

18 Dyadic microanalysis of mother–infant communication informs clinical practice

Beatrice Beebe and Joseph Jaffe

Our research began in the 1960s with the study of adult dialogue by Joseph Jaffe and Stanley Feldstein. Our interest was in features of speech rhythms relevant to the communication of mood, the phenomenon of empathy, and the breakdown of effective dialogue. Speech rhythms include turn-taking, pausing and interrupting. By the late 1960s, when Daniel Stern and Beatrice Beebe joined the team, our interests widened to the study of mother–infant dialogues. Since then, the analysis of speech rhythms has been expanded to analogous rhythms of many modalities (gaze, vocal quality, facial expression, touching, head movement, and posture).

This dyadic “microanalysis” research looks at the joint behaviors of two people. It operates like a microscope, identifying in detail the instant-by-instant interactive events which are so fast and subtle that they are usually lost to the naked eye (ear), and operate largely out of awareness. The analysis of different modalities of communication operates like the stains lighting up different coexisting structures under the microscope. Using this approach we discovered that maternal depression affected facial expression and gaze direction in opposite ways: mothers and infants were vigilant to each other’s facial shifts, but withdrawn from monitoring each other’s visual availability, as we describe in detail below.

The discoveries made with this research have tremendous implications for early intervention in mother–infant communication disturbances. Both embodying the unusual combination of researcher and psychoanalyst, Beebe and Jaffe are intensely concerned with translating research findings into clinical interventions. Beebe offers a video-assisted therapeutic consultation to mother–infant pairs presenting for treatment, observing them in the same split-screen, videotaping format used for research pairs, and using research findings to guide treatment interventions. A therapeutic viewing of the videotape with the parent is the springboard for the treatment. We will illustrate this approach with

two mother–infant treatment cases. In addition, we use this approach in an ongoing project to treat mothers who were pregnant and widowed in the World Trade Center disaster of September 11, 2001, and their infants and young children.

History of our research program

The history of our research program shows how an increasingly detailed picture of the interactive system emerged. In the 1960s, when Jaffe and Feldstein set out to study communication in adult psychotherapy, voice recording of therapy sessions was becoming popular. Psychotherapy was still defined as a “talking cure,” so words and sentences sufficed for raw data. We rendered these words *computer readable*, and the very first digital computer at the New York State Psychiatric Institute soon followed. Process research in all therapies that utilized interviews seemed within reach.

But we knew that words were not enough. The “music” needed to be brought to life. Our problem was that there was no easy way to record or measure the non-verbal communication that accompanied the words. We studied movie film frame by frame, by numbering the frames sequentially, but videotape and computers were still uncommon. Gaze coding was done by hand, in real time, on running paper tape. And once videotape was available, we had no automated system to quantify movements of interest, such as face and gaze. Thus, the field of non-verbal behavior research was both theoretically and technologically years behind the automated linguistic analysis of speaking and listening.

Dyadic systems view of communication

Our approach to non-verbal face-to-face exchange was based on a “dyadic systems” view of communication in which any action in a dyadic relationship is jointly defined by the behavior of both partners. The power of this definition is particularly evident when social roles cannot be actualized in the absence of the other, such as in predator–prey, or approach–avoid patterns such as “maternal chase – infant dodge.”

The coding of *dyadic states* was our concrete contribution to the systems notion, as we describe shortly. The concept of dyadic states was developed at a time when the reigning psychological model was stimulus-response theory, a one-way process, in which the passive receiver could not influence the sender during message transmission. This model was inadequate for face-to-face communication, a simultaneous, bidirectional exchange, in which sending and receiving are concurrent and reciprocally evoked.

Dyadic microanalysis of vocal rhythms

In the 1960s, dialogue was conceptualized simply as two alternating monologues, such as “question–answer” interviewing, without any consideration of a dyadic process, generating phenomena such as interruptions, or the exchange of turns.

