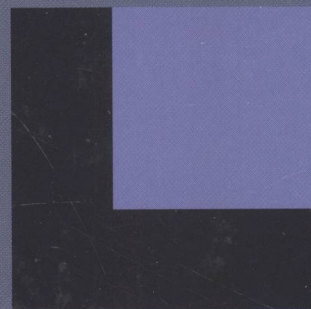
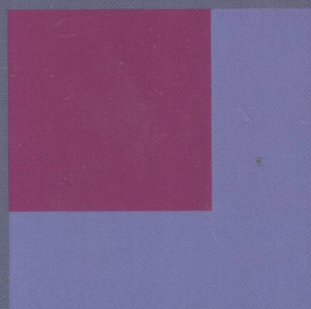
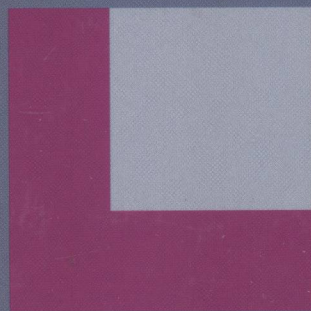
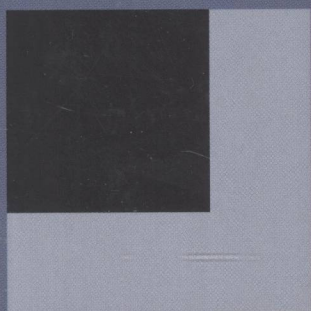


On Being Moved

From Mirror Neurons to Empathy

Edited by
Stein Bråten



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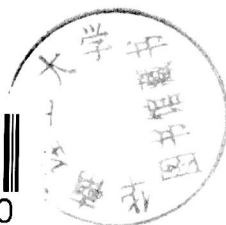
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On Being Moved
From Mirror Neurons to Empathy

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Introduction

Examining the origins, neurosocial support, and therapeutic implications of (pre)verbal intersubjectivity, and with a focus on implications of the discovery of mirror neurons, this collective volume brings together lines of research that jointly hold the promise of a paradigmatic revolution. Pertinent new findings and results are presented on these topics:

- i. The matrix and multiple layers of intersubjectivity and empathy
- ii. The mirror neurons discovery, and origins and neuro-social support of intersubjectivity and other-centred participation
- iii. From preverbal sharing and speech perception to meaning acquisition and verbal intersubjectivity
- iv. Implications and applications of the intersubjective matrix in therapy, intervention, and music.

Serving as proceedings of the Theory Forum Symposium on “Foundations of (pre)verbal intersubjectivity in light of new findings”, The Norwegian Academy of Science and Letters, October 3–5 2004, the present volume may be seen to be a sequel to at least three previous publications.

First, it follows up the proceedings of the first Theory Forum symposium in the Academy ten years earlier. This resulted in the collective volume *Intersubjective Communication and Emotion in Early Ontogeny* (ed. by Stein Bråten 1998, and now re-issued by Cambridge University Press as a paperback (2006)). Here were brought together for the first time seminal authors whose findings had challenged psychological theories of child development and pertinent comparative distinctions in psychopathology, primatology, and neuroethology.

Second, it has links to a symposium on implications of the mirror neurons discovery, held at the Hanse Institute for Advanced Study, Delmenhorst July 5–8 2000, which resulted in the John Benjamins proceedings *Mirror Neurons and the Evolution of Brain and Language* (ed. by Maxim Stamenov & Vittorio Gallese 2002). Here, in addition to evolutionary, communicative and language implications, functional interpretations and learning contexts applications were examined, including models of perception and learning by imitation.

Third, earlier in the same year that the Theory Forum symposium underlying the present volume took place, Daniel Stern (2004) published his book on *The*

Present Moment in Psychotherapy and Everyday Life in which he lays out in Chapter 5 what he terms ‘The intersubjective matrix’ with reference to recent developmental and neuroscience findings that invite a revolution in our understanding of the roots, nature, and implications of intersubjectivity.

A paradigmatic revolution

The intersubjective matrix entails *inter alia* two radical turnabouts. First, no longer can be upheld as valid Cartesian and Leibnizian assumptions about monadic subjects and disembodied and self-centred minds without windows to each other except as mediated by constructed or symbolic representations. Modes of participant perception have been identified entailing co-movements with others in felt immediacy, supplementing perception of others in re-presentational mediacy. Second, no longer can be retained the Piagetian attribution of infant egocentricity as a point of departure for children’s language acquisition and cognitive development. In the last decades some of the story of human infancy has been re-written, as it were, replacing earlier theoretical views of infants as a-social and ego-centric with a new understanding of infant capacity from the outset for interpersonal communion and learning by altercentric participation.

The first turnabout is partly consistent with what G. H. Mead (1934) emphasized when he refused to take as a point of departure the monad locked in a cell, and insisted on the priority of the interpersonal. In his posthumous book on *Mind, Self, and Society*, he offers a seminal account of the emergence of preverbal and symbolic intersubjectivity albeit, like J. M. Baldwin (1891) before him, he was not open to the possibility of imitation in the first months of life. The second radical turn was announced 45 years later, when Colwyn Trevarthen (1979) puts forward a description of ‘primary intersubjectivity’ in human infants, which at first was ignored or contested. Later, pointing out that the human infant’s anticipatory cerebral system is prepared for direct perception of the variety of sounds, gestures, and movements that humans afford, he defined ‘alteroception’, in analogue to proprioception, as direct perception of the other’s motivated act (Trevarthen 1986). By now, in line with his definitions, replacing the previous attribution of egocentricity made in Piagetian theories of child development and acquisition of language, infant altercentricity or other-centred participation has been identified (Bråten 1998; Stern 2000/2003: xi–xxxix, 2004; Trevarthen et al. 1998). Already in 1985, in his seminal *The Interpersonal World of the Infant*, Daniel Stern had emphasized the infant in interpersonal communion, and introduced his radical multi-layer model of the four senses of self (and other). This he modifies in an even more radical direction in the new introduction to the paperback version in the light of new findings:

evidence for the presence of mirror neurons and adaptive oscillators along with the deepening literature on early imitation suggest that probably from the beginning of life, infants have the capacity for what Bråten (1998) terms altero-centric participation or what Trevarthen (1979) has long called primary intersubjectivity. (Stern 2000: xx)

