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Daniel Stern: Microanalysis and the Empirical Infant Research Foundations

Beatrice Beebe, Ph.D.

ABSTRACT

Daniel Stern changed the face of psychoanalysis, as well as that of infant research. He was a brilliant, innovative, and playful thinker. Psychoanalysis particularly values his contributions on the relevance of infant research to adult clinical practice and theory, for which he is best known. But this work has its foundation in his early empirical infant research, which is less well known. I believe that a better appreciation of the original empirical basis of his work using microanalysis will deepen our appreciation of his later thinking.

In this article I return to the beginning of his work, using frame-by-frame microanalysis of film and, particularly, his first paper published in 1971. I sketch out some of the important findings and ideas emerging from this paper that continued to influence his thinking throughout his career. This research was conducted in the 1970s, the period in which I worked with him directly.

The experienced micro-world always enters awareness but only sometimes enters consciousness (verbalizable awareness). [Stern, 2004, p. xiv]

Stern operated at the interface of the empirical analysis of mother-infant communication, systems theories, philosophy, neuroscience, and psychoanalysis. Dyadic face-to-face communication was the focus. Using the method of frame-by-frame microanalysis of film, moment-by-moment interaction sequences became the center of his thinking: *miniplots* of brief interaction scenarios. He described the reciprocal dyadic communication process across time: Each partner is changing with the other. Miniplots of the temporal-spatial-affective flow of each partner changing in relation to that of the other became his definition of procedural representations. Stern emphasized the primacy of time and temporal process over more static notions of psychological organization. Most fundamentally, Stern's work in microanalysis has changed what one can see, and thus what one can know. His work fostered a dynamic, interactive model of the organization of experience. The foundation of experience, the origin of mind, and the key to change in psychotherapy are found in the moment-by-moment interactive process itself.

Dan's fascination with the micro-momentary details of the present moment, which became the title of one of his books (Stern, 2004), was the core of his inspiration and talent. In the preface to that book he wrote,

In considering the micro-world of the present moment, I first thought of the working title, *A world in a grain of sand* from William Blake. ... It captured the size of the small world revealed by micro-analysis. ... One can often see the larger panorama of someone's past and current life in the small behaviors and mental acts making up this micro-world. ... Seeing the world at this scale of reality changes *what can be seen* [italics added] and thus changes our basic conceptions. [Stern, 2004, p. xiv]

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History

When I entered graduate school in 1968, the empirical microanalysis analysis of mother-infant face-to-face communication did not yet exist as a field of its own. It was just beginning. Dan Stern (1971), T. Berry Brazelton (Brazelton, Kozlowski, and Main, 1974) and Colwyn Trevarthen (1979) were the first to publish in this new field (see Beebe et al., 2003). It was a very exciting time. We all knew that we were at the beginning of something very new, and very important. Other early pioneers included Louis Sander, Michael Lewis, Alan Fogel, Hanus and Mechtilde Papousek, and Tiffany Field. Ed Tronick, Brazelton's student, soon became a leading figure in the late 1970s. Lynne Murray, Trevarthen's student, and Jeffrey Cohn, Ed Tronick's student, and Karlen Lyons-Ruth, among others, were active at that time.

Dan Stern was Joseph Jaffe's postdoctoral fellow at the New York State Psychiatric Institute (NYSPI), Columbia University in 1966. I was Stern's graduate student in 1969, and his postdoctoral fellow, 1973–1975. When I arrived, Dan was already collaborating with Joe Jaffe. Steve Bennett (1971), a psychoanalyst fascinated by the research, was also working with Stern. When Dan left NYSPI for Cornell in the late 1970s, I became Jaffe's collaborator. Jaffe's dyadic systems view of communication (Jaffe, 1961; Jaffe and Feldstein, 1970; Beebe, Jaffe, and Lachmann, 1992) was developed in the 1960s. Jaffe's models of monologue (Jaffe, Cassota, and Feldstein, 1964, published in *Science*) and dialogue (Jaffe, Feldstein, and Cassotta, 1967, published in *Nature*) informed Stern's data analyses and influenced Stern's emphasis on the dyad as the unit of study.

