

The mission of ISIS is to advance the study of children from birth to 3 years, and to publish and communicate research through print and electronic media. The principal venues for this information are the Society's official journal, *Infancy*, and a biennial meeting. ICIS, organized by the Society.

ISIS Membership: Membership in the society is open to the scientific community. Professionals with an advanced degree (beyond the B.A.) and students engaged in the process of obtaining an advanced degree in the area of infant development are eligible for membership. The annual dues for the year 2003 are US \$60 for regular members and US \$40 for students. Membership in the Society includes a subscription to *Infancy*, the official journal of the Society, and the Society's newsletter. In addition, members can attend the Society's biennial meeting at a reduced registration cost.

For more information about the Society or for a membership application, please visit the website at <http://www.isisweb.org>, or write to ISIS, Institute for Children, Youth, & Families, 27 Kellogg Center, Michigan State University, East Lansing, MI 48824-1022, USA.

International Conference on Infant Studies

May 6-10, 2004, Chicago, USA

Officers of the International Society on Infant Studies

President
Arnold Sameroff

Past President
Rachel Keen

Treasurer
Lauren Adamson

Secretary
David Levkowitz

Subscription Information

Subscriptions: *Infancy* is published quarterly by Lawrence Erlbaum Associates, Inc., 10 Industrial Avenue, Mahwah, NJ 07430-2262. Subscriptions for Volume 4, 2003, are available only on a calendar-year basis. Paid members of the International Society on Infant Studies (ISIS) automatically receive a printed subscription to *Infancy*. Individual rates: **Print Plus Online:** \$65.00 in USA, \$95.00 outside USA. Institutional rates: **Print-Only:** \$245.00 in USA, \$275.00 outside USA. **Online-Only:** \$245.00 in USA and outside USA. **Print Plus Online:** \$275.00 in USA, \$305.00 outside USA. Visit LEA's website at <http://www.erlbaum.com> to view a free sample. Send subscription orders, information requests, and claims to the Journal Subscription Department, Lawrence Erlbaum Associates, Inc., 10 Industrial Avenue, Mahwah, NJ 07430-2262.

Change of Address: Address changes should include the mailing label or a facsimile. Send address changes for non-ISIS members to the Journal Subscription Department, Lawrence Erlbaum Associates, Inc., 10 Industrial Avenue, Mahwah, NJ 07430-2262. Address changes for ISIS members should be sent to ISIS, Institute for Children, Youth, & Families, 27 Kellogg Center, Michigan State University, East Lansing, MI 48824-1022, USA. Attr: Member Subscription Address Change.

Claims: Claims for missing issues cannot be honored beyond 4 months after mailing date. Duplicate copies cannot be sent to replace issues not delivered due to failure to notify publisher of change of address.

This journal is abstracted or indexed in *EBSCOhost Products: EMBASE/Excerpta Medica; Linguistics and Language Behavior Abstracts; and ScienceDirect Navigator*. Microform copies of this journal are available through ProQuest Information and Learning, P.O. Box 1346, Ann Arbor, MI 48106-1346. For more information, call 1-800-521-0600 x2888.

Copyright © 2003, Lawrence Erlbaum Associates, Inc. No part of this publication may be used in any form or by any means, without permission of the publisher. Send requests for permission to the Permissions Department, Lawrence Erlbaum Associates, Inc., 10 Industrial Avenue, Mahwah, NJ 07430-2262.

Printed in the United States of America

ISSN 1525-0008

TARGET ARTICLE

**The Still Face: A History of a Shared
Experimental Paradigm**

Lauren B. Adamson
Department of Psychology
Georgia State University

Janet E. Frick
Department of Psychology
University of Georgia

When faced by a suddenly unresponsive social partner, young infants typically react by sobbing and gazing away. This still-face reaction has intrigued researchers for several decades. In this article, we present a history of the still-face paradigm in which we locate early observations of the still-face effect, describe the formalization of a procedure that reliably produces it, and discuss how this procedure has been used to investigate a broad range of questions about early social and emotional development. In addition, we reflect on the heuristic value of shared experimental paradigms.

During the 1975 biennial meeting of the Society for Research in Child Development (SRCD), developmental psychologist Edward Tronick and his colleagues (Tronick, Adamson, Als, & Brazelton, 1975) presented a paper entitled "Infant Emotions in Normal and Perturbed Interactions." The highlight was the illustration of a phenomenon, the still-face effect, using then-novel videotape technology. First, a split screen image of a 70-day-old infant and his mother appeared on the conference ballroom's big screen as they engaged in the pleasant cyclic ebb and flow of a face-to-face interaction. Then, the dyad reappeared in a "still-face" con-

Requests for reprints should be sent to Lauren B. Adamson, Department of Psychology, Georgia State University, Atlanta, GA 30303. E-mail: ladamson@gsu.edu

dition during which the mother remained "completely unresponsive, with a flat expressionless face for 3 minutes." According to Tronick et al.'s text, the infant first "orients toward the mother" and "greet[s] her expectantly." But then, when the mother "fails to respond appropriately," the infant

rapidly sobers and grows wary. He makes repeated attempts to get the interaction into its usual reciprocal pattern. When these attempts fail, the infant withdraws [and] orients his face and body away from his mother with a withdrawn, hopeless facial expression.

This presentation was not the first sighting of the young infants' reaction to an unresponsive adult, but it succeeded in initiating broad interest in the still-face effect. There are likely several reasons for this presentation's influence. Undoubtedly, the addition of a video clip to words and data heightened attention to the infant's immediate and intense reaction. More significantly, the presentation placed the infant's reaction in a new interpretative frame. For the first time, an experimental manipulation of an adult's behavior embedded a period of unresponsiveness into an ongoing social interaction. Observing an infant's actions before, during, and after a perturbed interaction raised issues not only about infants' early perceptual experience but also about their social understanding and their ability to regulate affect and attention.

The study reported at the SRCD meeting was soon published as a peer-reviewed article (Tronick, Als, Adamson, Wise, & Brazelton, 1978) in a journal outside the mainstream of the burgeoning field of infancy research (the *Journal of the American Academy of Child and Adolescent Psychiatry*, which was renamed the *Journal of the American Academy of Child and Adolescent Psychiatry* in 1979), with a title ("The Infant's Response to Entrapment Between Contradictory Messages in Face-to-Face Interactions") that did not explicitly evoke the still-face effect. Nevertheless, the still-face effect rapidly piqued interest that has yet to abate a quarter-century later. This experimental manipulation has become a common procedure with which to probe topics as varied as person perception, the emergence of gendered and cultural differences in communication, the roots of individual differences in attachment, and the effect of maternal depression on infants. Moreover, the still-face effect still challenges our understandings of young infants' social, emotional, and cognitive capacities.

In this article, we document how developmental scientists have employed and understood the still face. Our primary aim is to trace the emergence of the still face as a popular method in infancy research. To accomplish this, we systematically reviewed the burgeoning experimental literature that has used the still-face manipulation to construct a historical narrative about how it has been used and interpreted. This exercise lets us focus specifically on the emergence of the still face as an experimental paradigm. To date, portions of the still-face literature have been sum-

marized in articles and chapters that discuss the manipulation, but the still face has not been isolated from other related phenomena and manipulations to produce a comprehensive summary focused primarily on the still face itself. It is important to note that placing the still face in a historical frame is a complement to, not a substitute for, theoretical interpretations of robust findings or meta-analyses of the empirical literature, both of which we hope will be stimulated by this article.

Our second aim is to treat our review of the still-face literature as a case study of the emergence and use of a standardized research protocol. The formulation of shared procedures is one of the hallmarks of investigative practice within psychology (Danziger, 1990). Although infancy researchers readily acknowledge their use of shared procedures, we rarely reflect on how these shared procedures influence the focus and the findings of our investigations. The still-face manipulation is a particularly good candidate for such an exploration. Like the Strange Situation (Ainsworth, Blehar, Waters, & Wall, 1978), it is easy to locate in the literature through the citation of a small number of source articles. However, unlike the Strange Situation, the still-face manipulation has varied considerably across studies. By examining variations in how the procedure was performed, the data were coded and analyzed, and the findings interpreted, we hope to gain a fuller appreciation of the promises and the pitfalls of shared experimental practices.

