ORIGINAL PAPER

Microanalysis of 4-Month Infant Vocal Affect Qualities and Maternal Postpartum Depression

Donna Demetri Friedman · Beatrice Beebe · Joseph Jaffe · Don Ross · Sandra Triggs

Abstract This study examined the association of 6-week maternal self-report depressive symptoms measured by the Center for Epidemiological Studies-Depression Scale (CES-D) with 4-month infant vocal affect qualities. This was part a larger study which examined many additional domains of both infant and maternal behavior. Infant vocal affect qualities were examined in 122 4-month old infants during face-to-face play in relation to 6-week maternal depressive symptoms. Mothers were categorized depressed (26.2%) based on a 16+ cutoff on the CES-D. Videotaped interactions were coded on a 1-s time basis for infant vocal affect qualities (high positive, neutral/positive, fuss/whimper, cry, angry protest and silent.) Infants of depressed mothers were more vocally activated in both positive and negative qualities. In addition, infants of depressed mothers were more vocally variable, specifically in and out of fuss/whimper, as well as more likely to change, rather than maintain vocal states.

Keywords Infant vocal quality · Maternal depression · Face-to-face play · Microanalysis of behavior

Introduction

Learning how to communicate represents perhaps the most important developmental process to take place in infancy.

D. D. Friedman (✉)
Silver School of Social Work, New York University,
New York, NY, USA
e-mail: donnademetrif@msn.com

B. Beebe · J. Jaffe · D. Ross · S. Triggs
New York State Psychiatric Institute, Columbia University,
New York, NY, USA

This process depends on innate predispositions as well as on sociocultural factors. It requires a complex combination of abilities including, motor skills, physiological functions, and integrative processes. When the face-to-face interaction is impacted by maternal depression it appears to affect the communication.

Maternal postpartum depression compromises maternal emotional responsivity and infant socio-emotional functioning (Weinberg and Tronick 1998). Research on the interactions of depressed mothers and their infants revealed the importance of early interactions for later development (Field 1995). Infants of depressed mothers were at risk for later developmental and social problems, including disturbances in affect, in secure attachments, and poorer intellectual and academic performance (Field 1992, 1995). In addition, children of depressed parents were at increased risk for developing affective disorders (Field et al. 1990).

Infants were sensitive to the emotional states of their mothers and other caregivers (Tronick and Weinberg 1997; Murray and Cooper 1997). In the communicative domains of face, voice, and touch, and in the dimensions of quantity, quality and timing, depressed mothers' social and affective behavior was distorted in ways that contrast with the behavior of non-depressed mothers (Tronick and Weinberg 1997; Weinberg and Tronick 1997).

Infants whose mothers are depressed expressed more vocal distress such as fussing and crying (Field et al. 1988; Murray et al. 1996a, b; Weinberg and Tronick 1998). Infants of depressed mothers used negative vocalizations to communicate (Cohn and Tronick 1989; Field et al. 1988; Murray et al. 1996a, b; Weinberg and Tronick 1998). However, little work investigates whether they were also vocally more positive.

This study examined 4-month infant vocal affect qualities during face-to-face play with mothers in relation

to 6-week maternal depression. It broadened the focus of previous research by examining a range of positive to negative vocal affect qualities of infants of depressed mothers.

Mother–Infant Studies: A Microanalytic View

In the 1970s, researchers such as Jaffe, Stern, Beebe and Tronick, among others, began to analyze the mother–infant relationship in more detailed ways (Stern 1971; Stern et al. 1975; Beebe and Stern 1977; Tronick et al. 1978). With the advent of new technology, interactions between mothers and their infants could be videotaped and analyzed second-by-second.

Analysis of videotape on a second-by-second basis was a widely used method to code the behavior of mothers and infants (Stern 1971; Beebe et al. 1979; Beebe 1982; Beebe et al. 2007, 2008). This microanalytic approach identifies events in the interaction that are subtle and would otherwise be missed by the naked eye. This type of analysis also allows for sequential analysis of patterns in behavior. Microanalysis is more objective than global clinical judgment methods.

In the mid-1980s, a number of important microanalytic studies examined the effect of postpartum depression on mother–infant interaction. The work of Field (1995), Cohn and Tronick (1989) created profiles of difficulties in maternal communication occurring in depressed mothers and its effect on the infant (Murray and Cooper 1997).

Developmental Significance of Infant Vocalization

In the first few months infant vocalization is social and interactive. The infant's first expression of non-cry vocalization comes with stretching vowel sounds and modifying pitch. In a study by Papousek and Papousek (1997), mothers responded to their infants by frequently using elongated vowels and infants responded vocally to a mother who was attentive and who talked to them.