Stern's 1985 book, *The Interpersonal World of the Infant*, ushered in a paradigm shift in the way psychoanalysis viewed early development. Arnold Cooper wrote on the back cover of the first edition, "This dazzling book represents a truly original, perhaps revolutionary, contribution to psychodynamic theory and practice." John Bowlby also wrote on this back cover that Stern's "splendid book will be welcomed by every thinking clinician." His first book, *The First Relationship* (Stern, 1977), is less well-known and is underutilized. It summarized in an elegant, experience-near way all the key findings to that point, and it remains accurate and informative today. *The Motherhood Constellation* (Stern, 1995) was a seminal book articulating his thinking on infant representation and parent-infant treatment. Many books followed. Work with the Boston Change Process Study Group (BCPSG; Dan Stern, Lou Sander, Ed Tronick, Karlen Lyons-Ruth, Alexandra Harrison, Jeremy Nahum, Alex Morgan, and Nadia Bruchweiler-Stern) brought him more directly into the dialogue within psychoanalysis. But the key ideas were first worked out in the empirical realm.

Stern's "manifesto:" Instant-by-instant interactive events

In his very first paper, "Microanalysis of mother-infant interaction," Stern (1971) set out a key theme of his work, which I term his *manifesto*:

"It is generally agreed that the mother-infant relationship plays a large role in influencing the developing personality. Yet it remains unclear exactly which interactive events affect which emerging infant social behaviors with what short- and long-run consequences." He gives the example of maternal "controlling" behavior and argues, "Unless we know the specific maternal and infant behaviors involved, we remain at a level of generalization which is no longer proving fruitful. [Stern, 1971, p. 501]"

In his paper, "The goal and structure of mother-infant play," Stern (1974, p. 402) elaborated this theme:

By providing a more fine-grained view of the instant-by-instant interactive events which make up the mother-infant relationship, we may be in a better position to modify and expand current working theories on the nature of developing object relations or attachments.

Many infant researchers in the ensuing four decades have been inspired by Stern's vision. And remarkable progress has been made in providing detailed descriptions of early forms of mother-

infant communication and their relevance for the origins of attachment, as well as other social and cognitive outcomes (see, for example, Field, 1995; Trevarthen, 1998; Jaffe et al., 2001; Feldman, 2007; Murray and Cooper, 2007; Tronick, 2007; Messinger et al., 2009; Beebe et al., 2010; Lavelli and Fogel, 2013).

The concept of instant-by-instant interactive events first developed in Stern's early empirical infant research became the underpinning of his theorizing in adult treatment. For example, in Stern et al. (1998), one finds the key terms *moments*, *moments of meeting*, and *microdescriptions*. In BCPSG (2002), one finds the terms *micro-events*, *microprocess of interaction*, *the moment-to-moment interactive process in psychoanalytic therapy referred to as the local level*, and a *theory of therapeutic action based on "local-level" process*. In BCPSG 2007, one finds, "All the things that are the stuff of the interactive flow, such as gestures, vocalizations, silences and rhythms, constitute this moment-to-moment exchange, which we refer to as the local level" (p. 845).

Although all of the later papers give brief examples of what Stern meant by the local level, and the moment-to-moment process remained key in his theorizing, the empirical basis recedes far into the background. Without familiarity with the remarkable details of the interactive process revealed by microanalysis, the concept of the *local level* can remain too general. His early empirical work on mother-infant communication spells out the moment-to-moment process of the local level in exquisite detail. This early work remained his inspiration.

Microanalysis

Stern's interest in the instant-by-instant interactive events required a research method known as microanalysis of film or video. His approach to microanalysis was influenced by ethology, which privileges the careful description of behavior in its natural habitat, detailing the form, sequence and timing of behavior. Stern was fascinated by the details of interaction. He insisted on careful description as a prerequisite to understanding the social communication value of behavior. This ethological approach continues to influence the microanalysis of mother-infant communication today. He was also familiar with other researchers who used film and various approaches to microanalysis of adult behavior (Goffman, 1963; Schefflen, 1965; Kendon, 1967).

When I joined Stern's research team in 1969 as a volunteer research assistant at NYSPI, I learned microanalysis of mother-infant communication. I was in my second year of graduate school at Teachers College, Columbia University. The use of video cameras was relatively new, and computers were still uncommon. Video was reel-to-reel and difficult to code. Both partners are filmed so as to be simultaneously visible during a face-to-face interaction. To perform a microanalysis of the interaction, we converted video to 16mm film, which had 24 frames per second. This was an expensive conversion at that time. We used an editing viewer, a small metal box anchored to a board, through which one could view the film. The board had metal posts on either side of the box, onto which two film reels were securely attached. The film fit through the metal box, and a light projected the film onto the wall. But to see the film one had to be in a dark room. The setup was just like one for editing a film, except instead of cutting the film, we were analyzing it. Numbers were printed on the top of each film frame. With one's own hands, one could slowly move the film forward and back to watch movement unfold in time. We identified the beginning and ending frame of each little movement of mother and infant. These movements, such as slight shifts of gaze, head turn, head-up, or mouth-opening, typically last about a quarter to a third of a second (Stern, 1971; Beebe, 1982).

