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Mothers who are securely attached in pregnancy show more attuned infant mirroring at 7 months postpartum

Sohye Kim^{1,2,3}, Peter Fonagy^{2,4}, Jon Allen², Sheila Martinez^{1,3}, Udita Iyengar^{1,3,4}, and Lane Strathearn^{1,2,3,5,*}

¹ Department of Pediatrics, Baylor College of Medicine, Houston, TX

² Menninger Department of Psychiatry and Behavioral Sciences, Baylor College of Medicine, Houston TX

³ Attachment and Neurodevelopment Laboratory, Children's Nutrition Research Center, Houston, TX

⁴ Research Department of Clinical, Educational and Health Psychology, University College London, London, United Kingdom.

⁵ The Meyer Center for Developmental Pediatrics, Texas Children's Hospital, Houston, TX

Abstract

This study contrasted two forms of mother-infant mirroring: the mother's imitation of the infant's facial, gestural, or vocal behavior (i.e., “direct mirroring”) and the mother's ostensive verbalization of the infant's internal state, marked as distinct from the infant's experience (i.e., “intention mirroring”). Fifty mothers completed the Adult Attachment Interview during the third trimester of pregnancy. Mothers returned with their infants 7 months postpartum and completed a modified still-face procedure. While direct mirroring did not distinguish between secure and insecure/dismissing mothers, secure mothers were observed to engage in intention mirroring more than twice as frequently as did insecure/dismissing mothers. Infants of the two mother groups also demonstrated differences, with infants of secure mothers directing their attention toward their mothers at a higher frequency than did infants of insecure/dismissing mothers. The findings underscore marked and ostensive verbalization as a distinguishing feature of secure mothers' well-attuned, affect-mirroring communication with their infants.

Keywords

Attachment; mother-infant communication; maternal mirroring; infant attention

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***Corresponding Author:** Dr. Lane Strathearn, MBBS FRACP PhD. Baylor College of Medicine/Texas Children's Hospital, Department of Pediatrics, Attachment and Neurodevelopment Laboratory, Children's Nutrition Research Center. 1100 Bates St, Suite 4004-B, Houston, TX, 77030, USA (713) 798-0351 lanes@bcm.edu..

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1. Introduction

In many mammalian species, mothers and infants engage in a rich repertoire of species-specific, reciprocal, dyadic interactions. Non-human primate mother-infant pairs show capacity for mutual eye gaze, reciprocal lip smacking, and vocal and gestural mimicry (Bard, et al., 2005; Ferrari, Paukner, Ionica, & Suomi, 2009; Mancini, Ferrari, & Palagi, 2013). Human mother-infant dyads participate in communicative exchanges that are far more complex and affectively enriched (Beebe, et al., 2010; Brazelton, Koslowski, & Main, 1974; Carpenter, Nagell, & Tomasello, 1998; Feldman, 2007; Gergely & Watson, 1996; Lavelli & Fogel, 2013; Malatesta, Culver, Tesman, & Shepard, 1989; Sroufe, 1996; Tronick, 1989). The infant routinely directs a broad range of affectively nuanced expressions to the mother (Bennett, Bendersky, & Lewis, 2005; Colonnese, Zijlstra, van der Zande, & Bogels, 2012; Messinger, 2002). The mother sequentially mirrors the infant's signals as she empathically delivers her finely tuned response (Jonsson & Clinton, 2006; Lavelli & Fogel, 2013; Papousek & Papousek, 1989; Stern, 1985). In turn, the infant attentively responds, organizing his¹ behavior with respect to the mother's input (Beebe, et al., 2010; Bigelow & Walden, 2009; Cohn & Tronick, 1987; Soussignan, Nadel, Canet, & Gerardin, 2006). A relatively synchronous flow of affective communication is one of the key indicators of secure mother-infant attachment (Beebe, et al., 2012; Crandell, Fitzgerald, & Whipple, 1997; Feldman, Gordon, & Zagoory-Sharon, 2011; Isabella & Belsky, 1991; Lundy, 2003).

Maternal mirroring, or emotionally attuned responsiveness, has received extensive attention in the study of mother-infant behavior (Bigelow & Walden, 2009; Fraiberg, Adelson, & Shapiro, 1975; Gergely & Watson, 1996; Jonsson & Clinton, 2006; Lavelli & Fogel, 2013; Lyons-Ruth, 2000; Stern, 1985; Winnicott, 1967). Mirroring is a construct closely tied to that of secure attachment. Maternal attachment security is a critical determinant of the mother's capacity to provide adequate mirroring for the infant (Main, Kaplan, & Cassidy, 1985; Pederson, Gleason, Moran, & Bento, 1998; Tarabulsky, et al., 2005; van IJzendoorn, 1995; Whipple, Bernier, & Mageau, 2011). Well-attuned maternal mirroring, in turn, is a necessary antecedent to the development of secure attachment in the infant (Ainsworth, Blehar, Waters, & Wall, 1978; Belsky, Rovine, & Taylor, 1984; Bigelow, et al., 2010; Bretherton, Biringen, Ridgeway, Maslin, & Sherman, 1989; De Wolff & van IJzendoorn, 1997; Isabella, 1993; Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001). In the early literature that followed Ainsworth's pioneering work on infant attachment (Ainsworth, et al., 1978; Ainsworth & Wittig, 1969), mirroring was often studied as an aspect of the broader construct of sensitive responsiveness, which encompasses heterogeneous sets of maternal behaviors (Belsky, et al., 1984; De Wolff & van IJzendoorn, 1997; Grossmann, Grossmann, Spangler, Suess, & Unzner, 1985; Isabella, 1993; Main, Tomasini, & Tolan, 1979). While theoretically important distinctions had been made between types of mirroring generated by the mother, mirroring was coarsely defined as a generic construct under the rubric of sensitivity, and the fine-grained distinctions were overlooked in the early studies.

¹For convenience, we refer to the mother as "she" and the infant as "he" in the present paper, even though both male and female infants were included in our sample.

In his seminal volume on infant development, Stern (1985) drew a stark contrast between mirroring of the external behavior and mirroring of the internal state, which was echoed with some variation by later developmentalists. In imitation, the mother mirrors and replicates the infant's external cues – facial, gestural, or vocal. The mother need not tune into the infant's internal experiences in order to imitate his external behavior. In contrast, a more sophisticated form of mirroring necessitates that the mother “get inside” the mind of the infant and “read” the affective state that underlies his overt behavior (Stern, 1985, pp. 138-139). This form of mirroring moves beyond the mere matching of the infant's external signals. What the mother observes and mirrors here is not the infant's external behavior per se, but his subjective internal state. Whereas a close within-modal match is found between the mother and the infant in imitation, the mother's mirroring of the infant's internal state is often cross-modal. As Stern (1985) famously observed (p. 140), the mother may match the feeling state conveyed by the infant's vocalization (e.g., exuberant “aaah!”) with her body movement (e.g., performing a shimmy with her upper body for the duration of the “aaah!”), or match the feeling state captured in the infant's movement (e.g., hitting a toy) using her voice (e.g., saying “kaaaaa-bam” in rhythm with the hitting movement).

Thereafter, important empirical advances were made in the literature by Fonagy (1991) and Meins (1997, 1999), who led converging lines of research underscoring the mother's mentalizing capacity. These were respectively termed parental reflective functioning (Fonagy, Gergely, Jurist, & Target, 2002; Fonagy, Steele, Steele, Moran, & Higgitt, 1991; Fonagy & Target, 1997; Slade, 2005) and maternal mind-mindedness (Meins, Fernyhough, Fradley, & Tuckey, 2001; Meins, et al., 2003), referencing a mother's capacity to adequately mirror her infant's subjective internal state (see Sharp & Fonagy, 2008 for a detailed review of relevant constructs). High levels of reflective functioning and maternal mind-mindedness have been reported in mothers who are securely attached (Arnott & Meins, 2007; Demers, Bernier, Tarabulsy, & Provost, 2010; Fonagy, et al., 1991; Slade, Grienberger, Bernbach, Levy, & Locker, 2005). Others have demonstrated that the secure mother's accurate perception and reflection of her infant's internal state are causally related to the key features of the infant's self-development, including self-awareness, self-regulation, and self-efficacy (Bigelow, et al., 2010; Fonagy, et al., 2002; Fonagy, Gergely, & Target, 2007; Lyons-Ruth, 2000; Mcquaid, Bibok, & Carpendale, 2009; Nadel, Prepin, & Okanda, 2005; Schore, 2005; Tronick & Beeghly, 2011). Far less consensus and empirical support, however, exist on what constitute the essential ingredients of such mirroring and what mechanisms mediate these developmental effects.

Recent research has begun to address this gap. Gergely (2007) has undertaken a fine-grained analysis of the nature of maternal mirroring. He proposed that *markedness* and *ostensiveness* were essential ingredients of mirroring (Gergely, 2007; Gergely & Unoka, 2008a). The putative mechanisms mediating the developmental functions of the *marked* and *ostensive* mirroring were also articulated. At birth, infants are understood to be incapable of differentiating universal categories of emotions that they experience, such as anger, fear, or sadness (Camras, 2011; Gergely & Watson, 1996; Walle & Campos, 2012; Widen, 2013). To infants, their affective experience is one of undifferentiated visceral arousal with overarching positive or negative valence, rather than one characterized by well-defined,

discrete emotions (Fonagy, et al., 2002; Fonagy, et al., 2007; Gergely & Watson, 1996, 1999). Central to Gergely's proposal is the hypothesized role of the mother's *marked, ostensive* mirroring in the infant's emerging capacity for subjective awareness of his discrete internal states. When provided consistently to the infant, the mother's *marked, ostensive* mirroring is proposed to serve as the essential foundation upon which the infant learns to organize and make sense of his internal experiences (Gergely & Unoka, 2008a, 2008b).

