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SYMPOSIUM ON INTERSUBJECTIVITY IN INFANT RESEARCH AND ITS IMPLICATIONS  
FOR ADULT TREATMENT, PART I

## A Comparison of Meltzoff, Trevarthen, and Stern

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Beatrice Beebe, Ph.D.  
Steven Knoblauch, Ph.D.  
Judith Rustin, M.S.W.  
Dorienne Sorter, Ph.D.

Whereas the first paper of this series compared the work of three theorists of intersubjectivity in psychoanalysis, this paper compares three theorists of intersubjectivity in infant research, Andrew Meltzoff, Colwyn Trevarthen, and Daniel Stern. By evaluating the points at which the theorists concur and differ, we hope is to clarify the meanings or “forms” of intersubjectivity in infancy. All three have addressed the question of how infants can sense the state of the other, and all have used the concept of cross-modal correspondences as a central aspect of the answer. Nevertheless each has a distinctly different theory of intersubjectivity in infancy.

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Beatrice Beebe, Ph.D. is a Clinical Professor of Psychology in Psychiatry, NYS Psychiatric Institute, Columbia University; Faculty, Columbia Psychoanalytic Center, the Institute for the Psychoanalytic Study of Subjectivity, and the NYU Postdoctoral Program in Psychotherapy and Psychoanalysis.

Steven H. Knoblauch, Ph.D. is faculty and supervisor, Institute for the Psychoanalytic Study of Subjectivity; faculty, New York University Postdoctoral Program in Psychoanalysis and Psychotherapy; a member of the Editorial Board, Progress in Self Psychology.

Judith Rustin, M.S.W. is Faculty and Supervisor, Institute for the Psychoanalytic Study of Subjectivity; and Psychoanalytic Psychotherapy Study Center.

Dorienne Sorter, Ph.D. is Cochair, Coordinating Committee and Faculty and Supervisor, Institute for the Psychoanalytic Study of Subjectivity; and Executive Committee member, Faculty, and Supervisor, Psychoanalytic Psychotherapy Study Center.

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IN THIS SECOND PAPER OF THE SERIES WE COMPARE THREE THEORISTS OF intersubjectivity in infant research, Andrew Meltzoff, Colwyn Trevarthen, and Daniel Stern. We chose these three infancy theorists because they explicitly use the term intersubjectivity to describe their theories. Other infant researchers who have also used this term at times, but who do not use it as the central metaphor of their theories, such as Sander (1977, 1995) and Tronick (Tronick, Als, and Adamson, 1977; Tronick, Als, and Brazelton, 1980) are omitted from this review. Because we focus specifically on the concept of intersubjectivity, we also do not include more recent work by Stern in the context of the Boston Study group on change (Stern et al., 1998). By evaluating where Meltzoff, Trevarthen, and Stern concur and differ, we aim to clarify the meanings or “forms” of intersubjectivity in infancy. In the third paper we consider the relevance of these infant forms of intersubjectivity for adult forms of intersubjectivity in psychoanalysis.

Trevarthen and Stern have been key figures in the tradition of microanalysis of film and videotape of mother–infant face-to-face interaction; through their analyses they have addressed infant representation and an infant “theory of mind.” Coming from an experimental tradition, Meltzoff has studied infant imitation behavior as a basis for drawing inferences about the origins of representation and “self.” All three have addressed the question of how infants can sense the state of the other, and all have used the concept of cross-modal correspondences as a central aspect of the answer. Nevertheless each has a distinctly different theory of intersubjectivity in infancy.

### Meltzoff’s Theory of Intersubjectivity in Infancy

Meltzoff has used imitation experiments in the first weeks of life to argue that infants are biologically prepared to perceive cross-modal correspondences between what they see on the faces of their partners and what they sense proprioceptively on their own faces. An infant’s perception of correspondences between his own behavior and that of his partner provides the infant with a fundamental relatedness between self and other (Meltzoff, 1985, 1990; Meltzoff and Gopnick, 1993). In Meltzoff’s view, the perception and production of similarity has a privileged position in the experience and representation of relatedness.



Meltzoff (1985, 1990; Meltzoff and Moore, 1998) begins with the question of how an infant develops a sense of self. Whereas self-recognition is usually referred to as static featural information, another key source of information about the self is spatiotemporal movement patterns. "The first, psychologically primary notion of self concerns not one's featural peculiarities but rather one's movements, body postures and powers" (Meltzoff and Moore, 1998, p. 142). Adults are potentially social mirrors: they can see themselves in the actions of others. Infants similarly can recognize that movements in the other are "like me."

Meltzoff (1990; Meltzoff and Moore, 1977, 1994, 1998) has done a series of experiments at varying infant ages to test this thesis. For example, at 14 months the infant looks more, smiles more, and shows more test-explore behavior toward the adult who imitates, compared with another adult who is making child-like gestures, but not imitating. The idea that imitation of others is critical to the development of the self has a long history (Baldwin, 1902; Mead, 1934). In Meltzoff's view, imitation is a process by which something of the other is taken on by the self. The infant's ability to imitate novel as well as familiar behaviors, after a lengthy delay, was termed "deferred imitation" by Piaget (1954), who used this behavior as an index of the infant's representational capacity. Whereas Piaget argued that this ability was not available until 16 months, Meltzoff and Moore (1994, 1998) have documented the capacity for deferred imitation at nine months, and even as early as six weeks. Like Piaget, Meltzoff is interested in the implications of imitation for representation. Unlike Piaget, Meltzoff believes that neonatal imitation proves that (presymbolic) representation begins at birth.

The younger the infant's age at which Meltzoff and Moore (1998) have been able to demonstrate some rudimentary form of imitation, the more remarkable. The earliest age that he has tested is 42 minutes, after birth. At 42 minutes the infant watches a model while he sucks on a nonnutritive nipple; he could not possibly imitate while he watches. The model poses a gesture, such as opening the mouth or sticking out the tongue. The nipple is now taken out of the infant's mouth. Over the next two-and-a-half minutes the infant progressively makes gestures increasingly similar to that of the model.

Meltzoff (1985, 1990; Meltzoff and Gopnick, 1993; Meltzoff and Moore, 1998) has used his imitation studies to argue that the infant has the capacity to detect correspondences between his own actions



and those of a model. How is this possible? The mechanism is cross-modal matching: the infant maps what he sees onto what he feels proprioceptively with his face. Detecting matches, from the beginning of life, the infant can translate between environmental stimuli and inner states. The infant can use the adult as a target against which to match an ongoing movement pattern. Meltzoff believes that this capacity yields the first sense in the infant that “you are like me.” In Meltzoff’s (1985, 1990) terms, this is the origin of presymbolic intersubjectivity: the state of being while intentionally trying to match. The apprehension that the other is similar to the self constitutes the origin of a theory of mind, in Meltzoff’s view: other persons have states similar to one’s own.

In the imitation experiment at 42 minutes after birth, during the two-and-a-half minutes that the infant is given to respond, there is a gradual increase in the success of the matching. Meltzoff and Moore (1989) uses this gradual increase in matching to argue that the imitation is far from reflexive, instead the imitation is intentional, goal corrected, and mediated by memory. If so, the infant is comparing a motor action against an internal memory, schema, or *representation* of what was previously seen. The infant monitors and modifies her own actions to match the model increasingly well.

Pursuing the argument that the infant *represents* what she sees, Meltzoff and Moore (1994) tested six-week-old infants in an experiment where an experimenter exposed them to several facial displays, but now required them to imitate after a 24-hour delay. When the infants returned one day later, the experimenter sat in front of them with a neutral face. The infants first stared at the experimenter and then gradually made successive efforts to make the same facial displays as they had seen the day before. “These studies suggested that imitation can be mediated by a representation of the now-absent acts” (Meltzoff and Moore, 1998, p. 56).