Today digitized video makes this whole process so much easier. But the hand method of frame-by-frame analysis of film has one interesting advantage. One's own body movement is involved in detecting the onset and offset of each behavior. As the coder rocks the film back and forth between the two reels, the coder's hands and body move with the mother's and infant's movements. For example, as mother looms with her face close into the infant's face, the infant's head moves back and away. We termed this sequence with the metaphor, *mother chase and infant dodge* (Beebe and Stern,

1977). The coder's own visceral feedback facilitates comprehension of how these movements might be experienced by the infant, and by the mother. This is a form of embodied simulation. Performing the action of another person influences one's perception of the person's action and facilitates recognition of it (Oberman, Winkielman, and Ramachandran, 2007; Niedenthal et al., 2010; Beebe and Lachmann, 2013).

Stern's first paper (1971)

The moment-to-moment process of the "local level" is beautifully illustrated in Dan Stern's (1971) first paper, "A microanalysis of mother-infant interaction." This paper was in progress as I joined his research team in 1969. It was a film microanalysis of a mother and her dizygotic twins, showing striking differences in interactive regulation between the mother and each of the twins. When Dan had finished coding the behaviors for this paper, we pasted the data all over the walls of his office. Tremendous excitement was in the air.

For this study, Stern videotaped in the home, using one camera. He knew this family well. Beginning at infant age 3 months, he had videotaped twice a week for 3 weeks, then every other month through 9 months, and then every 3 months through 15 months. Stern chose to analyze 7 minutes at infant age 3½ months. He described this footage as typical of their interactions.

The mother was filmed seated on the floor, with the two twins in infant seats in front of her. Although both twins were calm and alert at the beginning of the interaction, by 7 minutes Fred was upset, and mothers' efforts to soothe him were unsuccessful. Mark remained calm. The mother had identified one twin, Mark, with herself and the other twin, Fred, as "more like father" (Stern, 1971, p. 504). Stern notes that the differences in the interactions of the mother and the two twins that he observed continued across the period that he followed them.

Stern (1971) described it this way:

The clinical impression was that the mother was "controlling," "overstimulating," and "insensitive," in that she imposed the degree and amount of social context she wanted, at the time she wanted it, with little sensitivity to the infant's wants and responsiveness to her behavior. This impression pertained mainly to her interaction with Fred. Her intrusions with Mark were fewer, shorter, and less intense. He remained calm. [p. 503]

We wanted two interactions which "felt" differently clinically, and had psychodynamic reasons to be different. We did not know, however, the nature of the differences upon which our impressions rested. Finding the nature of the differences, in terms of interactive events, was the goal of the study. [p. 504]

If the mother and each twin are treated as separate dyads, there are two dyads: mother-Mark and mother-Fred. Dan showed fascinating ways in which this mother interacted so differently with her two twins, and each twin, Fred and Mark, interacted differently with her. Although split-second coordination was present in both dyads, mother and Fred had an approach-avoid spatial pattern, whereas mother and Mark had largely an approach-approach pattern.

Because Stern videotaped with one camera, some behaviors were not easily visible, such as eye contact. But he could easily identify head turns, and determine whether each person was facing the partner or facing away. Although the twins were seated directly in front of the mother, she had to slightly shift her head to be directly facing either one of them. Using frame-by-frame analysis of 16mm film (24 frames per sec), Dan coded head turns and facing toward/away for all three partners at the 1/24 sec unit, one frame. Units of behavior were defined as movements in process of transformation, from the beginning to the end of ongoing action. Reliability was 96% agreement for presence of movement and 95% agreement for direction of movement. The mean error in identifying the start or stop frame of a movement was .73 frames.

In choosing to code facing position and head turning, Stern (1971, p. 502) argued that these behaviors, along with actual eye-contact, are "uniquely qualified to perform subtle instant-by-instant regulation of social contact." He was interested in the infant's ability to control the amount of stimulation. At three months, an infant cannot walk away, but he can look away and turn away.