The mother's *marked* affective communication (Fonagy, et al., 2002; Fonagy, et al., 2007) is one in which the mother demonstrates her understanding of the infant's internal state, while concurrently signaling that she is not experiencing the same state herself. The mother accomplishes this by displaying the infant's affect in a schematic and exaggerated manner. Consider the mother mirroring her infant's distress. The mother exaggerates her display of distress; she slows down her expression as she ensures that it is seen by the infant. Some aspects of the distressed affect are made salient in the mother's expression, while other peripheral aspects are ignored. The mother may also mix in other emotions in her expression (e.g., distress intermingled with concern). What is shown in the mother's mirroring response is the schematically modified display of the infant's distress, which is perceptually distinguishable from the mother's expression of her own distress. Trevarthen (1977), Fogel (1993), and Stern (1985) had previously noted the qualitatively distinct nature of the mother's mirroring from the infant's original affective display, which was captured in their descriptions of "echo," "elaboration," and "affect attunement," respectively. Gergely elaborated on the functional significance of the mother's *marked* mirroring, particularly underscoring its role in developing the infant's capacities for organizing and regulating his internal states (Gergely, 2007; Gergely & Unoka, 2008a). In *marked* mirroring, the mother's exaggerated display, coupled with her soothing tone, serves to mitigate the potentially arousing effect of direct imitation (e.g., the mother crying when the infant cries), while simultaneously making salient to the infant central aspects of his internal experience.

The mother's *marked* response is often accompanied by what Gergely calls *ostensive* communicative cues, which manifest the mother's intention in displaying the affect (Csibra, 2010; Csibra & Gergely, 2009; Egyed, Kiraly, & Gergely, 2013). The term "*ostensive*" is borrowed from the communication literature (Russell, 1940; Sperber & Wilson, 1995), which posits the inherently dual nature of intention (i.e., informative and communicative) in human communicative acts (Grice, 1989). In a communicative act, the communicator intends to convey the desired information ("informative intention") by making this intention evident to the addressee ("communicative intention"). *Ostensive* cues are signals employed by the communicator to reveal that she has a communicative intention directed toward the addressee. The mother's gaze at her infant, the slight tilting of her head toward him, her direct eye contact, the "motherese" intonation, and the calling of the infant's name all constitute ostensive cues that prototypically accompany the mother's *marked* mirroring, and signal to the infant that her expression concerns him and what unfolds within him. These ostensive signals orient the infant toward his own face and body, setting the stage for him to learn that this display matches his own subjective internal state. Gergely proposes that such instances of *marked, ostensive* communication, to which the infant is hard-wired to attend (Colombo, Frick, Ryther, Coldren, & Mitchell, 1995; Farroni, Csibra, Simion, & Johnson,

2002; Parise & Csibra, 2013; Senju & Csibra, 2008), repeatedly orient him to his subjective internal states (Csibra, 2010; Gergely, 2007; Gergely & Jacob, 2012); through this process, the infant comes to develop awareness of, and later adequate control over, his internal experiences (Fonagy, et al., 2007; Gergely & Unoka, 2008a, 2008b). In Gergely's model, the mother's *marked* and *ostensive* mirroring functions to prompt the infant to look to the mother as a way of learning about himself, which serves as an impetus for the infant's subsequent self-development.

In the present study, we contrast two types of maternal mirroring. The first is imitation, or what we hereafter refer to as *direct mirroring*. We consider this to be a rudimentary form of mirroring, which allows the infant to see his facial, gestural, and vocal behavior directly replicated by the mother in the same modality (i.e., when the infant frowns, he sees the mother frowning; when the infant coos, he hears the mother cooing back). We see this imitation as akin to the mother *holding up a physical mirror* to the infant. The second is what is hereafter called *intention mirroring*. Intention mirroring is the type of mirroring that is characterized by marked and ostensive verbalization, and lies at the crux of sensitive mothering as Gergely has hypothesized (Gergely & Unoka, 2008a, 2008b). Rather than acting as a mere physical mirror, as in the former, here the mother *holds up an intention mirror* to the infant, allowing him to see, through her, his own intentions, feelings, and attitudes, many of which he may not have otherwise made sense of (e.g., as the infant frowns, he sees the concerned look on the mother's face; gazing at the infant, the mother states in a motherese voice, "Aww, you didn't like that"). Here the mother uses verbalization as a vehicle for representing the infant's internal state originally conveyed in his facial, gestural, or vocal behavior.

Utilizing a micro-analytic coding system devised to distinguish between the two types of mirroring, we examined, at 7 months postpartum, the use of mirroring in mothers who were prospectively assessed to be securely attached compared to those insecurely attached during a modified still-face procedure (MSFP; Koos & Gergely, 2001). The MSFP is a three-phase procedure, in which the mother interacts freely with the infant in the first and third phases, but is instructed to maintain a motionless and neutral 'still face' during the second phase, suddenly depriving the infant of maternal contingency and henceforth inducing stress in the infant (Koos & Gergely, 2001; Tronick, Als, Adamson, Wise, & Brazelton, 1978). The MSFP thereby offers an opportunity to observe moment-by-moment exchange between the mother and the infant in the presence of and during recovery from an interpersonal stressor. Developmentalists have pointed to 7 months as the juncture at which the external environment develops a particular importance in the infant's developing awareness of his subjective internal states. Stern (1985) observed that, starting at 7 months, domains of mother-infant relatedness expand significantly to include the dyad's subjective internal states. Gergely also noted that infants demonstrate rudimentary mentalizing abilities at around 7 months (Gergely, 2011; Kovacs, Teglas, & Endress, 2010). Furthermore, behavioral (Walker-Andrews, 1986) and electrophysiological (Grossmann, Striano, & Friederici, 2006) evidence suggests that infants' abilities to recognize and process cross-modal correspondence in emotional stimuli are initially seen to emerge at around 7 months.

Therefore, we conducted the MSFP at 7 months to capture early experiences of coordinated communication between mother and infant seen during this formative juncture.

Our primary aim in the study was to investigate whether the infant-directed communication of securely attached mothers at 7 months could be reliably distinguished from that of insecurely attached mothers by the extent to which intention mirroring was used. Three hypotheses were addressed in the present study. First and foremost, we hypothesized that securely attached mothers would engage in more intention mirroring than insecurely attached mothers during the free-interaction phases (i.e., first and third phases) of the MSFP. We also predicted that secure mothers would show an increase in intention mirroring during the third phase relative to the first phase, demonstrating sensitivity to the infant's experience of stress during the still-face phase (Leerkes, 2011; McElwain & Booth-LaForce, 2006). We did not expect to find differences in the frequency of direct mirroring, either facial/gestural or vocal, between the two mother groups. Second, we hypothesized that infants of securely attached mothers would direct their attention more frequently to their mothers, compared with infants of insecurely attached mothers. We tested this hypothesis by comparing the two infant groups on the frequency of their gaze toward and away from the mother during the still-face phase. Whereas the infant's gaze during the free-interaction phases may be directly confounded by the mother's behavior, the still-face phase was considered apropos for this examination because the mother's behavior is controlled across participants. Third, we tested the possibility that the relationship between maternal attachment security and the infant's attention toward the mother would be mediated by the mother's use of intention mirroring. Through examining these hypotheses, we attempted to carry out an empirical substantiation of an aspect of Gergely's model concerning the role of the mother's marked, ostensive mirroring in shaping the infant's attention and readiness to learn from his primary social environment—his mother.

2. Material and Methods

2.1. Participants

First-time mothers were recruited during the third trimester of pregnancy through local prenatal clinics and community advertisements. Of 116 participants initially recruited, 61 met eligibility criteria, and 50 completed the MSFP procedure 7 months postpartum. Enrolled women were between ages 19 and 41 ($M = 27.9 \pm 4.8$), and were generally from middle to high socioeconomic backgrounds. None of the participants had a history of past or present alcohol or substance abuse, nicotine use during pregnancy, or were on psychotropic medications at the time of the study. Each participant provided written informed consent in accordance with the protocol approved by the local institutional review board.

2.2. Measures and Procedure

We adopted a prospective design: mothers' attachment was assessed prenatally during the third trimester of pregnancy; mothers returned with their infants 7 months postpartum and completed the MSFP.

2.2.1. Maternal prenatal attachment—Maternal attachment was assessed using the modified version of the Adult Attachment Interview (AAI; Crittenden & Landini, 2011; George, Kaplan, & Main, 1985). The AAI is a semi-structured 1- to 1.5-hour interview comprising probes that elicit attachment-related autobiographical memories, usually those involving childhood experiences with parents. The coding is determined by the participant's style of discourse in describing attachment-related experiences and their impact on present functioning. The AAI yields three basic categories that parallel Ainsworth's classification of infant attachment (Ainsworth, et al., 1978): 'secure,' 'insecure/dismissing,' and 'insecure/preoccupied.' Those who are classified as secure describe their experiences in a balanced manner, flexibly integrating cognition and affect as they recount their past history and process attachment-related information. Those with insecure/dismissing attachment tend to be cognitively organized; they describe events in a temporally ordered manner, while inhibiting or distorting any display of negative affect. In contrast, individuals with insecure/preoccupied attachment are organized around their feelings; they oscillate between intense affect and draw causal relations that are erroneous and contradictory (Crittenden & Landini, 2011). The AAIs were audio-recorded, transcribed, and blindly coded by reliable raters in accordance with Crittenden's Dynamic Maturational Model (DMM) of Attachment and Adaptation. Fifty percent of transcripts were double-coded to ensure inter-rater reliability; there was 77% agreement for the AAI classification, with kappa of .66 ($p < .001$). Discrepancies were resolved through conferencing between coders.

Of the 50 mothers who completed both the AAI and the MSFP, 25 (50.0 %) were classified as having secure attachment, 16 (32.0%) had insecure/dismissing attachment, five (10.0%) demonstrated insecure/preoccupied attachment, and the remaining four (8.0%) alternated between or showed a combination of insecure/dismissing and insecure/preoccupied attachment patterns. Due to the small size of the latter two groups, all analyses were conducted comparing the two predominant attachment groups—those with secure attachment versus those with insecure/dismissing attachment.