Meltzoff (1985, 1990) suggests that, by forming these presymbolic representations, the infant encodes the visual-spatial-temporal events of human actions of self and other in a non modality-specific representational code. All modalities speak the same language from birth. The social partner may be processed through one modality (for example, visual image of experimenter’s face) but is accessible to the self in another modality (proprioceptive sensations of one’s own facial movements). The *perception* as well as the *production* of human action



are both represented within the same framework. The infant maps the visually perceived behavior of the partner onto his own motor plans. *Thus the other is accessible to the self through cross-modal correspondences. The infant appreciates self-other correspondences from birth.* This is the core of Meltzoff's theory of the origins of intersubjectivity and representation. Meltzoff's concept that the infant maps the visually perceived behavior of the partner onto his own motor plans may well be validated by the discovery of "mirror neurons," described later in the discussion section.

Since both parent and infant recognize these correspondences, they provide a common language, and special moments of connection. Correspondences have their own motivational significance: both partners enjoy these moments. Meltzoff and Moore (1998) describe the parent's intention to participate in these exchanges as selective, interpretive, and creative. They are an essential aspect of parental "scaffolding" (Vygotsky, 1962; Bruner, 1977, 1986).

Elemental to Meltzoff's (1985, 1990) argument is that the perception of correspondence has a privileged status in the experience of human relatedness, and create a fundamental relatedness between self and other. It establishes the first sense that "you are like me" in form and in timing. The other is thus *directly accessible* to the self through proprioceptive perception of cross-modal correspondences. Self and other can be related because their bodily actions can be compared in commensurate terms: I can act like the partner, and the partner can act like me (Meltzoff and Moore, 1998). Meltzoff's thus work provides a way of conceptualizing how both infant and partner can sense the state of the other through the perception of correspondences.

Meltzoff's work is important in another way as well. His explication of mechanisms of matching is relevant to all the studies of face-to-face interaction in the first half of the first year, the lion's share of which demonstrate some form of correspondence in timing or spatial format. Although many analyses are unimodal, for example, vocal rhythm coordination and facial-visual engagement, in the actual interaction all modalities operate at once as a "package," and thus all information is potentially cross-modal. His mechanism of cross-modal mapping of correspondences can help explain the intense affective involvement that matching interactions, such as facial mirroring and vocal rhythm-matching generate, since both mother and infant receive both modalities of information at once.



Finally, Meltzoff has played a central role in the documentation and conceptualization of a neonatal form of presymbolic representation. His work builds on Piaget's (1954) but also provides a radical critique: rudimentary representational formats are available at birth rather than at the end of the first year. Meltzoff's experiments have changed our concepts of the origin of mind.

### **Trevarthen's Theory of Intersubjectivity in Infancy: A "Psychology of Mutually Sensitive Minds"**

Trevarthen is as interested in neonatal imitation as Meltzoff is. He cites many authors working in the area of neonatal imitation (for example, Meltzoff and Moore, 1977; Field, 1981; Uzgiris, 1981; Maratos, 1982; Kugiumutzakis, 1985, 1993; Heimann, 1989; Nagy and Molnar, 1994). Trevarthen (1998) describes in detail the work of Nagy and Molnar (1994), who found that newborns a few hours old may readily imitate tongue protrusion, mouth opening, lip protrusion, smiles, a surprise expression, and hand and finger movements. If the partner waits after eliciting tongue protrusion, the baby will, after two or three minutes, poke out his tongue, or "provoke" (Nagy and Molnar, 1994; Trevarthen, 1998).

Trevarthen (1998) has argued that the work on neonatal imitation can provide the basis for a "*psychology of mutually sensitive minds*", based on an "effective interpersonal intelligence" in newborns. "It has generally been assumed . . . that human sympathetic consciousness is . . . an acquired skill. The new evidence from infancy [is] incompatible with this belief" (p. 1.) On this basis, his "theory of innate intersubjectivity" was formulated: "the child is born with the motives [capacity] to use the motives [behaviors] of the partner in 'conversational' negotiation of purposes, emotions, experiences and meaning" (p. 1). Each partner can mirror the motivations and purposes of companions, immediately. Infants and their partners are thus in *immediate sympathetic contact*" (p. 8). From a different route, then, Trevarthen came to the same conclusion as Meltzoff, that innate "intersubjectivity" exists, with neonatal imitation the key piece of evidence. But in Trevarthen's hands, this theory is more dyadic than Meltzoff's: it has to do with communication between partners.



Trevarthen (1998) proposes that “the idea of infant intersubjectivity is no less than a theory of how human minds, in human bodies, can recognise one another’s impulses, intuitively, with or without cognitive or symbolic elaborations” (p. 17). His position is that the infant demonstrates a crucial awareness of the partner’s feelings and purposes before words and language. He argues that the core of human consciousness is the potential for the self’s rapport with another’s mind. This potential is immediate, unrational, unverballed, conceptless, and atheoretical: “A delicate and immediate with-the-other awareness” (Trevarthen, 1993b, p. 122).

Trevarthen’s ideas about innate human intersubjectivity as the foundation for the development of language were influenced by Ryan and Habermas. Ryan (1974) held that children begin to speak by communicating states of mind and shared interests with familiar people. Impressed by “how mothers succeed in questioning, prohibiting, informing, encouraging or rejecting their infants before the latter can speak” (quoted by Trevarthen, 1988, p. 8), Ryan proposed that *communicative competence is more fundamental and prior to language* (italics added).

Ryan was also influenced by Habermas (1970), and Trevarthen (1988) quotes Ryan at length:

Habermas (1970) argues that verbal communication cannot be understood only as an application of linguistic competence, limited by prevailing empirical conditions, but instead that the “structure of intersubjectivity” that makes such application possible has to be explained. Intersubjectivity between any speakers capable of mutual understanding is made possible by what he calls “dialogue constituent universals.” . . . Whilst one might query the explicitly linguistic nature of Habermas’ dialogue universals, *his emphasis on the structure of intersubjectivity presupposed by successful speech is extremely important* [p. 9, italics added].

Thus Trevarthen takes the position that intersubjectivity in infancy is initially preverbal. One implication is that linguistic forms of intersubjectivity are built on, and are influenced by, preverbal forms.

Trevarthen’s research began around the same time as Stern’s, and both initially used the same method, frame-by-frame analysis of



16 mm film of split-screen, face-to-face interaction where both partners are simultaneously visible. Numbers are printed on the top of each frame (24 frames = one second). This method allows the researcher to rock the reels of film back and forth over a small number of frames, across a second or two of time, to see exactly how the behavior of each partner unfolds in time and its precise onset and offset frame, as well as to see patterns of synchronization where two behaviors co-occur in time. Trevarthen began his research in 1967–1968 with Martin Richards at Jerome Bruner’s Research Program on Intellectual Development at Harvard University, where they examined 16 infants from birth to three months. In 1968 he also worked with T. Berry Brazelton on infants’ differential response to persons versus objects. In 1972 he presented microanalyses of film (see Trevarthen, 1974) and proposed that newborns are coherent in their behavior. He observed a precise coordination in time, synchronized to within .10 seconds, of lip and tongue movements, expressive head movements, eye movements, hand gestures, finger movements, and pointing. He suggested that “intrinsic rhythmicity is essential to the inter-coordination observed in protoconversations” (Trevarthen, 1998, p. 5).