To study dialogue, two-channel voice recordings could easily be produced via microphones attached to therapist and patient. But we wanted an automated way of obtaining data that would obviate long hours of transcription. An analogue-to-digital (A to D) converter, the *Automated Vocal Transaction Analyzer (AVTA)*, coded the parallel speech streams into sequences of sound and silence, that is, “speech rhythms.” Dispensing with the words, and substituting the ongoing vocal rhythms, enabled us to *automate* our analysis of the communication process. This breakthrough played a central role in our research for the next forty years.

The AVTA system samples a conversation between partners A and B at regular “split-second” (0.25 sec) intervals. As we will see below, analyzing interactions in such fine detail yielded a goldmine of important information about infant development. We used the AVTA system to generate dyadic states. At each instant of sampling we code one of four dyadic states: 0 = both silent; 1 = A speaks and B is silent; 2 = B speaks and A is silent; and, 3 = both speak. Each state is a slice of a dyadic relationship, but the *individual* gets lost in two of them. Note that when partners A and B are doing the same thing, *i.e.*, state 0 (both silent) and state 3 (both speaking), the distinction between speaker and listener is momentarily lost. If both are silent, who is the speaker, and if both are talking, who interrupted whom? Only a *sequence of states* solves this ambiguity and preserves the continuity of roles. By preserving sequence, the data become analogous to a movie film, rather than a still photo.

First, we imagined that at each instant the partners make simultaneous, but independent “decisions” to vocalize or not. But in our model, each pair of decisions is contingent upon their joint “dyadic state” at the previous instant. Next, a “turn rule” was introduced that acted like a parliamentarian, assigning the turn as a “right of way” to the alternating speakers. A partner gained the turn at a moment of unilateral speech, and kept it (despite any sounds of the listener) until the listener vocalized unilaterally, defining a *turn switch*.

Within the turn, the ambiguous “joint silence” was then assigned to the person who holds the turn. The ambiguous “joint speaking” was termed an interruption, assigned to the listener unless it resulted in a turn switch, in which case the interruptor becomes the speaker.

Together, these tactics “rescued the individuals” who had been homogenized in the four dyadic states. Thus, we could define a separate turn for each individual; within each turn, states were defined dyadically. This approach allows study of both the *dyad and the individual* in a dyadic context. Our sound-silence model of communication was later applied to other kinds of nonverbal interactions, such as “gaze-on, gaze-off” and “approach-avoid.”

What was by then dubbed the “Jaffe-Feldstein conversational model” grew from six to ten states to further subdivide states of joint silence and joint speaking. This enabled measurement of those brief silences between speaker and listener as they exchange turns. First considered a “reaction time,” it was soon renamed a “switching pause” that was terminated by a “turn switch.” *The matching of switching pause durations between partners* was a crucial early discovery: each partner tends to wait a similar amount of time before taking a turn, facilitating a smooth exchange of turns. This discovery led directly to the establishment of Jaffe’s Department of Communication Sciences at NYSPI in 1964. The descriptive papers of Jaffe and Feldstein of that era were published in *Science* (1964) for monologue, in *Nature* (1967) for dialogue, and led to a book, “Rhythms of Dialogue,” in 1970.

The switching pause became the most powerful predictor of outcomes in our research and in that of other investigators as well. In our later work it predicted infant attachment and cognitive outcomes. The switching pause is uniquely dyadic, in the sense that it does not exist in a monologue. It begins as the turnholder stops speaking, and it ends as the listener begins to speak. The switching pause is related to the turn rhythm and is interpreted as a complex regulation moment, composed of reciprocal speaker-listener role-exchange involving synchronized disengagement and re-engagement. In this sense it is a fundamental aspect of the structure of dialogue. That may account for its clinical usefulness, as we illustrate below, in the mother–infant treatment of “Roberta.”

Preverbal conversations

In the 1970s, our basic research on dyadic vocal timing changed its focus from adult–adult to adult–infant vocal and movement (gaze, face, touch) interactions. At that time, a long term project of split-screen, video-recording of mother–infant interaction was begun by Dan Stern (a postdoctoral fellow) and his graduate student, Beatrice Beebe. The adult work on dialogic timing influenced our infancy work though our focus on (a) the dyadic systems approach which studies both the dyad

and the individual in a dyadic context, (b) the temporal structure of dialogue, (c) the bidirectional coordination of rhythms in which each partner's behavior is coordinated with that of the other, (d) the relation of dialogic timing coordination to affect and bonding, and (e) the impact of a novel partner, the stranger, on dialogic timing.