In the third or fourth months of life, in the course of vocal development, infants shouted excitedly, cried and laughed, in addition they made other sounds which were coordinated with their gestures and use of objects (Trevarthen and Hubley 1978; Trevarthen 1977).

Jaffe et al. (1973) analyzed mother–infant patterns of on–off cycles of vocalizing and pausing. They investigated the predictability of each partner's behavior from that of the other's. They found that a very high mother–infant bi-directional coordination of vocal patterns predicted C and D attachment. Insecure-disorganized (D) attachment is the most disturbed of the attachment styles leading to potential psychopathology later in life. This finding pointed to the potential long-term negative consequences of disturbance in the mother–infant interaction.

Maternal Postpartum Depression

Postpartum depression is an important social and health problem for women and their families (Boyce and Stubbs 1994; Cox 1986; O'Hara 1994, 1995). A postpartum depression refers to an onset of depressive symptomatology after delivery of a child. A fluctuating course and mood lability may be more common in postpartum episodes. Women with postpartum depressive episodes often have severe anxiety, panic attacks, spontaneous crying long after the usual duration of "baby blues" (for example., 3–7 days postpartum), disinterest in their new infant, and insomnia (more likely to be difficulty falling asleep). It tears at the fabric of a woman's self-esteem, her marital relationship, and her relationship with her children (Weissman and Paykel 1974). It can be especially devastating at a time when a woman and her family expect joy and happiness, not sadness and depression. The mother–child relationship and the child's social and cognitive development suffer as a consequence of maternal depression (O'Hara 1995).

The Association Between Maternal Depression and the Mother–Infant Relationship

The mother's ability to be sensitively attuned to her baby may depend on several factors. Her psychological state may affect her ability to cue and respond to the baby (Weinberg and Tronick 1996). Specifically, whether or not she is depressed affects the way she interacts with her baby (Leadbeater et al. 1996).

Depressed mothers tended to be less sensitive and to have fewer affirmations and more negations that they express to their infants (Murray et al. 1996a, b).

Depressed mothers were less positive while feeding, in face-to-face play and in toy play (Campbell et al. 1995). Depressed mothers showed increased negative affect, specifically irritation and intrusiveness during face-to-face interaction (Cohn et al. 1990).

Depressed mothers and their infants tended to match negative rather than positive behavior (Cohn et al. 1990; Field et al. 1990). Negative states for the baby included fussing, crying and wary expressions.

This study took a closer look at infant vocal affect quality in relation to maternal self-report depressive symptomatology at 6 weeks. We expected to replicate findings in the literature that infants of depressed mothers are more negative than infants of non-depressed mothers. We also investigated the prevalence of positive vocal affect in infants of depressed versus non-depressed mothers, as well as, how vocal states were regulated.

Method

Participants

One-hundred and twenty-two infants, 70 males and 52 females, and their mothers, participated in a larger study from which this study examined the infants' vocal affect qualities. Of the 122 mothers, 52.5% were Caucasian, 17.2% African-American, 28.7% Hispanic, and 1.6% Asian-American. Most mothers had either some college (25.9%), a college degree (33.0%) or graduate school (27.7%), while (4.5%) had only grade school and 8.9% had high school education. Mothers' ages ranged from 18 to 45, with an average of 28.8 (SD = 6.58).

Recruitment

Within 24 hours of delivering a healthy, full-term, singleton infant without major complications, mothers were recruited from Babies Hospital, Columbia Presbyterian Medical Center, according to the established procedures for informed consent. Initially in the larger study, 152 mothers were contacted and recruited for the study. A female postdoctoral clinical psychologist explained to each mother that the purpose of the study was to investigate mother–infant communication and infant social development; that the project involved telephone interviews with the mother at 6–8 weeks and at 2 months postpartum; that she and the infant would be videotaped at the lab when the infant was 4 months old; that she would be asked to complete some questionnaires.

Procedure

In the larger study, at age 4 months, 132 of the original 152 mother–infant pairs were videotaped in a face-to-face play interaction in the Communications Sciences Laboratory at Psychiatric Institute. The scheduling of the lab visit took into account the infants' eating and sleeping patterns. Mother–infant pairs were observed in a lab setting that consisted of an office with an adjacent soundproof video studio. In the filming studio, an infant seat was mounted on a table with a chair facing it toward the mother. Images from two cameras were transmitted through a split-screen generator into a single video recorder, yielding simultaneous frontal views of the mother and infant. A digital timer display was superimposed on the video picture. After being greeted, the mother was instructed to interact with her infant as she would normally at home, but without toys. The play episode was intended to last twelve uninterrupted minutes (to obtain vocalization data not used in this study). However, if the infant became too upset to continue, the taping was stopped until the infant was calm enough to proceed. The audio and video recording was monitored from outside the studio.