During approximately the same period, 1969–1972, Catherine Bateson studied mother–infant vocal exchanges from films made by Margaret Bullowa. Bateson first published her results in 1971, the same year as Stern. Bateson described a pattern of alternating vocal exchanges, which she termed “protoconversation”. Trevarthen (1974, 1977) concurred with Bateson that an infant’s behavior is an innate emotional foundation for learning language and culture and for forming emotional bonds (see Dissanyake, 1992, for an elaboration). Stern et al. (1975) argued that these vocal exchanges are coactive as well as alternating, providing the basis for two different functions, one organized through simultaneous exchanges (bonding, emotion, oneness) and the other through sequential, alternating exchanges (logic, language).

In what follows, the key mechanisms of interpersonal coordination proposed by Trevarthen are summarized:

(1) *Infants possess an emotional and communicative brain at birth.* The capacity for communication is innate in the human brain: we possess an inherently dyadic “conversational” mind. Within a few weeks after birth, infants take up “direct face-to-face exchanges . . . [and] effectively coordinate vocal, oral and gestural expressions”



(Trevarthen, 1988, p. 1). Influenced by the work of Holstege, Bandler, and Sapir (1997), and Damasio (1994) on the “emotional brain,” Trevarthen (1998) concluded that neonatal imitation and proto-conversation prove that the human brain is designed to integrate expressive movements of eye, face, mouth, vocal apparatus, hand, and posture. The neonate brain senses corresponding movements and expression in a human conversational partner through temporal and morphological markers (Trevarthen, 1998), a position very similar to that of Meltzoff.

An infant who is only a few months old has a remarkable range of perceptual capacities that allow for “imitative identification, emotional empathy and reciprocal communication that all humans possess” (Trevarthen, 1993b, pp. 127–128). These capacities include binocular acuity; selective attention (Fantz, Fagen and Miranda, 1975); categorization of objects (Bornstein, 1985; Younger and Cohen, 1985; Mandler, 1988); memory of contexts for object recognition (Fagen et al., 1984; Shields and Rovee-Collier, 1992; ); physical laws of objects with mass, such as above–below, container–barrier (Mandler, 1988); discrimination of face patterns (Meltzoff and Moore, 1977; Field et al., 1982; Meltzoff, 1990); and discrimination of the musical and phonological parameters of sounds (Trehub, 1990). By six months, infants discriminate features of tempo, rhythm, melody, and key, and they can isolate musical invariants. In addition, Mandler (1988) has shown that infants perceive animacy, which provides them with a primitive perception of agency, causality, and intentionality. Infants detect the “effort” or “vitality” of action (see Werner, 1948, who described “physiognomic perception” of the directedness, shape, and velocity of action).

(2) *The basic dimensions through which intersubjective coordination occurs are time, form, and intensity*, which neonates can perceive. Fundamental carriers of information about changes in the emotional and motivational state of the partner include “fine and rapid . . . glides and leaps of pitch or volume of voice, eye-brow flashes, pre-beat syllables, suffix morphemes, rhythmic details and embellishments, rapid hand gestures, quick head moves, shifts of gaze . . . that appear in abundance in all spontaneous conversational communication” (Trevarthen, 1993b, p. 151. As evidence, Trevarthen cites Duncan and Fiske (1977), Buck (1984), Eibl-Eibesfeldt (1989), Kendon (1980), and Stern (1985).



Infants in the first few months are not conversational unless appropriate receptive invitations are given by the partner. Mother's expressive behavior is adapted to the multimodal perceptual readiness of the infant and conveys animacy, vitality, and energy. The movements of the mother "include the fundamental beat of repeating movement, short bursts of expression, repetition of rhythmic groups of movement, exaggerated dynamic expressive 'sentic' forms, and precise modulation of the intensity or force of expression in a moderate to weak range" (Trevarthen, 1993b, p. 135). Predictable cycles of behavior become entrained on an adaggio beat, one per 700-800 msec.

(3) *The infant is aware of, and shows a preference for, contingent effects. The human brain is specialized for mutual regulation of joint action* (based on contingent effects). In a "dual prospective motor control," each partner anticipates in detail what the other will do. One translation of this concept is that the infant experiences being experienced. Here Trevarthen is very similar to Stern (as described later). An experimental confirmation of the mutual-regulation model (see Tronick, 1989) was conducted by Murray and Trevarthen (1985) in Murray's "replay" experiment. Murray and Trevarthen first showed that normal two-month-old infants and their mothers could communicate successfully in separate rooms by way of closed-circuit TV of the other's live, interacting face. Then both mother and infant were subjected to a "replay" of the partner from the normal interaction a few minutes before. In the replay condition both partners lost the normal moment-by-moment, contingent responsiveness of the other, although each "seemed" to be interacting normally. In the replay condition, the infants became distressed and avoidant, and the mothers lost their usual empathic mode, becoming controlling, critical, and self-focused. Trevarthen (1998) commented that "*normal happy protoconversational games need mutual awareness and purposeful replies, with both parties in immediate sympathetic contact*" (see p. 8; Tronick, 1989, for a description of the "still-face" experiment). Emotions are regulators of interpersonal contact and relationships, not just state-regulators of the infant's self.

(4) *The infant coordinates perception and action through a single time base, a "neural conductor," mapped in the neurons and probably operating through the coupling of coordinated rhythmic oscillators. The pacemakers of motor systems are already coupled at birth, and all movements are played out in one time frame, 'intersynchronized'*



(Poppel, 1994). This coupling provides a physiological basis for endogenous coordination of perception and action in time, guided by environmental input and producing motor schemes and selection of sequences. The infant seeks information to direct and control actions and their effects. From birth, the human brain is able to coordinate movements of trunk and limb with receptors capable of aiming the pickup of detailed information about objects. To illustrate this intercoordination of infant movements within a single time-base, Trevarthen (1998) described “prespeech” in a seven-week-old infant, “lip and tongue movements resembling adult articulation movements and coupled with expressive head movements, eye movements, and hand gestures” ( p. 6).

(5) *The most basic mechanism of intersubjective coordination is matching of communicative expressions through time, form, and intensity, across modalities. Patterns are entrained in time, imitated in form, and brought into register in intensity range. This intercoordination of inner states between subjects enables each to resonate with or reflect the other. The particular temporal-spatial-intensity patterns formed by the dyad will guide actions, tune each to notice and remember them, and affect learning and memory. “Reciprocity in rhythmic timing” and “equivalence of movement or mimetic sympathy” (matching of form) characterize protoconversation (Trevarthen, 1998, p. 9).*

(6) *How does this “intersubjective matching” occur?* Trevarthen uses a theory of coupled rhythms to explain not only coordination within the infant, but also the infant’s coordination with the partner. Just as timing is central to intrapersonal coordination, timing is fundamental to interpersonal coordination. Infants and adults share a common time base. They demonstrate similar autonomous periodicities, for example, those of oculomotor saccades, or pre-reaching and reaching.

Trevarthen (1974, 1989, 1998) hypothesized that infant and adult coordinate behaviors through coupled pacemakers or neural clocks. Expressions become manifestations of an empathic awareness and mutual control. This awareness is based on a sensitivity to rhythmic patterns through some process that couples inherent pacemakers in each partner. Intercoordination depends on a common beat, assisted by mutual imitation and matching/complementarity. For short intervals, infants and adults can achieve mutually “entrained” close inter coordinations. (For a critique of Trevarthen’s theories of coupled oscillators based on regular, *periodic*, rhythms, rather than the *loose*,



*nonperiodic* rhythms more generally observed in human interaction, as well as a discussion of other modes of rhythmic coupling in infancy, see Jaffe et al., 2001).