Closing the eyes and turning the head away are the only motor systems (besides sucking) over which the infant has substantial voluntary control. Stern construed infant gaze aversion and head turning away as active acts of avoidance and thus early infant coping capacities. A few years later, he showed that it is primarily the infant who “makes and breaks” the mutual gaze encounter (Stern, 1974, p. 206). Moreover, pursuing the idea that an early dialogue was being organized, Jaffe, Stern and Peery (1973), using Jaffe’s (Jaffe et al., 1967) dialogue model, documented that mother and infant gaze patterns had a dialogic structure that was mathematically identical to that of adult-adult vocal conversation.

In the 1971 paper, Stern was interested in patterns of making and breaking face-to-face contact: how much face-to-face contact occurs, who is responsible for initiating it and terminating it, how much avoidance of contact occurs, and who is responsible for initiating and maintaining the avoidance.

How does each partner affect the other?

Already in this first study, Dan was interested in bidirectional regulation: how each partner affects the other. This stood in direct contrast to the thrust of the literature which had emphasized the parent’s influence on the child (Bell, 1968). At this time, in the early 1970s, researchers hotly debated whether mother-infant interaction was bidirectional, or if the mother mainly structured the interaction. Not until the landmark paper of Cohn and Tronick (1988), with the introduction of time-series analysis, was this debate settled in favor of a bidirectional model.

How long does each infant sustain the face-to-face encounter?

Stern documented striking differences in interaction patterns in the two dyads. Mark holds the face-to-face position 5× longer (5.3 sec) than Fred (1.1 sec). This is a huge difference. Mark and Mother have sustained face-to-face encounters; Fred and Mother have brief, 1 sec glimpsed encounters. This pattern of *glimpsed* encounters prevents the development of the engagement.

Do the two partners both accept the other’s disengagement move?

When Mark and mother are facing each other, either of them is equally likely to terminate the mutual facing position and look away. It is a reciprocal system: if either looks away, the partner looks away. Either one accepts the other one’s disengagement move. In contrast, Fred terminates the face-to-face position with mother 9× more often than she does.

How clear is the infant’s moment of disengagement?

When Mother is facing Mark, and he is faced away, Mark will remain faced away for a relatively long time (mean 7.1 sec.). Thus Mark has sustained periods of engagement, and of disengagement. When Mother is facing Fred, and he is faced away, Fred will remain faced away for a much shorter mean duration long (2.3 sec.); 3/4 of the time Fred turns back to face mother. Fred’s moment of disengagement is brief and confusing. Thus Fred can neither stay face-to-face with Mother for long, nor remain faced away from her for long.

If the infant is already facing away, does the mother accept that as a signal that he is not available at the moment? Are increasingly extreme aversions necessary to indicate a disengagement move?

Mother is different with each twin, as well. If Mark is facing away, after looking at him for an average of 2 sec, mother will turn away 3/4 of the time. Or if mother turns to Mark and finds him turned even slightly away, she will not approach. Thus Mark’s facing away functions as a clear signal for

mother that he is not available at the moment. In contrast, if Mother turns to Fred and finds him turned away, she will make further approaches to capture his full attention, rather than turn away. To make mother turn away from him, Fred must turn his head past 45° away. Stern concludes here: “Simple face aversion by Mark acts on the mother as a signal to avoid further contact and to leave him alone. The same signal by Fred brings the opposite” (Stern, 1971, p. 508).

Fred and mother participate in a bidirectional approach-avoid pattern

As mother approaches, Fred withdraws; reciprocally, as Fred withdraws, mother approaches. This pattern is depicted in Figure 1, with drawings reprinted from the original Stern (1971) study.

Mutual approach-withdrawal

When mother is facing either twin, the twin’s direction of head turning is highly correlated with mother’s head movements in a pattern of mutual approach-withdrawal. This pattern is much stronger for Fred, illustrated in Figure 1.



Figure 1. Mutual approach-withdrawal pattern between mother and Fred, 3½ months, drawn from the film. Reprinted with permission from Stern, D. (1971), A microanalysis of mother-infant interaction. *J. Amer. Acad. Child Psychiatry*, 10: 501–517.

When mother turns away, is the infant's behavior still contingently coordinated with mother's? A form of staying-with while staying-away

When mother is facing away, Fred and mother continue the approach-withdrawal pattern: Their head movements remain highly correlated. In contrast, when either mother or Mark turns away, they both become uncoupled in time.

Stern suggests that the continuation of the Fred-mother approach-withdrawal pattern when mother is faced away may give mother the impression that Fred is still in contact with her. She may then approach him, which then forces Fred into a more exaggerated head aversion. Mother may then turn away, but relatively quickly Fred turns back to her. This form of interaction is likely confusing for both partners. Fred is neither with her nor away from her. It is a problematic cycle contributed to by both partners. Both mother and Fred never become *uncoupled* in time: They remained in a quasi-simultaneous head movement coordination. This pattern could be described as the *micro-co-creation of ambivalence*.