METHOD

The source materials for this analysis are published studies that employed an experimental still-face manipulation with young infants. The period covered is from the late 1970s through 2001. Two procedures were used to locate relevant articles and chapters. First, we traced a citation network through the literature by compiling a list of all unduplicated references in articles and chapters that employed a still-face condition and, if so, it was added to our list and its bibliography was checked for additional references. Second, we compiled all citations to Tronick et al. (1978) in the Social Science Citation Index through the first half of 2001. These two procedures generated a total of 45 unduplicated references to empirical studies using the still-face manipulation (for a list of these works, see the first section of the References). Characteristics of each report of an empirical study using the still-face manipulation were systematically coded to abstract information about the investigators' practices (what the still-face manipulation was called, how many unique data sets were contained in the published literature) and theoretical perspective (rationale for using the procedure and primary interpretation of its effect). Data coding also captured information about the methods used, including types of samples (age of infant, adult characteristics), procedural details (e.g., phases used, length of

phases, codes for infant and for adult behavior), and statistical analyses (including factors used).

Because our primary aim in this article was to construct a narrative that describes the emergence of a shared experimental paradigm, the timing and setting of each study was of particular importance. This historical motivation led us away from performing a meta-analysis, which, although it might have clarified some concerns about the strength of the still-face effect within the literature taken as a whole, would have obscured important contextualizing information. To gather such information, we made several forays into the large literature that refers to the results of the empirical studies of the still face and documents the effects of other experimental manipulations of adult-infant interactions. We selectively draw on this related literature in our narrative account of the development and use of the still-face procedure (for a list of these works, see the second section of the References).

RESULTS

An Overview of the Corpus of Still-Face Studies

Since the publication of Tronick et al.'s seminal work in 1978, there has been a steady stream of published empirical studies of the still-face effect that has recently escalated (see Figure 1). The corpus of published empirical studies contains 45 studies that were produced by a total of 20 different research groups.

The vast majority of these studies has examined responses in samples of healthy, full-term infants, who also tend to be primarily White. Other samples include Chinese infants (Kisilevsky et al., 1998), deaf infants (Koesler, 1995; Koesler & Meadow-Orlans, 1999; Smith-Gray & Koesler, 1995), African American infants (Segal et al., 1995), cocaine-exposed infants (Bendersky & Lewis, 1998), infants with Down syndrome (Carvajal & Iglesias, 1997; Legerstee & Bowman, 1989), children with autism (Nadel et al., 2000), and infants of depressed mothers (Pelaez-Nogueras, Field, Hossain, & Pickens, 1996).

Although all of these studies retain the basic structure of Tronick et al.'s (1978) still-face procedure (i.e., interactive adult, followed by nonresponsive, still-faced adult, typically followed by a return to normal social interaction), other important methodological elements have varied considerably across studies. These elements include the age of the infant ($M = 5.2$ months, range = 1–12 months, plus one study done with autistic children aged 5–12 years; see Figure 2), the length of the still-face portion of the session ($M = 106.3$ sec, range = 45 to 180 sec; see Figure 3), and the behavior of the adult between segments (e.g., turning away, exiting and re-entering the room, talking to the experimenter, or no break in interaction). Although Tronick et al. used a 180-sec still-face condition, 2 min is the modal length, and 90 sec is a close second.

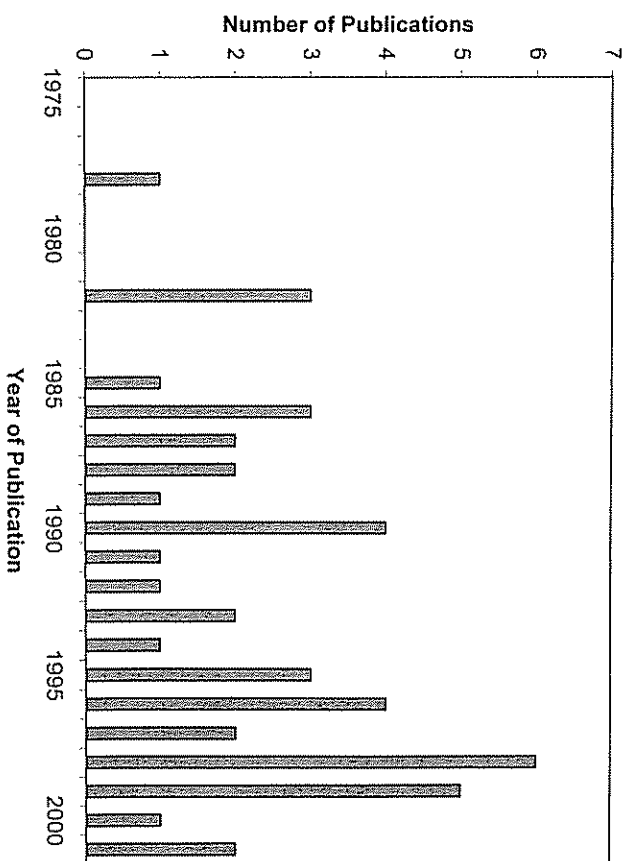


FIGURE 1 Empirical studies of the still-face effect as a function of Year of publication ($N=45$).

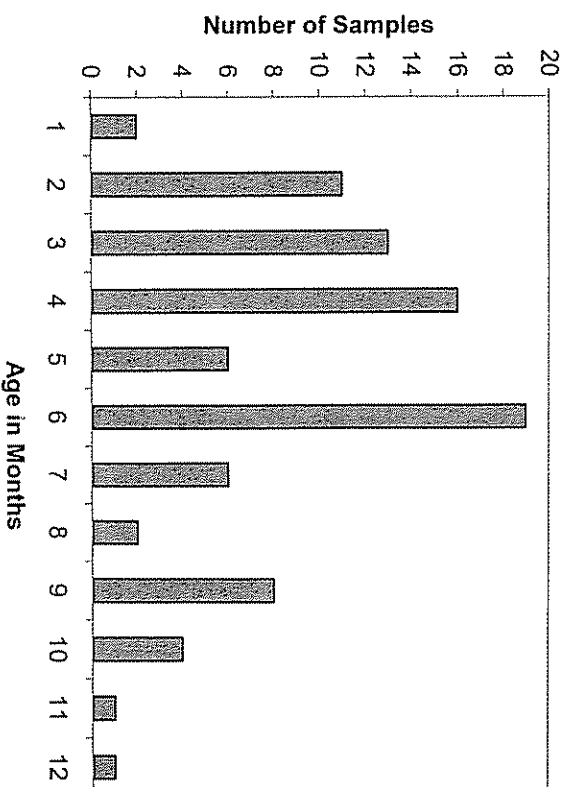


FIGURE 2 Age of infants observed in the still-face condition. $N = 89$ distinct samples used in 45 published studies, where a range of ages was used; mean age is displayed.

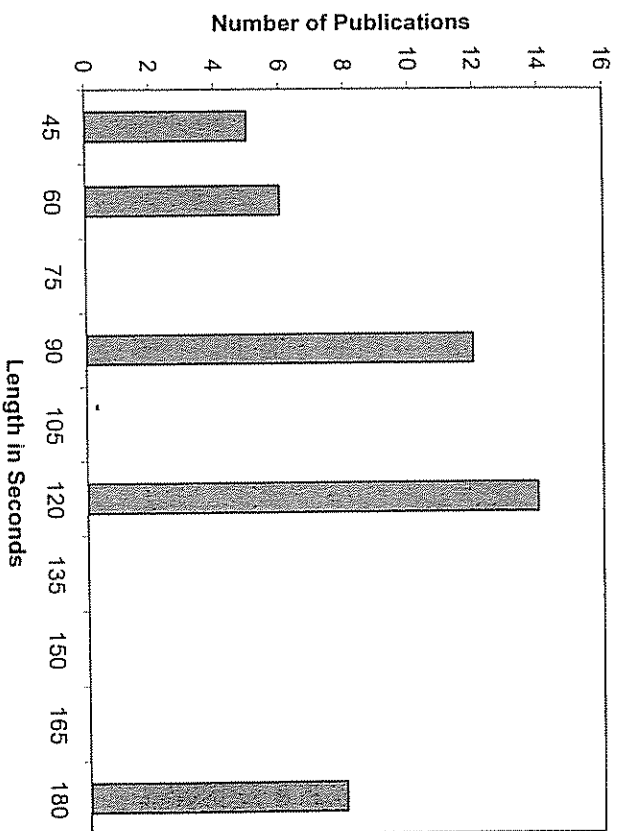


FIGURE 3 Length of the still-face condition in published studies ($N = 45$).