The videotapes were analyzed for infant vocal quality using second-by-second microanalysis. We examined the first two and a half usable continuous play minutes of videotaped mother–infant interaction, following the precedent in the literature (Cohn et al. 1996; Field 1984; Field et al. 1985; Weinberg and Tronick 1996) coding vocal affect.

Measuring Infant Vocal Affect

The vocal affect coding scheme was adapted from the Infant Regulatory Scoring System (IRSS) (Tronick and Weinberg 1997) by this investigator and a research partner. Close analysis of existing videotapes from a previous study of 4 months-old infants and their mothers was used to refine the coding scheme. The infant vocalization coding scheme for this study was as follows: 1 = cry; 2 = angryprotest; 3 = fuss/whimper; 4 = silence; 5 = neutral/positive; 6 = high positive.

Center for Epidemiological Studies-Depression Scale (CES-D)

The Center for Epidemiological Studies-Depression Scale (CES-D) was used to evaluate maternal depression at 6 weeks postpartum. The CES-D is a 20-item self-report measure designed to assess current but nonspecific distress, rather than clinically diagnosed depression. Items probe for depressive symptoms and attitudes within the past week. A score of 16 is considered the cutoff for distinguishing depressed from non-depressed individuals (Radloff 1977). Scores of 16–20 reflect a mildly depressed state, 21–30 is considered moderately depressed, and 31 and above indicates severe depression. The CES-D has been found to have a high level of internal consistency across age, sex, and race subgroups (coefficients alpha .85; split-half correlations corrected for attenuation approximately .87) (Radloff 1977). Test–retest correlations are considerably lower, although given the scales sensitivity to current depressive states, this is to be expected (Radloff 1977).

Data Analysis Strategy

Transition matrix analyses were used to identify the transition probabilities from one vocal affect state to another (Cohen and Cohen 1983). To evaluate the likelihood that infants initiate, maintain or terminate the various vocal affect codes, and to compare infants of depressed versus non-depressed mothers chi square analyses on the transition frequencies were performed. Multiple regression analyses were performed using CES-D as a continuous

variable rather than a categorical variable using (16+) as the cut-off.

Results

Table 1 presents the means and standard deviations of proportion of time spent in vocal states using the four-state coding scheme. Across the sample, infants were most likely to be silent, followed by fuss/whimper, neutral/positive/high positive and cry/angry protest.

Infants spent most of their time silent (77.0%), and reciprocally 23% of their time vocalizing. The other two vocal states most prevalent in infants were fuss/whimper (10.4%) and neutral/positive vocalization (9.7%). Infants cried only 2.0% of the time. Other more extreme forms of positive and negative vocal affect, namely high positive and angry protest were rare, accounting for .35 and .25% of infants' time, respectively.

Table 2 presents four linear regression equations predicting vocal affect by depression. In regression 3, maternal depression was a predictor of less silence, accounting for 3.5% of the variability in silence (Beta = −.186; t = −2.062). The negative beta weight indicated that as depression increased, silence decreased. In regression 4, depression was a predictor of infant neutral/positive/high positive vocalizations, accounting for 3.5% of the variability in neutral/positive/high positive vocalizations (Beta = .186; t = 2.056). The positive beta weight indicated that as maternal depression increased, infant neutral/positive/high positive vocalizations increased.

Table 3 shows the transition probabilities from one vocal state to another. Infants were most likely to maintain their vocal state in the following order: silence (.904), cry (.889), fuss/whimper (.724), high positive (.523), angry protest (.511) and neutral/positive (.50). In chi square 2, infants of depressed mothers were more likely to maintain fuss χ^2 (1) = 29.82, p < .001. In chi square 3, infants of non-depressed mothers were more likely to maintain silence χ^2 (1) = 8.58, p < .01. In chi square 4, infants of depressed mothers were more likely to maintain positive χ^2 (1) = 6.87, p < .01.

Across the sample, infants transitioned from neutral/positive to silence with a probability of .464. Next, they transitioned from high positive to silence (.313); then fuss/whimper to silence (.245); followed by angry to silence (.267).

With the exception of cry all four vocal states had a relatively high probability of transitioning to silence. The probability of transitioning from cry to silence was .049.

Table 4 presents fourteen additional chi-squares which were conducted on transition probabilities of vocal quality affect. In chi-square 11, infants of depressed mothers were more likely to maintain high positive (rare behavior), χ^2 (1) = 16.03, p < .001 more than infants of non-depressed mothers.

Finally, the ratio of maintaining vocal affect states to transitioning vocal affect states for infants of depressed mothers was 5.36:1 versus 5.69:1 for infants of non-depressed mothers.