We sensed that the dyadic timing system is a fundamental underpinning of both adult and child conversations. From this perspective, both vocalization and movement (gaze, facial expression, etc.) are parts of a larger communicative "package" that may be organized by a common rhythmic time base. For example, mother–infant vocal rhythms are correlated with those of looking, head movement, and gesture. As such, vocal rhythm is one easily quantified index of the rich communicative "package" that mothers and infants display and coordinate in face-to-face interaction. That makes it an ideal candidate for use in research.

Our team found startling similarities between the temporal patterns of adult conversation and the time patterns of mother and infant vocal and movement behaviors (such as gaze, head orientation shifts, facial changes). Mother–infant gaze interactions, for example, followed the same contingency structure as adult–adult verbal interactions, in the sense that much of what is happening any moment can be accounted for by the most recent event (within a second). We speculated that this form of contingency may be a universal formal property of dyadic communication, detectable in gaze patterns long before the onset of speech. Moreover, in both adult conversations and mother–infant vocal exchanges, the duration of the switching pause is matched (correlated). Because switching pauses regulate the turn exchange, aspects of a dialogic structure are thus already in evidence prior to speech onset, and are regulated in a manner similar to adult conversation.

We also documented approach–avoid patterns, dubbed "chase and dodge," in which maternal head approach (looming) predicted infant avoidance movements (head back, down, and away), and infant avoidance movements predicted maternal "chase" (head and body movements following the infant's direction of withdrawal). This pattern turned out to have great clinical usefulness, illustrated in the mother–infant treatment case of Linda and Dan, below.

Current research: adult–infant vocal rhythms

Although key infant researchers in the 1970s and 1980s appreciated the critical importance of the coordination of mother–infant rhythms, and considered it central to mother–infant bonding, our study of four-month vocal rhythm coordination (of vocalizations, pauses, and switching

pauses) and twelve-month attachment and cognition outcomes is one of the few empirical demonstrations of this idea. Four-month vocal timing taps a system in which the infant is highly competent. By four to five months, infants discriminate duration, rate and rhythm. Furthermore, sensitivity to timing necessarily involves sensitivity to affective and cognitive information.

Our highly detailed analysis of vocal timing paid off. *High* degrees of coordination between four-month infants and strangers in the lab was associated with optimal infant *cognitive* scores at twelve months. In contrast, *midrange* degrees of coordination between mother and infant, and stranger and infant, in home or lab, was associated with secure infant *attachment* at twelve months; high and low degrees predicted insecure attachment. High response to novelty is thus favorable for cognition, whereas midrange degree of coordination may allow more flexibility in a secure attachment climate. Very high coordination (associated with disorganized and anxious-resistant attachment) may index vigilance under conditions of uncertainty, challenge or threat; very low coordination (associated with avoidant attachment) may index withdrawal.

We construed our patterns of dialogic vocal timing as procedures for managing aspects of the “pragmatics” of social interactions: the “how” of communication, rather than the “what.” Infant and adult are organizing procedures for when to vocalize, when to pause, and for how long; procedures for managing attention, activity level, turn taking, joining and being joined, tracking and being tracked. Because these dialogic timing procedures predicted social/cognitive outcomes, we argued that through these procedures, infants and adults come to expect and procedurally represent the timing of ongoing vocal interactions, out of focal awareness. If so, these procedures may bias the trajectory of developing personality styles (such as joining, interrupting, management of turn taking, vigilant or withdrawn tracking) and may be spontaneously retrieved when similar contexts occur. This concept is illustrated in the treatment case of Roberta and her mother, described below. Roberta’s mother tended to interrupt Roberta, finishing Roberta’s sentences for her. Roberta’s mother had had similar experiences with her own mother interrupting her.