Coding procedures also varied across studies, although almost all captured the signature of the still-face effect, gaze aversion and a decrease in positive affect. In addition to coding for infant direction of gaze and basic facial expression of affect, some coding schemes have incorporated "rich" interpretations of clusters of behavior (e.g., Braungart-Rieker, Garwood, Powers, & Notaro, 1998; Weinberg & Tronick, 1994, 1996), or fine-grained microcoding of facial expressions (e.g., Carvajal & Iglesias, 1997; Shapiro, Fagen, Prigent, Carroll, & Shalun, 1998).

A Historical Narrative

Precursors of the still-face effect. At its inception, the still-face manipulation had several close cousins in the experimental literature related to the perceptual and social abilities of very young infants. Researchers had manipulated adult communicative behavior to observe reactions to perceptual paradoxes (e.g., Aronson & Rosenbloom's, 1971, study of young infants' reaction when the mother's voice is displaced in space) and to variations in facial expression and movement (e.g., Wilcox & Clayton's, 1968, observations of 5-month-old infants' visual fixation and kicking as they watched silent motion pictures of a woman's face). Moreover, experimental manipulations had been used to discern what sorts

of stimulation best elicit infants' attention and affect (e.g., Brossard & Decarie's, 1968, study of the reinforcing value of faces alone and in combination with additional stimulation such as touch and holding). Other studies systematically exposed young infants to different experimental treatments, including the presentation of unresponsive social partners (e.g., Roedel & Slaby, 1977), to investigate the formation of social preferences.

In addition to these relatives, there were a few advance sightings of still-face-like phenomena. The earliest account was probably Kaila's (1932; cited in Kaufmann & Kaufmann, 1980) brief description in German of how a 3-month-old infant responded to his social partner's suddenly immobile, neutral face with reduced smiling, uneasiness, and distress. The most tantalizing previews were produced by Stechler, Carpenter, and their colleagues during their studies of very early social perception. Stechler and Latz (1966) first spotted an intriguing anomaly when they repeatedly showed three nursery-reared newborns an assortment of real and schematic faces. At the end of the first month, two of the infants unexpectedly started to avert their gaze from an immobile full face, but not from a face in profile or a simple drawing of a face. They (Carpenter, 1974a, 1974b; Carpenter, Tecco, Stechler, & Friedman, 1970; Stechler & Carpenter, 1967) observed this phenomenon again in other studies that compared infants' reactions to different stimuli, including the mother's face, a mannequin head, and an abstract facelike colander that appeared through a rectangular hole in a uniform dark green felt field. Stechler and his colleagues provided rich descriptions of the infants' behavior, including the "frequent almost surreptitious glancing back at the target while holding the head averted" (Stechler & Carpenter, 1967, p. 182), and of the sequential aspects of the reactions, noting that "there is smiling or cooing followed by a sober-faced pause, followed by repeated smiling or cooing, followed by distressed crying which required intervention" (Carpenter et al., 1970, p. 105). Moreover, they were convinced that the behavior was "clearly based on the informational rather than the energetic qualities of the stimulus" (Stechler & Latz, 1966, p. 525), and they mentioned qualities including stimulus incongruity and the violation of expectation. Finally, they contended that the reaction was deliberate:

The infant is trying to alter the behavior of the stimulus. It is as if the infant has expectations of the target which are not being met and it appears that the baby is attempting to change its discrepant environment. (Carpenter et al., 1970, p. 105)

Thus, by the beginning of the 1970s, the infant's striking reaction to the immobile face had entered the literature. It initially appeared against the backdrop of the traditional experimental literature related to young infants' discrimination of the human face, and so much of the primary contrast was drawn to reactions to other stimuli defined more or less as faces.

The next, and for our purpose, defining move was to develop an experimental procedure that situated the phenomenon within the context of social interaction. The ground for this step was readied during lively interdisciplinary collaborations that focused on infants' early communicative abilities. Bruner's Center for Cognitive Studies at Harvard was an especially noteworthy forum. In the late 1960s, Bruner drew to his Center postdoctoral fellows from several disciplines to observe young infants as they interacted with people and objects. Included in this extraordinary collaboration were Brazelton (who offered Bruner a course in what "infants 'were really' like"; Bruner, 1983, p. 147), Papoušek, Trevarthen, and Tronick. Together they filmed very young infants as they interacted with people and with objects.

Two features of this work set the stage for the still-face manipulation. First, it was informed by the central insights that young infants had different ways of interacting with people and with objects ("communicating" vs. "doing"; Bruner, 1968) and, more specifically, that they delighted in reciprocal exchanges with responsive caregivers (see Brazelton, Koslowski, & Main, 1974; Trevarthen, 1974). Second, this research began to take an expanded view of the young infant as ethological methods tempered reigning experimental approaches. As Trevarthen (1977) later noted, researchers were beginning to observe infants in ways that let them "express themselves more naturally," and their reactions were recorded "more directly than before" (p. 227). In addition, there were fledgling attempts made to have mothers collaborate with researchers to demonstrate infants' capacities (e.g., see Bruner's, 1968, description about how he and Papoušek asked mothers to disappear unpredictably so that they might demonstrate how a "failure to obtain reciprocal produces an active avoidance," p. 57; see also Papoušek & Papoušek, 1977).

The experimental production of the still-face effect. In 1972, Tronick, working with Adamson, Als, and Wise, made the decisive move of asking mothers to deliberately alter the way they interacted with their 2- to 6-month-old infants within the frame of an experimental paradigm. Tronick recognized that the still-face manipulation could be used to test the hypothesis that infants were active participants in social interactions that were mutually regulated. This was a bold hypothesis at the time, because several leading researchers (e.g., Kaye, 1979) were championing the opposing view that mothers were experts at acting as if the young infant was an active participant in early dialogues.

The still-face manipulation was one of three perturbations (the others asked the mother to count slowly or to sit still in profile) that were included in the pilot study that inaugurated the observation laboratory in Brazelton and Tronick's new Child Development Unit at the Children's Hospital Medical Center in Boston. The perturbations all involved three periods: a normal interaction without toys ("play with your baby as you typically do"), an experimental condition (e.g., "look at your baby with a neutral face" or "count very slowly as you play with your baby"), and a

reunion period during which the mother resumed the normal interaction. Between periods, the mother briefly left the infant alone in a curtained alcove.

The first published study of the still-face effect (Tronick et al., 1978) was done to establish that mothers both could and would alter their actions in ways that were consistent with an experimenter's instructions and, more interestingly, that infants would react to these perturbations in intriguing ways. Data from seven infants ranging in age from 1 to 4 months were derived from videotapes that were systematically coded to describe vocalizations, direction of gaze, head orientation, facial expression, and amount and type of movement. The still-face effect was displayed by all of the infants, beginning with the first participant in the procedure. As captured on the videotape that was later shown at SRCDD in 1975 and the still photographs reproduced in Figure 4 (Tronick et al., 1978; also reproduced in Tronick, 1980; Tronick, Als, & Adamson, 1979), this mother maintained a staring pose for 3 min, and her infant reacted with a complex blend of greeting, retreating, and monitoring behaviors.



FIGURE 4 A times series of photographs taken from the videotape of the first infant observed in the still-face condition. From "The Infant's Response to Entrapment Between Contradictory Messages in Face-to-Face Interaction" by E. Tronick, H. Als, L. Adamson, S. Wise, & T. B. Brazelton, 1978, *Journal of the American Academy of Child Psychiatry*, 17, p. 9. Reprinted with permission.

In addition to demonstrating the existence of the still-face effect, Tronick et al. (1978) discussed several aspects of the phenomenon. They described the occurrence of a carry-over from the still-face period into the beginning of the subsequent reengagement as infants often engaged in "wary monitoring" (p. 8) as their mothers issued an apology. They sketched the developmental course of the still-face effect. Drawing on the work of Stechler and Carpenter, they suggested that infants as young as 2 to 3 weeks appear to recognize when mothers violate the reciprocity of a social interaction and that over the first months of life, they may become increasingly skilled at reestablishing a reciprocal interaction. They illustrated the growing richness of the infants' repertoire of social acts with the memorable behavior of the boy depicted in Figure 4 who at 5 months of age remained wary for only half of the still-face condition, after which he

looked at the mother and laughed briefly. After this brief tense laugh, he paused, looked at her soberly, and then laughed again, loud and long, throwing his head back as he did so. At this point, the mother became unable to maintain an unresponsive still face. (p. 12)

Finally, Tronick et al. (1978) noted that the still-face effect is reminiscent of the patterns of staring and appeasement displayed by other primates (Altmann, 1962; Chance, 1962) and of the reactions of infants to isolation (Bowlby, 1969; Harlow & Zimmerman, 1959).

