A Still-face Paradigm for Young Children: 2½ Year-olds' Reactions to Maternal Unavailability during the Still-face

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Abstract

This study evaluated similarities and differences in 2½ year-old children's reactions to maternal unavailability during a brief still-face episode and subsequent resumption of social interaction during a reunion episode. Seventy mothers and children were videotaped in the Toddler Still-Face paradigm (T-SF), an age appropriate adaptation of the Face-to-Face Still-Face paradigm. Similar to their younger counterparts, 2½ year-olds displayed the traditional "still-face effect," including an increase in negative affect, gaze aversion, and a wide array of behaviors indicative of proximity seeking to the mother, solicitation of her attention, and avoidance and a "reunion effect," characterized by a carryover of negative affect and avoidance behavior (e.g., moving away from the mother) from the still-face episode to the reunion play episode. However, differences in toddlers' behaviors during the still-face and reunion episodes were also observed, which highlight age-related changes in the toddlers' ability to cope with the stress of maternal unavailability during the still-face during the third year of life. Contrary to reports for younger infants, few gender differences were found in toddlers' reactions to the still-face. The findings support the hypothesis that the toddlers are attempting to make meaning out of an unexpected and senseless event.

Introduction

Several similar and generally accepted interpretations have been advanced to account for the still-face effect (Adamson & Frick, in press; Tronick, Als, Adamson, Wise, & Brazelton, 1978; Weinberg & Tronick, 1996). First, the still-faced mother violates the infant's expectation for a normal interaction (Tronick et al., 1978). Second, by withdrawing all forms of interaction with the infant, the mother no longer provides the infant with the regulatory scaffolding often needed for the infant to maintain an organized social and affective state (Beeghly & Tronick, 1994; Stack & Muir, 1990; Weinberg & Tronick, 1996). And third, the mother's lack of responsiveness disrupts the infant's goal for social engagement and connectedness with her (Tronick et al., 1978) and the contingency between the infant's and mother's behaviors (Gergely & Watson, 1999; Rochat, Neisser, & Marian, 1998).

Tronick (2004, 2007) has integrated these interpretations in his dyadic expansion of psychobiological states of consciousness hypothesis. Following Bruner (Bruner, 1990) Tronick has argued that humans are meaning-makers. They make meaning to gain a sense of the self in relation to itself and to the world of things and other people. Moreover, with development, meaning-making capacities change qualitatively and the meanings that are made change as a consequence. For example, infants make meanings that are sensori-motor (Piaget, 1952) and sensori-affective (Stechler & Latz, 1966) in nature, whereas toddlers make meanings that utilize their burgeoning representational and locomotor skills (Piaget, 1962; Beeghly, 1997; Bretherton & Beeghly, 1982). Moreover, meanings and meaning-making systems are polymorphic and include physiologic, behavioral, speech, representational, and cognitive components (Tronick, 2007).

Meanings are both self-organized (regulated internally and private) and also dyadically organized (regulated with others and shared). When meanings are dyadically organized, a dyadic state of consciousness emerges between the individuals—something akin to Vygotsky's zone of proximal development (Vygotsky, 1967). These dyadically organized meanings contain new co-created meanings that, in turn, can be appropriated by each individual into his own private state of consciousness. Successful self- or dyadic creation of new meanings leads to an expansion of the complexity and coherence of the individual's state of consciousness. The still-face in this view is a situation that challenges children's meaning-making capacities and already existing meanings about the mother, including their expectations, implicit knowing, and representations.

To examine meaning-making capacities in infants is difficult because of their lack of speech. Inferences about their intentions and representations are based on observations of their dynamic expressive and communicative actions including gestures, facial expressions, vocalizations, and posture (Fogel, Nelson-Goens, Hsu, & Shapiro, 2000; Hsu & Fogel, 2003; Meltzoff & Gopnik, 1993). For example, Weinberg and Tronick (1994) argued that infants' expressive behaviors form coherently organized configurations that convey meanings such as "continue" or "stop" and that these meanings are related to context (e.g., normal interaction versus the still-face). Bruner (1990) has argued that infants' intentionality can be seen in their actions, such as reaching for an object, and the change in their actions when they succeed in fulfilling their intentions. Spitz (1965) has made a similar argument. However, although watching preverbal infants react to the still-face is compelling, inferences of intentionality and meaning-making must be cautiously asserted, given their lack of speech. Thus, in this study our goal was to examine the meaning-making capacities of 2½ year-olds and how they make meaning of the still-face with their more advanced developmental capacities including speech and nonverbal representational capacities.

Over the past 25 years, hundreds of infants have been videotaped in the Face-to-Face Still-Face paradigm (Tronick et al., 1978). This paradigm has proven to be a particularly fruitful methodological tool for evaluating young infants' socio-emotional, regulatory, and coping abilities (see Adamson & Frick, 2003a, for a review). However, with the exception of two studies with autistic children (Escalona et al., 2002; Nadel et al., 2000), no study to date has examined toddlers' reactions to this perturbation in maternal interactive behavior during the third year of life. Thus, in this study we wanted to evaluate 2½ year-old children's reactions to maternal unavailability during the still-face and the subsequent resumption of maternal availability during the reunion episode of an age-appropriate adaptation of the Face-to-Face Still-Face paradigm—the Toddler Still-Face (T-SF). We expected that the way in which toddlers reacted and coped with this social stressor would reveal their underlying meaning-making processes at this age.

The classic Face-to-Face Still-Face paradigm confronts young infants with three successive interactive contexts: 1) a "normal" face-to-face caregiver-infant social interaction during which the caregivers are asked to play with their infants in a normal manner, followed by 2) a still-face episode during which caregivers are instructed to keep an unresponsive poker face and not to smile, touch, or talk to their infants, followed by 3) a reunion episode during which the caregivers and infants resume normal face-to-face social interaction. Each episode typically lasts 2–3 minutes with 2 minutes being the modal length. The paradigm has been used with infants ranging in age from 2–12 months with a mean age of 5.2 months (Adamson & Frick, 2003b).

Infants typically respond to the still-face with what has come to be called the "still-face effect." In study after study, infants react to the still-face with a signature increase in gaze aversion and a decrease in positive affect (Adamson & Frick, 2003b; Cole, Martin, & Dennis, 2004). In studies that have used microanalytic scoring systems, infants in addition react to the still-face with an increase in negative affect, visual scanning, pick-me-up gestures, distancing behavior such as twisting and turning in their seat, autonomic behavioral stress indicators such as spitting up (Toda & Fogel, 1993; Weinberg & Tronick, 1996; Weinberg, Tronick, Cohn, & Olson, 1999) and pyschophysiologic stress indicators, such as heart, respiratory sinus arrhythmia, skin conductance, and cortisol changes (Gunnar & Davis, 2003; Haley & Stansbury, 2003; Ramsay & Lewis, 2003; Stansbury & Gunnar, 1994).

Although the powerful effect of the still-face is well established and extensively described, the reunion episode that follows the still-face has received relatively scant attention. Though a carry-over effect of negative affect was found in an early study of the still-face (Tronick et al., 1978), until recently researchers have not empirically focused on the reunion episode as a regulatory challenge for infants and caregivers (Kogan & Carter, 1996; Rosenblum, McDonough, Muzik, Miller, & Sameroff, 2002; Weinberg & Tronick, 1996; Weinberg, Olson, Beeghly, & Tronick, 2006). These authors have described a "reunion effect" on infants ranging in age from 3 to 7 months that consists of increased negativity (i.e., facial expression of anger and sadness, fussing, and crying), gaze aversion, and object focus and, at least in infants aged 6 months or older, a rebound of positive affect to levels close to or beyond those observed in the first play. The reunion episode is thought to be stressful for dyads because the mothers and children must re-establish and repair the interaction following the still-face. The reunion episode therefore presents dyads with an affectively complex and demanding regulatory meaning-making task of coming to a renewed shared meaning about what they are doing together. Infants must simultaneously cope with the resumption of maternal behavior and with the intra- and interpersonal carry-over of negative affect and stress from the still-face that was generated by the senselessness of the mother's unresponsive behavior during the still-face.