Clinical implications of vocal rhythms. These dialogic vocal timing procedures provide a unique entry into clinical intervention in mother–infant treatment. Infants presenting with the symptom of avoiding gazing at the mother’s face can often be lured back into visual contact when the mother is taught to match the tempo of the infant’s vocalization–pause rhythm. Frequently the switching pause is mis-regulated in dyads

presenting for treatment, as we see in the case of Roberta, below. Mothers can be taught to wait slightly longer after they vocalize, to see if the infant will “take a turn;” and to “get into synch” with the infant after the infant vocalizes, by matching his switching pause before resuming her turn.

The case of Roberta. Roberta and her mother were referred for treatment by the mother’s therapist when Roberta was sixteen months. Although a full-term infant, Roberta had suffered multiple invasive medical procedures in the first month of life because of acute asthma. She had thus experienced pain, overarousal, and helplessness. Roberta now bit herself whenever severely frustrated, and this symptom did not yield despite numerous consultations with the pediatrician, who now gave Roberta a clean bill of health. Roberta and her mother were invited to “play as they would at home,” as they were videotaped in our split-screen filming lab. They played face-to-face, both sitting on chairs at a low table.

Mother sat with shoulders tensed, leaning forward, smiling, but with a quizzical raised-eyebrows look. Roberta was delighted with the toys, exclaiming “bird, mommy!” Mother rapidly asked many questions, directing Roberta’s attention. There was little time for Roberta to develop her own play themes. Mother was so coordinated that she often finished Roberta’s sentences for her.

Roberta then became alert to a slight sound of the camera moving, and mother herself alerted to Roberta’s attention shift. As Roberta carefully watched the camera, mother was highly coordinated with Roberta’s rhythms of vocalization and gesture, “joining” Roberta. But immediately mother tried to shift her to something else, pointing to another toy, as if to try to control her interest. Roberta frequently altered her own focus to follow that of mother. But eventually, as mother continued to redirect her, Roberta heightened her intense attention to the camera, avoiding the mother.

After many repetitions of this pattern we began to see that mother’s joining through rapid, contingent high coordination was in the service of shifting Roberta, as if to ward off where Roberta might go, namely into over-arousal and self-biting. We also saw that the turn-switching between mother and Roberta was extremely rapid. The switching pause was often truncated as mother rushed in, highly coordinated, but leaving little room for Roberta. Frequently mother actually interrupted Roberta. We speculated that mother’s worry about Roberta had made her hyper-vigilant to the slightest shifts in Roberta, even though mother was affectionate and warm. For her part, Roberta’s biting herself may have been a solution to her hyper-arousal, first caused by a medical condition, but now also precipitated by mother’s own anxiety and fear for Roberta.

Following the videotaping, in a series of sessions utilizing therapeutic viewing of the videotape, mother was helped to see her own hypersensitivity to Roberta and how it might escalate Roberta. When we pointed out how she tended to finish Roberta's sentences for her, she remembered that her own mother had been that way with her. Mother was helped to slow down, to pause more, and make more room for Roberta. In follow-up videotaping sessions three and six months later, Roberta's self-biting was much less frequent. At follow-up a year later, it was very rare.

Current research: the effects of maternal depression on multiple mother–infant communication modalities

Under the leadership of Beatrice Beebe, with the collaboration of Jaffe, Feldstein, and Patricia Cohen and her statistical team of Karen Buck and Henian Chen, the design of the vocal timing study was repeated and expanded in a major NIMH-funded study of self-report depression (CES-D) at six weeks postpartum. Both video (completed) and audio recording (in progress) were performed. The video study demonstrated that six-week maternal depression had strikingly different effects on the different communication modalities of gaze, face, vocal quality, and touch during, mother–infant four-month face-to-face play.