Clarifying the still-face effect. The significance of the experimental production of the still-face effect was quickly recognized (e.g., see the discussion, which included Carpenter and Papousek, that followed Brazelton's brief description of the still-face effect at a Ciba Foundation symposium; Brazelton, Tronick, Adamson, Als, & Wise, 1975). Citation of Tronick et al. (1978) rapidly spread, even when the still-face manipulation was not performed (e.g., Arco & McCluskey, 1981). Moreover, the still-face effect was quickly replicated, not only by Tronick and his colleagues (Tronick, Ricks, & Cohn, 1982), but also by independent research teams (Fogel, Diamond, Langhorst, & Demos, 1982; Gussella, Muir, & Tronick, 1988; Murray & Trevarthen, 1985; Stoller & Field, 1982).

There were several reasons for the immediate interest in the still-face effect. First of all, it is dramatic: Infants appear to find it more disturbing than several other perturbations of social interactions, including brief physical separations (Field, Stoller, Vega-Lahr, Scalfidi, & Goldstein, 1986; Field, Vega-Lahr, Scalfidi, & Goldstein, 1986; see also Field, 1994) and short interruptions of an interaction that occur when the mother turns away to talk briefly with an experimenter (Murray & Trevarthen, 1985). In addition, the effect is richly textured, with infants often displaying behavior patterns that include subtly timed dampened smiles, side glances at a partner, and yawns. Above all, the still-face effect is revealing. Al-

though researchers had already come to appreciate how well young infants could engage in reciprocal social exchanges with their obliging caregivers (e.g., Brazelton et al., 1974; Stern, 1974; Trevarthen, 1974), the still-face condition let them demonstrate infants' unaided ability to initiate exchanges and subtly modulate their attention. Only Lamb, Morrison, and Malkin (1987) raised any reservation about its value as a probe of early social expectancies.

In addition to the still-face effect's appeal, the still-face procedure was greeted as an efficient method for generating variables. It was simple, if not emotionally easy, for a parent to execute and an experimenter to validate. Moreover, researchers from several different laboratories quickly agreed on a recognizable signature for the still-face effect of increased gaze aversion and decreased smiling that contrasted markedly with infants' attentive, gleeful engagement during face-to-face interactions. To detect this signature, all that was needed was an observational coding scheme that characterized gaze, facial expression, and vocalizations so that a pitiful set of variables related to gaze aversion, positive affect, and, less often, negative affect could be derived.

It is important to note that the simple signature of increased gaze aversion and decreased positive affect does not provide a rich description of the infants' emotional experience during the still-face manipulation. For one, it does not retain information from the entire procedure. With rare exceptions (Fogel et al., 1982; Stoller & Field, 1982), researchers have focused on behavior during the still-face condition, although recently some investigators (Bendersky & Lewis, 1998; Kogan & Carter, 1996; Weinberg & Tronick, 1996) have argued persuasively that the reengagement period provides an excellent opportunity to observe the infant's ability to reorganize following an emotionally distressing situation. Moreover, the signature glosses over some distinctive nuances of the infants' self-organizing behavior such as rapid gaze alterations, yawning, and self-comforting actions. It also does not provide a functional interpretation for the infants' actions, as do more rarely used synthetic schemes (e.g., Infant Coping Behavior System, Gianino & Tronick, 1988; Infant Regulatory Scoring System, Weinberg & Tronick, 1994; Weinberg, Tronick, Cohn, & Olson, 1999; the COPE procedure for coding comforting, object orientation, parent orientation, and escape by Braungart-Rieker et al., 1998) that are more difficult to apply. Finally, it does not probe beneath the behavioral surface to monitor the infants' physiological reaction to the perturbation (but see Frick & Abekop, 2000; Stoller & Field, 1982; Weinberg & Tronick, 1996).

A richer description of infants' responses during the still-face procedure may help clarify to what extent the still-face condition is stressful. Although the procedure has the reputation of being distressing (e.g., Legetstee & Bowman, 1989), several studies that have coded negative affect (e.g., Ellsworth, Muir, & Hains, 1993; Fogel et al., 1982; Mayes & Carter, 1990; but see Moore, Cohn, & Campbell, 2001) have replicated Tronick et al.'s (1978) finding that infants do not typi-

cally cry during the still-face phase of the manipulation, although they may be significantly more likely to do so in the reunion phase (Weniberg et al., 1999; but see Gusella et al., 1988; Kisilevsky et al., 1998). Moreover, a richer description of the still-face effect may also provide a fuller treatment of individual variations in its expression. Although the effect is remarkably robust, not all infants readily display it (e.g., see Fogel et al., 1982, who described two infants who were more avoidant during the preceding social interaction than during the still-face phase). Moreover, rarely has the basic issue of short-term stability been systematically addressed, although there are intriguing reports that individual differences in affective reactions (Stoller & Field, 1982) and coping strategies (Giamino & Tronick, 1988) may be relatively stable.

The full developmental course of the still-face effect has also not yet been fully clarified. Except for Stechler and Carpenter's early sightings of the effect, there has been little attention to how infants under 2 months of age respond. Moreover, by 9 months of age, and perhaps earlier, the implementation of the still-face condition may need to be changed because some infants appear able to actively alter or escape the impact of the manipulation by redirecting their attention toward objects or by successfully reengaging the adult (Cohn & Tronick, 1982; Tronick et al., 1978; Tronick et al., 1982; but see Striano & Rochat, 1999). Nevertheless, there are some indications that gaze aversion increases from 3 to 6 and perhaps 9 months of age (Gusella et al., 1988; Moore et al., 2001; Toda & Fogel, 1993), although at all these ages infants avert their gaze significantly more often during the still-face condition than during periods of normal social interaction. Moreover, there is mounting evidence that the expression of emotions during the still-face condition does not change systematically from 2 to 6 and perhaps even 9 months of age (Cohn, Campbell, & Ross, 1991; Gusella et al., 1988; Lamb et al., 1987; Moore et al., 2001; Shapiro et al., 1998; Stack & Muir, 1990; Toda & Fogel, 1993). One intriguing possibility is that the increase in gaze aversion reflects a more general developmental increase in the behavioral complexity and organization of coping mechanisms over time (for a discussion of this possibility, see Giamino & Tronick, 1988; Toda & Fogel, 1993).

Explaining the still-face effect. From the very first reports of the still face, researchers have moved beyond describing the still-face effect to trying to explain why the manipulation produces such a profound reaction. In turn, this search for an explanation has fueled some superb programmatic efforts to understand infants' behavior. The result has been a literature characterized by an unusual blend of careful experimentation and complex conceptualization.

According to Tronick and his colleagues (Tronick et al., 1978), a consideration of goals and emotions is critical to a full explanation of the still-face effect. They suggest that the still-face effect arises because the procedure violates the rules that govern the mutual regulation of social interactions. The adult is simultaneously

communicating "Hello" and "Goodbye" and the infant becomes "trapped in the contradiction" (p. 11). The infant's responses demonstrate an impressive capacity to detect the partner's intentions and to regulate affective displays to try to achieve the expected goals of a reciprocal interaction. This demonstration, in turn, underscores how important the transfer of emotion between the infant and caregiver is to the infant's growing sense of effacement (Tronick, Cohn, & Shea, 1985; Tronick & Giamino, 1986). One strength of this regulatory model is that it was able to predict the finding that infants sequentially weave positive and negative affective displays as they respond to a still-faced social partner (Tronick et al., 1982).

Early on, parsimonious interpretations were proposed that focused almost exclusively on the infants' immediate experience of the still-face stimulus. For example, Field's earliest explanation of the still-face effect (Stoller & Field, 1982; but see Field, 1994) was based on her optimal activation band model that emphasized the level rather than the quality of maternal stimulation. In a related attempt, Fogel (1982a, 1982b) assimilated the still-face effect into his broad consideration of an affective tolerance model of early social interactions that focused interpretation on the dynamic flow of the infant's arousal. However, soon most researchers echoed Tronick's suggestion that an adequate explanation of the still-face effect had to consider not only immediate experience but also the infants' appreciation that the expected patterns of social interaction had been violated.