Influenced by Sperry (1952), von Holst and Mittelstaedt (1950), and Bernstein (1967), Trevarthen (1998) formulated the theory of intersubjectivity in terms of “intersubjective motor control by rhythmic expression, “and” the infant’s innate sensitivity to kinematic, energetic, and physiognomic parameters of others’ movements” (p. 123). These parameters of movement are “transmodal features of motivation, coded as emotions.” They are transferred from subject to subject via timing, intensity and spatial configuration. This “permit[s] the intercoordination of inner psychological states between subjects” (Trevarthen, 1993b, p. 126). Corresponding parameters (in timing, intensity, and form) in the two subjects “enables them to ‘resonate with’ or ‘reflect’ one another.” Their patterns can become “entrained,” brought into register, imitated. “These are the features that make possible . . . empathic communication between infants and mothers” (p. 126).

(7) *Cerebral representation of self and other.* The process of matching in neonatal imitation “does not necessarily depend on body sensations caused by movement of the limbs or face, or comparison of seen and felt movement, but some kind of adjustment of the ‘image’ of a movement to be made, to that of a movement seen, must be taking place in the brain. In order to imitate, the infant must have a cerebral representation of persons” (Trevarthen, 1998, p. 6). Trevarthen (1984, 1998) hypothesizes a neural image of the expressive apparatus that can detect the species of affect in the other, while transmitting it to the perceiver’s own motor system. Here Trevarthen is very close to Meltzoff.

Influenced by Braten’s (1998) theory of the “virtual other,” Trevarthen (1998) argues that the mapping of the infant’s body into the infant’s brain must also be able to reflect the action of the other person’s body.

Now I would say that the cerebral ‘representation’ of the ‘other’ is rooted in a motor image (Sperry, 1952; Di Pelligrino et al., 1992; Jeannerod, 1994) sensitive to both the body-related form and the timing of the movement imitated, and in these respects indifferent to the sensory modality. . . . A formal theory of *how intrinsic pacemakers coordinate* body part with body part



prospectively, by reference to any or all forms of proprioceptive information . . . may offer a key to *the problem of what information is critical in intersubjective coordination*" [p. 29].

Trevarthen's idea that the cerebral representation of the other is rooted in a motor image may well be validated by the discovery of "mirror neurons," described later in the discussion section.

(8) *Primary and secondary intersubjectivity*. Trevarthen, conceptualizes progressive levels of intersubjectivity, specifically defining "primary" and "secondary" intersubjectivity. The three fundamental facets of motives and emotions are self, other, and object. Whereas "primary intersubjectivity" refers to the coordination of self and other based on correspondences of form, timing, and intensity, "secondary intersubjectivity" includes an object and refers to the intercoordination of self, other, and object based on the cooperative exchange of referential gestures. Secondary intersubjectivity develops at nine–twelve months with the beginning of symbolic functioning (Trevarthen and Hubley, 1978; Hubley and Trevarthen, 1979). Trevarthen defines a developmental sequence from (1) protoconversation (primary intersubjectivity) to (2) games to (3) cooperative awareness of persons and objects (secondary intersubjectivity). A critical shift occurs at nine–ten months, from game playing to increased initiative taking to systematic combining of purposes to partner and object. Symbols are motivated by a coorientation to people and to objective referents of potential joint interest, generating acts of meaning, rudimental demands, refusals, and inquiries. By nine–ten months, objects have permanence, self-awareness begins, and a theory of mind that includes other people emerges, accompanied by protolanguage and specific attachment patterns. As for Meltzoff, for Trevarthen intersubjectivity begins at birth. Unlike Meltzoff, but like Stern, Trevarthen reserves the origin of a theory of mind for the point at which a symbolic intelligence begins to emerge, toward the end of the first year.

### Stern's Theory of Intersubjectivity in Infancy

Stern reserves the term intersubjectivity for a later point than do either Meltzoff or Trevarthen: toward the end of the first year. Stern (1985) proposes that, at approximately nine–twelve months, the infant



discovers he has a mind, that other people have minds (see also Bretherton and Bates, 1979; Bretherton, McNew, and Beegley-Smith, 1981) and that inner subjective experiences are potentially shareable. This view of intersubjectivity is a theory of the infant's mind at the beginning of the transition to symbolic intelligence, and it contributes to our understanding of how symbols evolve out of presymbolic mentation. Intersubjectivity occurs at the point of a "quantum leap" (Stern, 1985, p. 124) in development, when the infant can point, use gestures to refer to objects, begin to use words, and have the intention to communicate. The infant discovers that the focus of attention (look at that toy), feeling state (this is exciting), and intention (I want that cookie), can be *shared*. In Stern's view, this discovery constitutes a new organizing principle, a new subjective perspective that can be aligned with that of another to become "inter-subjective".

Stern's theory of intersubjectivity is thus a view of how inner subjective states can be shared. Very different from Meltzoff and Trevarthen, for Stern the domain shifts from overt behaviors to inner states. The infant perceives his own attentional focus and that of the partner; these can be similar or different. Building on the infant's previous ability to perceive a distinct, separate self and other, now a mental self and a mental other can be interfaced, aligned, or misaligned. The partner's alignment is now a direct subject in its own right. "What is at stake . . . is nothing less than the shape and . . . extent of the shareable inner universe" (Stern, 1985, p. 151), what may become the subject matter of intimacy, and what may become linguistically encodable. In fact, psychic intimacy is first made possible by this developmental leap. What is not shareable may come to define "not-me" experiences.

Similar to Meltzoff, Stern argues that infants' capacity to recognize cross-modal correspondences is the central mechanism allowing them to capture the quality of another's inner feeling state. However, very different from Meltzoff, Stern is interested in correspondences as a reciprocal dyadic process across time: *each is changing with the other*. This emphasis on the bidirectional influence process is similar to Trevarthen's and defines a critical point of difference with Meltzoff. Whereas Meltzoff privileges "form" information over that of timing, both Stern and Trevarthen consider time, as well as form, absolutely critical.

Stern, like Trevarthen, uses timing, form, and intensity to define the dimensions of correspondences. Stern and his colleagues (1985)



are interested in the *how* of behavior, the dynamic, shifting patterns of rhythms, shapes, and activation: “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” (p. 263). This view is very similar to that of Werner (1948), who used the term dynamic-vectorial to describe the quality of feeling conveyed by action patterns changing over time. Stern et al.’s concept of the infant’s capacity to “feel-what-has-been-perceived-in-the-other” may well be validated by the discovery of “mirror neurons,” described later, in the discussion section.

Why does the infant take a quantum leap into intersubjective relatedness? Stern (1985) endorses three different viewpoints, all necessary. First, following Bates (1976), Stern notes that an infant discovers generative rules and procedures for interactions that lead to the discovery of intersubjectivity as an acquired social skill. Second, following Vygotsky (1962) and Newson (1977), the mother attributes meaning and interprets the infant’s behaviors. Third, consistent with Trevarthen and Meltzoff, Stern holds that intersubjectivity is an innate, emergent human capacity, based on a very highly developed special awareness of other humans. However, Stern quickly adds the caveat that not until 9-12 months can “true” intersubjectivity be said to exist. Here is Stern’s most essential point of disagreement with Meltzoff and Trevarthen.

Stern (1985) defines three forms of intersubjectivity: joint attention, joint intention, and joint affect (“interaffectivity” or “affect arrunement”). In describing joint *attention*, Stern notes that the infant’s capacity to point and to follow the other’s line of regard has been suggested by Bruner (1977) to constitute a critical means by which the infant can transcend egocentrism. In studies of social referencing (Klinnert et al., 1983) infants were enticed by interesting toys to cross a glass table that was made to look like a “visual cliff.” The infants hesitated, looked back to mother, and crossed only if mother’s face indicated that it was safe to do so. Stern suggests that this experiment portrays the infant’s deliberate attempt to make sure that the focus of attention is being shared.