Table 1 Proportion of time in infant vocal affect quality by total sample, and by maternal depression

	Total sample (n = 122)		Non-depressed (n = 90)		Depressed (n = 32)	
	Mean	SD	Mean	SD	Mean	SD
Proportion cry/angry protest	2.33	7.74	2.10	7.51	3.01	8.48
Proportion fuss/whimper	10.59	14.60	9.89	13.46	12.63	17.58
Proportion silence	76.86	20.93	78.64	20.11	71.72	22.72
Proportion neutral/positive/high positive	10.15	10.20	9.31	9.81	12.60	11.06

Table 2 Summary of four linear regression equations predicting vocal quality by depression

Regression	Criterion	Predictor	R^2	F	B	SEB	Beta	t
1	Cry	Depression	0.3	0.33	.047	.082	.053	.576
2	Fuss	Depression	1.3	1.52	.190	.154	.113	1.233
3	Silence	Depression	3.5	4.25*	−.450	.218	−.186	−2.062*
4	Positive	Depression	3.5	4.23*	.219	.106	.186	2.056*

df = 1, 118. * p < .05

** This analysis is based on the 4-state coding scheme: cry and angry were combined because angry is a rare behavior (.32% of time); positive includes neutral/positive and high positive because high positive is a rare behavior (.97% of time)

Table 3 Test of hypotheses: chi-square tests on transition matrices of likelihood of maintaining vocal affect qualities: depressed versus non-depressed

	Transition	Variables	Non-depressed ($n = 90$)		Depressed ($n = 31$)	Chi square
1	t to $t + 1$	Cry → cry	241		112	3.23
2	t to $t + 1$	Fuss → fuss	928	<	446	29.82***
3	t to $t + 1$	Silence → silence	9,685	>	3,061	8.58**
4	t to $t + 1$	Positive → positive	629	<	294	6.87**

* $p < .05$; ** $p < .01$,*** $p < .001$. $df = 1$ for all chi squares. This analysis is based on the 4-state coding scheme (cry includes angry; positive includes neutral/positive/high positive)

Table 4 Chi-square tests on transition matrices of likelihood of maintaining and changing vocal affect qualities: depressed versus non-depressed

	Transition	Variables	Non-depressed ($n = 90$)		Depressed ($n = 32$)	Chi square
1	t to $t + 1$	Cry → fuss	18		11	1.00
2	t to $t + 1$	Cry → silent	20		10	0.43
3	t to $t + 1$	Cry → positive	0		2	1.49
4	t to $t + 1$	Fuss → silent	341		123	0.10
5	t to $t + 1$	Fuss → positive	20		3	1.13
6	t to $t + 1$	Silent → cry	15		14	3.03
7	t to $t + 1$	Silent → fuss	350		117	0.04
8	t to $t + 1$	Positive → fuss	34		12	0.00
9	t to $t + 1$	Positive → cry	2		0	0.51
10	t to $t + 1$	Fuss → cry	25		11	0.22
11	t to $t + 1$	High positive → high positive	7	<	28	16.03***
12	t to $t + 1$	Angry → angry	18		5	0.10
13	t to $t + 1$	Neutral/positive → neutral/ positive	622		266	2.92

** $p < .01$,*** $p < .001$. $df = 1$ for all chi-squares

Chi square 1–10 are based on the 4-state coding scheme (cry includes angry; positive includes neutral/positive/high positive). Chi square 11–14 are based on the 6-state coding scheme (high positive alone; angry alone; cry alone; neutral/positive alone)

Discussion

Vocal affect is one central way in which infants communicate with their caregivers (Bowlby 1969, 1982). This investigation focused on maternal depressive symptoms and its relation to infant vocal affect quality. The results indicated that infants of depressed mothers are more vocally activated and dysregulated in both positive and negative directions.

The current findings replicated those of Weinberg and Tronick (1998). Infants of mothers with psychiatric illness, including depression, had a greater tendency to fuss and cry than did controls during the reunion face-to-face play following the still-face paradigm. Infants fussed and cried more in response to episodes that presented them with a challenge or distress.

A unique finding of the current study was the documentation of high positive vocal affect. No other study had coded and analyzed the rare behavior of high positive vocal affect. Infants of depressed mothers maintained high positive vocal affect more than infants of non-depressed mothers.

The vocalizations most used by infants to communicate with their mothers were fuss/whimper and neutral/positive. In our study as well, we replicated the finding that infants of depressed mothers would remain in fuss/whimper and neutral/positive a greater proportion of the time.

The current results can be interpreted as the infant being vocally activated in the face of maternal depression. Infants of depressed mothers were more vocally activated using both negative and positive vocal qualities as they attempt to elicit responses from depressed mothers.

Beebe et al. (1985), showed that the depressed mothers in this same study showed heightened facial coordination with infant facial and vocal quality shifts. This was construed as a vigilant pattern. This finding was consistent with the idea that infants of depressed mothers are highly activated in terms of vocal quality.