Central themes visible in Stern's first paper

The value of microanalysis

It is remarkable even now, 35 years later, to see how nuanced and complex these interactions are at infant age 3½ months. In the world of microanalysis, so much is below the surface, not visible to the naked eye, and not discerned with other research methods.

The meaning of the behavior is co-created

In describing the differences in the Fred-mother dyad versus The Mark-mother dyad, Stern (1971) elegantly illustrated aspects of a systems view of communication. He showed that communication is bidirectionally regulated, and that the nature of relatedness is an emergent property of the unique dyadic system, unique to a particular dyad. Mother and Mark had a largely approach-approach system, and either one turning away was accepted as a disengagement move by the other. In contrast mother and Fred had an approach-avoid system.

But the approach-avoid system of mother and Fred was complex. Perhaps the most fascinating aspect of this study was the documentation of the extraordinary mutual ambivalence between mother and Fred. Despite the approach-avoid pattern, with neither one available when the other was available, each one turning away from the other with split-second bidirectional contingencies, at the same time mother and Fred remained in quasi-synchronous head movement coordination when they were not looking at each other. In this example, Stern illustrated a remarkable co-creation of ambivalence by both partners.

Although Stern approached all communication as bidirectionally regulated, this bidirectional regulation is still insufficiently understood in both infant research and adult treatment today. Many studies of mother-infant communication examine only one direction of influence (Beebe et al., 2016). And many conceptualizations of adult treatment examine the effect of the therapist on the patient, neglecting the effect of the patient on the therapist (Beebe et al, 1992; Beebe and Lachmann, 2002, 2013). The notion of bidirectional exchange between partners is an essential aspect of the more general idea that components of a system are in a continuous process of bidirectional exchange, resulting in increased complexity of the system and the elaboration of emergent properties.

The split-second world

Stern was fascinated by the rapidity of these interactions and was already using the term *split-second* in this first paper. He reported the mean duration of infant head turn movements as ¼ sec; 80% fell between ⅛ and ½ sec. Other microanalyses of more varied behaviors (including infant mouth opening, smile, head-up; maternal body movement forward, loom, side-follow) confirmed these

short durations for both infant (range = .305–.440 sec) and mother (.343–.494; summarized in Beebe, 1982). The term the “split-second world” appeared in his first book (Stern, 1977, p. 106).

Stern (1971) observed split-second infant head turns away as mother approached, and split-second head turns toward as mother withdrew, as illustrated for Fred in Figure 1. He found a high correlation between mother and infant behavior occurring synchronously (in the same 1/24th of a second) or with mother leading by ¼ second. His interpretation of this finding presages an important continuing theme in his work. He suggested that this high correlation

may result from mother and infant having sufficient daily experience with timing, rhythm, and sequencing of each other’s motions so that short runs of synchronous behavior could occur when there is not sufficient reaction time for a stimulus-response explanation. In between synchronous runs, movements are initiated by one and responded to by the other. A waltz serves as an analogy. Certain steps and turns will be cued by one partner—in between those cues both know the program well enough to move synchronously for short periods. [pp. 512–513]

In a microanalysis of one mother-infant pair (the chase and dodge dyad of Beebe and Stern, 1977), Beebe, Stern and Jaffe (1979) pursued the idea of the split-second world by asking how much time elapsed from the onset of the mother’s behavior to the onset of the infant’s behavior (infant onset time), and vice-versa (mother onset time), illustrated in Figures 2a and 2b respectively. We examined 171 one-step sequences across 2 minutes: 79 infant onset times and 91 maternal onset times. For neither mother nor infant did the onset time exceed 1 second in these one-step sequences. The two distributions of maternal and infant onset times had quite similar means (7.25 and 7.70 frames, respectively; not significantly different), variances (4.95 and 4.66 frames, respectively) and frequencies. Thus, each partner followed the other within one second, and on average within approximately ½ second. Later, Cohn and Beebe (1990; Beebe and Lachmann, 2002) documented the contingent bidirectional coordination of such rapid sequences by time-series analysis.

Critique of a stimulus-response explanation

Both Stern and Jaffe were critical of stimulus-response explanations of social behavior, the reigning paradigm at the time. First, many of the interactions were too rapid for a stimulus-response explanation. Second, stimulus-response theory viewed communication as a one-way process. But information can be simultaneously sent and received in face-to-face communication. For example, as my face lights up, so does yours; or as I speak, your head nods in the same rhythm as my speech. Moreover, later work on infant perception showed the infant to be capable of *anticipating* events (Haith, Hazan, and Goodman, 1988).