Depressed mothers and their infants showed a “split” in attention (gaze) vs. affect (facial/vocal quality) coordination. In depressed mothers and their infants, neither partner was as coordinated with the others’ shifts of gaze on and off the partner’s face as controls were. But depressed mothers heightened their facial coordination with infant facial and vocal shifts, as if becoming “overly thrilled” as infants became facially or vocally more positive, and overly “disappointed” as infants became facially or vocally more distressed. Similarly, infants of depressed mothers reciprocally heightened their vocal quality coordination with maternal facial shifts, overly sensitive to maternal facial fluctuations. Compared to controls, these infants were more likely to become vocally positive as maternal facial expressions were positive; and more likely to fuss or whimper as mothers sobered, frowned or grimaced. Thus, compared to controls both depressed mothers and their infants were “vigilant” to each other’s moment-by-moment affective shifts, while at the same time paying less attention to whether the partner was visually available for engagement.

In the modality of touch, depressed mothers and their infants showed a form of dyadic conflict: an “infant approach – mother withdraw” pattern. Infants heightened their self touch coordination with shifts in

maternal touch patterns, but mothers lowered their touch coordination with infant self touch shifts. Maternal lowered touch coordination may disturb infants' ability to anticipate the effects of their own behavior on maternal behavior. As we will see below, this pattern was evident in the mother–infant treatment of Linda and Dan, where Linda's high-intensity touch patterns were not sensitive to Dan's self-touch, self-soothe efforts.

Although the second-by-second video coding of separate modalities in this study took the labor of twenty PhD students across ten years, it yielded a goldmine of data which defines early communication disorders with remarkable multi-modal complexity and nuance. This identification of different kinds of communication difficulties in different communication modalities can teach clinicians to observe modality by modality for various kinds of dyadic patterns (such as mutual vigilance, mutual withdrawal, approach–withdrawal), rather than looking for more global patterns such as maternal “sensitivity” and “intrusion,” or infant “withdrawal.”

Clinical implications of maternal depression: the case of Linda and Dan

Dr. Phyllis Cohen brought her patient Linda, in individual psychotherapy following a severe postpartum depression, and her five-month-old son Dan, to Beebe and Jaffe's filming lab in the Department of Communication Sciences, NYSPI. The pediatrician had noted the lack of a social smile and a “peculiar” quality; neurological testing (and early intervention testing) turned up no findings. Linda said that Dan is not interested in her, he does not love her, and she had an easier time with her first child.

Instructed to play with her baby as she would at home, Linda played with Dan face-to-face in our split-screen filming chamber. Linda was no longer severely depressed but nevertheless there was a residual interaction disturbance. As Linda leaned in toward Dan with a high intensity touch pattern, her hands on his belly, Dan looked away instead of orienting to his mother, making eye-contact, perhaps vocalizing or smiling. He moved his head down and away, looked down, sobered with a serious face, then frowned. He made no sounds.

Dan began to self-soothe by delicately rubbing his finger tips on Mom's hands; Mom pulled her hands away, disturbing his touch pattern, and moved her hands again into his belly, leaning in quite close. This pattern is very similar to that described above in the research on the effects of maternal depression: Linda's touch pattern was not sensitive

to Dan's self-touch behavior. As she leaned in, Dan's head moved further away, and his foot pumped with an agitated quality, a maternal "chase" – infant "dodge" pattern. Each time Dan moved away, Mom called his name, asking him to look at her, and then plaintively asked if he did not like this game.

Following the filming, Dr. Beebe offered initial impressions. Dan was very aware of his mother, responsive to every move of her hands and head, but he was responding with withdrawal. He seemed to find Mom's play over-stimulating. By looking away so much he was able to reduce his arousal. This kind of play might be fine for another baby, but seemed to be too much for Dan. The first recommendation to Linda was to see if she could wait until Dan looked at her before trying to play, and see if Dan could respond if she kept her level of stimulation very low.

With ongoing individual sessions with Dr. Cohen, including therapeutic viewing of the videotapes with Dr. Cohen, and periodic visits to Dr. Beebe's filming lab every few months, Linda and Dan gradually began to find each other. Linda was gradually able to learn to "wait" until Dan returned her gaze and was visually available for engagement. This difficulty monitoring Dan's gaze is strikingly similar to that described above in the research on the effects of maternal depression. Linda was able to modulate her high-intensity, often rough touch games, so that Dan did not become as easily overwhelmed, perhaps a constitutional proclivity. Linda was taught how to match Dan's vocal rhythms, which often evoked Dan's visual interest, and he would then look at his mother. Treated over a three-year period, a follow-up when Dan was four years old showed a vital, enthusiastic child and a well-related pair.