Another important finding relevant to the current study was Beebe et al.'s report (1985) that across the overall sample, increasing infant touch predicted more positive infant vocal quality, and thus a decrease in infant vocal distress: a coping capacity. However, as maternal depression increased, infant self-comfort no longer predicted infant vocal quality. This finding was interpreted as a disturbance in the depressed infant's ability to use touch to modulate vocal distress.

One way to interpret this vocal overactivation is to consider the research of Ohman (2002). He noted that facial gestures of emotion are effective in activating the amygdala because they belong to a stimulus category of significance to primate behavior. According to Fridlund (1994), facial gestures signaled the motivation and intent that govern the unfolding social interaction between mother and infant. The central role of the amygdala was to look out for any early signs of threat. Changes in the face alerted the defense network that is controlled by the amygdala. Perhaps the amygdala of the infant of a depressed mother had been activated by the face-to-face interaction, and the infant's response was vocal activation, as well as heightened contingency or vigilance through vocal affect quality.

One wonders, as did Stern (1994), what long-term consequences there are for the infant. Stern (1994) postulated that the infant of the depressed mother becomes a charmer in relation to her, actively trying to bring the mother back to life. The infant serves as a kind of anti-depressant for the mother. Is it possible that we see this later in adults who constantly feel the need to be attuned to others and their needs, as opposed to their own? Perhaps the impact of maternal depression creates a "false self" (Winnicott 1965, p. 144) whereby survival is connected to being able to enliven the other in order that she will be available.

It is also important to address the issue of vocal silence. This study did not include the other domains of the communication system between the mother and infant, such as gaze, touch, and spatial orientation. However, there may be a great deal going on in the interaction between mother and baby during the vocal silence. This particular study was not designed to address these other cross-modal dimensions, although Beebe et al. (1985) did in the larger study of this data set.

Although crying was a relatively rare behavior, infants of depressed mothers had the highest probability of staying in cry than any other vocal state. Crying served an important function, to alert the mother to the infant's distress. According to Stern (1995), up until two and a half months, infants cried more often. During this early period, as the normal regulatory process breaks down frequently, much crying by the infant, with ensuing attempts to rectify the situation by the mother, took place. From two and a half months to five and a half months, other behaviors were available to regulate the face-to-face interaction, such as control of gaze, responsive smiling and vocalizing. Hence, crying was used less frequently. However, when it was used, infants of depressed mothers tended to maintain the state, perhaps to ensure a response from the mother.

In this study, infants of depressed mothers were most likely to maintain cry, 88.9% of the time, the second most likely vocal affect quality to be maintained despite how relatively little time they spent in cry (2%). This highlights the importance of crying and the role it served in mother–infant communication.

The findings of this study can be interpreted in terms of infant self-regulation. Infants of depressed mothers were more vulnerable to self-regulation difficulties and were more easily aroused. One definition of self-regulation is the predictability of the infant's own behavior over time in the presence of the mother (Beebe et al. 1985, 2002). This self-predictability had implications for the infant's future ability to use inner states to further organize the self (Sander 1977). Infants of depressed mothers were more likely to stay in both positive and negative vocal affect states which can be interpreted as more easily aroused.

When comparing the ratio of maintaining vocal states to transitioning in and out of vocal states infants of depressed mothers were less likely to maintain vocal states than infants of non-depressed mothers. Infants of depressed mothers were more likely to change vocal states. This was a unique finding. There are a number of ways in which this can be interpreted: less stability, greater dysregulation, overactivatation, heightened arousal or upset, in infants of depressed mothers.

Clinical Implications

This study documented patterns of vulnerability in infants of depressed mothers in terms of maintaining vocal distress and being more active in communicating with their mother. It is important to target vulnerable mothers who may be at risk for postpartum depression and offer them both individual and dyadic treatment. Women who have suffered from depression prior to pregnancy are more susceptible to developing depression after giving birth. Administering a screening tool such as the CES-D, in order to determine past or current depressive symptoms, will assist in identifying these women. Collaboration with obstetricians will increase the likelihood of targeting vulnerable women who are pregnant.

Understanding as a measure of self-regulation, the predictability of the infant's own behavior, over time (in the

presence of the mother), is important. Self-predictability may create future ability to use inner states to further organize the self (Sander 1977). Understanding that infants of depressed mothers are more vulnerable to self-regulation difficulties, helps in identification and treatment of at-risk mother–infant pairs.

There are a number of clinical interventions developed for working with depressed mothers and their infants. The following video interventions have been used to treat mothers and babies who have been identified as at-risk due to maternal depression.