Jaffe advocated an interpersonal feedback control model in which sending and receiving are reciprocally evoked and each partner can modify other’s behavior simultaneously. Working at the William Alanson White Institute for psychoanalysis in the 1960’s, Jaffe was influenced by Sullivan’s interpersonal theory, particularly his view that “a personality can never be isolated from the complex of interpersonal relations in which the person lives and has his being” (Sullivan, 1940, p. . Jaffe construed the dyad as the unit of analysis; he viewed each partner’s behavior as created in the process of joint coordination (Beebe et al., 1992; Jaffe and Feldstein, 1970; Jaffe et al., 2001). These ideas influenced Stern.

The waltz versus the tennis match

The metaphor of the waltz became one of Stern’s favorites. The waltz is one example of a “shared program:” shared, reciprocal expectations of the “moves” of the interaction. He developed this analogy further in his book, *The First Relationship* (Stern, 1977, p. 85):

When the mother and infant are acting synchronously, and well under reaction time, then we are forced think that they are following a shared program. A better analogy for this model is the waltz, where both partners

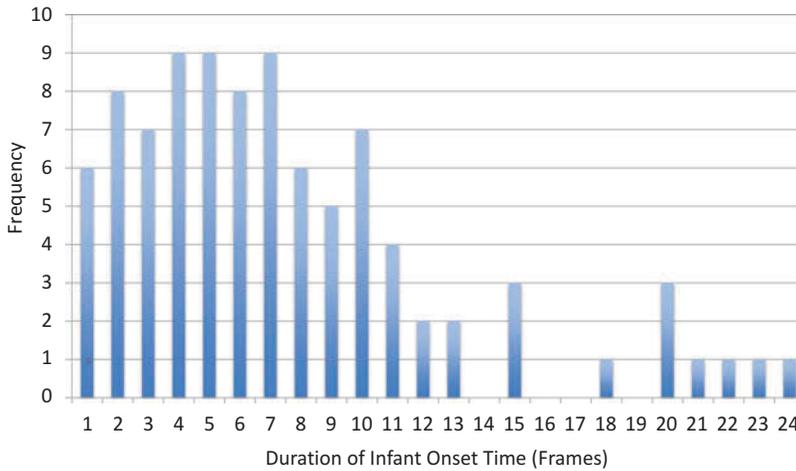


Figure 2a. Frequency distribution of infant onset times measured from initiation of maternal behavior to initiation of infant behavior. Twenty-four frames equals 1 second.

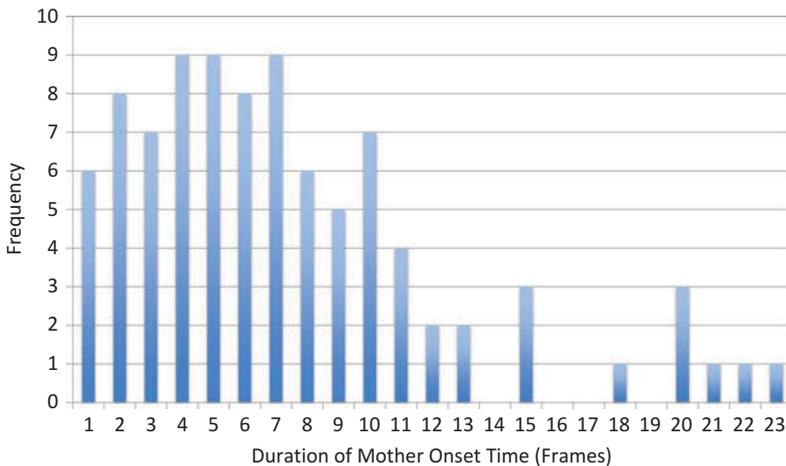


Figure 2b. Frequency distribution of maternal onset times measured from initiation of infant behavior to initiation of maternal behavior. 24 frames = 1 second.

Note. Figures 2a and 2b reprinted with permission from Beebe, B., Stern, D., and Jaffe, J. (1979), *The kinesic rhythm of mother-infant interactions*. In: *Of Speech and Time: Temporal Patterns in Interpersonal Contexts*, ed. B. Beebe, D. Stern, and J. Jaffe. Hillsdale, NJ: Erlbaum Assoc., pp. 23–24.

know the steps and music by heart and can accordingly move precisely together, as against the tennis-match analogy of the stimulus-response chain.