2.2.2. Mother-infant behavior at 7 months postpartum—The MSFP followed the standard still-face procedure (Tronick, et al., 1978), except that the mother and infant were seated next to each other, separated by a divider and facing a one-way mirror (Figure 1(a)). The infant was placed in a high chair in the observation room facing the one-way mirror. The mother sat directly adjacent to her infant facing the same mirror. The divider placed between the mother and infant precluded direct face-to-face communication, but they were able to see each other reflected in the mirror. On the opposing side of the one-way mirror were two cameras, generating a split-screen recording of the mother and infant. The dyads were videotaped as they interacted with each other during the three 2-minute phases: (1) the baseline normal interaction phase, (2) the still-face phase, during which the mother assumed a neutral face, and (3) the recovery phase, in which the mother resumed free interaction with the infant (Figure 1(b)). The start of each phase was signaled to the mother via an intercom. While each phase was recorded for 2 minutes, some variation in timing was noted due to infant behavior and parent compliance with procedure instructions. Trained raters, who were blind to the mother's attachment status, coded the videotaped interaction. Forty percent of

the videotapes were double-coded to establish inter-rater reliability. Coded variables are as follows.

2.2.2.1. Maternal mirroring variables: Two forms of maternal mirroring were coded: (a) direct mirroring and (b) intention mirroring. Direct mirroring (akin to holding a physical mirror) was defined as the mother's non-verbal attunement behavior in which the mother directly imitated her infant's expressions. We coded direct mirroring in two different modalities, facial/gestural and vocal. Maternal behavior was coded as direct mirroring if it entailed a direct replication of the infant's preceding behavior in the same modality without the use of verbalization. Common examples noted were the display of a maternal smile shortly following an infant smile (facial/gestural), and a maternal vocalization "brrr" following an infant's "brrr" (vocal).

The intention mirroring (i.e., holding an intention mirror) was defined as the mother's non-imitative, marked, ostensive, verbal attunement. This form of mirroring was distinguished by the following: (1) clear indication that the mother was reflecting the infant's experience rather than displaying her own internal state (markedness); (2) a specific signal which made manifest to the infant the mother's communicative intention to present some new relevant information for the infant by referencing and acknowledging his intentional, emotional, or attentional state using ostensive cues (e.g., her direct eye contact, "motherese" intonation, or calling of the infant's name); (3) accuracy and appropriateness from the perspective of an onlooker, which suggested that the mother's response was aligned with the infant's putative experience in terms of timing, content, and intensity (operationalized in terms of the subjective judgment of an independent coder who saw the interaction as reflecting reasonable congruence between the mother's expression and the infant's assumed experienced state). As this coding scheme aimed to capture the mother's interest in and understanding of the infant's internal state, only those attributions that explicitly acknowledged the infant's subjective state (e.g., "You are feeling hot.") were coded, whereas maternal verbalizations that were ambiguous or perceived as commenting on the infant's physical state (e.g., "You are hot.") were not coded. Likewise, whereas the mother's simple imperatives (e.g., "Don't cry!") did not qualify, similar statements that referenced the infant's state in a marked tone of expression (e.g., "Oh, you are so upset. This is so upsetting. Oh dear, oh dear. What's the matter?") were coded as intention mirroring. The most commonly observed examples of intention mirroring during the MSFP occurred when the mother recognized that the abrupt loss of maternal responsiveness in the still-face phase might be both puzzling and distressing for the infant. In such an instance, the mother might look into the infant's eyes and remark in a marked (exaggerated) tone of voice as she transitioned out of the still-face phase: "Wow, what was that? That was crazy, wasn't it? What happened to mommy?" Good to excellent inter-rater reliability was demonstrated for the mirroring variables, with the intraclass correlations of .80 (direct, facial/gestural), .60 (direct, vocal) and .83 (intention).

2.2.2.2. Infant attention variables: Infant attention was quantified by the frequency of gaze fixations toward and away from the mother. Our primary interests were (a) fixations on the mother's image in the mirror and (b) fixations away from the mirror, although we also

recorded fixations on the infant's own image in the mirror. Fixation was defined as an eye gaze that remained stationary for a minimum of 1 second. The intraclass correlation for the infant gaze fixations was .84 ($p < .001$).

2.2.3. Additional mother and infant characteristics—Several mother and infant characteristics were also examined as potential confounds. Mothers were screened for symptoms of depression and personality disorders using the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) and Personality Disorder Questionnaire 4+ (PDQ-4+; Hyler, Skodol, Oldham, Kellman, & Doidge, 1992), respectively. Maternal parenting stress was assessed using the Parenting Stress Index (PSI; Abidin, 1995), and maternal temperament was measured via the Adult Temperament Questionnaire-Short Form (ATQ; Rothbart, Ahadi, & Evans, 2000). We also collected information on the infant's daycare status (i.e., number of hours per week the infant was cared for by someone other than the mother). Infants were screened for developmental delays using the Bayley Scales of Infant and Toddler Development, Third Edition, Screening Test (Bayley-III; Bayley, 2005). Infant temperament was evaluated using the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) For details on the psychometric properties of these instruments, see Shah, Fonagy, and Strathearn (2010).

2.3. Data Analysis

Mother-infant dyads were classified into secure and insecure attachment groups based on the mother's AAI. Between-group comparisons were made on all measured sociodemographic and behavioral variables using chi-square statistics and t -tests for categorical and interval data, respectively. All analyses were performed using SPSS version 20 and STATA version 12.1.

2.3.1. Hypothesis 1: maternal direct mirroring versus intention mirroring—We analyzed the frequency of direct mirroring (facial/gestural and vocal) and intention mirroring, adjusting for the total length of time for which codable data were available in each respective phase. The mirroring variables were inspected for normality via quantile-quantile plots of residuals against fitted values. Square root transformations offered the closest approximation to normality. We probed for the main and interaction effects of maternal attachment status (secure vs. insecure) and phase (phase 1 vs. 3), using mixed-effects linear regression models that included a subject-level random intercept and a random coefficient for phase. The model was fitted by maximum likelihood estimation, and nested models were contrasted using likelihood-ratio chi-squares.

2.3.2. Hypothesis 2: infant gaze toward versus away from the mother—We analyzed the frequency of infants' gazes toward and away from the mother, adjusting for the total number of fixations recorded for each infant during the still-face phase. The total number of fixations was quantified as the sum of the infant's fixations on the mother, on himself, and away from the mirror. While used in the calculation of total fixation frequency, the infant's fixations on himself were of less interest in the present study and were excluded from the remainder of the analysis to minimize multicollinearity. The proportions of fixations computed were arcsine transformed and submitted to the 2×2 mixed ANOVA,

with maternal attachment status (secure vs. insecure) as a between-subjects factor and gaze direction (toward mother vs. away from mirror) as a within-subjects factor.

2.3.3. Hypothesis 3: mediating role of maternal intention mirroring—We used the non-parametric bootstrapping procedure (Preacher & Hayes, 2008) to test the model in which maternal intention mirroring was specified as a mediator between maternal attachment and infant gaze direction. This procedure uses ordinary least squares regression to estimate the total, direct, and indirect effects of a predictor on an outcome through a proposed mediator, and provides bias-corrected confidence intervals for the indirect effect. This approach makes no assumptions about the shape of the sampling distribution of the indirect effect, generates estimates based on empirically derived bootstrapped sampling distribution, and has been recommended over traditional approaches to mediation analysis (i.e., Sobel test or causal steps approach; Mackinnon, Lockwood, & Williams, 2004). A total of 5,000 bootstrapping samples were utilized in the present analysis.

3. Results

3.1. Participant Characteristics

Mother and infant characteristics are shown in Tables 1 and 2 for the secure and insecure/dismissing groups. No significant differences were observed between the two groups for any of the measured sociodemographic or behavioral variables.

3.2. Modified Still-Face Procedure: Secure and Insecure/Dismissing Dyads

3.2.1. Hypothesis 1: maternal direct mirroring versus intention mirroring—

Means and standard errors of the maternal mirroring variables are shown in Table 3 for the two attachment groups. Maternal direct and intention mirroring did not correlate with each other ($r_{\text{facial/gestural direct \& intention}} = .021, p = .85$; $r_{\text{vocal direct \& intention}} = .196, p = .08$), while the two forms of direct mirroring were significantly correlated ($r_{\text{facial/gestural direct \& vocal direct}} = .29, p = .009$).

3.2.1.1. Maternal direct mirroring: As hypothesized, maternal attachment status was not a significant predictor of direct mirroring, either alone (facial/gestural, $\beta_{\text{AAI}} = .001, 95\% \text{ CI} = -.05 \text{ to } .06, z = 0.03, p = .97$; vocal, $\beta_{\text{AAI}} = -.03, 95\% \text{ CI} = -.09 \text{ to } .03, z = -0.89, p = .37$) or in interaction with phase (facial/gestural, $\beta_{\text{AAI} \times \text{phase}} = -.006, 95\% \text{ CI} = -.06 \text{ to } .05, z = -0.20, p = .84$; vocal, $\beta_{\text{AAI} \times \text{phase}} = .005, 95\% \text{ CI} = -.06 \text{ to } .06, z = 0.15, p = .88$; Figure 2). Both secure and insecure/dismissing mothers engaged in a higher frequency of facial/gestural direct mirroring during the first phase of the MSFP compared to the third phase ($\beta_{\text{phase}} = -.04, 95\% \text{ CI} = -.08 \text{ to } -.01, z = -2.49, p = .01$). No difference was found in the frequency of vocal direct mirroring between the two phases ($\beta_{\text{phase}} = -.01, 95\% \text{ CI} = -.05 \text{ to } .02, z = -0.68, p = .50$).

3.2.1.2. Maternal intention mirroring: A significant main effect was found for maternal attachment status ($\beta_{\text{AAI}} = -.08, 95\% \text{ CI} = -.15 \text{ to } -.02, z = -2.73, p = .006$), with secure mothers displaying intention mirroring at a frequency greater than twice that of their insecure/dismissing counterparts (Figure 2). Both mother groups engaged in intention

mirroring more frequently in the third phase as compared to the first phase ($\beta_{\text{phase}} = .04$, 95% CI = .01 to .07, $z = 2.79$, $p = .005$). Maternal attachment and phase did not interact significantly in the prediction of intention mirroring ($\beta_{\text{AAI} \times \text{phase}} = .01$, 95% CI = $-.04$ to $.06$, $z = 0.46$, $p = .64$).

