for mother–son than mother–daughter dyads. It is possible that boys' greater negative emotional expressivity may make it harder for mother–son dyads than for mother–daughter dyads to move to and share joint social and object states.

As expected, the data replicated previous research on the stressful nature of the still face (Carter et al., 1990; Toda & Fogel, 1993; Weinberg & Tronick, 1996). The data also supported Weinberg and Tronick's and Kogan and Carter's (1996) interpretation that the process of reparation and regulation is more complex in the reunion play than in the play preceding the still face. During the

reunion play, mothers and infants must renegotiate the interaction and cope with a carryover of negative affect from the still face. At the same time, there is a rebound of positive mother-oriented infant behaviors when the mother resumes normal behavior. These interactive challenges are illustrated in the coordination data. Mothers and infants were more likely to be in social matches during the reunion play, which is consistent with a rebound effect of positive mother-focused behavior. Furthermore, the rate of change between matching and mismatching states was slower during the reunion than the first play interaction, indicating that the infants and mothers took longer to repair interactive errors and to move into joint social and object states during the reunion episode. This finding makes sense in light of the ambivalent nature of the infants' behavior in the reunion episode, during which they alternated between negative and positive affective displays.

The MRM provides a framework for explaining the observed gender differences in infant expressivity and mother–infant coordination. Tronick (1980) hypothesized that infants have limited regulatory capacities and therefore require a caregiver's input to help them maintain affective regulation. Infants communicate their need for additional regulatory support through their affective displays (Weinberg & Tronick, 1994). The findings from this study suggest that male infants must make their needs explicit to the mother because of their more limited capacity for self-regulation. Thus, much of their expressive behavior (both positive and negative) is directed toward the mother and serves the function of communicating to the mother their needs and evaluation of the interaction. The data also suggest that mother–son dyads may need to work harder than mother–daughter dyads in keeping the interaction affectively well organized. Thus, it took longer for mother–son than mother–daughter dyads to move from matching to mismatching states and to repair the interaction. Furthermore, mothers and sons carefully monitored and synchronized each other's behavior, which may function to help boys maintain self-regulation.

The findings supported the hypothesis that positive maternal affect in the play preceding the still face would be associated with negative expressive displays for boys and with interest and object exploration for girls during the still face. Positive maternal affect in the first play was associated with an increase in fussiness in the still face for boys and with more looking at objects and less scanning for girls. These findings support an interpretation that maternal behavior in the play before the still face differentially mediates male and female infants' responses to the still face. From the perspective of the MRM, boys may be vulnerable to the abrupt withdrawal of positive maternal affect during the still face because of their greater difficulty in maintaining self-regulation. The more sensitive and positive the maternal support, the more likely boys may be to react negatively to its withdrawal and to use negative social cues in an effort to reengage the mother. On the other hand, girls, who are better able to self-regulate, may be less dysregulated by the still face than boys and therefore better able to maintain a focus on objects. Alternatively, girls may have redirected their gaze away from the still-faced mother to use objects as a means of self-regulation.

The hypothesis that mother–infant coordination in the first play would be associated with negative expressivity during the still face and reunion play was supported, but only for boys. Higher mother–son synchrony and rate of change in the first play predicted more negative affect, less positive affect, and less social and object engagement in the subsequent episodes. These findings are consistent with the explanation that, for boys, more coordination in the interaction may be associated with more disruption in the still face when maternal regulatory support is withdrawn. The alternative hypothesis that greater coordination in the first play would be associated with greater capacity to cope with the stress of the still face and the reunion play was also supported. For both boys and girls, social matching during the first play was associated with positive expressive behaviors that served to elicit or maintain interaction with the mother. This effect was not found for object matching.

These findings indicate that the measures of coordination may serve different functions in the mother–infant interaction and may have differential effects on the infant's socioemotional development. For instance, high levels of synchrony can be achieved when both the mother and baby consistently move together in positive or negative affective states or move back and forth from positive to negative states. In this study, negative maternal affect was extremely rare. However, Field, Healy, Goldstein, and Guthertz (1990) found that mothers with high levels of depressive symptomatology and their infants spent a substantial amount of time together in negative affective states. This is an example in which high levels of coordination occur in the negative affective domain and may actually be detrimental to the infant's development. On the other hand, social matching, as defined in this study, always involved mutual gaze and shared positive affect. Thus, social matching may serve a protective role that buffers the infant against stress, facilitates the infant's coping with stress, and increases the infant's sense of agency and effectance. These possibilities raise the issue of the developmental appropriateness of particular measures of coordination in mother–infant interactions. Further research on the role of coordination in the mother–infant relationship is needed.

The findings from this study support an interpretation that the capacity for self-regulation may be at the base of gender differences in infant emotional expressivity. Boys appeared to have a more limited capacity for self-regulation than girls and made their needs explicit to the mother by using a wider range of both positive and negative expressive displays. Girls, on the other hand, showed more interest and object exploration than boys and seemed less vulnerable to interactive stresses such as those created by the still face and the reunion play. These gender differences in emotional expressivity and self-regulation differentially affected the regulatory demands of mothers and sons and mothers and daughters. Thus, mothers and sons attempted to carefully synchronize their behavior but had more difficulty than mothers and daughters in moving to joint social and object states. These dyadic regulatory demands are likely to become attenuated or elaborated over time, shaping the mother–infant relationship and leading to different emotional and interactive experiences for boys and girls. For example, it is likely that these regulatory differences may become part of the process that leads to gender differences seen in children only 1 or 2 years older than the children in this study (see Golombok & Fivush, 1994). It remains unclear whether the gender differences in self-regulation and expressivity observed in this study are attributable to biological factors or socialization forces or, as is most likely, a combination of these factors. However, the findings indicate that the study of the emergence of gender differences must start very early in the infant's life and highlight the

importance of focusing on self and mutual regulatory affective processes in the mother–infant relationship.

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