In some studies, gender differences have been found in young infants' reactions to both the still-face and the reunion episode. We (Weinberg et al., 1999) found that male infants have more difficulty than female infants in maintaining affective regulation. In both the still-face and the reunion episodes, boys were more likely than girls to show facial expressions of anger, to fuss, to gesture to be picked up, and to try to get away by turning and twisting in the infant seat. Boys were also more socially oriented than girls and thus more likely than girls to look at the mother, smile, and vocalize. Girls, on the other hand, spent substantially more time exploring objects and showing facial expressions of interest. We hypothesized that boys and girls may use different types of self-regulatory strategies. Whereas female infants use visual attention to objects as a form of regulation (perhaps as a result of their greater developmental maturation), male infants need more regulatory support from a caregiver. As a consequence, much of boys' expressive behavior (both positive and

negative) is directed toward the caregiver and may serve the function of communicating to the care-giver their greater need for external regulation.

Compared to infants, it is likely that toddlers' experience of and strategies of coping with the still-face and reunion are even more complex phenomena reflecting their more advanced social, emotional, cognitive, and motor capacities (Kagan, 1998; Kopp & Neufeld, 2003; Thompson, 1994). For instance, by 2½ years of age, toddlers are beginning to understand social standards and to be concerned about the regulation of their and others' behavior around these standards (Kagan, 1998; Kopp, 1982; Kopp & Neufeld, 2003; Sroufe, 1996). The still-faced and socially unavailable mother violates social standards for appropriate maternal behavior, and toddlers are forced to cope with the notion that this is not the way that their mother *should* behave (Kagan & Lamb, 1987). Toddlers also have to determine whether to respond to the still-faced mother in a way that is concordant with the social standards that they are beginning to internalize. For example, a child may be confronted with the dilemma of yelling at the mother or asking questions to elicit information about what is happening. Obviously these issues of meaning-making are not relevant to infants.

The still-faced mother also violates toddlers' representations of the mother-child relationship (Weinberg & Tronick, 1996). Based on months of prior interaction with the mother, toddlers know that this is not the way their mother typically behaves. The mother's still-faced countenance and unavailability for social interaction violates children's implicit as well as explicit knowledge of what they normally do together (Adamson & Frick, 2003b; Muir & Hains, 1993; Shapiro, Fagen, Prigot, Carroll, & Shalan, 1998). It also disrupts children's need for social connection and may stress their sense of security. As is the case for infants, toddlers may attempt to repair this interactive perturbation and re-engage the mother. However, toddlers are likely to do so in more complex ways that reflect their greater developmental maturity and self-regulatory skills. For instance, toddlers may try to regain connection with the mother by seeking physical proximity to her, soliciting her attention (e.g., asking questions or showing her a toy), or attempting to re-engage her in the same play activities they had engaged in prior to the still-face. Toddlers may also turn away and avoid the mother (perhaps in an effort to self-regulate) or they may become dysregulated (e.g., throw toys) and exhibit negative behavior (e.g., cry, whine, or yell in anger). Younger infants also experience this violation but they do not have the same extended history with the mother as toddlers do, and their representational capacities are different and more limited.

Another significant developmental difference between infants and toddlers is that, during the second and third years of life, toddlers are beginning to acquire a rudimentary and possibly explicit understanding of the emotional states and intentions of other people (Beeghly & Cicchetti, 1994; Bretherton, 1991; Bretherton & Beeghly, 1982; Trevarthen, 1980; Wellman, 1993). During the still-face, toddlers may make implicit or even explicit explanations for their mother's sudden unresponsivity. For example, children may think that the mother did not hear them and make repeated requests for interaction or information that escalate in volume and intensity. Or they may attribute the mother's behavior to a change in her physiological state such as her being tired. Analytic theory would suggest that the maternal still-face may also force children to question whether the mother's changed behavior is their fault or caused by their behavior, e.g., "Why is she doing this to *me*?" and "Did *I* do something to cause this?" (Emde, 1983; Winnicott, 1964). While these questions are difficult to answer at any age, young children's answers may reflect the history of the mother-child relationship ("Mommy, are you sad?"), children's tendency to attribute explanations that are internal or external to them (e.g., "I was bad" versus "Mommy is tired and needs a rest"), and/or children's history of coping with problems successfully or unsuccessfully ("I can cope with this" versus "I can't deal with this").

The present study addresses three primary questions: 1) Do 2½ year-old toddlers exhibit a similar still-face effect during the T-SF as has been consistently reported for young infants in the Face-to-Face Still-Face paradigm? What differences, if any, can be observed? 2) Do 2½ year-old toddlers exhibit a similar reunion effect during the T-SF as has been reported for young infants in the Face-to-Face Still-Face paradigm? It seems likely that toddlers (like infants) would be affected by the breaking of the interactive connection with the mother and attempt to reestablish that connection, but given their greater developmental maturity, it is unclear how specifically they will react and deploy their actions and coping behaviors. And, 3) Are there gender differences in toddlers' affective and behavioral reactions during the still-face and reunion episodes of the T-SF, and, if so, how do these differences correspond to or contrast with those reported for younger infants during the Face-to-Face Still-Face paradigm? We expected that maternal unavailability during the still-face episode and the subsequent resumption of normal interaction in the reunion episode would be a powerful and age-appropriate social stressor at age 2½ years that would elicit a variety of regulatory strategies in children to help them cope with this unexpected violation in social interaction. Specifically, we expected that toddlers would show both a still-face and a reunion effect as has been reported for young infants, but they would manifest these effects in age-appropriate ways that reflect their more mature representational, motor, and self-regulatory skills. We also anticipated that toddlers' behaviors during the still-face and reunion episodes would reflect an intention to reconnect and maintain an engagement with the mother, as observed in a heightened prevalence of requests for joint attention, information, or social interaction, proximity seeking, and verbal repetitions. Moreover, we expected that "better coping" at 2½ years during both the still-face and reunion episodes would reflect a greater ability to maintain emotional self-regulation and to avoid becoming distressed or behaviorally dysregu-lated (e.g., crying, yelling, hitting the mother, or throwing toys). Based on the infancy literature, we also expected that boys would have greater difficulty than girls regulating their affect and behavior in both the still-face and reunion episodes at age 2½ years.

Methods

Subjects

Seventy mothers and their 2½ year-old children (34 boys and 36 girls) participated in this study (M child age = 31 months, SD = 1.7 months). On average, mothers were 36 years old (SD = 3.5) and had achieved 16 years of education (SD = 1.6, range = 12 to 23 years). Subjects were recruited from a larger pool of 109 mothers and infants who had participated in a larger and longitudinal study of mother-child social interaction.

At the time of recruitment, the original sample met a set of low risk social and medical inclusion criteria. The mothers were healthy, married or living with the infant's father, 21 to 40 years of age, and had completed at least 12 years of education (high school diploma or equivalent). Recruited families ranged in socio-economic status (SES) from working class to upper-middle class, as measured by Hollingshead's Four-Factor Index of Social Status (Hollingshead, 1979). Although mother-infant dyads were recruited regardless of race or ethnic background, all but one was Caucasian. The infants were all full-term and healthy at birth as determined by pediatric examination in the newborn period.