In describing joint *intention*, Stern is influenced by the work of Bates (1979, p. 36), who defined intentional communication as “signaling behavior in which the sender is aware, a priori, of the effect that the signal will have on his listener, and he persists in that behavior until



the effect is obtained or failure is clearly indicated” (quoted by Stern, 1985, p. 130). For example, the infant requests a cookie with an imperative prosody and attributes to the partner the capacity to understand the infant’s intention: “interintentionality”.

### Stern’s Theory of Affect Attunement

Stern (1985) suggests that the term intersubjectivity is too broad, covering interattentionality, interintentionality, and inter-affectivity. He wants to specify affect attunement as a particular kind of intersubjectivity, specifically about interaffectivity. Of the three forms of intersubjectivity, joint affect, or “affect attunement,” is the first and most important mode of sharing subjective experiences. Throughout the first year, affects are both the “primary medium and the primary subject of communication” (p. 133). Not only interpersonal exchanges, but exchanges involving objects and intentions are affective as well.

As an example of interaffectivity, Stern (1985) cites an experiment of MacKain et al. (1985) in which nine-month-old infants were briefly separated from their mothers and then reunited. Immediately after the reunion, the infants were no longer upset, but they remained solemn. At that moment they preferred to look at a sad face than a happy face. They seemed to notice the congruence between their own affective state and the expression on the other’s face. “One conclusion is that the infant somehow makes a match between the feeling state as experienced within and as seen ‘on’ or ‘in’ another, a match that we can call *interaffectivity*” (Stern, 1985, p. 132). This position is the same as Meltzoff’s, except that Meltzoff describes this capacity at birth.

What is Stern’s evidence for affect attunement? Nine- to twelve-month-old infants were videotaped in the lab during a free-play session with their mothers. Coders first noted moments when the infants made some affect expression—facial, vocal, gestural, or postural. Coders then evaluated the mothers’ observable response—verbal comments, imitations (defined as matching within the same modality), and attunements (defined as matching across modalities). Attunements were coded along the dimensions of matching intensity, timing, and shape of the infant’s behavior, dimensions that are identical to those of interest to Trevarthen. Intensity was subdivided into absolute intensity and intensity contour (acceleration–deceleration). Timing



was subdivided into beat (a regular pulsation was matched), rhythm (a pattern of pulsations of unequal stress was matched), and duration. Shape was illustrated by an infant's up-down movement of the arm matched by mother's up-down movement of the head.

Stern's first finding was that, of all the mothers' responses, 33% were verbal comments, 19% were exact imitations of the infant's behavior, and 48% were considered attunements (occurring on average approximately once per minute). Second, in most attunements, more than one dimension of behavior was matched. Third, the dimension of intensity contour (profile of change in intensity over time) was the most frequent dimension of matching, occurring in 97% of attunements, and the dimension of timing the next most frequent, occurring in 76%. Stern (1985) coined the term "vitality affects" or "activation contours" to describe the feeling quality of *how* a behavior is performed. To illustrate an attunement, Stern described a nine-month-old girl excited about a toy. She reached for it, and as she grabbed it, she let out an "ahh." Simultaneously with the "ahh," mother did a shimmy, wiggling her body with the same activation as the infant's sound.

These data, together with his earlier work on younger infants (Stern, 1971, 1977), consolidated one of Stern's most central contributions, that is, his emphasis on the micromomentary dynamic shifts in each person's behavior that allow the partner to *change with*. Affect attunement is thus defined as the cross-modal matching of intensity, timing, and "shape" (contour) of behavior, based on dynamic, micromomentary shifts over time, perceived as patterns of change that are similar in self and other. The infant perceives a mental state in the other on the basis of intensity, timing, and shape of the partner's behavior. Stern argues that the infant's capacity to recognize cross-modal correspondences is the perceptual underpinning of affect attunement, enabling the infant to capture the quality of another's inner feeling state and to discriminate whether it is shared.

Stern's description of affect attunements as "automatic," with relative lack of awareness, places them clearly within implicit, procedural processing. Following the free-play interaction while watching the videotape with the experimenter, mothers were interviewed about their responses. Twenty-four percent of the mothers judged themselves to be entirely unaware of their attunement; only 43% were partly aware; 32% were fully aware. Even so, Stern argued



that mothers were more aware of the desired consequences of their behavior than the behavior itself, and he concluded that the attunement process itself occurs largely out of awareness.

Stern (1985) also experimented with perturbing attunements and showed that the infants were indeed aware of attunements and were affected by their perturbations. After viewing the videotape together, Stern and the mothers “tailor-made” perturbations based on observation of specific attunements to frequent infant behaviors. The mothers agreed to play with the infants again, to pretend that they perceived the infants as, for example, less excited than he really appeared to be, and accordingly to slightly misattune. During the perturbation misattunements, the infants completely stopped playing and looked over to the mothers. By contrast, in the first interaction, during ongoing natural attunements, infants simply continued to play without missing a beat.

In discussing the possible functions of attunements, Stern (1985) differentiates between communication and communion. The functions of communication include to imitate, to tune the baby up or down, to restructure the interaction, to reinforce, and to teach. Communing is something very different: it is to participate, *to share without altering*, to maintain the thread of feeling connectedness. Affect attunement is a form of communing.

To demonstrate the potential power of attunements, Stern describes two mother–daughter pairs playing in the same free-play set-up. Molly’s mother tended to match when Molly was on the way up the crescendo of exuberance. Annie’s mother tended to match when the bubble had just burst. Stern describes the two styles as attuning to enthusiasm versus “exthusiasm.” Each style, when exaggerated, can introduce a selective bias, placing the opposite pole outside the “shareable universe.”

It is important to note that Stern does not consider affect attunement an equivalent to empathy, although both concepts share the phenomenon of emotional resonance. Whereas attunement occurs largely automatically and out of awareness, empathy requires the mediation of cognitive processes (see Basch, 1977). “Attunement is a distinct form of affective transaction in its own right” (Stern, 1985, p. 145) and need not proceed toward empathic knowledge.

Unlike imitation, attunement shifts the focus to the quality of feeling that is “behind” the behavior. It treats the feeling quality as the referent, and the overt behavior as one of several possible expressions of the referent: “Attunement takes the experience of emotional



resonance and recasts that experience into another form of expression,” by way of nonverbal metaphor and analogy (Stern, 1985, p. 161). For example, the same level of exuberance might be expressed as a facial expression, a vocalization, or a gesture. All three overt behaviors would refer to the same inner state.

Stern (1985) considers how perceptual qualities, such as forcefulness, crescendo–decrescendo, rhythm, and activation, could be translated into feeling states. He uses Suzanne Langer’s (1967) argument that the organization of the perceptual elements in art create the “illusion” of “forms of feeling,” such as vastness or being enclosed, calm or frenzy, advancing or receding. This translation of concrete behavioral dimensions of timing, form, and intensity in the mother–infant interaction into forms of feeling constitutes a significant step in an infant’s development of symbolic capacity. As we do when viewing art, we translate the acceleration, speed, and fullness of display of the other’s gesture, facial expression, or vocalization into a feeling quality. This is a critical aspect of Stern’s theory of intersubjectivity, and it differentiates him sharply from Trevarthen and Meltzoff, who remain at the level of behavioral correspondences. Affect attunement is a critical step on the way to symbolic capacity, organized toward the end of the first year.

Why is intersubjectivity and particularly affect attunement so powerful? Stern suggests that it contributes to attachment and a sense of security and that it ushers in the capacity for psychic intimacy. The focus shifts from the mutual regulation of behavior to the mutual sharing of experience. Even minor failures in attunement can be experienced as ruptures in a relationship. Each individual learns that some subjective states are shareable and some are not.