Muir and his colleagues at Queen's University have been especially persistent in their attempt to come to grips with what causes the still-face effect (for a review, see Muir & Hams, 1993). Beginning with a much-needed control study that demonstrated that the still-face effect was not merely due to the passage of time (Gusella et al., 1988, Study 1), they then systematically decomposed the still-face stimulus in hopes of determining what it means to young infants. The most provocative stream of findings delineated the role of touch in mitigating the still-face effect. When mothers did not touch their infants during both the normal and still-face periods (Gusella et al., 1988, Experiment 2), the contrast between periods was eliminated for 3-month-olds but not for 6-month-olds, suggesting that there is a developmental change in sensitivity to purely visual and auditory aspects of mothers' interactive behavior. Muir and Stack continued to probe the role of touching by systematically allowing different forms of touch to the still-face manipulation. Stack and Muir (1990) confirmed that touching often occurred when mothers were allowed to do so during both normal interactions (Experiment 1) and during still-face periods when touching was permitted (Experiment 2) and that the still-face effect was partially mitigated when the mother was allowed to actively touch the infant. After replicating this finding (Stack & Muir, 1992, Experiment 1), they began to explore the effects of more nuanced variations of the adults' hand movements by, for example (Experiment 2), having an experimenter actively or passively touch 5-month-old infants during the still face with or without the infant's vision of the hands being blocked by an opaque bin. Once again, it appeared

that even when an adult's facial and vocal expressions were unresponsive, active touch could elicit a substantial amount of infant smiling. Stack (Stack & Arnold, 1998; Stack & LePage, 1996) subsequently took this research in an interesting direction by asking if by touch alone still-faced and silent mothers could communicate different interactive aims such as getting the infant to imitate, engage in a playful interaction, or maintain eye contact.

This research program has produced findings that "create a bit of a mystery" (Stack & Muir, 1992, p. 1522). On the one hand, touch by a still-faced adult may elicit a substantial amount of positive affect. On the other hand, the dynamic face seemed to have privileged status in early social interactions. When touch is absent, the sight of a still face provokes the still-face effect while a loss of general stimulation, adult vocalizations, or contingency does not (Muir & Hains, 1993; for related work, see Rochat, Neisser, & Maran, 1998). However, "the story is not so simple" (Muir & Hains, 1993, p. 182). The more one varies the still-face procedure by, for example, altering the order of conditions or substituting a stranger for the mother, the more it appears that young infants' expectations are informed by the specific interactive context.

In short, the still-face effect clearly does not admit to a simple explanation. Indeed, the significance of the still face as an experimental effect may rest in large measure on its success as a focal point for discussions of the essence of the young infants' experience of social interactions. These discussions are characterized by unusually broad scope. Researchers have cast wide nets to find possible theoretical approaches that might stimulate satisfying explanations. For example, Muir and his colleagues have been inspired by views as varied as Gibson's (1979) notion of amodal stimulation (see Stack & Muir, 1992) and dynamic systems theory (Fogel & Thelen, 1987; see Muir & Hains, 1993), whereas others, such as Trevarthen (1998), have emphasized intersubjective perspectives. Moreover, the still-face effect has brought into consideration processes as fundamental as early perception, emotion, and cognition and as multifaceted as self and mutual regulatory affective processes in mother-infant relationships (e.g., Weinberg et al., 1999).

Adopting and adapting the still-face procedure. Once the still-face effect was accepted as a phenomenon, several researchers incorporated the still-face procedure into their arsenal of methodological tools. For our purpose, it is interesting to note how rapidly the procedure was adopted and how it was adapted to address a range of concerns.

One productive but relatively uncommon use of the still face has been as a theoretical probe. Fogel and colleagues (Fogel et al., 1982) provided the earliest example of this use when they modified the still-face procedure to test their dynamic model of emotion. They argued that their model would be supported if the arousing effect of the still face was modulated by when the still face occurred relative to the

infant's rapid cycles of tension during social interactions. More specifically, if the level of tension was on the rise, as they suggested it is when the infant first looks at the mother, a sudden still face might be more upsetting than if the level of tension was decreasing, as it might be when the infant first smiles at the mother.

Fogel et al.'s (1982) comparison of how infants reacted to the still face beginning after a first look versus after a first smile produced empirical findings that were equivocal at most: The still-face effect was robust in both conditions, and subtle variations in postcondition behavior were not replicated by Stoller and Field (1982). However, the general strategy of comparing the still-face effect across conditions to map out the young infant's experience of the social world proved informative. At least in its basic signature, the still-face effect was readily elicited not only by the mother but also by strangers (e.g., Ellsworth et al., 1993; Stack & Muir, 1992, Experiment 2), by fathers (Braungart-Rieker et al., 1998), and even by a televised image of an adult (Gusella et al., 1988, Experiment 3). However, infants seem to draw the line based on animacy. When infants were faced with various still-faced people and "dynamic, interactive, multimodal" objects (Ellsworth et al., 1993; see also Legerstee, Corter, & Klennapple, 1990; Legerstee, Pomerleau, Malcuit, & Feider, 1987), they appeared to make a categorical judgment. The affective aspect of the still-face effect was reserved only for people; infants reacted to all manners of more-or-less humanlike objects with only flat affect regardless of how similar the object was to a person.

A second application of the still-face procedure has been as an indicator of group differences. Often replication of the effect rather than the documentation of differences has been the focus of studies that have included groups such as preterm and full-term middle-class and lower class African American infants (Segal et al., 1995; see also Kogan & Carter, 1996), Chinese and Canadian infants observed with fathers and with mothers (Kisilevsky et al., 1998), and infants who participated in day care (Field, Stoller, et al., 1986). However, the still-face manipulation has been used to study the effects of various developmental disorders including Down syndrome (Carvajal & Iglesias, 1997; Legerstee & Bowman, 1989), deafness (Koeester, 1995; Koeester & Meadow-Orlans, 1999), and autism (Nadel et al., 2000) as well as to address enduring questions about gender differences in early communication (Weinberg et al., 1999).

Using the still-face procedure to probe group differences is no simple matter. The study of gender differences in the still-face effect provides an instructive example. Unlike studies of developmental disorders, this work has not been plagued by the difficulty of selecting an appropriate comparison group or adapting the still-face procedure for participants who are not young infants. Nevertheless, results related to gender effects have run the full gamut from none (e.g., Toda & Fogel, 1993), to girls displaying more distress than boys (Mayes & Carter, 1990; Stoller & Field, 1982), to girls appearing more positive than boys (Braungart-Rieker, Courtney, & Garwood, 1999; Cohn & Tronick, 1983). These

different findings may reflect seemingly minor variations in the still-face procedure, including how affect is coded. The problem also may run deeper. To locate reliable group differences, it is likely necessary to consider how infants are acting just before (e.g., see Weinberg et al.'s, 1999, study of gender differences) and after (e.g., Bendersky & Lewis's, 1998, investigation of the effect of prenatal exposure to cocaine on infants' arousal) the still-face phase to get a fuller picture of variations in self-regulatory processes.

A third broad group of applications of the still-face procedure involves using it as a gauge of developing relationships to answer a myriad of questions about how differences in interactive experiences with a partner might stem from earlier experiences and might predict later social-emotional status. Variations in the still-face effect have been related to variations in mothers' baseline behavior characterized in terms of sensitivity (Kogan & Carter, 1996), responsiveness (Bendersky & Lewis, 1998), positivity (Carter, Mayes, & Payer, 1990), interactive style (Stolter & Field, 1982; Tronick et al., 1982), and depression (Moore et al., 2001; Pelaez-Nogueras et al., 1996; Tronick et al., 1985). Infants' response to the still face at 6 months of age has been related to later attachment classification at 1 year (Braungart-Rieker et al., 1999; Braungart-Rieker, Garwood, Powers, & Wang, 2001; Cohn et al., 1991; Kiser, Bates, Maslin, & Bayles, 1986; Tronick et al., 1982), externalizing and internalizing behaviors at 18 months (Moore et al., 2001), and behavior problems at 3 years (Bates, Maslin, & Frankel, 1985).

DISCUSSION

In this article, we have taken a method-defined slice of the infancy research literature to draw together studies that have used the still-face procedure (Tronick et al., 1978). This strategy generated a rich corpus of studies that support the claim that the still-face paradigm has become an essential part of discussions about early social interactions. Over the past 25 years, interest in the still face has remained unabated. Indeed, the procedure's use is on the rise (see Figure 1) and the pipeline remains filled (e.g., see the program of the 2002 biennial meeting of the International Society for Infant Studies, including Frick, 2002).