Of the 109 mother-infant dyads that had been part of the infancy study, 70 (64%) were recruited to participate in an additional single laboratory visit when the children were 2½ years old. The 70 participants did not differ significantly from the 39 non-participants on any infant biologic or maternal socio-demographic variable. Most non-participants were lost to follow-up (i.e., moved or could not be located) or had children who were too old by the time the present study began. A few families were no longer interested in participating, or no

longer met our inclusion criteria due to health reasons (e.g., two dyads were excluded because the children had been diagnosed with an autism spectrum disorder).

At the time of the toddler visit, all 70 mothers and children were healthy and the children were developing normally. Two of the 70 mothers (3%) had separated from the children's fathers. Study families varied in the number of children living in the household. Forty percent had just the target 2½ year-old, 51% had two children in the household (including the target child), and 9% had three or more children. Mothers also varied in employment status. Fifty-four percent had returned to work by the 2½ year observation, whereas 46% were full-time homemakers.

Procedures

The 2½-year visit took place in a laboratory playroom at Children's Hospital, Boston. All mothers signed an informed consent form at the start of the visit, and were given the option of shortening or terminating the videotaped interactions including the still-face at any time, if they so desired. None of the mothers chose to do so. The Institutional Review Board (IRB) at Children's Hospital of Boston approved all procedures.

Toddler Still-Face Paradigm (T-SF)—Following the informed consent procedures, mother-child dyads were videotaped during the T-SF, an age-appropriate adaptation of the Face-to-Face Still-Face paradigm. Similar to the infancy paradigm, the T-SF consisted of three 2-minute episodes: 1) normal play with the mother, 2) still-face, and 3) resumption of normal play with the mother (reunion). However, unlike the infancy paradigm, the toddler paradigm took place in the middle of a longer mother-child free play session, during which dyads played on the floor with a standard set of assorted toys appropriate for toddlers. During the first play and the reunion play episodes, the mothers were instructed to play with their children as they normally would at home. During the still-face episode, the mothers were instructed to remain on the floor and maintain a neutral "poker" or still-face and to refrain from talking, smiling, nodding, or touching the child. They were also instructed not to accept or give toys to the child.

The T-SF was videotaped from behind a one-way mirror using two cameras. To facilitate later coding, the experimenter selected the view that maximized full-frontal or 3/4 frontal views of the child and mother. Videotapes were also initialized with computer-readable time code (SEMPTE).

Coding of Videotapes

In order to mimic the infant Face-to-Face Still-Face procedure, coding was based on the last two minutes of mother-child free play prior to the still-face (play 1), the two-minute still-face episode, and the first two minutes of free play following the still-face (reunion episode). The children's affect and behavior during each episode were scored from videotapes using the child codes from the Child and Caregiver Mutual Regulation (CCMR) scoring system (Weinberg, Beeghly, & Tronick, 2003), which are presented in the appendix. The CCMR was specifically designed for this study to capture the wide repertoire of regulatory strategies that toddlers may deploy in response to maternal unavailability during the still-face. Coding was accomplished using the Action Analysis Coding and Training system (AACT, 1996), which provided computer-assisted observational coding. The computer directly controlled the S-VHS machine and video monitor and allowed single frame accuracy in coding and automatic time code capture. The AACT system permitted on-line continuous coding of variables of interest. Coders typically viewed videotapes in real time but replayed segments, used slow motion, and edited their coding as needed.

In the first coding pass, coders focused on scoring the children's negative, positive, or neutral affect. The affect codes were based on facial expressions (e.g., smiles, frowns) and vocalizations with affective tone or content (e.g., crying, squealing in enthusiasm). "Negative affect" included facial expressions of anger, sadness, fear, subdued/withdrawn, or puzzled/concerned affect, and negative vocalizations such as crying, whining, complaining, frustration, irritation, annoyance, or impatience. "Neutral affect" included facial expressions of interest and vocalizations characterized by a normal conversational tone. "Positive affect" included facial expressions of joy (e.g., smiling, laughing) and positive vocalizations such as exuberance, and enthusiasm. In addition, a code for nonscorable affect was included in case the child was not visible momentarily because of problematic camera angles. The affect codes were coded continuously, and every change in the children's affect was recorded. In addition, the affect codes were mutually exclusive so that the occurrence of one affect code terminated the previous affect code.

In a second coding pass, coders scored specific child behaviors. The specific child actions included verbal and nonverbal initiations (e.g., verbal requests, showing mother a toy, pointing to an object), disruptive/ aggressive acts (e.g., yelling, throw a toy, hitting the mother), proximity/contact seeking (e.g., moving closer to the mother, touching or hugging the mother), avoidance behavior (e.g., turning the back to the mother), self-comforting behaviors (e.g., sucking on a thumb or finger), verbal explanation (e.g., the child provides an explanation or rationalization for the still-face, "Mommy is tired" or "Wake up!"), and self-evaluations (e.g., "I can't do it"). These codes were coded on a frequency (rate per minute) basis. However, the duration of some of these codes (e.g., child's back turned to mother, touch, hug/cling, and self-comforting) was also captured, as indicated in the appendix.

The videotapes were coded by independent teams of two coders masked to toddlers' and mothers' background information and the study's hypotheses. In pilot work with the CCMR, we found that coders were better able to capture all the child's behaviors accurately if they coded in teams of two. For reliability, teams of two coders independently double-coded 20% of the videotapes. Reliability was evaluated in two ways. First, percent agreement between teams was assessed using the formula: (agreements / (agreements + disagreements)) × 100 = % correct agreements. Mean percent agreement overall was high (96.18%). The Cohen Kappa statistic was also applied to the codes to correct for chance agreements. Mean kappa was 0.63, indicating good overall reliability.

Analytic Plan

In the Results section, findings from quantitative analyses addressing the study's three questions are presented first. These are followed by transcribed excerpts of three toddlers' behavior during the T-SF.

In the quantitative analyses, two types of dependent variables were derived from the CCMR for analytic purposes in the present study: 1) Mean percent time was calculated for the CCMR codes for which duration was available. These included the affect codes and the codes of touch, hug/cling, back turned to mom, and self-comforting. For affect, mean percent time in negative, positive, and neutral/interest was calculated. 2) Mean rate per minute (RPM) was calculated for CCMR codes that were scored on a frequency basis. Mean rate per minute was also calculated for the codes of touch, hug/cling, and back turned to mom.

Univariate and bivariate analyses were used to provide descriptive statistics for variables derived from the CCMR. Several codes were excluded because they did not occur with sufficient frequency to be included in the analyses. These included the codes for tantrum,

running around the room, pleading, physical requests (e.g., pulling mom's hand), and crying (no child cried during the T–SF).

To evaluate the primary objectives of the study, a 2 (gender) × 3 (episode: first play, still-face, reunion) ANOVA with repeated measures (SAS 9.1 proc mixed), including the two-way interaction, was conducted, with episode as the repeated measure. Any significant episode effects were further evaluated using simulated based post hoc tests.

Results

Quantitative Analyses

Do 2½ year-olds exhibit a still-face effect?—Descriptive statistics and ANOVA results for the CCMR variables are provided in Tables 1 and 2. Table 1 lists means and standard deviations for the CCMR duration codes (i.e., the percent time measures for the summary CCMR categories of negative, neutral/interest, and positive affect, and for touch, hug/cling, back turned to mother, and self-comfort codes). Table 2 presents means and standard deviations for the rate per minute (RPM) CCMR behavioral (frequency) codes. In both tables, the number of individual children (out of 70) who exhibited each CCMR code is also indicated for each episode.