3.2.2. Hypothesis 2: infant gaze toward versus away from the mother—Means and standard errors of the gaze fixation variables are presented in Table 4 for the secure and insecure/dismissing attachment groups. The 2 (secure vs. insecure maternal attachment) \times 2 (infant gaze toward mother vs. gaze away) mixed ANOVA yielded no significant main effects of maternal attachment status ($F(1, 39) < 0.001$, $p = .98$) or gaze direction ($F(1, 39) = .283$, $p = .60$). However, a significant interaction of maternal attachment and gaze direction was found ($F(1, 39) = 6.393$, $p = .02$). Consistent with our hypothesis, infants of secure mothers directed their gaze more frequently to their mothers compared to infants of insecure/dismissing mothers ($t(39) = 2.38$, $p = .02$). The reverse pattern was seen for gazes directed away, with infants of insecure/dismissing mothers looking away more frequently than infants of secure mothers ($t(39) = -2.06$, $p = .046$; Figure 3).

3.2.3. Hypothesis 3: mediating role of maternal intention mirroring—Results indicated a non-significant mediating effect of maternal intention mirroring. Regression analyses did not reveal a significant relationship between maternal intention mirroring and infant's gaze directed toward the mother ($b = -.33$, $t = -.69$, $p = .49$) or directed away from the mirror ($b = .22$, $t = .39$, $p = .70$).

4. Discussion

We contrasted a rudimentary form of maternal mirroring (i.e., direct mirroring) with the mother's marked and ostensive mirroring (i.e., intention mirroring), the type of mirroring that has been theorized to serve as an impetus for the infant's subsequent psychosocial development (Fonagy, et al., 2002; Fonagy, et al., 2007; Gergely, 2007). As hypothesized, direct mirroring did not distinguish between mothers who were prospectively assessed to be secure and those assessed to be insecure/dismissing. However, the two groups of mothers showed a significant difference in their use of intention mirroring, with the frequency in secure mothers observed to be more than twice as high as in insecure/dismissing mothers. A notable difference was also found in the frequency with which infants directed their attention to their mothers. Infants of secure mothers directed their gaze toward their respective mothers at a higher frequency than did infants of insecure/dismissing mothers.

Although Gergely proposed markedness and ostensiveness as essential ingredients of the mother's affectively attuned communication (Gergely, 2007; Gergely & Unoka, 2008a, 2008b), this is the first study, to our knowledge, that directly examined these elements as part of the mother's affect mirroring communication. Two aspects of our intention mirroring variable should be noted in considering our results. First, as opposed to direct mirroring, which is primarily concerned with the mother's matching of her behavior to her infant's external behavior, intention mirroring was coded when the mother went beyond the behaviors and remarked on the infant's subjective internal experiences. As has been described in the previous literature (Fonagy, et al., 2002; Meins, et al., 2001; Sharp &

Fonagy, 2008), the process of intention mirroring draws upon the mother's complex higher-order metacognitive capacities, such as parental reflective functions or maternal mind-mindedness, which enable her to make sense of the infant's unobservable internal states. In this respect, the construct of intention mirroring encompassed what previous studies have identified as critical elements of maternal sensitive responsiveness. Second, however, to be coded as intention mirroring, the mother's acknowledgment of her infant's subjective internal state had to be delivered in a manner that generates understanding in the infant that her mirroring display concerns his internal experiences (Fonagy, et al., 2002; Slade, 2005). In other words, to use Gergely's terms, the mother's use of *marked* and *ostensive* cues constituted a critical aspect of intention mirroring, which distinguished our intention mirroring variable from extant empirical constructs.

The distinct nature of our concept of intention mirroring emerges from Gergely's fine-grained analysis of the functional significance of *markedness* and *ostensiveness* in maternal mirroring (Gergely, 2007; Gergely & Unoka, 2008a). Intention mirroring shares similarities with Meins's mind-mindedness (1999) and Stern's affect attunement (1985) in that it concerns the mother's recognition and reflection of the infant's internal state. However, Gergely diverged from the primary intersubjectivist view of Stern (1985) and other theorists (e.g., Meltzoff, Trevarthen), which hinges on the assumption that infants have an inherent capacity to access their subjective internal states and to perceive the 'sharing' of these states by their mothers (Meltzoff, 2002; Meltzoff & Gopnik, 1993; Trevarthen, 1993; Trevarthen & Aitken, 2001). Detailing criticisms of this view (Gergely, 2007; Gergely & Csibra, 2005; Gergely & Watson, 1999), Gergely contended that the infant's ability to recognize his discrete internal states, and the sharing thereof, is a developmental outcome made possible by a unique form of maternal mirroring that enables this capacity to be fostered in the infant (Fonagy, et al., 2002; Fonagy, et al., 2007). In proposing this view, Gergely underscored specific elements of maternal mirroring—*markedness* and *ostensiveness*—that achieve this end. Meins similarly but independently proposed and demonstrated the functional significance of the mother's tendency to comment on her infant's mental states; namely, it facilitates the infant's developing understanding of the mind (Meins, 1997; Meins, et al., 2003). However, Meins's theory did not discuss the putative mechanisms that mediate this link, although in later writings Meins and colleagues also emphasized the importance of measuring "appropriateness" in addition to simple mental-state talk in achieving robust predictions from maternal mind mindedness to the development of the child (Osorio, Meins, Martins, Martins, & Soares, 2012). Gergely's distinct contribution lies in spelling out how the mother's appropriate affectively attuned communication, when using *marked* and *ostensive* cues, can be accessed via the infant's rudimentary abilities. The developmental significance of this is assumed to be in the understanding of emotional experience, which has an interpersonal aspect in Gergely's theory. A recent study with primary school children provided confirmatory evidence in that emotional validation by the mother predicted higher emotional awareness, whilst emotional invalidation reduced emotional awareness in the child (Lindberg, 2013).

Our measure of intention mirroring did not correlate with that of direct mirroring, indicating that distinct processes may underpin the two forms of mirroring. Also of note is that

intention mirroring was significantly associated with maternal attachment security, while direct mirroring showed no relationship. Whereas secure and insecure/dismissing mothers did not appear to differ in their ability to respond on a behavioral level, as assessed by direct mirroring, insecure/dismissing mothers were significantly less able than their secure counterparts to accurately extract meaning from their infants' behavior and respond to their underlying internal states using marked and ostensive cues, as assessed by intention mirroring. We had also hypothesized an increase in secure mothers' intention mirroring during the third phase of the MSFP, the phase in which infants undergo recovery from the stress of the still-face phase. The hypothesized increase was observed not only in the expected group of secure mothers but also in insecure/dismissing mothers, and was accompanied by a decrease in facial/gestural direct mirroring in both groups. While little attention has been directed toward mothers' responses in the still-face literature, a decrease² in the frequency of maternal direct mirroring has previously been reported during the third phase (Bigelow & Walden, 2009). Our documented increase in intention mirroring, coupled with a decrease in facial/gestural direct mirroring, suggests that mothers may be more inclined to go beyond simple facial/gestural imitation and attend to their infants' underlying needs in the face of infant dysregulation. This tendency appears to be present in both secure and insecure/dismissing mothers, although the frequency of intention mirroring was observed to be consistently higher in secure mothers.

In Gergely's model, the function of the mother's intention mirroring is to help the infant recognize that what he sees displayed externally by the mother congruently matches his internal experiences. In mother-infant dyads where changes in the infant's internal states repeatedly effect visible external changes in the mother, the infant is thought to routinely look to the mother, his "intention mirror," for a perceptual representation of his emotional and intentional states. Our study provided partial support for this model. Infants of mothers who were more proficient in intention mirroring (i.e., secure mothers) looked to their mothers more than infants of mothers who were less proficient (i.e., insecure/dismissing mothers). However, despite the significant difference that the two attachment groups demonstrated in both maternal intention mirroring and infant gaze direction, infant gaze direction was not directly associated with intention mirroring in our laboratory situation. Maternal attachment has been robustly associated with the quality of the affective communication that the mother provides for her infant (Arnott & Meins, 2007; Slade, et al., 2005; Tarabulsy, et al., 2005; Whipple, et al., 2011). The link we report herein between maternal attachment security and intention mirroring is in line with this research. Evidence also exists that, by 7 months of age, infants develop consistent expectations about their mothers' patterns of responsiveness, which helps guide and regulate their end of the communicative exchange (Hains & Muir, 1996; Legerstee & Varghese, 2001; Mcquaid, et al., 2009). This capacity has been demonstrated in the still-face or replay phases, where infants who have been exposed to high levels of maternal mirroring continued their attempts at engagement with their mothers (e.g., continued gaze or smile), even in the absence of their mothers' typical level of attunement (Bigelow & Walden, 2009; Legerstee & Varghese, 2001; Mcquaid, et al., 2009). In noteworthy contrast, infants in these studies who were

²The decrease became non-significant when the authors adjusted for the duration of infants' attention.

accustomed to low levels of mirroring displayed relatively little effort to carry on their side of the communication. While these results were obtained on measures of generic mirroring, and mothers were distinguished on the basis of the *amount* of mirroring they provide, we have demonstrated here that the *type* of mirroring may matter. We have shown that the above pattern of results was replicated when mothers were distinguished on the basis of intention mirroring. No noteworthy finding emerged, however, with regard to direct mirroring alone.

Contrary to our expectation, our hypothesis that intention mirroring may mediate the link between the mother's attachment and the infant's attention toward the mother was not confirmed in our laboratory. The lack of association seen in our data between intention mirroring and infant gaze raises the possibility that the relationship between maternal attachment security and infant gaze direction may be mediated by aspects of maternal attachment that are independent from intention mirroring. While it is difficult to rule out this possibility, it also seems plausible that the mediational link, which may have taken shape over a period of months while patterns of mother-infant interaction were developed, may not have been evident during a 6-minute structured interaction in the lab. In line with the previous studies (e.g., Bigelow & Walden, 2009; Legerstee & Varghese, 2001; McQuaid, et al., 2009), the differences seen in our infants' attention toward their mothers in the still-face phase, during which maternal behavior was held constant, may reflect differences in the infants' interactive histories with their mothers and the expectations that the infants have subsequently come to form. Infants of secure mothers may have directed frequent attention to their mothers during the still-face phase, given their routine experience of their mothers' intention mirroring. Indeed, despite the lack of association at the micro level in the lab, there may have been a general pattern of mediation at the macro level, linking the mother's attachment security, her history of intention mirroring, and the infant's pattern of attention toward the mother. The absence of association seen at the micro level may also serve to corroborate results from prior studies that the variation in the mother's behavior (e.g., mirroring) on a short-term basis does not alter the general expectations of the infant for responsive interactions.