Beebe (2003, 2005) utilized a brief treatment model that includes face-to-face split-screen videotaping (one camera on the mother and one on the infant) and therapeutic observation of the videotape with the parent. The intervention utilized video feedback, informed by a psychoanalytic approach. The intervention also included positive reinforcement, modeling, and information giving, as well as interpretation, while watching the videotape.

Downing (2001) developed a clinical intervention using video that is close to that of Beebe (2003, 2005) and Papousek (2000a, b). He integrated the use of video into a psychotherapeutic approach, drawing on techniques from both psychodynamic and cognitive-behavioral traditions. Downing (2001) reported this clinical intervention produces rapid change in the mother–infant interaction. It can either be used as a stand alone, short-term treatment, or in conjunction with on going psychodynamic, cognitive-behavioral or systemic family therapy.

In conjunction with on-going individual treatment with the mother, which might include medication in the case of severe depressive symptoms, mother–infant psychotherapy and video feedback can be offered. This combined treatment provided early in the postpartum period could help alleviate, the potential negative consequences of maternal depression on the mother–infant relationship.

Cooper and Murray (1997) suggested that a community-based intervention for mother–infant difficulties associated with postpartum depression would be beneficial. This was demonstrated in a study of British health visitors, community-based health nurses who were responsible for the welfare of mothers and their young children. These nurses were trained in general counseling and cognitive-behavioral strategies and the outcome was substantial improvement on the part of the infant and mother (Seeley et al. 1996).

References

Beebe, B. (1982). Micro-timing in mother–infant communication. In M. R. Key (Ed.), *Nonverbal communication today*. Series Edited by Joshua Fishman, Contributions to the sociology of language (Vol. 33). New York: Mouton.

Beebe, B. (2003). Brief mother–infant treatment: Psychoanalytically informed video feedback. *Infant Mental Health Journal, 24*(1), 24–52.

Beebe, B. (2005). Mother–infant research informs mother–infant treatment. *Psychoanalytic Study of the Child, 60*, 7–46.

Beebe, B., Feldstein, S., Jaffe, J., Mays, K., & Alson, D. (1985). Interpersonal timing: The application of an adult dialogue model to mother–infant and kinesic interactions. In T. Field & N. Fox (Eds.), *Social perception in infants*. Norwood, N.J.: Ablex.

Beebe, B., Jaffe, J., Chen, H., & Cohen, P. (2002). *Mother–infant 4-month self- and interactive regulation: Maternal states of mind, mother and infant distress patterns, and 12 month infant attachment*. Canada: International Conference Infant Studies.

Beebe, B., Jaffe, J., Buck, K., Chen, H., Cohen, P., Blatt, S., et al. (2007). Six-week postpartum maternal self-criticism and dependency and 4-month mother-infant self-and interactive contingencies. *Developmental Psychology, 43*(6), 1360–1376.

Beebe, B., Jaffe, J., Buck, K., Chen, H., Cohen, P., Feldstein, S., et al. (2008). Six-week postpartum depressive symptoms and 4-month mother-infant self-and interactive contingency. *Infant Mental Health Journal, 29*(5), 442–471.

Beebe, B., & Stern, D. (1977). Engagement-disengagement and early object experiences. In N. Freedman & S. Grand (Eds.), *Communicative structures and psychic structures* (pp. 35–55). New York: Plenum.

Beebe, B., Stern, D., & Jaffe, J. (1979). The kinesic rhythm of mother–infant interaction. In A. W. Siegman & S. Feldstien (Eds.), *Of speech and time: Temporal patterns in interpersonal contexts*. Hillsdale, NJ: Erlbaum.

Bowlby, J. (1969). *Attachment and loss* (Vol. 1). London: Hogarth Press.

Bowlby, J. (1982). *Attachment* (2nd ed., Vol. 1). London: Hogarth Press.

Boyce, P. M., & Stubbs, J. M. (1994). The importance of postnatal depression. *Medical Journal of Australia, 161*, 471–472.

Campbell, S. B., Cohn, J. F., & Meyers, T. (1995). Depression in first-time mothers: Mother–infant interaction and depression chronicity. Special Section: Parental depression and distress: Implications for development in infancy, childhood, and adolescence. *Developmental Psychology, 31*(3), 349–357.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for behavioral sciences* (2nd ed.). Hillsdale, N.J.: Erlbaum.

Cohn, J. F., Campbell, S. B., Matias, R., & Hopkins, J. (1990). Face-to-face interactions of postpartum depressed and non-depressed mother–infant pairs at 2 months. *Developmental Psychology, 26*, 15–23.

Cohn, J. F., Matias, R., Tronick, E. Z., Connell, D., & Lyons-Ruth, K. (1996). Face-to-face interactions of depressed mothers and their infants. In E. Z. Tronick & T. Field (Eds.), *Maternal depression and infant disturbance* (pp. 31–45). San Francisco: Jossey-Bass.