In this closing section, we move away from the particulars of the literature to reflect on the developmental course of the still face itself. As a first step, it is important to place the still face within the broader context of then contemporary studies of young infants. Although Tronick et al.'s (1978) formulation of the still-face procedure was innovative, it fits well within a vibrant period of transformation within developmental psychology when the study of early social interactions, and more generally, of the "competent infant" (Stone, Smith, & Murphy, 1973), was burgeoning. At this time, young infants were often surprising observers with unexpected perceptual, cognitive, and social capacities. Researchers were energized as

well by new observational methods that allowed the review of rapidly occurring actions. Yet the still face is relatively unique in that it, rather than many of its close procedural cousins, became a part of a field's repertoire.

It is a recurring puzzle in the history of psychology why a specific event, procedure, or concept captures and sustains interest. In some instances (e.g., the interesting case of Twitmyer and conditioned reflexes; Coon, 1982), it may be argued that a key deciding factor had less to do with science and more to do with reputation. Our analysis of the emergence of the still face suggests that in this instance, other factors deserve consideration. The still-face procedure was noteworthy because it successfully merged naturalistic and experimental procedures in a way that let infants demonstrate their appreciation of caregivers' activities. As Mur and Hans (1999) wryly wrote, the still-face context is "the infant's version of experimental instruction" (p. 157). It begins by homing in on the face-to-face social interactions that readily occur during early infancy, and it adds to it an unnatural pausing in the adult's activity that immediately provokes a complex response from the infant that, using cutting-edge video techniques, convincingly demonstrated the infant's sensitivity to a social partner's actions.

By now, hundreds of infants have reacted to the still-face experimental instruction with a series of dramatic actions that both regulate arousal and beckon the unresponsive partner. The basic signature of increased gaze aversion and decreased positive affect has been so robust that it has been often overlooked that both data collection and coding procedures have varied considerably across studies. Sometimes methodological variations have been signaled by the use of the term *modified* still face (e.g., Bendersky & Lewis, 1998) but more often, significant variations in adult behavior just prior to the manipulation (e.g., whether the person is absent, sitting in profile, engaged in face-to-face interaction) and in the length of the still face (ranging from 30–180 sec) go unevaluated.

This lack of standardization may hamper close comparisons across studies, which in turn makes it difficult to resolve some questions about the still-face effect, including lingering concerns about the presence and significance of crying and of gender differences. However, it may also be viewed in more positive ways. First, the robustness of the still face allows researchers to make meaningful modifications in method so that they can use the still-face effect to investigate new concerns such as infants' appreciation of maternal facial expression (D'Entremont & Muir, 1997; Rochat, 1999; Rochat & Striano, 1999). It also inspires researchers to design related but distinct manipulations designed to probe the specific interactive processes (e.g., the 5-sec contingent still face designed by Cohn & Elmore, 1988) or to investigate older infants' triadic interactions with people (Nadel & Tremblay-Leveau, 1999) or affective social referencing about objects (Markov, Adamson, & Bakeman, 2000; see Striano & Rochat, 1999, for a related idea).

The experimental creation of a phenomenon is not without possible perils. As Schneider, Bouyer, and Mietkiewicz (2000) warned, researchers must remain

mindful of ethical issues that may be involved in using classical research paradigms, including the still-face procedure. For example, we have rarely paid sufficient attention to the partners' experience of the still-face manipulation (with the fine exception of Mayes, Carter, Egger, & Payer, 1991). Moreover, there is always the troubling suspicion that we might overextend the still-face paradigm, using it even when another observational context might provide a better view of the process under study (e.g., see Lamb et al., 1987, who argued that social expectancies might best be studied not in face-to-face but in distress-relief contexts).

In addition to prompting creativity, the robustness of the still-face effect in light of procedural variability highlights young infants' nascent social abilities. When researchers employ the still-face procedure, they are adopting not only a (loose) script for conducting a study but, more important, essential elements of a compelling plot about how young infants are able to act. Thus, the still-face paradigm continues to attract interest not only because as an expedient method it helps regulate experimental practice, but also, and most significantly, because it creates a fascinating phenomenon that illustrates central qualities of the young infant's capacity for interpersonal engagement. Moreover, it is likely that the still-face procedure, or variants that develop from it, will continue to be used broadly in part because it is still not fully clear why infants react as they do to the perturbation of a social partner's actions. The still-face has been explained from several different perspectives, setting the stage for a debate about the underlying phenomenon. It is noteworthy that this debate has occurred at most at the margins, leaving some central issues, such as the centrality of contingency, still open for further exploration. Moreover, as the still-face becomes one of several measures of individual variability, its unique usefulness as a probe of processes such as attachment will need to be assessed.

In closing, the historical record to date provides ample evidence that the still-face has fulfilled its promise as a shared experimental paradigm. It has helped to structure our view of the very young infant's ability to modulate affect and attention in a way that can be readily captured across laboratories. Moreover, there is also ample evidence that it will continue to be a useful method in a wide range of investigations. Of course, one cannot read the future in the past. Nevertheless, we think it is safe to predict that there are still sections to be written in a history of the still-face. The still-face method still inspires experimental creativity; the still-face effect continues to elude full explanation. Moreover, and perhaps most important, the still-face paradigm continues to spotlight young infants' amazing social, emotional, and cognitive capacities.

ACKNOWLEDGMENTS

Portions of this article were presented at the International Conference on Infant Studies, Toronto, Ontario, Canada, April 2002. We thank Roger Bakeman for in-

spiring and guiding this project and Yana Markov and Tara Hottenstein for assisting with it.

REFERENCES

- Bendersky, M., & Lewis, M. (1998). Arousal modulation in cocaine-exposed infants. *Developmental Psychology, 34*, 555-564.
- Braungart-Rieker, J., Courtney, S., & Garwood, M. M. (1999). Mother- and father-infant attachment: Families in context. *Journal of Family Psychology, 13*, 535-553.
- Braungart-Rieker, J., Garwood, M. M., Powers, B. P., & Notario, P. C. (1998). Infant affect and affect regulation during the still-face paradigm with mothers and fathers: The role of infant characteristics and parental sensitivity. *Developmental Psychology, 34*, 1428-1437.
- Braungart-Rieker, J., Garwood, M. M., Powers, B. P., & Wang, X. (2001). Parental sensitivity, infant affect, and affect regulation: Predictors of later attachment. *Child Development, 72*, 252-270.
- Carter, A. S., Mayes, L. C., & Payer, K. A. (1990). The role of dyadic affect in play and infant sex in predicting infant response to the still-face situation. *Child Development, 61*, 764-773.
- Carvaja, F., & Iglesias, J. (1997). Mother and infant smiling exchanges during face-to-face interaction in infants with and without Down syndrome. *Developmental Psychobiology, 31*, 277-286.
- Cohn, J. F., Campbell, S. B., & Ross, S. (1991). Infant response in the still-face paradigm at 6 months predicts avoidant and secure attachment at 12 months. *Development and Psychopathology, 3*, 367-376.
- D'Eatherton, B., & Muir, D. W. (1997). Five-month-olds' attention and affective responses to still-faced emotional expressions. *Infant Behavior and Development, 20*, 563-568.
- Ellsworth, C. P., Muir, D. W., & Hanns, S. M. J. (1993). Social competence and person-object differentiation: An analysis of the still-face effect. *Developmental Psychology, 29*, 63-73.
- Field, T., Stohler, S., Vega-Lahr, N., Scalfi, F., & Goldstein, S. (1986). Maternal unavailability effects on very young infants in homecare vs. daycare. *Infant Mental Health Journal, 7*, 274-280.
- Field, T., Vega-Lahr, N., Scalfi, F., & Goldstein, S. (1986). Effects of maternal unavailability on mother-infant interactions. *Infant Behavior and Development, 9*, 473-478.
- Fogel, A., Diamond, G., Langhorst, B., & Dennis, V. (1982). Affective and cognitive aspect of the 2-month-old's participation in face-to-face interaction with the mother. In E. Tronick (Ed.), *Social interchange in infancy: Affect, cognition, and communication* (pp. 37-57). Baltimore: University Park Press.
- Giammo, A., & Tronick, E. Z. (1988). The mutual regulation model: The infant's self and interactive regulation and coping and defensive capacities. In T. M. Field, P. M. McCabe, & N. Schneidman (Eds.), *Stress and coping across development* (pp. 47-68). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Gausella, J. L., Muir, D., & Tronick, E. Z. (1988). The effect of manipulating maternal behavior during an interaction in 3- and 6-month-olds: affect and attention. *Child Development, 59*, 1111-1124.
- Kiser, L. J., Bates, J. E., Mastin, C. A., & Bayles, K. (1986). Mother-infant play at six months as a predictor of attachment security at thirteen months. *Journal of the American Academic of Child Psychiatry, 25*, 68-75.
- Kisilevsky, B. S., Hanns, S. M. J., Kang, L., Muir, D. W., Xu, F., Fu, G., et al. (1998). The still-face effect in Chinese and Canadian 3- to 6-month-old infants. *Developmental Psychology, 34*, 629-639.
- Koester, L. S. (1995). Face-to-face interactions between hearing mothers and their deaf or hearing infants. *Infant Behavior and Development, 18*, 145-153.