Several limitations of the study should be recognized. First, our sample consisted largely of middle- to upper-class mothers of average to above-average intelligence, and therefore may not have been representative of the general population. Second, we were not able to obtain a large enough sample of insecure/preoccupied mothers and their infants. Future research should examine direct and intention mirroring in this group. It would be of interest to evaluate whether intention mirroring could discriminate between different subtypes of insecure attachment. Third, the present study did not measure contingency in maternal mirroring, a construct that Gergely emphasized alongside markedness and ostensiveness (Gergely & Unoka, 2008a; Gergely & Watson, 1999). Fourth, we did not code the valence of the infant's signals to which maternal mirroring was directed. There is evidence from brain imaging and neuroendocrine research that disrupted maternal attunement may be strongly characterized by the mother's disengagement from and denial of negative infant cues (Kim, Fonagy, Allen, & Strathearn, 2014; Kim, Fonagy, Koos, Dorsett, & Strathearn, 2013). One may therefore postulate that the low levels of intention mirroring we

documented in insecure/dismissing mothers may be more specific to the infant's negative internal states (e.g., distressed state). This would be a fruitful area for further investigation.

The present study is the first attempt to examine markedness and ostensiveness as distinguishing features of the mother's well-attuned, affect-mirroring communication with her infant. We have found evidence for high levels of marked, ostensive mirroring in securely attached mothers, who were also frequently the focus of their infants' attention. Mothers with insecure/dismissing attachment were low in this form of mirroring, and were also less frequently the target of their infant's attention. While its direct links to infant behavior should be explored further in future research, the marked, ostensive mirroring may be more accurate than extant mirroring constructs in capturing the essence of securely attached mothers' affective attunement to their infants.

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References

- Abidin, R. Parenting Stress Index, 3rd edition, Professional manual. Psychological Assessments Resources; Lutz, FL: 1995.
- Ainsworth, MDS.; Blehar, MC.; Waters, E.; Wall, S. Patterns of attachment: a psychological study of the Strange Situation. Erlbaum; Hillsdale, NJ: 1978.
- Ainsworth, MDS.; Wittig, BA. Attachment and exploratory behavior of one-year-olds in a strange situation.. In: Foss, BM., editor. Determinants of infant behaviour. Vol. 4. Methuen; London: 1969. p. 111-136.
- Arnott B, Meins E. Links among antenatal attachment representations, postnatal mind-mindedness, and infant attachment security: a preliminary study of mothers and fathers. *Bulletin of the Menninger Clinic*. 2007; 71:132–149. [PubMed: 17666003]
- Bard KA, Myowa-Yamakoshi M, Tomonaga M, Tanaka M, Costall A, Matsuzawa T. Group differences in the mutual gaze of chimpanzees (*Pan troglodytes*). *Developmental Psychology*. 2005; 41:616–624. [PubMed: 16060808]
- Bayley, N. Screening Test. Third Edition. PsychCorp; San Antonio, TX: 2005. Bayley Scales of Infant and Toddler Development.
- Beck, AT.; Steer, RA.; Brown, GK. Manual for the Beck Depression Inventory II. Psychological Corporation; San Antonio, TX: 1996.
- Beebe B, Jaffe J, Markese S, Buck K, Chen H, Cohen P, Bahrck L, Andrews H, Feldstein S. The origins of 12-month attachment: a microanalysis of 4-month mother-infant interaction. *Attach Hum Dev*. 2010; 12:3–141. [PubMed: 20390524]
- Beebe B, Lachmann F, Markese S, Buck KA, Bahrck LE, Chen H, Cohen P, Andrews H, Feldstein S, Jaffe J. On the origins of disorganized attachment and internal working models: Paper II. An empirical microanalysis of 4-month mother-infant interaction. *Psychoanal Dialogues*. 2012; 22:352–374. [PubMed: 23066334]
- Belsky J, Rovine M, Taylor DG. The Pennsylvania Infant and Family Development Project, III: The origins of individual differences in infant-mother attachment: maternal and infant contributions. *Child Development*. 1984; 55:718–728. [PubMed: 6734313]
- Bennett DS, Bendersky M, Lewis M. Does the organization of emotional expression change over time? Facial expressivity from 4 to 12 months. *Infancy*. 2005; 8:167–187. [PubMed: 16906232]

- Bigelow AE, MacLean K, Proctor J, Myatt T, Gillis R, Power M. Maternal sensitivity throughout infancy: continuity and relation to attachment security. *Infant Behav Dev.* 2010; 33:50–60. [PubMed: 20004022]
- Bigelow AE, Walden LM. Infants' response to maternal mirroring in the still face and replay tasks. *Infancy.* 2009; 14:526–549.
- Brazelton, TB.; Koslowski, B.; Main, M. The origins of reciprocity: the early mother-infant interaction.. In: Lewis, M.; Rosenblum, LA., editors. *The effect of the infant on its caregiver.* Wiley-Interscience; New York, NY: 1974. p. 49-76.
- Bretherton I, Biringen Z, Ridgeway D, Maslin C, Sherman M. Attachment: the parental perspective. *Infant Mental Health Journal.* 1989; 10:203–221.
- Camras LA. Differentiation, dynamical integration and functional emotional development. *Emotion Review.* 2011; 3:138–146.
- Carpenter M, Nagell K, Tomasello M. Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development.* 1998; 63:i–vi. 1–143. [PubMed: 9835078]
- Cohn JF, Tronick EZ. Mother-infant face-to-face interaction: the sequence of dyadic states at 3, 6, and 9 months. *Developmental Psychology.* 1987; 23:68–77.
- Colombo J, Frick JE, Ryther JS, Coldren JT, Mitchell DW. Infants' detection of analogs of 'motherese' in noise. *Merrill-Palmer Quarterly.* 1995; 41:104–113.
- Colonnese C, Zijlstra BJ, van der Zande A, Bogels SM. Coordination of gaze, facial expressions and vocalizations of early infant communication with mother and father. *Infant Behav Dev.* 2012; 35:523–532. [PubMed: 22721749]
- Crandell LE, Fitzgerald HE, Whipple EE. Dyadic synchrony in parent-child interactions: A link with maternal representations of attachment relationships. *Infant Mental Health Journal.* 1997; 18:247–264.
- Crittenden, P.; Landini, A. *Assessing adult attachment: A dynamic-maturational approach to discourse analysis.* W. W. Norton & Company; New York, NY: 2011.
- Csibra G. Recognizing communicative intentions in infancy. *Mind and Language.* 2010; 25:141–168.
- Csibra G, Gergely G. Natural pedagogy. *Trends Cogn Sci.* 2009; 13:148–153. [PubMed: 19285912]
- De Wolff MS, van Ijzendoorn MH. Sensitivity and attachment: a meta-analysis on parental antecedents of infant attachment. *Child Development.* 1997; 68:571–591. [PubMed: 9306636]
- Demers I, Bernier A, Tarabulsky GM, Provost MA. Maternal and child characteristics as antecedents of maternal mind-mindedness. *Infant Mental Health Journal.* 2010; 31:94–112.
- Egyed K, Kiraly I, Gergely G. Communicating Shared Knowledge in Infancy. *Psychol Sci.* 2013; 24:1348–1353. [PubMed: 23719664]
- Farroni T, Csibra G, Simion F, Johnson MH. Eye contact detection in humans from birth. *Proceedings of the National Academy of Sciences of the United States of America.* 2002; 99:9602–9605. [PubMed: 12082186]
- Feldman R. Parent-infant synchrony and the construction of shared timing; physiological precursors, developmental outcomes, and risk conditions. *Journal of Child Psychology and Psychiatry and Allied Disciplines.* 2007; 48:329–354.
- Feldman R, Gordon I, Zagoory-Sharon O. Maternal and paternal plasma, salivary, and urinary oxytocin and parent-infant synchrony: considering stress and affiliation components of human bonding. *Dev Sci.* 2011; 14:752–761. [PubMed: 21676095]
- Ferrari PF, Paukner A, Ionica C, Suomi SJ. Reciprocal face-to-face communication between rhesus macaque mothers and their newborn infants. *Current Biology.* 2009; 19:1768–1772. [PubMed: 19818617]
- Fogel, A. Two principles of communication: Co-regulation and framing.. In: Nadel, J.; Camaioni, L., editors. *New perspectives in early communicative development.* Routledge; London, UK: 1993. p. 9-22.
- Fonagy P. Thinking about thinking: some clinical and theoretical considerations in the treatment of a borderline patient. *International Journal of Psycho-Analysis.* 1991; 72:639–656. [PubMed: 1797718]