As seen in Table 1, there were several significant episode effects for the duration CCMR codes. A significant main effect of episode for negative affect indicated that children showed significantly more negative affect during the still-face episode than they did during the first play episode. Children also spent significantly more time with their back turned to the mother and touching the mother during the still-face than in the first play. Although not statistically significant, there was also a trend for positive affect to decrease from the first play to the still-face episode ($p = 0.10$). In contrast, the duration of self-comforting behaviors was statistically equivalent during each of the three episodes (first play, still-face, reunion).

As seen in Table 2, a larger number of significant episode effects were observed for the RPM variables derived from the behavioral frequency codes. Children were more likely to make verbal requests and to show a toy to the mother during the still-face than during either the first play or the reunion play. They were also significantly more likely to repeat verbal utterances and to exhibit escalating behavior (i.e., by making increasingly loud and insistent vocalizations) during the still-face as compared to the first play or the reunion play. Furthermore, the children were more likely to seek proximity to the mother, to touch the mother, and to hug/cling to the mother during the still-face than during either of the two play episodes. They were also more likely to turn their back to the mother and to move away from the mother during the still-face. In contrast, contrary to our expectations, children were not more likely to provide explanations for maternal behavior, self-evaluations, or engage in disruptive actions such as yelling, throwing toys, or hitting the mom during the still-face than during either of the first play or reunion play episodes.

Do 2½ year-olds show a reunion effect?: Results provided evidence for a reunion effect, although this was less striking than the evidence for a still-face effect at this age. As seen in Table 1, the rise in children's negative affect, touching the mother, and turning their back to the mother that was observed in the still-face did not significantly abate during the reunion play. As seen in Table 2, the children were also equally likely to move away from the mother during the reunion episode as they had been in the still-face episode.

Are there gender effects in toddlers' reactions during the still-face and reunion episodes?: Contrary to our expectations, only two significant main effects for gender were

observed. The first indicated that girls were more likely than boys to initiate joint attention and social interaction with the mother using non-verbal means, by either showing her a toy, handing her a toy, pointing to a toy, or putting a toy in the mother's face/line of vision (M RPM for boy s= 0.67, SD = 0.89; M RPM for girls = 1.04, SD = 1.32, F (df = 1,68) = 4.60, p = 0.035). The second main effect indicated that boys were significantly more likely than girls to elicit the mother's attention via physical touch (M RPM for boys = 0.47, SD = 0.78; M RPM for girls = 0.26, SD = 0.52, F(df = 1,68) = 4.35, p = 0.041). There were no significant episode x gender interactions.

Qualitative Results

To illustrate the quantitative results described above, transcribed excerpts of the verbal and behavioral reactions of three toddlers (two boys and one girl) during the T-SF are now provided.

Transcript 1: Alligator Boy Transcript (3m 08s)

Play Episode (30s)—Child: (leans to mom) Baby (toy) can go right here (a toy bathtub).

Mother: Oh, you think she's warm?

Child: (reaches for baby) No, she's cold. We have to wrap her up (wraps baby doll in a towel).

Mother: (leans closer and looks) Nice.

Child: And this alligator (reaches for alligator toy with his right hand) he's gonna bite the baby (moves alligator toward baby, for whom he reaches with his left hand).

Mother: (gasps) Uh oh, uh oh.

Child: (moves alligator to "bite" the baby and then looks at mom).

Mother: Where's the baby's mommy?

Child: (plays with baby).

Mother: (feigned anxiety) That baby needs a mother to help.

Child: Help the… (incomprehensible; mom interrupts and starts talking; child is playing with baby doll and toy schoolhouse).

Mother: (interrupts and speaks in a frightened voice for the baby) Help me, help me. That alligator is biting me.

Child: (puts the doll back in bathtub and looks at mom) Oh look, no alligator is biting you.

Still Face Episode—Child: (immediately looks at mom and holds alligator) No alligator, no alligator. He's in the cage (voice rising).

Child: (looks at mom and moves alligator as if he were walking) He's in the cage (louder).

Child: (moves toward mom, looks at her and speaks with an escalated tone) He's in the cage.

Child: (continues to move toward mom) No alligator.

Child: (continues to move toward mom) No alligator.

Child: (sits, looks at mom and speaks with a slightly more escalated tone) No alligator.

Child: (looks a mom and speaks with the same tone) No alligator.

Child: (looks at mom, shakes head "no," and speaks with the same tone) No alligator.

Child: (moves away from mom, sits near schoolhouse and speaks with initial tone) No more alligator.

Child: (plays with school house for approximately five seconds, then looks at mom and speaks matter-of-factly) There is no more alligator.

Child: (looks at mom intensely, moves hand and points) They're over here, Mom.

Child: (looks at mom and speaks with the same tone which escalates as he picks up a toy pickle) No more alligator. He needs a pickle.

Child: (looks at mom, speaks with the same tone and emphasizes each word) Mom, he needs (looks down), Mom, (looks up at mom again, speaks with an escalated tone and scowls) he needs a pickle.

Child: (looks down and frowns, approximately three seconds later he looks at mom and speaks with the same tone) Mom, he needs a pickle.

Child: (looks away and tone returns to initial intensity) He needs a pickle.

Child: (looks around and speaks quietly) He needs a pickle.

Child: (continues to look around, speaks too quietly to comprehend and then looks away from mom).

Child: (reaches for an object and holds it out to mom, looks at her, and speaks with original tone intensity, but words are incomprehensible)

Child: (leans closer to mom and speaks with a slightly more escalated tone, holding a toy potato chip) For alligator.

Child: (looks away from mom and tone returns to initial intensity) For alligator.

Child: (reaches for potato chip and gives it to mom, looks at her and speaks with same tone) Chip for alligator.

Child: (looks at mom, leans closer, continues to hand her the same chip and speaks with a slightly more escalated tone) Chip for alligator.

Child: (looks at mom, holds the chip at mom's eye level and speaks with a slightly more escalated tone, emphasizing each word) Chip for alligator.

Child: (places chip on mom's knee).

Child: (returns to normal sitting position and speaks with original tone intensity) Chip for alligator.

Child: (looks at mom) Chip for alligator.

Child: (points at chip, looks at mom and speaks with a slightly more escalated tone, emphasizing each word) Chip for alligator.

Child: (looks away from mom, plays with schoolhouse and speaks with the same tone, emphasizing each word) Chip for alligator.

Child: (becomes more engaged with the school house and tone returns to initial intensity) Chip for alligator.

Child: (plays with schoolhouse for thirty-five seconds, does not look at mom or say anything).

Reunion Episode—Mother: (leans in and touches toy in schoolhouse) Let's see if we can do that.

Child: (moves back from schoolhouse, but still keeps eyes on the schoolhouse).

Mother: Oh boy, want to have the girl throw it again?

Child: (reaches for small figures in schoolhouse, no eye contact with mom)

Mother: (leans in to play with the same toys as child) Have the girl throw it again.

Child: (moves back from schoolhouse, turns body away from mom to reach for toy and then begins to play with the schoolhouse again) Almost.

Mother: Almost. See if that person can throw better.

Child: (looks at toy) This one?

Mother: Yea.

Child: (plays with the new toy).

Mother: (reaches for the same toy as the child in the schoolhouse) Oh.

Child: (leans in and plays with the schoolhouse for approximately five seconds and speaks with original tone intensity) Almost.

Transcript 2: Alligator Girl Transcript (3m 31s)

Play Episode (30s)—Mother: (grabs baby doll and toy bathtub) I'm going to give the baby a bath.

Child: (watches mom).

Mother: (grabs towel) I'm going to wash the baby nice and clean in the baby bathtub. Then I'm going to wrap the baby up in the towel, dry the baby's hair. Rub, rub, rub, rub, rub (carries out each action she describes).