Later Stern returned to the findings of dyadic synchrony and dyadic coordination to define an essential aspect of intersubjectivity: “When people move synchronously or in temporal coordination, they are participating in an aspect of the other’s experience” (Stern, 2004, p. 81). “I view intersubjectivity at the local level of the small, micro-acts that underlie it” (Stern, 2004, p. 185).

Expectancies

The concept of the waltz already contained the key idea of expectancies: each person comes to expect, and anticipate, the moves of the other. Temporal mechanisms that facilitate the prediction of

events provide the framework for the creation of models or procedural representations of the moment-to-moment action sequences of communication. Predictability and the ability to anticipate in social behavior reduce uncertainty about what likely happens next and generate interactive agency (Jaffe et al, 2001; Warner, 1992).

Beebe and Stern (1977) suggested that the infant may represent modes of interactive regulation. They hypothesized that the dominant modes of mutual regulation will prevail in the infant's internalized representation of the relationship, and that

what is initially internalized is not an object *per se*, but an object-relation: actions of self with reference to actions of object. ... One aspect of what becomes internalized in the first object-relation is a time-frame of connectedness. ... The durations of behaviors, the mutual sequential patterning of onset and termination of behaviors, their rate and rhythmicity. [p. 52]

Stern collaborated with John Gibbon, an expert on the perception of time, to study how infant expectancies of durations of behaviors could develop. Lewis and Goldberg (1969) had already published a key paper on a generalized expectancy model for infants. Stern and Gibbon (1980) argued that infants must have a specific timing mechanism that would allow them to keep track of the timing of maternal social behaviors. They studied the timing structure of the mother's behavior to see what the infant might be learning. Examining multiple sessions of three mothers playing face-to-face with their three-month infants, Stern and Gibbon (1978) showed that the durations of mothers' on-off vocal behaviors conformed to a scalar process. They inferred that infants would detect maternal scalar timing, but they did not actually study the infants.

In a scalar process, the ratio of the standard deviation to the mean is a constant. As the mean duration increases, the standard deviation increases in direct proportion, so that the mean itself predicts the standard deviation. Using a scalar process, the individual can use changes in the mean duration of a behavior to anticipate changes in its variability. It is one efficient mechanism that may facilitate predictability and the creation of expectancies in mother-infant interaction.

Beebe et al. (2008) replicated aspects of the Stern and Gibbon (1980) study (see also Zlochower and Cohn, 1996). They examined 132 mothers and infants playing face-to-face with their four-month infants and coded mother and infant gaze at or away from the partner's face second-by-second. Two groups of hi- and lo-distress mothers were created using self-reported depression, anxiety, self-criticism, and childhood experiences. Lo-distress infants used scalar timing 100% of the time, about double that of hi-distress infants. Lo-distress mothers used scalar timing about nine times as much as hi-distress mothers. The diminished use of scalar timing patterns in hi-distress mothers and infants may make the anticipation of each other's gaze patterns more difficult for both partners.

The concept that mother and infant were in a predictive system with each other, based on expectancies, later received a great deal of support both from experimental studies (Haith et al., 1988) and studies of social interaction (Cohn and Tronick, 1988; Tronick, 1989; Jaffe et al., 2001). In *The Interpersonal World of the Infant*, Stern (1985) used the concept of expectancies to define early infant procedural representations, "RIGS" (representations of interactions generalized). He developed these ideas further in *The Motherhood Constellation* (Stern, 1995). The concept of expectancies became a critical link to psychoanalysis.

The concept of expectancies also became central to Beebe and Lachmann (1988, 2002, 2013) who construed self- and interactive regulation as patterns of expectancy. Both partners generate patterns of expectation, constructed through self and interactive processes. Both come to anticipate and represent, in a procedural format, the sequence of one's own actions over time, and the sequence of one's own actions in relation to those of the partner. The seed of this concept is already found in Stern's (1971) paper and is explicitly developed in Beebe and Stern (1977).

Micro versus macro. Stern contrasted patterns at the microlevel, "microevents," with the "larger macroevents that occupy most clinical theories" (Stern, 1995, p. 62). He gave the example of a mother becoming depressed, which is usually seen as a single traumatic event. In contrast, at the

level uncovered by microanalysis, there are many repetitive micro-events through which the infant experiences ways of being with a depressed mother. Stern (1994) described these in “One way to build a clinically relevant baby” (p. 14). For example, an infant looks to his mother with animation, but she turns away, flat and expressionless. The infant deflates, slumping in posture, losing positive affect. Or the infant is a “reanimator,” a “sparkle-plenty,” inviting the mother back to life with vocalizations and smiles. When it does not work, he waits and then tries again. Stern argues that, as analysts attempt to reconstruct the traumatic early experiences of their patients, infant research allows them to imagine early interactive experiences which are far richer and more elaborated. Clinical theories, in contrast, are at the macro level. This critique is one of Stern’s fundamental contributions.