- Kroemer, L. S., & Mendow-Orlans, K. P. (1999). Responses to interactive stress: Infants who are deaf or hearing. *American Annals of the Deaf, 144*, 395-403.
- Kogon, N., & Carter, A. S. (1996). Mother-infant reengagement following the still-face: The role of maternal emotional availability in infant affect regulation. *Infant Behavior and Development, 19*, 359-370.
- Lamb, M., Morrison, D. C., & Malkin, C. M. (1987). The development of infant social expectations in face-to-face interaction: A longitudinal study. *Merrill-Palmer Quarterly, 33*, 241-254.
- Legenstein, M., & Bowman, T. G. (1989). The development of responses to people and a toy in infants with Down syndrome. *Infant Behavior and Development, 12*, 463-477.
- Legenstein, M., Corser, C., & Kienapple, K. (1990). Hand, arm, and facial actions of young infants to a social and nonsocial stimulus. *Child Development, 61*, 774-784.
- Legessee, M., Pomerleau, A., Maitour, G., & Feidler, H. (1987). The development of infants' responses to people and a doll: Implications for research in communication. *Infant Behavior and Development, 10*, 81-95.
- Mayes, L. C., & Carter, A. S. (1990). Emerging social regulatory capacities as seen in the still-face situation. *Child Development, 61*, 754-763.
- Moore, G. A., Cohn, J. F., & Campbell, S. B. (2001). Infant affective response to mother's still-face at 6 months differentially predict externalizing and internalizing behaviors at 18 months. *Developmental Psychology, 37*, 706-714.
- Murray, L., & Trevarthen, C. (1985). Emotonal regulation of interactions between two-month-olds and their mothers. In T. M. Field & N. A. Fox (Eds.), *Social perception in infants* (pp. 177-197). Norwood, NJ: Ablex.
- Nadel, J., Crone, S., Maittinger, M.-J., Canet, P., Hudelot, C., Lecuyer, C., et al. (2000). Do children with autism have expectations about the social behavior of unfamiliar people? A pilot study using the still-face paradigm. *Autism, 4*, 133-146.
- Pelaez-Nogueras, M., Field, T. M., Hossum, Z., & Pickens, J. (1996). Depressed mothers' touching increases infants' positive affect and attention in still-face interactions. *Child Development, 67*, 1780-1792.
- Rochat, P., Neisser, U., & Marzan, V. (1998). Are young infants sensitive to interpersonal contingency? *Infant Behavior and Development, 21*, 355-366.
- Rochat, P., & Striano, T. (1999). Social-cognitive development in the first year. In P. Rochat (Ed.), *Early social cognition: Understanding others in the first months of life* (pp. 3-34). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Segal, L. B., Oster, H., Cohen, M., Caspi, B., Myers, M., & Brown, D. (1995). Smiling and fussing in seven-month-old preterm and full-term Black infants in the still-face situation. *Child Development, 66*, 1829-1843.
- Shapiro, B., Figen, J., Pngot, J., Carroll, M., & Shahan, J. (1998). Infants' emotional and regulatory behaviors in response to violations of expectations. *Infant Behavior and Development, 21*, 299-313.
- Smith-Gray, S., & Kroemer, L. S. (1995). Defining and observing social signals in deaf and hearing infants. *American Annals of the Deaf, 140*, 422-427.
- Stack, D. M., & Arnold, S. L. (1998). Changes in mothers' touch and hand gestures influence infant behavior during face-to-face interchanges. *Infant Behavior and Development, 21*, 451-468.
- Stack, D. M., & LePage, D. E. (1996). Infants' sensitivity to manipulations of maternal touch during face-to-face interactions. *Social Development, 5*, 41-55.
- Stack, D. M., & Mur, D. W. (1990). Tactile stimulation as a component of social interchange: New interpretations for the still-face effect. *British Journal of Developmental Psychology, 8*, 131-145.
- Stack, D. M., & Mur, D. W. (1992). Adult tactile stimulation during face-to-face interactions modulates five-month-olds' affect and attention. *Child Development, 63*, 1509-1525.
- Stoller, S., & Field, T. (1982). Alternation of mother and infant behavior and heart rate during a still-face perturbation of face-to-face interaction. In T. Field & A. Fogel (Eds.), *Emotion and early interactions* (pp. 57-82). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Striano, T., & Rochat, P. (1999). Developmental link between dyadic and triadic social competence in infancy. *British Journal of Developmental Psychology, 17*, 551-562.
- Toda, S., & Fogel, A. (1993). Infant response to the still-face situation at 3 and 6 months. *Developmental Psychology, 29*, 532-538.
- Tronck, E., Als, H., Adamson, L., Wise, S., & Brazelton, T. B. (1978). The infant's response to entrainment between contradictory messages in face-to-face interaction. *Journal of the American Academy of Child Psychiatry, 17*, 1-13.
- Tronck, E. Z., Ricks, M., & Cohn, J. F. (1982). Maternal and infant affective exchange: Patterns of adaptation. In T. Field & A. Fogel (Eds.), *Emotion and interaction: Normal and high-risk infants* (pp. 83-100). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Weinberg, M. K., & Tronck, E. Z. (1994). Beyond the face: An empirical study of infant affective configurations of facial, vocal, gestural, and regulatory behaviors. *Child Development, 65*, 1503-1515.
- Weinberg, M. K., & Tronck, E. Z. (1996). Infant affective reactions to the resumption of maternal interaction after the still-face. *Child Development, 67*, 905-914.
- Weinberg, M. K., Tronck, E. Z., Cohn, J. F., & Olson, K. L. (1999). Gender differences in emotional expressivity and self-regulation during early infancy. *Developmental Psychology, 35*, 175-188.

ADDITIONAL REFERENCES

- Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the strange situation*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Altmann, S. A. (1962). A field of study of the sociobiology of Rhesus monkey. *Annals of the New York Academy of Science, 102*, 338-435.
- Aro, C. M. B., & McCluskey, K. A. (1981). "A change of pace": An investigation of the salience of maternal temporal style in mother-infant play. *Child Development, 52*, 941-949.
- Aronson, E., & Rosenblum, S. (1971). Space perception in early infancy: Perception within a common auditory-visual space. *Science, 172*, 1161-1163.
- Bates, J. E., Maslin, C. A., & Frankel, K. (1985). Attachment security, mother-infant interaction, and temperament as predictors of behavior problem ratings at age three years. In I. Bretherton & E. Waters (Eds.), *Growing points in attachment theory and research. Monographs of the Society for Research in Child Development, 209*, 167-193.
- Bowlby, J. (1969). *Attachment and loss*. New York: Basic Books.
- Brazelton, T. B., Koslowski, B., & Mann, M. (1974). The origins of reciprocity: The early mother-infant interaction. In M. Lewis & L. Rosenblum (Eds.), *The effect of the infant on its caregiver* (pp. 49-76). New York: Wiley.
- Brazelton, T. B., Tronck, E., Adamson, L., Als, H., & Wise, S. (1975). Early mother-infant reciprocity. In *Child Foundation Symposium: Vol. 33. Parent-infant interaction* (pp. 137-154). Amsterdam: ASP.
- Brossard, L. M., & Decarie, T. G. (1968). Comparative reinforcing effect of eight stimulations on the smiling response of infants. *Journal of Child Psychology and Psychiatry, 9*, 51-59.
- Bruner, J. S. (1968). *Processes of cognitive growth: Infancy*. Worcester, MA: Clark University Press.
- Bruner, J. (1983). *In search of mind: Essays in autobiography*. New York: Harper Colophon.
- Carpenter, G. C. (1974a). Mother's face and the newborn. *New Scientist, 21*, 742-744.
- Carpenter, G. C. (1974b). Visual regard of moving and stationary faces in early infancy. *Merrill-Palmer Quarterly, 20*, 181-194.
- Carpenter, G. C., Tecco, J. J., Steehler, G., & Friedham, S. (1970). Differential visual behavior to human and humanoid faces in early infancy. *Merrill-Palmer Quarterly, 16*, 91-108.
- Chance, M. R. A. (1962). An interpretation of some agonistic postures: The role of "cut-off" acts and postures. *Symposium of the Zoological Society of London, 8*, 71-90.