- Fonagy, P.; Gergely, G.; Jurist, EL.; Target, M. Affect regulation, mentalization, and the development of self. Other Press; New York, NY: 2002.
- Fonagy P, Gergely G, Target M. The parent-infant dyad and the construction of the subjective self. *Journal of Child Psychology and Psychiatry and Allied Disciplines*. 2007; 48:288–328.
- Fonagy P, Steele M, Steele H, Moran GS, Higgitt AC. The capacity for understanding mental states: the reflective self in parent and child and its significance for security of attachment. *Infant Mental Health Journal*. 1991; 12:201–218.
- Fonagy P, Target M. Attachment and reflective function: their role in self-organization. *Development and Psychopathology*. 1997; 9:679–700. [PubMed: 9449001]
- Fraiberg S, Adelson E, Shapiro V. Ghosts in the nursery. A psychoanalytic approach to the problems of impaired infant-mother relationships. *Journal of the American Academy of Child Psychiatry*. 1975; 14:387–421. [PubMed: 1141566]
- Gartstein MA, Rothbart MK. Studying infant temperament via the Revised Infant Behavior Questionnaire. *Infant Behavior and Development*. 2003; 26:64–86.
- George, C.; Kaplan, N.; Main, M. Adult Attachment Interview. Department of Psychology, University of California at Berkeley; 1985. Unpublished manuscript
- Gergely, G. The social construction of the subjective self: the role of affect-mirroring, markedness, and ostensive communication in self development.. In: Mayes, L.; Fonagy, P.; Target, M., editors. *Developmental science and psychoanalysis*. Karnac; London, UK: 2007. p. 45-82.
- Gergely, G. Kind of agents: The origin of understanding instrumental and communicative agency.. In: Goswami, U., editor. *Blackwell handbook of childhood cognitive development*. 2nd ed.. Wiley-Blackwell Publishing; West Sussex, UK: 2011. p. 76-105.
- Gergely G, Csibra G. A few reasons why we don't share Tomasello et al's intuitions about sharing. Commentary on Tomasello et al.: Understanding and sharing intentions. *Behavioral and Brain Sciences*. 2005; 28:731–732.
- Gergely G, Jacob P. Reasoning about instrumental and communicative agency in human infancy. *Advances in Child Development and Behavior*. 2012; 43:59–94. [PubMed: 23205408]
- Gergely, G.; Unoka, Z. Attachment and mentalization in humans: the development of the affective self.. In: Jurist, EL.; Slade, A.; Bergener, S., editors. *Mind to mind: infant research, neuroscience, and psychoanalysis*. Other Press; New York, NY: 2008a. p. 50-87.
- Gergely, G.; Unoka, Z. Attachment, affect-regulation, and mentalization: The developmental origins of the representational affective self.. In: Sharp, C.; Fonagy, P.; Goodyer, I., editors. *Social cognition and developmental psychopathology*. Oxford University Press; New York, NY: 2008b. p. 305-342.
- Gergely G, Watson J. The social biofeedback theory of parental affect-mirroring: the development of emotional self-awareness and self-control in infancy. *International Journal of Psycho-Analysis*. 1996; 77:1181–1212. [PubMed: 9119582]
- Gergely, G.; Watson, J. Early social-emotional development: contingency perception and the social biofeedback model.. In: Rochat, P., editor. *Early social cognition: understanding others in the first months of life*. Erlbaum; Hillsdale, NJ: 1999. p. 101-137.
- Grice, P. *Studies in the way of words*. Harvard University Press; Cambridge, MA: 1989.
- Grossmann K, Grossmann KE, Spangler G, Suess G, Unzner L. Maternal sensitivity and newborns' orientation responses as related to quality of attachment in northern Germany. *Monographs of the Society for Research in Child Development*. 1985; 50:233–256. [PubMed: 4069129]
- Grossmann T, Striano T, Friederici AD. Crossmodal integration of emotional information from face and voice in the infant brain. *Dev Sci*. 2006; 9:309–315. [PubMed: 16669802]
- Hains SM, Muir DW. Effects of stimulus contingency in infant-adult interactions. *Infant Behavior and Development*. 1996; 19:49–61.
- Hyler SE, Skodol AE, Oldham JM, Kellman HD, Doidge N. Validity of the Personality Diagnostic Questionnaire-Revised: a replication in an outpatient sample. *Comprehensive Psychiatry*. 1992; 33:73–77. [PubMed: 1544299]
- Isabella RA. Origins of attachment: maternal interactive behavior across the first year. *Child Development*. 1993; 64:605–621. [PubMed: 8477637]
- Isabella RA, Belsky J. Interactional synchrony and the origins of infant-mother attachment: a replication study. *Child Development*. 1991; 62:373–384. [PubMed: 2055128]

- Jaffe J, Beebe B, Feldstein S, Crown CL, Jasnow MD. Rhythms of dialogue in infancy: coordinated timing in development. *Monographs of the Society for Research in Child Development*. 2001; 66:iviii, 1–132.
- Jonsson C, Clinton D. What do mothers attune to during interactions with their infants? *Infant and Child Development*. 2006; 15:387–402.
- Kim S, Fonagy P, Allen J, Strathearn L. Mothers' unresolved trauma blunts amygdala response to infant distress. *Soc Neurosci*. 2014; 9:352–363. [PubMed: 24635646]
- Kim S, Fonagy P, Koos O, Dorsett K, Strathearn L. Maternal oxytocin response predicts mother-to-infant gaze. *Brain Research*. 2013
- Koos O, Gergely G. A contingency-based approach to the etiology of 'disorganized' attachment: the 'flickering switch' hypothesis. *Bulletin of the Menninger Clinic*. 2001; 65:397–410. [PubMed: 11531135]
- Kovacs AM, Teglas E, Endress AD. The social sense: susceptibility to others' beliefs in human infants and adults. *Science*. 2010; 330:1830–1834. [PubMed: 21205671]
- Lavelli M, Fogel A. Interdyad Differences in Early Mother-Infant Face-to-Face Communication: Real-Time Dynamics and Developmental Pathways. *Developmental Psychology*. 2013; 49:2257–2271. [PubMed: 23527490]
- Leerkes EM. Maternal sensitivity during distressing tasks: a unique predictor of attachment security. *Infant Behav Dev*. 2011; 34:443–446. [PubMed: 21616538]
- Legerstee M, Varghese J. The role of maternal affect mirroring on social expectancies in three-month-old infants. *Child Development*. 2001; 72:1301–1313. [PubMed: 11699672]
- Lindberg, A. Children's emotional awareness: Its causes, consequences and the specific role of parental emotional validation. Department of Psychology, Anglia Ruskin University; Cambridge, UK.: 2013. Unpublished manuscript
- Lundy BL. Father-- and mother--infant face-to-face interactions: Differences in mind-related comments and infant attachment? *Infant Behavior and Development*. 2003; 26:200–212.
- Lyons-Ruth K. 'I sense that you sense that I sense...': Sander's recognition process and the specificity of relational moves in the psychotherapeutic setting. *Infant Mental Health Journal*. 2000; 21:85–98.
- Mackinnon DP, Lockwood CM, Williams J. Confidence Limits for the Indirect Effect: Distribution of the Product and Resampling Methods. *Multivariate Behav Res*. 2004; 39:99–128. [PubMed: 20157642]
- Main M, Kaplan N, Cassidy J. Security in infancy, childhood and adulthood: A move to the level of representation. *Monographs of the Society for Research in Child Development*. 1985; 50:66–104.
- Main M, Tomasini L, Tolan W. Differences among mothers of infants judged to differ in security. *Developmental Psychology*. 1979; 15:472–473.
- Malatesta CZ, Culver C, Tesman JR, Shepard B. The development of emotion expression during the first two years of life. *Monographs of the Society for Research in Child Development*. 1989; 54:1–136. [PubMed: 2770755]
- Mancini G, Ferrari PF, Palagi E. Rapid facial mimicry in geladas. *Sci Rep*. 2013; 3:1527. [PubMed: 23538990]
- McElwain NL, Booth-LaForce C. Maternal sensitivity to infant distress and nondistress as predictors of infant-mother attachment security. *Journal of Family Psychology*. 2006; 20:247–255. [PubMed: 16756400]
- Mcquaid NE, Bibok MB, Carpendale JIM. Relation between maternal contingent responsiveness and infant social expectations. *Infancy*. 2009; 14:390–401.
- Meins E. Security of attachment and the social development of cognition. Hove, UK: Psychology Press. Meins, E. (1999). Sensitivity, security and internal working models: bridging the transmission gap. *Attachment and Human Development*. 1997; 1:325–342. [PubMed: 11708230]
- Meins E, Fernyhough C, Fradley E, Tuckey M. Rethinking maternal sensitivity: mothers' comments on infants' mental processes predict security of attachment at 12 months. *Journal of Child Psychology and Psychiatry and Allied Disciplines*. 2001; 42:637–648.

- Meins E, Fernyhough C, Wainwright R, Clark-Carter D, Das Gupta M, Fradley E, Tuckey M. Pathways to understanding mind: construct validity and predictive validity of maternal mind-mindedness. *Child Development*. 2003; 74:1194–1211. [PubMed: 12938713]
- Meltzoff, AN. Imitation as a mechanism of social cognition: Origins of empathy, theory of mind, and the representation of action.. In: Goshwami, U., editor. *Blackwell handbook of childhood cognitive development*. Blackwell Publishers; Oxford, UK: 2002. p. 6-25.
- Meltzoff, AN.; Gopnik, A. The role of imitation in understanding persons and developing a theory of mind.. In: Baron-Cohen, S.; Tager-Flusberg, H.; Cohen, DJ., editors. *Understanding other minds: Perspectives from autism*. Oxford University Press; Oxford, UK: 1993. p. 335-365.
- Messinger D. Positive and negative: infant facial expressions and emotions. *Current Directions in Psychological Science*. 2002; 11:1–6.
- Nadel J, Prepin K, Okanda M. Experiencing contingency and agency: First step toward self-understanding in making a mind? *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*. 2005; 6:447–462.
- Osorio A, Meins E, Martins C, Martins EC, Soares I. Child and mother mental-state talk in shared pretense as predictors of children's social symbolic play abilities at age 3. *Infant Behav Dev*. 2012; 35:719–726. [PubMed: 22982271]
- Papousek H, Papousek M. Forms and functions of vocal matching in interactions between mothers and their precanonical infants. *First Language*. 1989; 9:137–158.
- Parise E, Csibra G. Neural responses to multimodal ostensive signals in 5-month-old infants. *PLoS One*. 2013; 8:e72360. [PubMed: 23977289]
- Pederson DR, Gleason KE, Moran G, Bento S. Maternal attachment representations, maternal sensitivity, and the infant-mother attachment relationship. *Developmental Psychology*. 1998; 34:925–933. [PubMed: 9779739]
- Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*. 2008; 40:879–891. [PubMed: 18697684]
- Rothbart MK, Ahadi SA, Evans DE. Temperament and personality: origins and outcomes. *Journal of Personality and Social Psychology*. 2000; 78:122–135. [PubMed: 10653510]
- Russell, BB. *An enquiry into meaning and truth*. Allen and Unwin; London, UK: 1940.
- Schore AN. Back to basics: attachment, affect regulation, and the developing right brain: linking developmental neuroscience to pediatrics. *Pediatrics in Review*. 2005; 26:204–217. [PubMed: 15930328]
- Senju A, Csibra G. Gaze following in human infants depends on communicative signals. *Current Biology*. 2008; 18:668–671. [PubMed: 18439827]
- Shah PE, Fonagy P, Strathearn L. Is attachment transmitted across generations? The plot thickens. *Clin Child Psychol Psychiatry*. 2010; 15:329–345. [PubMed: 20603421]
- Sharp C, Fonagy P. The parent's capacity to treat the child as a psychological agent: constructs, measures and implications for developmental psychopathology. *Social Development*. 2008; 17:737–754.
- Slade A. Parental reflective functioning: an introduction. *Attachment and Human Development*. 2005; 7:269–281. [PubMed: 16210239]
- Slade A, Grienenberger J, Bernbach E, Levy D, Locker A. Maternal reflective functioning, attachment, and the transmission gap: a preliminary study. *Attachment and Human Development*. 2005; 7:283–298. [PubMed: 16210240]
- Soussignan R, Nadel J, Canet P, Gerardin P. Sensitivity to social contingency and positive emotion in 2-month-olds. *Infancy*. 2006; 10:123–144.
- Sperber, D.; Wilson, D. *Relevance: Communication and cognition*. 2nd ed.. Blackwell Publishers; Oxford, UK: 1995.
- Sroufe, LA. *Emotional development: the organization of emotional life in the early years*. Cambridge University Press; Cambridge, UK: 1996.
- Stern, DN. *The interpersonal world of the infant*. Basic Books; New York, NY: 1985.
- Tarabulsky GM, Bernier A, Provost MA, Maranda J, Larose S, Moss E, Larose M, Tessier R. Another look inside the gap: ecological contributions to the transmission of attachment in a sample of