Cohn, J. F., & Tronick, E. (1989). Specificity of infants' response to mothers' affective behavior. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 242–248.

Cooper, P. J., & Murray, L. (1997). The impact of psychological treatments of postpartum depression on maternal mood and infant development. In L. Murray & P. Cooper (Eds.), *Postpartum depression and child development*. New York: The Guilford Press.

Cox, J. L. (1986). *Postnatal depression*. Edinburgh: Churchill Livingstone.

Downing, G. (2001). *Changing procedural representations* (Submitted manuscript).

Field, T. (1984). Early interactions between infants and their postpartum depressed mothers. *Infant Behavior and development, 7*, 527–532.

Field, T. (1992). Infants of depressed mothers. *Development and Psychopathology, 4*, 49–66.

Field, T. (1995). Infants of depressed mothers. *Infant Behavior and Development, 18*, 1–13.

Field, T., Healy, B., Goldstein, S., & Guthertz, M. (1990). Behavior-state matching and synchrony in mother–infant interactions of non-depressed versus depressed dyads. *Developmental Psychology, 26*, 7–14.

Field, T., Healy, B., Goldstein, S., Perry, S., Bendell, D., Schanberg, S., et al. (1988). Infants of depressed mothers show "depressed" behavior even with non-depressed adults. *Child Development, 59*, 1569–1579.

Field, T., Sandberg, D., Garcia, R., Vega-Lahr, N., Goldstein, S., & Guy, L. (1985). Pregnancy problems, postpartum depression, and early mother–infant interactions. *Developmental Psychology, 21*(6), 1152–1156.

Fridlund, A. J. (1994). *Human facial expression: An evolutionary view*. San Diego: Academic Press.

Jaffe, J., Stern, D., & Peery, J. C. (1973). "Conversational" coupling of gaze behavior in prelinguistic human development. *Journal of Psycholinguistic Research, 2*(4), 321–329.

Leadbeater, B. J., Bishop, S. J., & Raver, C. C. (1996). Quality of mother–toddler interaction, maternal depressive symptoms, and behavior problems in preschoolers of adolescent mothers. *Developmental Psychology, 32*(2), 280–288.

Murray, L., & Cooper, P. (1997). *Postpartum depression and child development*. New York, London: The Guilford Press.

Murray, L., Fiori-Cowley, A., Hooper, R., & Cooper, P. (1996a). The role of postnatal depression and associated adversity on early mother–infant interactions and later infant outcome. *Child Development, 67*, 2512–2526.

Murray, L., Stanley, C., Hooper, R., King, F., & Fiori-Cowley, A. (1996b). The role of infant factors in postnatal depression and mother–infant interaction. *Developmental Medicine and Child Neurology, 38*, 109–119.

O'Hara, M. W. (1994). *Postpartum depression: Causes and consequences*. New York: Springer.

O'Hara, M. W. (1995). Childbearing. In M. W. O'Hara, R. Reiter, S. Johnson, A. Milburn, & J. Engeldinger (Eds.), *Psychological aspects of women's reproductive health* (pp. 26–48). New York: Springer.

Ohman, A. (2002). Automaticity and the amygdala: Nonconscious responses to emotional faces. *Current Directions in Psychological Science, 11*(2), 62–66.

Papousek, M. (2000a). Einsatz von Video in der Eltern-Sauglings-Beratun und-Psychotherapie. *Praxis der Kinderpsychologie und Kinderspsychiatrie, 49*, 611–627.

Papousek, M. (2000b). Zur Fruherkennung und Behandlung von Storungen der Eltern-Kind-Beziehung im Sauglingsalter. In L. Koch-Kneidl & J. Wiesse (Eds.), *Fruhkindliche Interaktion und Psychoanalyse*. Gottingen: Vandenhoech & Roprecht.

Papousek, H., & Papousek, M. (1997). Postpartum depression and cognitive development. In L. Murray & P. Cooper (Eds.), *Postpartum depression and child development*. New York: The Guilford Press.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385–401.

Sander, L. (1977). The regulation of exchange in the infant-caretaker system and some aspects of the context–content relationship. In M. Lewis & L. Rosenblum (Eds.), *Interaction, conversation, and the development of language* (Vol. 5, issue 40, pp. 579–593).

Seeley, S., Murray, L., & Cooper, P. J. (1996). The outcome of mothers and babies of health visitor intervention. *Health Visitor, 69*, 135–138.

Stern, D. (1971). A microanalysis of the mother–infant interaction. *Journal of the American Academy of Child Psychiatry, 10*, 501–507.

Stern, D. N. (1994). One way to build a clinically relevant baby. *Infant Mental Health Journal, 15*(1), 9–25.