### Discussion of the Three Theorists of Infant Intersubjectivity

Meltzoff, Trevarthen, and Stern share a number of central tenets. All three attempt to conceptualize the origins of a theory of mind in infancy. For each, mind begins as a *shared* mind, and the central question is, how can an infant sense the state of the other? All three theories posit that the infant’s perception of correspondence is the central mechanism in the creation of intersubjectivity. The infant’s



capacity for cross-modal perception is seen as key in detecting correspondences, and in translating from one modality to another. All three conceptualize a highly complex, presymbolic representational intelligence, a motivated and intentional (rather than reflexive) infant, capable of distinguishing self from environment at a perceptual level. And all three emphasize positive emotion, playfulness, intimacy, and bonding as an essential function of intersubjectivity. Nevertheless, each author has a distinctly different theory of infant intersubjectivity. Two points of difference stand out: the definition of correspondence/matching, and the theory of mind underlying infant intersubjectivity. In addition, the recent discovery of “mirror neurons” may validate key ideas of all three theorists and may provide a way of further understanding the power of the perception of correspondences.

### Definition of Correspondence/Matching

For Meltzoff (1985, 1990; Metzoff and Moore, 1994, 1998), the definition of correspondence rests on *form*: an imitation model. For Trevarthen (1980, 1993a, 1998), correspondence is defined by behavioral similarities in timing, form, and intensity. Stern (1985) uses the same criteria as Trevarthen, timing, form, and intensity, but elaborates these criteria in two important ways: (1) the similarities are cross-modal rather than intramodal, and (2) this cross-modal similarity allows each partner to infer *inner state* rather than overt behavior.

Whereas Meltzoff uses an experimental paradigm, Trevarthen and Stern study quasi-naturalistic, ongoing, face-to-face communication. This important difference affects the definition of correspondence. Since Meltzoff studies the behavior of infants within an experiment, his concept of correspondence is more static, than the other's and is by design primarily a one-person view, although he certainly acknowledges the importance of parent–infant imitation games. By contrast, Trevarthen and Stern study face-to-face *two-way communication*. They construe the dyad to be the unit of study, and their concept of matching is more process oriented, emphasizing shifts over time. Stern and Trevarthen both operate within a mutual-regulation model of communication, in which each partner affects the other, in the sense that each partner is predictable from the other, moment-by-moment. Meltzoff does not work within this mutual regulation model.



## Theory of Mind

The three theorists hold rather different theories of mind. Meltzoff and Trevarthen describe a capacity for the perception of intersubjectivity that they consider to be *innate*: a neonatal form of presymbolic representational intelligence. By contrast, Stern argues that ‘true’ intersubjectivity does not begin until the 9–12 month transition to the earliest stage of a symbolic form of intelligence. Trevarthen conceptualizes two stages, a neonatal “primary” intersubjectivity and a “secondary” intersubjectivity at the end of the first year. Thus two very different forms of mind are being considered by these three theorists: presymbolic, and rudimentary symbolic, which begins toward the end of the first year.

For Meltzoff, the origin of mind begins at birth with the perception, “You are like me.” The key mechanism is the perception and production of similarity. The sense of self derives from one’s own movements as seen in the actions of the other, and the actions of the other are experienced proprioceptively as similar to one’s own movements. Others have states similar to one’s own. Meltzoff’s imitation experiments powerfully present a case for the point of view that an infant in the first months of life has a presymbolic *representational* intelligence. This is a fundamental contribution.

Trevarthen and Stern, by contrast, see the origins of mind in the interactive process itself. For however, Trevarthen, patterns of movement, transferred from subject to subject through form, timing, and intensity, permit the intercoordination of inner psychological states; the key mechanism is the rhythmic coupling of these patterns of movement. From birth, an infant has an inherently emotional and communicative brain, a dyadic “conversational” mind.

Stern begins with views of the interactive process rather similar to Trevarthen’s, but ends up with a very different theory. Because he posits that intersubjectivity begins with the critical shift toward symbolic functioning at the end of the first year, Stern emphasizes that an infant has a theory of *separate* minds. Two separate minds align to a third thing, an inner feeling state. The key mechanism of this alignment is a process of matching in which each partner is “changing with” the other. The cross-modal matching of form, timing, and intensity allows the infant to infer, by metaphor and analogy, forms of feeling “behind” the behavior. The infant detects whether or not the two separate minds: are aligned to the same forms of feeling. Thus



Stern's theory of intersubjectivity describes the origin of a symbolic mind. Meltzoff's and Trevarthen's theories of (primary) intersubjectivity describe the origins of a presymbolic mind.

### **The Role of Mirror Neurons in the Perception of Correspondences**

The recent discovery of "mirror neurons" may increase our understanding of how the correspondences described by Meltzoff, Trevarthen, and Stern may work at the neural level (see Pally, 1999, 2000). One hot summer day, the Italian researcher Rizzolatti, who was however, however, studying the premotor cortex in monkeys, took an ice-cream cone. A monkey nearby was watching. As Rizzolatti moved the cone to his mouth and began to lick it, Rizzolatti was surprised to see that the electrodes implanted in the monkey's premotor cortex became active. After many experiments, Rizzolatti and his colleagues concluded that a class of visual-motor neurons in the premotor cortex, which are active when a monkey performs a goal-directed action himself (such as reaching for an ice-cream cone), are also active when the monkey simply *observes* this same action in someone else (the researcher reaching for an ice-cream cone) (Rizzolatti et al., 1995; Rizzolatti and Arbib, 1998; Pally, 2000; Wolf et al., 2001). A number of researchers argue that humans share the mirror neuron system with monkeys in a homologous area, Broca's area, which is responsible for speech production (Fadiga et al., 1995; Grafton et al., 1996; Rizzolatti et al., 1996; see also Wolf et al., 2001). Rizzolatti and Arbib (1998) suggest that mirror neurons provide an "action-recognition" mechanism: the actor's actions are reproduced in the premotor cortex of the observer. Wolf et al., (2001) suggest that, through mirror neurons, the observer has an enhanced capacity to recognize the intention of the actor. Pally (1999) puts it this way: I understand your intention by understanding what my own intention would be, if I were doing what you are doing.

Mirror neurons can be seen as a "biological correlate" (see Wolf et al., 2001) of the correspondences described by Meltzoff, Trevarthen, and Stern. All of these theorists, in different ways, had the insight, long before the discovery of mirror neurons, that infants appreciate correspondences between their own actions and those of the partners. Meltzoff holds that an infant maps the visually perceived behavior of the partner onto his own motor plans; however, however, Trevarthen



proposes that the cerebral representation of the other is rooted in a motor image, and Stern conceptualizes the infant's capacity to "feel-what-has-been-perceived-in-the-other." The language of Meltzoff and Trevarthen comes very close to that of mirror neurons. The discovery of mirror neurons may corroborate this insight, although the relevant research has not yet been conducted on infants. As important as the discovery of mirror neurons is, however, it does not address, or substitute for, the subtle differences in the ways the three theorists conceptualize how correspondences may work between infants and parents. All three theorists make important contributions to the understanding of how correspondences are played out in behavioral transactions, and how they may be understood by the infant.

### Summary

This second paper has articulated the multiple meanings of the term intersubjectivity for the three infancy theorists. Because of the vast differences between a presymbolic and symbolic mind, we strongly question the use of the same term across both kinds of intelligence. Instead we emphasize the distinction between the symbolic and the presymbolic realms of intersubjectivity and on the use of the term forms of intersubjectivity within each realm. For adult as well as infant theorists of intersubjectivity, there is no single meaning to this complex yet central concept. In the third paper of this series we turn to the question of how the three theories of intersubjectivity in infancy, as well as related infant research, can inform and expand concepts of intersubjectivity in adult psychoanalysis.