- adolescent mother-infant dyads. *Developmental Psychology*. 2005; 41:212–224. [PubMed: 15656750]
- Trevarthen, C. Descriptive analyses of infant communicative behavior.. In: Schaffer, HR., editor. *Studies in mother-infant interaction*. Academic Press; London, UK: 1977. p. 227-270.
- Trevarthen, C. The self born in intersubjectivity: An infant communicating.. In: Neisser, U., editor. *The perceived self*. Cambridge University Press; New York, NY: 1993. p. 121-173.
- Trevarthen C, Aitken KJ. Infant intersubjectivity: research, theory, and clinical applications. *Journal of Child Psychology and Psychiatry and Allied Disciplines*. 2001; 42:3–48.
- Tronick E, Als H, Adamson L, Wise S, Brazelton TB. The infant's response to entrapment between contradictory messages in face-to-face interaction. *Journal of the American Academy of Child Psychiatry*. 1978; 17:1–13. [PubMed: 632477]
- Tronick E, Beeghly M. Infants' meaning-making and the development of mental health problems. *American Psychologist*. 2011; 66:107–119. [PubMed: 21142336]
- Tronick EZ. Emotions and emotional communication in infants. *American Psychologist*. 1989; 44:112–119. [PubMed: 2653124]
- van IJzendoorn MH. Adult attachment representations, parental responsiveness, and infant attachment: a meta-analysis on the predictive validity of the Adult Attachment Interview. *Psychological Bulletin*. 1995; 117:387–403. [PubMed: 7777645]
- Walker-Andrews AS. Intermodal perception of expressive behaviors: Relation of eye and voice? *Developmental Psychology*. 1986; 22:373–377.
- Walle EA, Campos JJ. Interpersonal responding to discrete emotions: A functionalist approach to the development of affect specificity. *Emotion Review*. 2012; 4:413–422.
- Whipple N, Bernier A, Mageau GA. A dimensional approach to maternal attachment state of mind: relations to maternal sensitivity and maternal autonomy support. *Developmental Psychology*. 2011; 47:396–403. [PubMed: 21171748]
- Widen SC. Children's interpretation of facial expressions: The long path from valence-based to specific discrete categories. *Emotion Review*. 2013; 5:72–77.
- Winnicott, DW. Mirror-role of mother and family in child development.. In: Lomas, P., editor. *The predicament of the family*. Hogarth; London, UK: 1967. p. 127-146.

Highlights

We examined mothers' prenatal attachment and their mirroring at 7 months postpartum.

Secure and insecure/dismissing mothers were compared, along with their infants

Two mother groups mirrored their infant's external behavior at a similar frequency

Secure mothers mirrored their infants' internal states more than insecure mothers

Infants of secure mothers attended to their mothers more frequently

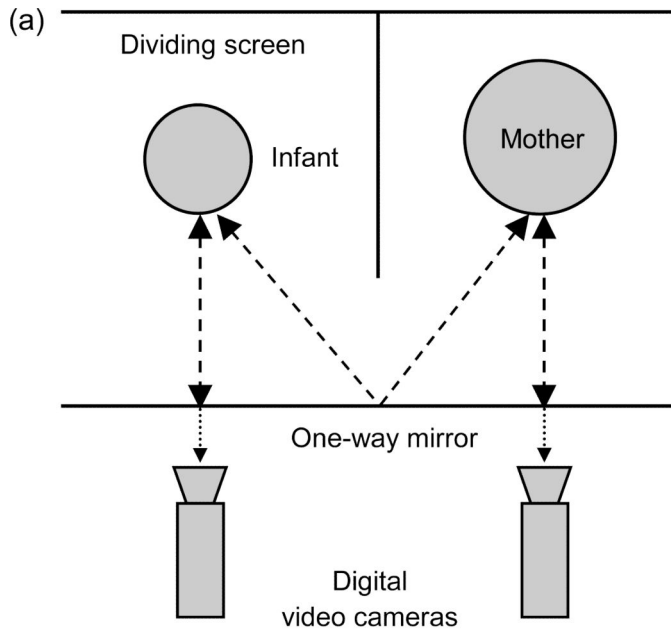


Figure 1. The modified still face procedure (MSFP): (a) experimental setting and (b) still-frame examples from each of the three phases. Phases 1 and 3 provide examples of infant gaze toward mother and phase 2 provides an example of infant gaze away from mother. Adapted from “Maternal Oxytocin Response Predicts Mother-to-Infant Gaze,” by S. Kim, P. Fonagy, O. Koos, K. Dorsett, and L. Strathearn, 2013, *Brain Research*. Copyright 2013 by Elsevier B. V. Adapted with permission.

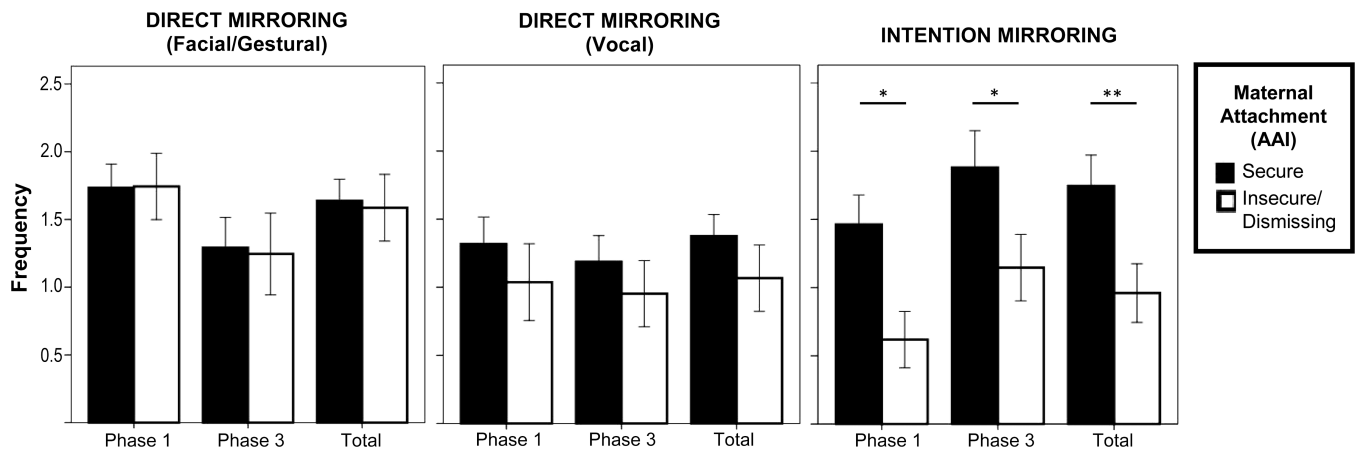


Figure 2.

Frequency of maternal direct mirroring (facial/gestural and vocal) and intention mirroring during the interaction phases (i.e., phases 1 and 3) of the MSFP. Total values represent data collapsed over phases 1 and 3. y axis indicate square root transformed frequency values. The values were adjusted for the total length of time for which codable data were available in each respective phase of the MSFP. Error bars represent the standard error of the mean.