Child: (laughs and shows alligator to mom) Mom, I got an alligator.

Child: (laughs) I got a snake.

Child: (turns back to mom and speaks incomprehensibly with alligator in hand, then turns back to mom and sits next to her).

Child: (looks at mom) I put a giraffe in the bath.

Mother: A giraffe? I think that's an alligator (looks at alligator and touches it, while daughter holds it) or a lizard or something.

Child: (grabs alligator and puts it in mom's face).

Mother: It's not a giraffe (mom pretends to scream).

Child: (still holds alligator in mom's face and laughs and speaks incomprehensibly).

Mother: (moves alligator away from face and smiles) I think he wants to eat a hotdog (turns body away from daughter to get a toy hotdog and gives it to daughter) Yum, yum, yum.

Child: (takes hotdog from mom's hand) I'll give him one.

Mother: You give him the hotdog.

Child: (pretends to feed alligator for and looks at mom) Yum, yum.

Mother: Yum, yum.

Child: (pretends to feed alligator, hears a knock on the observational window signaling the start of the still-face and looks at mom) What was that, Momma? (looks back at alligator).

Child: (puts alligator down and looks at mom) I think that was a banging noise.

Mother: (looks away from daughter) No, that wasn't a banging noise. That's okay.

Child: (walks around behind mom, but stops when she hears a second knock on the window, looks up and then looks back to mom) I hear noise.

Still Face Episode—Child: (bends down to pick up a toy, turns to face mom, speaks incomprehensibly, picks up towel and moves to sit near toy bathtub, speaks incomprehensibly and looks at bathtub).

Child: I give baby a bath. Will you give her a bath? (immediately after speaking she picks up a gorilla, looks at it, and holds it in front of mom's face and makes a growling noise and smiles).

Child: (moves gorilla closer to mom's face).

Child: (takes gorilla back, looks at it, and then tries to give it back to mom) Momma, momma (holds alligator in front of mom's face).

Child: Momma, (turns back to mom, bends down to pick up alligator then turns back to mom, smiles and puts alligator in mom's face) Big alligator.

Child: (smiles and holds alligator in front of mom).

Child: (waves alligator in front of mom's face and speaks with a slightly escalated tone) Momma.

Child: (holds alligator steady in front of mom's face and speaks with the same tone) Momma.

Child: (moves alligator away from mom, looks at mom and speaks with an escalated tone) Momma!

Child: (moves alligator in front of mom's face and speaks with the same tone) Momma!

Child: (tone returns to original intensity) Momma, Momma, there you go. (moves alligator closer to mom's face, alligator touches mom's nose).

Mother: (turns head away from daughter).

Child: (turns slightly away from mom, sits down and looks at baby doll and bathtub) Here, let's give baby a bath. You give baby a bath.

Child: (plays with baby doll and bathtub for approximately seven seconds, does not make any eye contact with mom).

Child: (plays with toys and speaks with a slightly escalated tone, but does not make eye contact with mom) You give the baby a bath. You give the baby a bath. You give the baby a bath.

Child: (looks at mom and speaks with a slightly escalated tone) You give the baby a bath.

Child: (looks down at toys, then looks up at mom quickly and then back down to play with toys and speaks with initial intensity) Will you give baby a bath?

Child: (continues to play with toys, keeps head down and speaks quietly) Momma, will you give baby a bath right now?

Child: (still looks at toys and speaks with a slightly escalated tone) You give (looks at mom and stops playing with toys) baby a bath.

Child: (looks around briefly and speaks with the same tone) Momma, (looks down, plays with toys and speaks with original intensity) will you give baby a bath? Can you give her a bath, Momma?

Child: (smiles and tries to give mom alligator) Here comes a snake, Momma.

Child: (moves alligator away from mom, hears knock on the observational window and looks at mom) I don't know what that was, Momma.

Reunion Episode—Mother: (looks at daughter and shakes head no) That was nothing.

Child: (looks away from mom) What was that?

Mother: (looks at daughter) That was nothing, honey.

Child: (looks at mom when mom is speaking, then looks away, rests head against fist and speaks) What was that?

Mother: Huh?

Child: (looks down at the ground) I want to see … (incomprehensible).

Mother: (plays with toys while speaking) That was just, that was just a, that was just a noise. Somebody in the other room hit the wall. (looks at daughter) You know how Christopher hits the wall with the powder?

Child: (looks at toy) Yeah.

Mother: (looks at daughter) Yeah, somebody in the next room hit the wall by accident.

Child: (looks at toys) I don't want to bang.

Mother: (shakes head no and turns away to grab cooking utensils) Okay, they won't bang. (turns back to daughter and shows her cooking utensils) Want to cook?

Child: (looks at cooking utensils and smiles) Yeah.

Transcript 3: Cuddling Boy (3m 05s)

Play Episode (30s)—Child: (sits with back against mom, leaning on her and playing with toys).

Mother: (reaches out to son with cup in hand and watches son's actions) Here's your juice. Here you go (smiles).

Child: (pretends to have dinosaur drink from cup).

Mother: Oh, the dinosaur is going to drink the juice?

Child: (turns head slightly toward mom) Mmm.

Mother: (nods head in agreement) Mmm.

Child: Mmm.

Mother: (smiles and laughs) Good.

Child: (turns head back to toys and puts dinosaur in alligator's mouth).

Mother: Oh no, the alligator is going to eat the dinosaur (speaks in a scared voice). Help!

Child: (kisses dinosaur twice) Mwa, mwa.

Mother: (plays with toy truck and speaks) Oh, you gave the dinosaur a kiss? That's nice.

Child: (turns head up toward mom nods head in agreement and smiles, then turns head back toward toys).

Still Face Episode—Child: (puts dinosaur in alligator's mouth and speaks incomprehensibly, then turns head back toward mom and looks at her).

Child: (turns head back towards alligator and continues to speak incomprehensibly).

Child: (turns head and looks at mom quickly, then turns back toward toys and speaks incomprehensibly).

Child: (puts dinosaur in mouth, removes it, puts dinosaur in the alligator's mouth and speaks incomprehensibly).

Child: (looks down at toys on ground, takes two deep breaths and yawns).

Child: (speaks incomprehensibly, picks up dinosaur, turns toward mom, looks at her, holds alligator up to her face and speaks) Dinosaur. Dinosaur.

Child: (moves dinosaur away from mom, turns away and looks down at ground) Dinosaur. Dinosaur.

Child: (turns toward mom and holds dinosaur up to mom's face) Dinosaur. Dinosaur.

Child: (moves dinosaur away from mom, turns away and looks down at ground) Dinosaur.

Child: (turns toward mom and holds dinosaur up to mom's face) Dinosaur. Dinosaur.

Child: (turns around so that his entire body is facing mom, has dinosaur in one hand, alligator in the other and holds them up to mom's face) Dinosaur. Dinosaur. Dinosaur. Dinosaur.

Child: (continues to hold alligator and dinosaur close to mom's face, looks at mom, remains quiet, then speaks) Dinosaur.

Child: (moves alligator and dinosaur away from mom's face) Dinosaur.

Child: (holds alligator up to mom's face, looks at mom and speaks quietly) Dinosaur. Dinosaur. Dinosaur.

Child: (turns head away from mom, then turns back toward her and holds dinosaur close to mom's face).

Child: (speaks quietly) Dinosaur. Dinosaur. Dinosaur.

Child: (looks down at ground and continues to speak quietly) Dinosaur. Dinosaur.

Child: (places head against mom's chest and speaks with original intensity) Dinosaur. Dinosaur.