- Cohn, J. F., & Elmore, M. (1988). Effect of contingent changes in mothers' affective expression on the organization of behavior in 3-month-old infants. *Infant Behavior and Development, 11*, 493-505.
- Cohn, J. F., & Tronick, E. Z. (1982). Communicative rules and the sequential structure of infant behavior during normal and depressed interaction. In E. Z. Tronick (Ed.), *Social interchange in infancy: Affect, cognition, and communication* (pp. 59-77). Baltimore: University Park Press.
- Cohn, J. F., & Tronick, E. Z. (1983). Three-month-old infants' reaction to simulated maternal depression. *Child Development, 54*, 185-193.
- Coom, D. J. (1982). Eponymy, obscurity, Twitmyer and Pavlov. *Journal of the History of the Behavioral Sciences, 18*, 255-262.
- Danziger, K. (1990). *Constructing the subject: Historical origins of psychological research*. Cambridge, England: Cambridge University Press.
- Field, T. (1991). The effects of mother's physical and emotional unavailability on emotion regulation. *Monographs of the Society for Research in Child Development, 59*, 208-227.
- Fogel, A. (1982a). Affect dynamics in early infancy: Affective tolerance. In T. Field & A. Fogel (Eds.), *Emotion and early interaction* (pp. 25-56). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Fogel, A. (1982b). Early adult-infant interaction: Expectable sequences of behavior. *Journal of Pediatric Psychology, 7*, 1-22.
- Fogel, A., & Thelen, E. (1987). The development of early expressive and communicative action: Reinterpreting the evidence from a dynamic systems perspective. *Developmental Psychology, 23*, 747-761.
- Frick, J. E. (Chair). (2002, April). *The still-face procedure: Historical perspectives, current trends and future directions*. Poster symposium presented at the International Conference on Infant Studies, Toronto, Ontario, Canada.
- Frick, J. E., & Abelekop, B. S. (2000, July). *Infant attention in the still-face procedure: Physiological responses and individual differences*. Poster presented at the International Conference on Infant Studies, Brighton, England.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.
- Hardow, H. F., & Zimmerman, R. R. (1959). Affective responses in infant monkeys. *Science, 8*, 421-432.
- Kaiba, E. (1932). Die Reaktion des Säuglings auf das menschliche Gesicht [The reaction of infants to the human face]. *Annalen Universitäts Abweiss, 17*, 1-114.
- Kaufmann, R., & Kaufmann, F. (1980). The face schema in 3- and 4-month-old infants: The role of dynamic properties of the face. *Infant Behavior and Development, 3*, 331-339.
- Kaye, K. (1979). Thickening thin data: The maternal role in developing communication and language. In M. Bullock (Ed.), *Before speech: The beginning of interpersonal communication* (pp. 191-206). Cambridge, England: Cambridge University Press.
- Markov, Y., Adamson, L. B., & Bakeman, R. (2000, July). *Infants' communicative strategies during social referencing volitions*. Poster presented at the International Conference on Infant Studies, Brighton, England.
- Mayes, L., Carter, A., Egger, H., & Payer, K. (1991). Reflections on silliness: Mothers' reactions to the still-face situation. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 22-28.
- Muir, D. W., & Hains, S. M. J. (1993). Infant sensitivity to perturbations in adult facial, vocal, tactile, and contingent stimulation during face-to-face interaction. In B. de Boysson-Bardies, S. de Schonen, P. W. Juszyk, P. McNeillage, & J. Morton (Eds.), *Developmental neurocognition: Speech and face processing in the first year of life* (pp. 171-185). Dordrecht, The Netherlands: Kluwer Academic.
- Muir, D., & Hains, S. (1999). Young infants' perception of adult intentionality: Adult contingency and eye direction. In P. Rochat (Ed.), *Early social cognition: Understanding others in the first months of life* (pp. 155-187). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Nadel, J., & Tremblay-Leveau, H. (1999). Early perception of social contingencies and interpersonal intentionality: Dyadic and triadic paradigms. In P. Rochat (Ed.), *Early social cognition: Understanding others in the first months of life* (pp. 189-212). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Papoušek, H., & Papoušek, M. (1977). Mothering and the cognitive headstart: Psychological considerations. In H. R. Schaffer (Ed.), *Studies in mother-infant interaction* (pp. 63-88). London: Academic.
- Rochat, P. (1999). Direct perception and representation in infancy. In E. Winograd, R. Frush, & W. Hirst (Eds.), *Ecological approaches to cognition* (pp. 3-30). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Rochat, P., & Sloby, R. G. (1977). The role of distal and proximal interaction in infant social preference formation. *Developmental Psychology, 13*, 266-273.
- Schneider, B., Bouyer, S., & Mueckevez, M.-C. (2000). Ethical problems posed by several (too) classical research paradigms in psychology and in developmental psychopathology. *Psychiatrie de l'enfant, 43*, 5-22.
- Seecher, G., & Carpenter, G. (1967). A viewpoint on early affective development. In J. Hellmuth (Ed.), *Exceptional infant: Vol. 1. The normal infant* (pp. 165-189). Seattle, WA: Special Child Publications.
- Seecher, G., & Lutz, E. (1966). Some observations on attention and arousal in the human infant. *Journal of the American Academy of Child Psychiatry, 5*, 517-525.
- Stern, D. N. (1974). Mother and infant at play: The dyadic interaction involving facial, vocal and gaze behaviors. In M. Lewis & L. A. Rosenblum (Eds.), *The effect of the infant on its caregiver* (pp. 187-213). New York: Wiley.
- Stone, L. J., Smith, H. T., & Murphy, L. B. (1973). *The competent infant: Research and commentary*. New York: Basic Books.
- Trevarthen, C. (1974). Conversations with a two-month-old. *New Scientist, 21*, 230-235.
- Trevarthen, C. (1977). Descriptive analyses of infant communicative behavior. In H. R. Schaffer (Ed.), *Studies in mother-infant interaction* (pp. 227-270). London: Academic.
- Trevarthen, C. (1998). The concept and foundations of infant intersubjectivity. In S. Braten (Ed.), *Intersubjective communication and emotion in early ontogeny* (pp. 15-46). Paris: Cambridge University Press.
- Tronick, E. (1980). The primacy of social skills in infancy. In D. B. Sawin, R. C. Hawkins, L. O. Walker, & J. H. Pentecuff (Eds.), *The exceptional infant* (Vol. 4, pp. 144-158). New York: Brunner/Mazel.
- Tronick, E., Adamson, L. B., Als, H., & Brazelton, T. B. (1975, April). *Infant emotions in normal and perturbed interactions*. Paper presented at the biennial meeting of the Society for Research in Child Development, Denver, CO.
- Tronick, E., Als, H., & Adamson, L. (1979). Structure of early face-to-face communicative interactions. In M. Bullock (Ed.), *Before speech: The beginning of interpersonal communication* (pp. 349-370). Cambridge, England: Cambridge University Press.
- Tronick, E. Z., Cohn, J., & Shea, E. (1985). The transfer of affect between mothers and infants. In T. B. Brazelton & M. Yogman (Eds.), *Affect development in infancy* (pp. 11-25). Norwood, NJ: Ablex.
- Tronick, E. Z., & Gianino, A. F. (1980). The transmission of maternal disturbance to the infant. In E. Z. Tronick & T. Field (Eds.), *Maternal depression and infant disturbance* (pp. 5-11). New York: Wiley.
- Wilcox, B. M., & Clayton, F. L. (1968). Infant visual fixation on motion pictures of the human face. *Journal of Experimental Child Psychology, 6*, 22-32.