* $p < .05$, ** $p < .001$

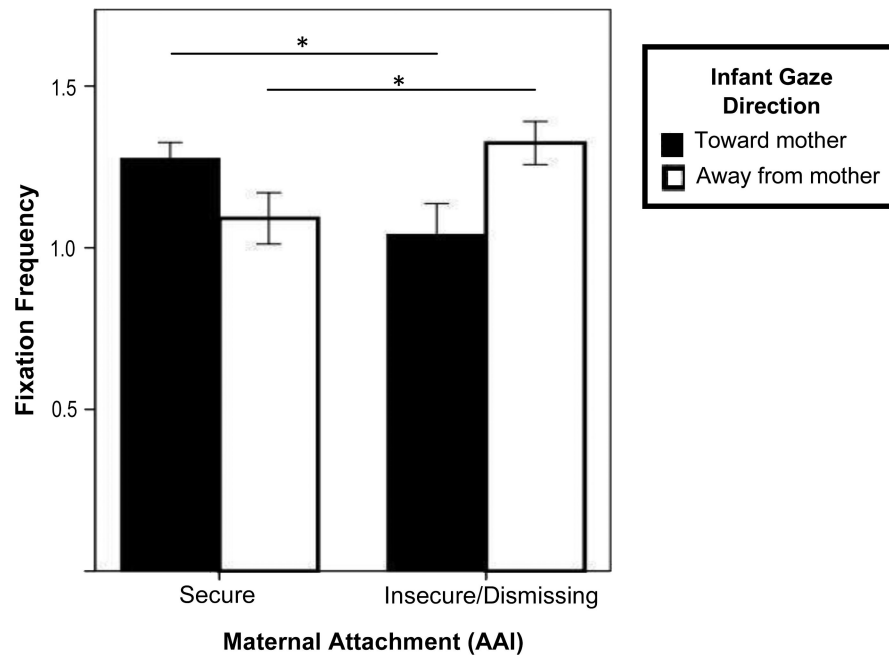


Figure 3. Frequency of infant gaze fixations toward and away from the mother. Maternal behavior was held constant (i.e., assumed neutral face) during the still face phase when the infant gaze fixations were recorded. Frequency values were adjusted for the total frequency of gaze fixations recorded for each infant during the still-face phase. y axis indicate arcsine transformed frequency values. Error bars represent the standard error of the mean.
* $p < .05$

Table 1

Sociodemographic and Behavioral Characteristics of Mothers by Attachment Classification (N = 41)

Characteristics	Secure (<i>n</i> = 25)	Insecure/Dismissing (<i>n</i> = 16)	<i>p</i>
Maternal age (in years), mean ± <i>SD</i> ^a	27.4 ± 5.4	28.7 ± 3.5	.39
Maternal race, <i>n</i> (%)			.51
White	13 (52.0)	10 (62.5)	
Non-White	12 (48.0)	6 (37.5)	
Marital status, <i>n</i> (%)			.35
Married	19 (76.0)	10 (62.5)	
Not married	6 (24.0)	6 (37.5)	
Maternal education, <i>n</i> (%)			.59
College incomplete	6 (24.0)	4 (26.7)	
College/university degree	13 (52.0)	6 (37.5)	
Postgraduate degree	6 (24.0)	6 (37.5)	
Socioeconomic status, mean ± <i>SD</i> ^b	46.6 ± 12.9	49.4 ± 10.4	.50
Maternal IQ ^c	110.0 ± 8.7	109.6 ± 9.9	.91
Maternal depression (BDI), mean ± <i>SD</i> ^d	5.6 ± 5.0	6.1 ± 5.2	.79
Maternal personality pathology (PDQ)			
Total score, mean ± <i>SD</i> ^e	19.8 ± 11.6	21.2 ± 13.0	.72
Maternal parenting stress (PSI)			
Child Domain Total Score, mean ± <i>SD</i>	92.2 ± 13.8	93.0 ± 12.6	.88
Parent Domain Total Score, mean ± <i>SD</i>	111.3 ± 23.7	117.5 ± 21.6	.46
Total Stress Score, mean ± <i>SD</i> ^f	203.5 ± 32.2	210.5 ± 23.3	.52
Maternal temperament (ATQ)			
Effortful Control, subscale score, mean ± <i>SD</i>	4.4 ± 0.7	4.6 ± 0.6	.59
Negative Affect, subscale score, mean ± <i>SD</i>	4.0 ± 0.6	4.1 ± 0.9	.68
Extraversion/Surgency, subscale score, mean ± <i>SD</i>	4.9 ± 0.6	4.7 ± 0.9	.55
Orienting Sensitivity, subscale score, mean ± <i>SD</i>	5.1 ± 0.7	5.0 ± 0.7	.51

Note. The *p* values represent those from the *t* and χ^2 tests for continuous and categorical variables, respectively. BDI = Beck Depression Inventory-II; PDQ = Personality Disorder Questionnaire-4+; PSI = Parenting Stress Index; ATQ = Adult Temperament Questionnaire – Short Form.

^aMaternal age at the time of the Adult Attachment Interview.

^bSocioeconomic status was estimated using Hollingshead (1975)'s Four-Factor Index of Social Status, and represents joint information with partner, when applicable.

^cMaternal Full Scale IQ was estimated from the Wechsler Test of Adult Reading (WTAR).

^dBDI-II score of ≤ 9 indicate minimal depression.

^ePDQ-4+ total score of ≥ 50 is highly suggestive of DSM-IV personality disorder.

^fPSI Total Stress Score of < 260 is considered normal range.

Table 2

Sociodemographic and Behavioral Characteristics of Infants by Maternal Attachment Classification (N = 41)

Characteristics	Secure (n = 25)	Insecure/Dismissing (n = 16)	p
Infant age (in months), mean \pm SD ^a	6.7 \pm 2.0	6.2 \pm 1.6	.37
Infant sex, n (%)			.71
Male	11 (44.0)	8 (50.0)	
Female	14 (56.0)	8 (50.0)	
Hours of separation from mother per week, n (%) ^b			.63
Less than 20 hours	12 (57.1)	6 (66.7)	
More than 20 hours	9 (42.9)	3 (33.3)	
Infant development (Bayley) ^c			
Cognitive, subtest score, mean \pm SD	17.4 \pm 1.4	17.4 \pm 2.0	.90
Receptive communication, subtest score, mean \pm SD	14.6 \pm 2.3	13.6 \pm 2.1	.19
Expressive communication, subtest score, mean \pm SD	13.7 \pm 1.7	13.5 \pm 1.7	.76
Fine motor, subtest score, mean \pm SD	15.9 \pm 2.0	15.4 \pm 2.1	.48
Gross motor, subtest score, mean \pm SD	18.0 \pm 1.3	17.7 \pm 1.9	.51
Infant temperament (IBQ)			
Approach, subscale score, mean \pm SD	5.7 \pm 0.8	5.1 \pm 1.7	.26
Distress to limitations, subscale score, mean \pm SD	3.9 \pm 0.7	3.8 \pm 0.6	.69
Fear, subscale score, mean \pm SD	2.7 \pm 1.0	2.4 \pm 1.1	.49
Duration of orienting, subscale score, mean \pm SD	4.4 \pm 1.0	4.3 \pm 1.2	.66
Smiling/laughter, subscale score, mean \pm SD	5.1 \pm 0.8	5.1 \pm 1.1	.96
High intensity pleasure, subscale score, mean \pm SD	6.0 \pm 0.6	6.1 \pm 0.5	.87
Low intensity pleasure, subscale score, mean \pm SD	5.0 \pm 1.4	5.2 \pm 0.9	.55
Soothability, subscale score, mean \pm SD	4.5 \pm 1.5	4.6 \pm 1.5	.85
Rate of recovery from distress, subscale score, mean \pm SD	4.9 \pm 0.9	4.9 \pm 1.1	.98
Cuddliness, subscale score, mean \pm SD	5.5 \pm 0.7	5.7 \pm 0.7	.43
Perceptual sensitivity, subscale score, mean \pm SD	4.7 \pm 1.2	4.8 \pm 1.2	.73
Sadness, subscale score, mean \pm SD	3.8 \pm 0.9	3.8 \pm 0.9	.95
Activity level, subscale score, mean \pm SD	4.4 \pm 0.7	4.6 \pm 0.6	.83
Vocal reactivity, subscale score, mean \pm SD	5.2 \pm 0.8	5.3 \pm 1.1	.76

Note. The *p* values represent those from the *t* and χ^2 tests for continuous and categorical variables, respectively. Bayley = Bayley Scales of Infant and Toddler Development, Third Edition, Screening Test; IBQ = Infant Behavior Questionnaire-Revised.

^aInfant age at the time of the modified still face procedure (MSFP).

^bHours per week that someone other than the mother looked after the infant. Data were missing for 7 participants.

^cBayley scores that indicate the likelihood of developmental delays are as follows: 13 for Cognitive subtest, 9 for Receptive communication subtest, 9 for Expressive communication subtest, 10 for Fine motor subtest, and 12 for Gross motor subtest.

Table 3

Frequency of Maternal Direct and Intention Mirroring by Maternal Attachment Classification

	Secure ^b (n = 25)	Insecure/Dismissing ^b (n = 16)
Maternal direct mirroring (facial/gestural)		
Phase 1	0.037 ± 0.006	0.039 ± 0.007
Phase 3	0.029 ± 0.007	0.029 ± 0.008
Total ^a	0.033 ± 0.005	0.034 ± 0.005
Maternal direct mirroring (vocal)		
Phase 1	0.027 ± 0.005	0.023 ± 0.007
Phase 3	0.023 ± 0.005	0.018 ± 0.006
Total ^a	0.025 ± 0.003	0.020 ± 0.005
Maternal intention mirroring		
Phase 1	0.033 ± 0.009	0.010 ± 0.004
Phase 3	0.053 ± 0.012	0.022 ± 0.007
Total ^a	0.043 ± 0.008	0.016 ± 0.004

Note. Numbers shown ($M \pm SE$) are frequency values, adjusted for the total length of time for which codable data were available in each respective phase of the MSFP. Untransformed values are reported here for illustrative purposes, while statistical tests were conducted using square-root transformed variables.

^aTotal values represent data collapsed over the two interaction phases (i.e., phases 1 and 3) of the MSFP.

^bMaternal attachment was assessed prenatally during the third trimester of pregnancy.

Table 4

Frequency of Infant Gaze Fixations by Maternal Attachment Classification

	Secure ^b (n = 25)	Insecure/Dismissing ^b (n = 16)
Infant gaze direction ^a		
Gaze at mother	0.359 ± 0.023	0.268 ± 0.033
Gaze away	0.289 ± 0.030	0.382 ± 0.031

Note. Frequency values ($M \pm SE$) shown are proportion values, adjusted for the total number of gaze fixations recorded for each infant during the still-face phase of the MSFP. Data for infant gaze are shown separately for infants whose mothers were prospectively classified to have secure vs. insecure/dismissing attachment. Untransformed values are reported here for illustrative purposes, while statistical tests were conducted using arcsine transformed variables.

^aFrequency of infant gaze was assessed during the still-face phase.

^bMaternal attachment was assessed prenatally during the third trimester of pregnancy.