Child: (moves head away from mom's chest and looks up at her) Dinosaur. Dinosaur. Dinosaur. (holds dinosaur up to mom's face and continues speaking) Dinosaur. Dinosaur. Dinosaur.

Child: (moves dinosaur away from mom's face, puts head on mom's chest and speaks with a sad tone). Dinosaur. Dinosaur. Dinosaur.

Child: (keeps head on mom's chest, but turns away so he is no longer facing her, he also holds dinosaur and alligator close to his body).

Child: (keeps head against mom's chest, turns back toward her and speaks in a sad tone) Dinosaur. Dinosaur. Dinosaur.

Child: (rubs head against mom's chest and continues to speak with the same tone) Dinosaur. Dinosaur.

Child: (keeps head against mom's chest, looks up at her face and then moves head off mom's chest up towards mom's face and speaks in a sad tone) Mommy, Mommy.

Child: (puts head back against mom's chest and whimpers). I gotta pee.

Child: (moves alligator away from body, turns toward alligator and speaks incomprehensibly).

Child: (holds alligator up to mom's face and speaks quietly) Alligator.

Child: (moves head off of mom's chest and speaks with original intensity) Alligator. Roarrr!

Child: (moves alligator away from mom's face, looks at mom and continues speaking with the same tone) Mommy. Mommy. Mommy. Mommy (each time his voice becomes quieter).

Child: (turns head away from mom, stands up, looks at mom, smiles and sits back down on mom's lap).

Reunion Episode—Mother: (wraps arms around son, smiles and speaks with positive vocal tone) Hi (child's name). Are you playing with that toy?

Child: (turns toward mom, holds alligator up to mom's face and speaks with initial intensity) Alligator. Alligator. Alligator.

Mother: (reaches for alligator and looks at son) The alligator, what does the alligator do?

Child: It goes mwa. (kisses alligator and smiles).

Mother: Oh, we'll give him a kiss. Mwa. (kisses alligator).

Child: (smiles and gets off mom's lap).

Mother: (reaches for toys) What can we make?

Child: (walks toward toys mom is holding, bends down near her and speaks incomprehensibly).

Mother: Oh, you want to play basketball?

Discussion

This study evaluated similarities and differences in 2½ year-old children's reactions to the still-face and reunion episodes of the Toddler Still-Face paradigm (T-SF), compared to those reported for young infants during the Face-to-Face Still-Face paradigm. Three empirical questions were addressed that have been evaluated in the infancy literature but not beyond that age: Is there a still-face effect, is there a reunion effect, and are there gender differences in 2½ year-old children's reactions to the still-face and reunion episodes of the T-SF? Results confirmed that the 2½ year-olds displayed the "still-face effect" and that their behavior during the still-face episode was similar in several respects to that observed for younger infants. These results also show that older, more developmentally mature toddlers continue to react in dramatic ways to even a brief period of maternal unavailability such as that afforded by the still-face, and that the still-face continues to be a powerful and age-appropriate stressor at this age, one that elicits a variety of affective reactions, regulatory coping behaviors, and meaning-making.

The infancy literature indicates that young infants typically react to the still-face with a signature decrease in positive affect, increase in negative affect, and gaze aversion, as well as pick-me-up gestures, distancing behaviors, and autonomic stress indicators (Adamson & Frick, 2003b; Toda & Fogel, 1993; Weinberg & Tronick, 1996; Weinberg et al., 1999). In this study, the 2½ year-olds appeared to be acutely aware that their mother was not behaving the way she typically behaves. Like their younger counterparts, the toddlers reacted to the still-face with an increase in negative affect and gaze aversion as indicated by turning their back to the mother. They also displayed a trend toward a decrease in positive affect from the first play to the still-face episode. Furthermore, they displayed a wide array of behaviors

indicative of proximity seeking to the mother, solicitation of her attention, and avoidance. All in all, a remarkable number of parallels between young infants' reactions to the still-face and toddlers' reactions to the still-face were observed.

At the same time, toddlers displayed a wider array of responses and reactions than their younger counterparts, which reflects the advances in the older children's social, cognitive, emotional, and motor development that have taken place by the third year of life. When confronted with unexpected maternal unavailability during the still-face episode, most of the toddlers worked effortfully to re-establish a connection with the mother (Kopp, 1989). The majority tried to regain her attention by initiating joint attention or social interaction with her (e.g., by showing toys, making verbal requests for action, and repeating verbal utterances, which became increasingly loud and more insistent when the mother did not respond). Repetition of verbal utterances in particular was a powerful and common reaction during the still-face episode among these children. Metaphorically, it was as if the children made sense of their mothers' sudden unavailability by assuming their mother didn't hear them and that, if they repeated themselves often enough and at a sufficiently loud volume, the mother would eventually hear them and respond. The children also moved physically closer to the mother, touched her, and hugged and clung to her. Perhaps several of these actions reflected their need for a feeling of security given that more complex emotional and affective sharing was not possible.

Contrary to our expectations, only a few toddlers provided verbal explanations for the mother's behavior during the still-face. Understandably these explanations were based on concrete, direct observations of the mother rather than on internal self-reflections. The most common were questions focused on the mother's presumed physiological state (e.g., sleep/wake state, level of fatigue) such as "Mom, are you awake?" or "Are you tired?" Rarely observed were self-evaluative explanations that were attributable to themselves or their prior actions, such as "Did I do something to cause this?" or "It is my fault." These results are consistent with prior reports indicating that while children in the third year of life read intentions, they are just beginning to understand the reasons for changes in the intentions, emotional states, and state of mind of other people (Bretherton, 1991; Bretherton & Beeghly, 1982).

As has been reported for younger infants, the 2½ year-olds in this study displayed both approach and avoidance behaviors to the mother during the still-face. On the one hand, they sought physical proximity to the mother, touched the mother, and hugged and clung to the mother during the still-face episode. On the other hand, they also moved away from the mother and turned their back to her during the still-face. It is possible that these conflicting reactions reflect the child's relationship history with the mother and that the still-face stressed the child's sense of security. In future research it will be important to examine the relation between the children's attachment classifications and their reactions to unexpected maternal unavailability during the still-face episode of the T-SF. In the infancy literature, significant associations between infant behavior during the still-face and subsequent attachment classifications have been reported (Braungart-Reiker, Garwood, Powers, & Wang, 2001; Cohn, Campbell, & Ross, 1991; Kogan & Carter, 1996).

Alternatively, it is possible that maternal unavailability during the still-face episode elicits ambivalent reactions in children that may or may not be attributable to their relationship history. Tronick and colleagues have argued that the maternal still-face presents the child with a prolonged mismatch or interactive error that cannot be repaired by the young child (Tronick, 1989; Tronick & Cohn, 1989; Tronick & Gianino, 1986; Weinberg & Tronick, 1996). That is, it is difficult for the toddlers to make meaning out of what the mother is doing in a consistent way that would give directional intentionality to their behavior. Thus at

one moment, they approach and try to solicit the mother's attention, but when it fails, they withdraw. It appears that they oscillate between making sense of what she is doing as available and then as unavailable. As such, they are trapped between these two meanings. Therefore, children may have both a goal of repairing the interaction and playing (making meaning) with the mother and a conflicting goal of withdrawing and avoiding connecting to her. Were the meaning-making chronically unsuccessful, that is, taking the form of an entrapment, it would seem to speak to an experiential process that could generate a disorganized attachment style, which at its core is characterized by children's failure to be able to give sustained directional intentionality to their behavior.