Stern, D. (1995). *The motherhood constellation*. New York: Basic Books.

Stern, D., Jaffe, J., Beebe, B., & Bennet, S. (1975). Vocalizing in unison and alternation: Two modes of communication within the mother-infant dyad. *Annals of the New York Academy of Sciences, 263*, 89–100.

Trevarthen, C. (1977). Descriptive analyses of infant communicative behavior. In H. R. Schaffer (Ed.), *Studies in mother–infant interaction*. London, N.Y. & San Francisco: Academic Press.

Trevarthen, C., & Hubley, P. (1978). Secondary intersubjectivity: Confidence, confiding and acts of meaning in the first year. In A. Lock (Ed.), *Action, gesture and symbol: The emergence of language*. London, New York, San Francisco: Academic Press.

Tronick, E., Als, H., Adamson, L., Wise, S., & Brazelton, T. B. (1978). The infant's response to entrapment between contradictory messages in face-to-face interaction. *American Academy of Child Psychiatry, 17*, 1–13.

Tronick, E. Z., & Weinberg, M. K. (1997). Depressed mothers and infants: Failure to form dyadic states of consciousness. In L. Murray & P. J. Cooper (Eds.), *Postpartum depression and child development*. New York, N.Y.: Guilford Press.

Weinberg, M. K., & Tronick, E. Z. (1996). Infant affective reactions to the resumption of maternal interaction in the still-face. *Child Development, 67*, 905–914.

Weinberg, M. K., & Tronick, E. Z. (1997). Maternal depression and infant maladjustment: A failure of mutual regulation. In J. Noshpitz (Ed.), *The handbook of child and adolescent psychiatry*. N.Y.: Wiley.

Weinberg, M. K., & Tronick, E. Z. (1998). The impact of maternal psychiatric illness on infant development. *Journal of Clinical Psychiatry, 59*, 53–61.

Weissman, M. M., & Paykel, E. S. (1974). *The depressed woman: A study of social relationships*. Chicago: University of Chicago Press.

Winnicott, D. W. (1965). *The maturational processes and the facilitating environment*. Madison, CT: International Universities Press, Inc.

Author Biographies

Donna Demetri Friedman, LCSW, PhD is a mother-infant therapist, as well as a child and adult therapist. She completed her PhD with Dr. Beatrice Beebe and is one of the child therapists in the 9/11 Project. Dr. Friedman is the Deputy Executive Director of RMHA, an outpatient mental health clinic. She teaches Attachment Theory, Child Development, and Clinical Practice with Individuals and Groups at New York University. Dr. Friedman has published two book chapters and several articles. She is currently co-editing a special issue on attachment for The Journal of Clinical Social Work. Dr. Friedman was given the Outstanding Alumna Award for her work in infant mental health in 2009 from NYU. Dr. Friedman also has a private practice in Manhattan.

Beatrice Beebe, PhD is a psychoanalyst and an infant researcher. She is Clinical Professor of Medical Psychology (in Psychiatry), College of Physicians & Surgeons, Columbia University, New York State Psychiatric Institute; faculty at the Columbia Psychoanalytic Center, the Institute for the Psychoanalytic Study of Subjectivity, and the N.Y.U. Postdoctoral Program in Psychotherapy and Psychoanalysis; co-author with Jaffe et al. of *Rhythms of Dialogue in Infancy* (Monographs of the Society for Research in Child Development, 2001), author with Lachmann of *Infant Research and Adult*

Treatment: Co-Constructing Interactions (Analytic Press, 2002), and author with Knoblauch, Rustin and Sorter of *Forms of Intersubjectivity in Infant Research and Adult Treatment* (Other Press, 2005). She has a forthcoming monograph in the journal *Attachment and Human Development, The Origins of 12-Month Attachment: A Microanalysis of 4-Month Mother-Infant Interaction*. She is in private practice in New York City, specializing in adult psychoanalysis and mother-infant treatment. Currently she directs a primary prevention program for mothers who were pregnant and widowed on 9–11.

Joseph Jaffe, MD is Professor of Clinical Psychiatry (in Neurological Surgery), Columbia University and Chief, Department of Communication Sciences, New York State Psychiatric Institute. He is a basic behavioral researcher in infant and adult communication. Jaffe and Beebe published Rhythms of Dialogue in Infancy in the Monograph Series of the Society for Research in Child Development (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001), predicting cognitive development and attachment security at one year from degrees of vocal rhythm coordination at 4 months, in mother-infant and stranger-infant face-to-face interactions.

Don Ross, PhD is a Research Scientist at Columbia University, New York State Psychiatric Institute who has published extensively.

Sandra Triggs, MA is the Director of the Continuing Day Treatment Program of an outpatient mental health center in NYC.