### REFERENCES

- Baldwin, J. M. (1902), *Development and Evolution*. New York: Macmillan.
- Basch, M. (1977), Developmental psychology and explanatory theory in psychoanalysis. *The Annual of Psychoanalysis*, 5:229–263. New York: International Universities Press.
- Bates, E. (1976), *Language and Content: The Acquisition of Pragmatics*. New York: Academic Press.
- (1979), *The Emergence of Symbols: Cognition and Communication in Infancy*. New York: Academic Press.



- Bateson, M. C. (1971), The interpersonal context of infant vocalization. *Quarterly Progress Rep. Res. Lab. Electronics*, 100:170–176.
- Beebe, B. & Lachmann, F. (1994), Representation and internalization in infancy: Three principles of salience. *Psychoanal. Psychol.*, 11:127–165.
- Bernstein, N. (1967), *The Coordination and Regulation of Movements*. London: Pergamon.
- Bornstein, M. (1985), Infant into adult: Unity to diversity in the development of visual categorization. In: *Neonate Cognition*, ed. J. Mehler & R. Fox. Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 115–138.
- Braten, S. (1988), Dialogic mind: The infant and adult in protoconversation. In: *Nature, Cognition and System*, ed. M. E. Carvallo. Dordrecht: Kluwer Academic Publishers, pp. 187–205.
- Bretherton, I. & Bates, E. (1979), The emergence of intentional communication. In: *New Directions for Child Development, Vol. 4*, ed. I. C. Uzgiris. San Francisco: Jossey-Bass.
- McNew, S. & Beeghley-Smith, M. (1981), Early person knowledge as expressed in gestural and verbal communication: When do infants acquire a “theory of mind”? In: *Infant Social Cognition*, ed. M. E. Lamb & L. R. Sherrod. Hillsdale, NJ: Lawrence Erlbaum Associates, pp.
- Bruner, J. (1977), Early social interaction and language acquisition. In: *Studies in Mother-Infant Interaction*, ed. H. R. Schaffer. New York: Norton, pp. 271–289.
- (1986), *Actual Minds, Possible Worlds*. Cambridge, MA: Harvard University Press.
- Buck, R. (1984), *The Communication of Emotion*. New York: Guilford Press.
- Damasio, A. (1994), *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Grosset/Putnam.
- Dissanayake, E. (1992), *Homo Aestheticus*. New York: Free Press.
- Duncan, S. & Fiske, D. (1977), *Face-to-Face Interaction*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Eibl-Eibesfeldt, I. (1979), Ritual and ritualization from a biological perspective. In: *Human Ethology: Claims and Limits of a New Discipline*, ed. M. Von Cranach, K. Foppa, W. Lepenies & D. Ploog. Cambridge, MA: Cambridge University Press, pp. 3–55.
- Fadiga, L., Fogassi, L., Pavesi, G. & Rizzolatti, G. (1995), Motor facilitation during action observation: A magnetic stimulation study. *J. Neurophysiol.*, 73:2608–2611.
- Fagen, J., Morrongiello, B., Rovee-Collier, C. & Gekoski, M. (1984), Expectancies and memory retrieval in three-month-old infants. *Child Develop.*, 55:936–943.
- Fantz, R., Fagen, J. & Miranda, S. (1975), Early visual selectivity as a function of pattern variables, previous exposure, age from birth and conception, and expected cognitive deficit. In: *Infant Perception*, ed. L. Cohen & P. Salapatek. New York: Academic Press, pp. ??
- Field, T. (1981), Infant gaze aversion and heart rate during face-to-face interactions. *Infant Behavior & Develop.*, 4:307–315.
- Woodson, R., Greenberg, R. & Cohen, D. (1982), Discrimination and imitation of facial expressions by neonates. *Science*, 218:179–181.
- Grafton, S., Arbib, M., Fadiga, L. & Rizzolatti, G. (1996), Localization of grasp representations in humans by positron emission tomography. 2. Observation compared with imagination. *Experimental Brain Research*, 112:103–111.



- Habermas, J. (1970), Towards a theory of communicative competence. In: *Recent Sociology, Vol. 12*, ed. H. Dreitzel. London: Macmillan, pp. 115–148.
- Heimann, M. (1989), Neonatal imitation, gaze aversion, and mother-infant interaction. *Infant Behav. & Develop.*, 12:493–503.
- Holstege, G., Bandler, R. & Sapir, C., eds. (1997), *The Emotional Motor System*. Amsterdam: Elsevier.
- Hubley, P. & Trevarthen, C. (1979), Sharing a task in infancy. In: *Social Interaction During Infancy: New Directions in Child Development, Vol. 4*, ed. I. C. Uzgiris. San Francisco: Jossey-Bass, pp. 57–80.
- Jaffe, J., Beebe, B., Feldstein, S., Crown, C. & Jasnow, M. (2001), Rhythms of dialogue in infancy. *Monographs of the Society for Research in Child Development*, 66:1–132. Blackwell.
- Kendon, A. (1980), Gesticulation and speech: Two aspects of the process of utterance. In: *The Relationship of Verbal and Nonverbal Communication*, ed. M.R. Key. New York: Mouton.
- Klinnert, M., Campos, J., Sorce, J., Emde, R. & Svejda, M. (1983), The development of social referencing in infancy. In: *Emotion: Theory, Research, and Experience: Vol. 2. Emotion in Early Development*, ed. R. Plutchik & H. Kellerman. New York: Academic Press, pp. 57–86.
- Kugiumutzakis, G. (1985), *The Origin, Development and Function of Early Infant Imitation*. Unpublished Ph.D. dissertation, Upsala University.
- (1993), Intersubjective vocal imitation in early mother-infant interaction. In: *New Perspectives in Early Communicative Development*, ed. J. Nadel & L. Camaioni. London: Routledge, pp. 23–47.
- Langer, S. K. (1967), *Mind: An Essay on Human Feeling, Vol. I*. Baltimore: Johns Hopkins University Press.
- MacKain, K., Stern, D., Goldfield, A. & Moeller, B. (1985), The identification of correspondence between an infant's internal affective state and the facial display of that affect by an other. Unpublished manuscript.
- Mandler, J. (1988), How to build a baby: On the development of an accessible representation system. *Cog. Develop.*, 3:113–136.
- Maratos, O. (1982), Trends of development of imitations in early infancy. In: *Regressions in Mental Development: Basic Phenomena and Theories*, ed. T. G. Bever. Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 81–101.
- Mead, G. H. (1934), *Mind, Self, and Society*. Chicago: University of Chicago Press.
- Meltzoff, A. (1985), The roots of social and cognitive development: Models of man's original nature. In: *Social Perception in Infants*, ed. T. Field & N. Fox. Norwood, NJ: Ablex, pp. 1–30.
- (1990), Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modeling, and self practice in infancy. In: *The Self in Transition: Infancy to Childhood*, ed. D. Cicchetti & M. Beeghly. Chicago: University of Chicago Press.
- & Gopnick, A. (1993), The role of imitation in understanding persons and developing a theory of mind. In: *Understanding Other Minds*, ed. S. Baron-Cohen, H. Tager-Flusberg & D. Cohen. New York: Oxford University Press, pp. 335–366.
- & ——— (1977), Imitation of facial and manual gestures of human neonates. *Science*, 198:75–78.