The micro-dimensions that Stern addressed in the 1971 paper remain highly relevant today. The moment-to-moment dimensions of interaction that Stern addressed in this first paper could be used to richly conceptualize therapist-patient communication, as well as mother-infant communication. These dimensions included: (1) How long does each person sustain the face-to-face encounter? This dimension could help to define the quality of a face-to-face engagement in adult treatment. (2) Do the two partners both accept the other’s disengagement move? This dimension could be a way of thinking about the therapist’s ability to accept the disengagement needs of the patient, as well as the patient’s ability to tolerate therapist moments of pausing, moments of reverie, or periods of silence. (3) How clear is each person’s moment of disengagement? This dimension could apply to both therapist and patient. (4) If the person is already facing away, does the partner accept that as a signal that he or she is not available at the moment? This dimension could also apply to both patient and therapist. (5) Are increasingly extreme aversions necessary to indicate a disengagement move? This dimension could apply to both patient and therapist, but is likely more relevant to how the therapist accepts the patient’s disengagement moves. (6) Is the interaction organized by an approach-approach pattern? Or by an approach-avoid pattern? This dimension describes a very basic patterning that could be used to differentiate most therapist-patient interactions. (7) When one person turns away, is the partner’s behavior still contingently coordinated? This is a form of staying-with while staying-away. This fascinating pattern deserves further research.

“Changing with”

Stern and colleagues described a reciprocal dyadic process across time in which each partner is changing with the other:

Dynamic micro-momentary shifts in intensity over time that are perceived as patterned changes within ourselves and others ... allow us, rather automatically and without awareness, to change with the other, to feel-what-has-been-perceived-in-the-other. [Stern et al., 1985, p. 263]

Stern carefully distinguished this process from empathy and mirroring. “Changing with” is an invaluable concept for the psychoanalyst (Beebe et al., 2003). Each partner senses and anticipates her own, as well as the partner’s, moment-to-moment process. This sensing occurs largely out of awareness, in a nonconscious, procedural format, although one can, at times, have glimmers of it. Each partner tracks and coordinates with slight shifts in the partner’s level of activation of face, voice or body, a way of “feeling into” what the partner feels. This procedural format provides a key dimension of therapeutic action (Beebe, 1998; Stern et al., 1998; Beebe and Lachmann, 2013).

Action and language

Stern’s immersion in the microanalysis of interaction led to a critique of psychoanalysis’s tendency to privilege language:

There exists a strong intellectual current against placing action at the center in understanding human behavior. Many people conclude that anything human depends entirely on language, concepts, history. Many modern strains of psychoanalysis privilege the narration or interpretation that stands behind or over an act, that presumably defines it, gives it its psychic reality. Many approaches assume that what one experiences is not determined by the actions and interactions that make up the lived event, but rather by the later mental reconstruction of what happened. The reconstructed event after the fact becomes not only the real event, but the only event. In ethology and behavioral psychology, the opposite tendency previously reigned: Many considered the mental representation of actions off-limits. Currently, the 2 extremes are approaching an integration. [Stern, 1995, pp. 77–78]

At some moments, Stern took a more integrative view, for example, in *The Present Moment* (2004), he wrote, “I am not trying to lessen the importance of language and the explicit in favor of implicit experience. I am trying to call attention to direct and implicit experience because it has been relatively neglected” (p. 222). But at other moments Stern placed the micro-interactive process at the center of his thinking: “interactive process itself is primary ... the level of relational action is the foundation for the grasping of the psychodynamics to which the analyst will respond implicitly and interpretively” (BCPSG, 2007, p. 843).

In closing

It was Dan who inspired my love of figuring out how the moment-by-moment process of mother-infant communication works, and who taught me about frame-by-frame analysis of film. Dan was very playful. He always wanted to go get a cup of coffee and tell me about his newest ideas. He had tremendous energy and enthusiasm and brilliance. Everything seemed possible with Dan. I thank Dan for the gift of sharing his love and enthusiasm for discovering how the moment-to-moment process of mother-infant communication unfolds. It continues to be my life’s journey.

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