Despite the increase in negative affect (e.g., sad or angry-toned vocalizations) during the still-face episode, none of the children cried, although a few showed aggressive or dysregulated behavior such as yelling, hitting the mom, throwing toys, or engaging in tantrum behavior. This indicates that the 2½ year-old children in this study managed to maintain an organized state during the still-face episode, even though the mother had withdrawn all forms of regulatory support. These findings indicate just how much self-regulatory capacity these children have. This was the case even for the boys who were expected to show greater dysregulation than girls based on the infancy literature (Weinberg et al., 1999). In addition the findings showing a low incidence of aggressiveness (e.g., hitting mom, throwing toys) and yelling provide some general support for the idea that typically developing 2½ year-olds are beginning to behave in a manner that is concordant with internalized social standards (Kagan & Lamb, 1987).

The results of this study also indicate that 2½ year-olds show a reunion effect following the still-face. Similar to their younger counterparts, toddlers' negative affect increased during the still-face and did not significantly abate during the subsequent reunion play episode. Furthermore, the rise in the percentage of time they spent touching the mother and turning their back to the mother, as well as the frequency of moving away from the mother during the still-face, did not significantly diminish during the reunion episodes. In contrast, many other behaviors that peaked during the still-face returned to first play (baseline) levels during the reunion episode, including verbal requests, showing toys to mom, repetition and escalation of verbal utterances, proximity seeking, and hugging/clinging to the mother.

These reunion findings are similar to those observed among young infants (Kogan & Carter, 1996; Rosenblum et al., 2002; Weinberg & Tronick, 1996; Weinberg et al., 2006). The findings replicate the oft-observed carryover effect of negative affect from the still-face to the reunion. The data also suggest that infants and toddlers alike must cope with the simultaneous return of maternal interactive behavior and the negative intra- and interpersonal aftermath of the still-face. In particular, they may have to confront a new and confusing situation in which their mother is now acting normally but was just prior to that acting in a senseless way. Again, chronic experience with this type of inconsistency in maternal emotional availability would likely generate chronic confusion and disrupt children's engagement with things and people. The reunion episode therefore presents researchers with an excellent opportunity to observe the child's regulatory behavior and ability to re-negotiate the interaction after the stress and disruption of the still-face.

Unlike prior reports for infants, and contrary to our expectations, there were few gender differences in the toddlers' reactions to the T-SF. The hypothesis that boys would show greater dysregulation than girls during the still-face and reunion episodes was not supported. Rather, boys and girls were equally likely to show an increase in negative affect, although very few of either gender exhibited more extreme behaviors such as yelling or hitting. The gender differences that were observed, however, were in line with the infancy findings. Across all episodes of the paradigm, girls were more likely than boys to try to initiate joint

attention with the mother's attention using nonverbal means (by showing or giving her a toy), which is consistent with the younger female infants' use of object engagement as a coping strategy during the Face-to-Face Still-Face paradigm. In turn, boys were more likely than girls to elicit social interaction with the mother by physically touching the mother, which is consistent with the younger male infants' greater tendency to elicit the mother's attention directly. These differences in the way the genders attempt to re-connect with the mother are likely to reflect a complex and dynamic interaction between genetics and relational history.

These findings also suggest that, by the third year of life, 2½ year-old boys compared to younger male infants have become better at regulating their affect and less dependent on the mother as an external source of regulation. Alternatively, it is possible that the still-face is not sufficiently stressful to elicit greater dysregulation in boys at this age. A longer duration of the still-face or other stressful situations focused on age-appropriate developmental tasks such as autonomy and exploration (e.g., coping when physical movement is restricted, or with trying to master a challenging or frustrating toy), might reveal gender differences at this age.

There are several limitations to this study. First, the sample consisted only of adult healthy (as opposed to adolescent or chronically ill) mothers from mostly intact, middle-class families, and their healthy, typically developing children. Generalizability of the data is therefore limited to samples at low medical and socio-demographic risk status. Future studies on the still-face at older ages should include more diverse samples of mothers and children from different racial and ethnic backgrounds and with varying social, psychiatric, and medical risk status. Second, although the sample size is relatively large, the sample size may have limited the study's statistical power to identify gender-related effects on children's reactions to the still-face and reunion episodes during the T-SF. The study also did not examine whether broader child (e.g., difficult temperament) or maternal psychosocial factors (e.g., maternal depression) are associated with individual differences in boys' and girls' reactions during this paradigm. Finally, the study did not evaluate longitudinal changes in children's reactions to the still-face and reunion episodes over time. It will be important in future work to assess more specifically the developmental processes underlying children's reactions to the still-face and how toddlers' coping strategies change over time.

Despite these limitations, the results from this study point to how important social and emotional connections with others continue to be for toddlers during the third year of life, as has been shown in prior research with young infants. The data also suggest that the still-face paradigm, such as the T-SF or other variations of it, may be a valid and interesting tool to evaluate social connectedness beyond infancy. The quantitative findings as well as the descriptions of toddlers' reactions to the T-SF support Tronick's (2007) hypothesis that the toddlers are attempting to make coherent and complex sense of their self in relation to others, what he calls a "dyadic biopsy-chological state of consciousness." In normal interactions, the meaning is made (co-created) with the partner. During the still-face, dyadic meaning-making is prevented and the toddler must try to make sense of what is happening on his or her own. Unlike infants, for whom the meaning-making must be inferred, toddlers' meaning and meaning-making are more explicit. As expressed in their words, actions, and prosodic vocal changes, the toddlers in a very real sense seem genuinely confused by the still-face and struggle to make sense of what their mothers are doing. They ask questions and make commands coordinated with expressive behaviors. These actions are what Bruner (1990) would call "acts of meaning" or what Searle (Searle, 1983) might call "speech acts." They indicate the child's need to do something together with the mother in order to feel connected.

Although caution in interpretation of the findings is warranted, the similarity of the toddlers' reactions (especially their non-speech acts of meaning) to younger infants' meaning-conveying acts support the hypothesis that infants too are trying to make sense of the maternal still-face. Of course, the infants are doing it with their limited developmental capacities that do not include speech. Furthermore, the similarity of their communicative actions suggests that toddlers conserve as well as elaborate the meaning-making capacities of infants during the still-face. Emde (1984) and Ekman and Oster (1979) have argued that emotional expressions are conserved over the entire course of development and suggest that they may be a universal form of communication that operates across cultures. We would extend this hypothesis in two ways. We would suggest that there are meanings expressed in emotional displays as well as in other actions and behaviors, and that this polymorphic array of meanings and meaning-making systems bridges the developmental gap between infants and adults, making coordinated action and social connectedness possible (Fogel, 1993; Fogel et al., 1992).

At the core, our findings regarding toddlers' reactions to the still-face demonstrate that they view it as a perturbated, sense*less* situation. As such, its senselessness reveals the strategies children use to make sense of it. Just as importantly, by disrupting meaning-making and seeing its effects, we become aware of the normal continuous moment-by-moment process of meaning-making engaged in by all humans—infants, children, adults—as they attempt to make more sense of the world and themselves. Future research focusing more explicitly on the developmental evolution of children's meanings and meaning-making capacities during the still-face from infancy to older ages may provide a fascinating glimpse into the polymorphic meanings children hold in their states of consciousness at different ages.

Appendix

The Child and Caregiver Mutual Regulation Scoring System (CCMR) Weinberg, Beeghly, & Tronick, 2003

CHILD AFFECT (all duration codes)

Negative

- Facial expressions of anger, sadness, fear / subdued/withdrawn countenance / puzzled/concerned affect / negatively toned vocalizations such as crying, whining, complaining, frustration, irritation, annoyance, or impatience

Interest

- Facial expressions of interest / neutral affect /normal conversational tone of voice

Positive

- Facial expressions of joy (smiling) / positively toned vocalizations (laughing, exuberant squealing, enthusiasm)

- Nonscorable affect: Scored when the child cannot be seen or heard on the video

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CHILD ACTIONS (these codes are coded on a frequency basis unless otherwise specified)

Requests

1   *Verbal Request:* Child requests an action or attention verbally (e.g., child asks mother to play with a toy or to watch him/her do something "Hey Mommy, watch!" or "Play with me?")