- & ——— (1989), Imitation in newborns: Exploring the range of gestures imitated and the underlying mechanisms. *Developmental Psychol.*, 25:954–62.
- & ——— (1994), Imitation, memory, and the representations of persons. *Infant Behav. & Develop.*, 17:83–99.
- & ——— (1998), Infant intersubjectivity: Broadening the dialogue to include imitation, identity and intention. In: *Intersubjective Communication and Emotion in Early Ontogeny*, ed. S. Braten. Cambridge: Cambridge University Press, pp. 47–62.
- Murray, L. & Trevarthen, C. (1985), Emotional regulation of interactions between two-month-olds and their mothers. In: *Social Perception in Infants*, ed. T. Field & N. Fox. Norwood, NJ: Ablex, pp. 177–197.
- Nagy, E. & Molnar, P. (1994), “Homo imitans” or “homo provocans?” *Internat. J. Psychophysiol.*, 18(2):128.
- Newson, J. (1977), An intersubjective approach to the systematic description of mother–infant interaction. In: *Studies in Mother–Infant Interactions*, ed. H. R. Schaffer. New York: Academic Press, pp. 47–61.
- Pally, R. (1999), Mirror Neurons. Unpublished manuscript, Los Angeles, CA.
- (2000), *The Mind-Brain Relationship*. London: Kamac Books.
- Piaget, J. (1954), *The Construction of Reality in the Child*. New York: Basic Books.
- Poppel, E. (1994), Temporal mechanisms in perceptions. *Internat. Rev. Neurobiol.*, 37:185–202.
- & Arbib, M. (1998), Language within our grasp. *Trends in Neuroscience*, 21:188–194.
- Camarda, R., Gallese, V. & Fogassi, L. (1995), Premotor cortex and the recognition of motor actions. *Cog. Brain Res.*, 3:131–141.
- Matelli, M., Bettinardi, V., Paulesu, E., Perani, D. & Fazio, R. (1996), Localization of grasp representations in humans by PET: 1. Observation vs. execution. *Exper. Brain Res.*, 111:246–252.
- Ryan, J. (1974), Early language development. In: *The Integration of a Child into a Social World*, ed. M. P. M. Richards. Cambridge: Cambridge University Press, pp. 185–213.
- Sander, L. (1977), The regulation of exchange in the infant–caretaker system and some aspects of the context-content relationship. In: *Interaction, Conversation, and the Development of Language*, ed. M. Lewis & L. Rosenblum. New York: Wiley, pp. 133–156.
- (1995), Identity and the experience of specificity in a process of recognition. *Psychoanal. Dial.*, 5:579–593.
- Shields, P. & Rovee-Collier, C. (1992), Long-term memory for context-specific category information at six months. *Child Develop.*, 63:245–259.
- Sperry, R. (1952), Neurology and the mind-brain problem. *Amer. Scientist*, 40:291–312.
- Stern, D. (1971), A microanalysis of mother–infant interaction. *J. Amer. Acad. of Child Psychiat.*, 19:501–517.
- (1977), *The First Relationship*. Cambridge, MA: Harvard University Press.
- (1985), *The Interpersonal World of the Infant*. New York: Basic Books.
- Hofer, L., Haft, W. & Dore, J. (1985), Affect attunement: The sharing of feeling states between mother and infant by means of intermodal fluency. In: *Social Perception in Infants*, ed. T. Field & N. Fox. Norwood, NJ: Ablex.



- Jaffe, J., Beebe, B. & Bennett, S. (1975), Vocalizing in unison and in alternator: Two modes of communication within the mother-infant dyad. *Annals of the New York Academy of Science*, 263:89–100.
- Sander, L., Nahum, J., Harrison, A., Bruschiweiler-Stern, N. & Tronick, E. (1998), Non-interpretative mechanisms in psychoanalytic therapy. *Internat. J. Psycho-Anal.*, 79:903–921.
- Trehub, S. (1990), The perception of musical patterns by the human infant. In: *Comparative Perception, Vol. 1: Mechanisms*, ed. I. M. Berkeley & W. Stebbins. New York: Wiley, pp. 429–459.
- Trevarthen, C. (1974), The psychobiology of speech development. *Neurosci. Res. Program Bull.*, 12:570–585.
- (1977), Descriptive analyses of infant communicative behavior. In: *Studies in Mother-Infant Interaction*, ed. H. R. Schaffer. London: Academic Press, pp. 227–270.
- (1980), The foundations of intersubjectivity. In: *The Social Foundations of Language and Thought*, ed. D. R. Olson. New York: Norton, pp. 216–242.
- (1984), Emotions in infancy: Regulators of contacts and relationships with persons. In: *Approaches to Emotion*, ed. K. Scherer & P. Ekman. Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 129–157.
- (1988), Universal cooperative motives: How infants begin to know language and skills and culture. In: *Acquiring Culture: Cross-Cultural Studies in Child Development*, ed. G. Jahoda & I. M. Lewis. London: Croom Helm, pp. 37–90.
- (1989), Development of early social interactions and the effective regulation of brain growth. In: *Neurobiology of Early Infant Behavior*, ed. C. Von Euler, H. Forsberg & H. Langercrantz. New York: Stockton Press, pp. 191–216.
- (1993a), The function of emotions in early infant communication and development. In: *New Perspectives in Early Communicative Development*, ed. J. Nadel & L. Camaioni. London: Routledge, pp. 48–81.
- (1993b), The self born in intersubjectivity: The psychology of an infant communicating. In: *The Perceived Self: Ecological and Interpersonal Sources of Self-Knowledge*, ed. U. Neisser. New York: Cambridge University Press, pp. 121–173.
- (1998), The concept and foundations of infant intersubjectivity. In: *Intersubjective Communication and Emotion in Early Ontogeny*, ed. S. Braten. Cambridge: Cambridge University Press, pp. 15–46.
- & Hubble, P. (1978), Secondary intersubjectivity: Confidence, confiding and acts of meaning in the first year. In: *Action, Gesture and Symbol: The Emergence of Language*, ed. A. Lock. London: Academic Press, pp. 183–229.
- Tronick, E. (1989), Emotions and emotional communication in infants. *Amer. Psychol.*, 44:112–119.
- Als, H. & Adamson, L. (1977), Structure of early face-to-face communicative interactions. In: *Before Speech*, ed. M. Bullowa. Cambridge: Cambridge University Press, pp. 349–372.
- & Brazelton, T. (1980), The infant's communicative competencies and the achievement of intersubjectivity. In: *The Relationship of Verbal and Nonverbal Communication*, ed. M. R. Key. The Hague: Mouton, pp. 261–273.
- Uzgiris, I. C. (1981), Two functions of imitation during infancy. *Internat. J. Behav. Develop.*, 4:1–12.



- von Holst, E. & Mittelstaedt, H. (1950), Das reafferenzprinzip. *Natur Wissenschaften*, 37:256–272.
- Vygotsky, L. (1962), *Thought and Language*. Cambridge, MA: MIT Press.
- Werner, H. (1948), *Comparative Psychology of Mental Development*. New York: Harper & Row.
- Wolf, N., Gales, M., Shane, E. & Shane, M. (2001), The developmental trajectory from amodal perception to empathy and communication: The role of mirror neurons in this process. *Psychoanal. Inq.*, 21:94–112.
- Younger, B. A. & Cohen, L. B. (1985), Developmental change in infant's perception of correlations among attributes. *Child Develop.*, 57:803–815.

Beatrice Beebe, Ph.D.  
219 West 22nd Street  
New York, NY 10011  
beebebe@pi.cpmc.columbia.edu

Steven H. Knoblauch, Ph.D.  
30 West 13th Street, #3B  
New York, NY 10011  
sk@psychoanalysis.net

Judith Rustin, M.S.W.  
79 West 12th Street  
New York, NY 10011  
jrustin@psychoanalysis.net

Dorienne Sorter, Ph.D.  
26 West 9th Street, #3B  
New York, NY 10011  
dsorter@psychoanalysis.net