This case illustrates how our dyadic microanalysis of the details of communication in the various modalities of vocal rhythm, as well as gaze, face, vocal quality and touch, can inform clinical practice with mothers and infants. The details of the interaction patterns are used both for assessment of the difficulties as well as for the treatment itself. Therapeutic viewing of the videotapes, identifying the specific modalities through which the disturbances were communicated, was invaluable in helping the mother have "new eyes," new ways of seeing her child and her own responses, and new ways of behaving.

World Trade Center disaster and pregnant widows

When the disaster of September 11, 2001 struck, the infants and young children of the adult victims were in danger of being forgotten. We therefore began a treatment program for mothers who were pregnant and widowed, and their infants and young children, using therapeutic

viewing of videotaped play interactions between mother and child. Dr. Beebe directs this program with Drs. Phyllis Cohen.

Policy implications: basic research informs clinical practice

Even the best clinical eye must observe so many different things in an interaction that only global gestalts are registered. In contrast, microanalysis uncovers aspects of non-verbal communication that the unaided human brain cannot report. For example, our finding that maternal depression affected gaze and facial patterns in opposite directions could not have been discovered with more global forms of coding. Furthermore, this micro level is indispensable for formulating treatment interventions. It is at this micro level that interactions are organized, and it is at this micro level that interactions go away.

Continued basic dyadic microanalysis research on the effects of parental distress on parent-child communication and infant development is essential and should be a top funding priority. Although a great deal is now known about the effects of maternal depression on mother-infant communication and infant development, surprisingly little is known about the effects of other forms of distress, such as anxiety. This research is a critical source of information in designing early interventions and in teaching parent-infant clinicians, as well as other health providers such as pediatricians, how to evaluate early interactions.

A brief screening, based on split-screen video microanalysis of face-to-face interaction, together with a brief intervention, a therapeutic viewing of the videotape with a skilled parent-infant clinician, is an inexpensive and powerful tool that should be available to any concerned parent-infant pair. Parent-infant clinicians should be recognized as a new clinical specialty and a priority for future training opportunities. Video-assisted mother-infant treatment interventions are based on infant research evidence of the nature of early interactions, but research that demonstrates the efficacy of this approach in double-blind studies is scarce and should be a funding priority.

SUGGESTED READINGS

- Beebe, B. (2003). Brief mother-infant treatment using psychoanalytically informed video microanalysis. *Infant Mental Health Journal*, 24(1), 24-52.
 (2005, in press). Mother-infant research informs mother-infant treatment. *Psychoanalytic Study of the Child*, 6.
- Beebe, B., and F. Lachmann (2002). *Infant research and adult treatment: co-constructing interactions*. Hillsdale, NJ: The Analytic Press.

- Beebe, B., J. Jaffe, and P. Cohen (2002). Support groups and video-bonding consultations for mothers and infants of 9–11. Manuscript, NYSPI, April, 2002. FEMA Liberty Fund; Robin Hood Foundation.
- Beebe, B., S. Knoblauch, J. Rustin, and D. Sorter (2005). *Forms of intersubjectivity in infant research and adult treatment*. New York: Other Press.
- Cohen, P., and B. Beebe (2002). Video feedback with a depressed mother and her infant: a collaborative individual psychoanalytic and mother–infant treatment. *Journal of Infant, Child, and Adolescent Psychotherapy*, 2(3), 1–55.
- Jaffe, J., and S. Feldstein (1970). *Rhythms of dialogue*. New York: Academic Press.
- Jaffe, J., B. Beebe, S. Feldstein, C. L. Crown, and M. Jasnow (2001). Rhythms of dialogue in infancy. *Monographs of the Society for Research in Child Development*, 66 (serial no. 265).