2   *Physical Request:* Child requests an action or attention physically (e.g., child pulls mom's hand, moves/manipulates her face during the still-face, looks at mom for help)

3   *Request Information:* Child requests information about a toy, how to do something, or why something is happening (e.g., "What's this thing?" or "Mommy, what's the matter? What's wrong?")

4	*Request to Leave:* Child requests to leave the laboratory room or to go home (e.g., "Mommy, I need to go potty," "I want to go home")
5	*Show Toy:* Child points to a toy, shows or gives the mother a toy, or puts a toy in the mother's face/line of vision
6	*Plead:* Child pleads with mom to do or stop something (e.g., "Please, Mommy, play with me.")
7	*Repetition:* Child repeats verbal utterances. The utterance must occur at least twice (e.g., "Mommy, look at me. Mommy, look at me"). In this example, the first utterance is coded as a verbal request, and the second as a Repetition.
8	*Escalation:* Child exhibits escalating behavior. That is, the child sounds increasingly upset, loud, or insistent.

Explanation

The child provides an explanation or rationalization for why the mother is behaving in a particular manner. For example: "Mommy, are you tired?" or "Are you awake"?

Active disruptive/aggressive actions

1	*Yell:* The child yells at the mother or in general.
2	*Hit mom:* The child throws a toy at the mother or hits the mother.
3	*Throw toy:* The child throws a toy against the wall, hits toys against each other, or stomps on a toy.
4	*Prohibits mom:* The child does not want to share, does not want the mother to participate or play with him, or do something. The child forbids the mother to do something verbally (e.g., "You can't play with the alligator. I had it first"; "No") or non-verbally (e.g., the child shakes his head NO; pulls a toy away from mom).
5	*Run Around:* The child runs around the laboratory and is not focused on the task at hand.
6	*Tantrum:* The child exhibits tantrum behavior (e.g., throws herself on floor). This code is often double coded with other active/disruptive/aggressive codes.

Proximity/contact seeking or avoiding behavior

1	*Seeks proximity:* The child moves closer to the mother.
2	*Touch mom (duration code):* The child touches the caregiver or caresses the caregiver in an affectionate manner.
3	*Hug/cling (duration code):* The child clings to the mother, sits on the mother's lap, or hugs the mother.
4	*Kiss:* The child kisses the caregiver. Code any kiss to the caregiver's body.
5	*Turn back to mom (duration code):* The child has or turns his back to the caregiver.
6	*Moves away:* The child moves away from the caregiver or gets off the caregiver's lap.
7	*Leave room:* The child goes to the door or tries to open the door.

Self-comforting (duration code)

The child sucks on a thumb or finger(s) or the child rubs her face or twirls her hair.

Self-evaluations

1	*Positive evaluation:* The child believes that he can do something or expresses pride in an achievement (e.g., the child claps hands at his own achievement, statements such as "I can do it," "I did it," "It's ok").
2	*Negative evaluation:* The child expresses self-doubt, or self-criticism, or believes she cannot do something ("I cannot do it," "I cannot deal with this").

Note. Only the child part of the CCMR is presented here. The entire system is available upon request.

Maternal procedure violations during the toddler still-face paradigm

1	*Smile:* The mother smiles or laughs during the still-face.
2	*Nod:* The mother nods or shakes her head during the still-face.

3	*Use Toy:* The mother accepts or hands a toy to the child during the still-face.
4	*Touch:* The mother touches the child during the still-face.
5	*Talk:* The mother talks to the child during the still-face.

As in previous infancy studies, the mothers were coded during the still-face to evaluate whether they violated the instructions of the still-face. Examples of violations included talking to or touching the child, any affect other than neutral, and accepting or giving toys.

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Table 1

Descriptive statistics for percent time CCMR (duration) codes during the episodes of the Toddler Still-Face paradigm (N = 70)

Affect/Behavior	Play 1			Still-Face			Reunion Play			$F(df = 2,67)$
	n/I	M	SD	n/I	M	SD	n/I	M	SD	Episode
Positive affect	49	6.04	9.13	43	3.81	5.48	52	4.42	8.40	2.35
Neutral/interest	70	93.31	9.23	70	92.54	11.78	70	94.17	10.15	0.43
Negative affect	10	0.64[a]	2.52	17	3.65[b]	11.12	12	1.42[a,b]	4.06	3.56*
Touch	14	2.14[a]	8.43	34	11.07[b]	23.29	26	6.60[a,b]	19.17	4.56*
Hug/cling	1	0.07	0.56	11	3.05	12.98	4	2.22	12.53	1.89
Back to mom	19	1.94[a]	5.46	35	9.48[b]	21.81	24	4.29[a,b]	13.85	4.76*
Self-comfort	10	0.32	1.16	18	2.07	11.98	14	0.50	1.25	1.06

n/I = number of individual children exhibiting a particular code in each episode (out of 70);

M = arithmetic mean; SD = standard deviation

*
$p < 0.05$,

**
$p < 0.01$,

***
$p < 0.000$.

Note: Means with differing superscripts are significantly different from each other as assessed using simulation based post hoc tests at $p < 0.05$.

Table 2

Descriptive statistics for rate per minute (RPM) CCMR behavioral (frequency) codes during the episodes of the Toddler Still-Face paradigm

Behavior	Play 1			Still-Face			Reunion			F(df = 2,67)
	n/I	M	SD	n/I	M	SD	n/I	M	SD	Episode
Verbal requests	28	0.43[a]	0.70	52	1.46[b]	2.13	35	0.46[a]	0.59	8.80***
Requests for info	35	0.67	1.06	44	0.98	1.34	42	0.81	1.12	1.93
Requests to leave	1	0.02	0.18	1	0.01	0.06	2	0.04	0.21	0.71
Show toy	36	0.69[a]	1.10	53	1.19[b]	1.21	39	0.71[a]	1.08	5.00**
Repetitions	22	0.24[a]	0.42	60	2.68[b]	2.94	24	0.32[a]	0.59	23.31***
Escalation	5	0.04[a]	0.13	19	0.30[b]	0.69	4	0.04[a]	0.16	4.95**
Seeks proximity	32	0.45[a]	0.62	48	0.79[b]	0.82	32	0.54[a]	0.78	6.09**
Touch mom	14	0.22[a]	0.57	34	0.55[b]	0.80	26	0.31[a]	0.57	5.38**
Hug/cling to mom	1	0.01[a]	0.06	11	0.11[b]	0.29	4	0.02[a]	0.13	5.21**
Turn back to mom	19	0.23[a]	0.52	35	0.44[b]	0.64	24	0.25[a]	0.47	3.78*
Move away	3	0.41[a]	0.55	40	0.63[b]	0.77	35	0.52[a,b]	0.70	3.15*
Disruptive actions	18	0.25	0.51	19	0.31	0.74	22	0.33	0.73	0.37
Explanations	3	0.04	0.18	3	0.05	0.26	2	0.01	0.09	1.98
Self-evaluations	2	0.01	0.08	1	0.01	0.06	2	0.03	0.19	0.56

n/I = number of individual children exhibiting a particular code in each episode (out of 70);

M = arithmetic mean; SD = standard deviation

*
$p < 0.05$,

**
$p < 0.01$,

***
$p < 0.000$.

Note: Means with differing superscripts are significantly different from each other as assessed using simulation based post hoc tests at $p < 0.05$.