The above are some of the keywords for findings and capacities subsumed in terms of ‘the Intersubjectivity Matrix’ implying a paradigmatic revolution.

On Part I: Introducing the matrix and multiple layers of intersubjectivity

Thus, as stressed also in the beginning of the prologue to this volume, the story of human infancy has been rewritten in the last decades, replacing earlier theoretical views of the infant as a-social and ego-centric with a new understanding of infant capacities for interpersonal communion and altercentricity. In their prologue, Bråten and Trevarthen (this volume (1)) distinguish these three layers of intersubjectivity remaining operative throughout normal life (Figure 1).

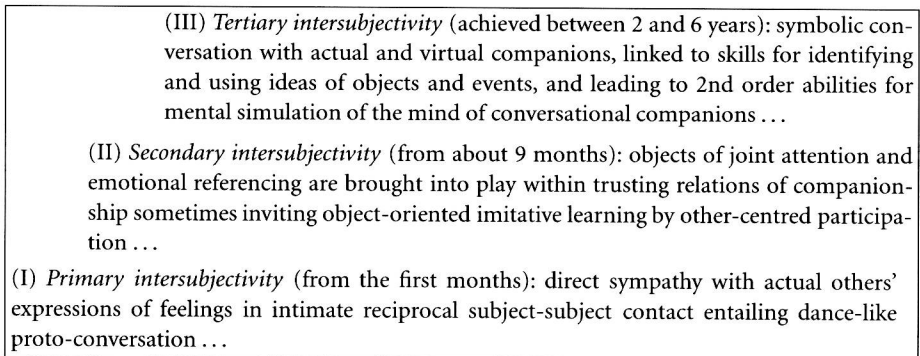


Figure 1. Layers of intersubjectivity succinctly specified (to be elaborated in the prologue)

In contrast to the stages in Piagetian theories of cognitive and moral development, in which earlier stages recede and are replaced by higher-order stages, the above tripartite distinction implies that the layers of primary and secondary intersubjectivity continue throughout life to support higher-order layers of intersubjectivity. This conforms to the multi-layer logic of the developmental model of senses of self (and other) proposed by Daniel Stern (1985/2000), who has specified how the earlier self-other senses continue to prevail and support higher order senses of self and other.

In his keynote contribution, Stern (this volume (2)) refers to recent neuroscientific findings that suggest mechanisms for intersubjective phenomena, and to

developmental accounts of such capacities subsumed in terms of the intersubjective matrix. Stern reviews developmental and infancy research findings attesting to the early foundations of primary intersubjectivity – revealed in neonatal imitation and reciprocal engagement in early infant-adult interplay, and supporting the kind of joint attention and object-oriented learning by imitation that follows around nine months, entailing mutual affect attunement and action- and object-oriented participation, which in turn come to support senses of verbal and narrative self and others. Stern points out how developmental and neuroscience findings on other-centred participation have bearings for understanding of processes of change in psychotherapy. He offers insight into the nature and contents of certain moments in psychotherapy and everyday life: critical “*now moments*” entail mini-crisis that may come to be resolved in what he terms “*moments of meeting*”, entailing a qualitative leap in the relationship, and with mutual participant perception as one of the characteristics. Such implications and applications are returned to in Part IV of the present volume.

In his key note contribution, Frans de Waal (this volume (3)) reviews expressions of empathy in animals, especially nonhuman primates, and presents a tripartite model of how animals perceive others. It ranges from a core mechanism of emotional linkage arising from a direct mapping of another’s behavioural state onto the subject’s representations. This Perception-Action mechanism (cf. Preston & de Waal 2002) provides the basis for higher layers in which the other is recognized as the source of felt emotions (Cognitive Empathy). This permits responses to be geared more specifically to the other’s situation, thus increasing the effectiveness of sympathetic support, care, or reassurance. Such responses have great survival value in cooperative animals, de Waal argues. At the highest layer, the other’s perspective, situation, and intentions are fully appreciated. As in a Russian doll, each earlier layer plays a role in the higher layers, so that even a fully developed empathic layer of attribution and perspective-taking (layer 3) includes and builds upon unconscious emotional reactions (layer 1). Thus, there is here some affinity and consistency with the three layers or modes of intersubjectivity laid out in the prologue (this volume (1)). The inner core of de Waal’s ‘Russian Doll’ model, entailing motor mimicry and emotional contagion, partly corresponds to the first layer or mode of primary intersubjectivity. While the innermost, automatic core of empathy is distinguished by de Waal in terms of affective resonance in an immediate sense, the higher-order layers entail empathy in a cognitive sense and through intersubjective perspective-taking. In these terms he gives many illustrations of consolations and helping by great apes.

On the front cover of the symposium pre-proceedings was used, as the middle part of three illustration, another illustration, a drawing of a chimpanzee holding out a sugar cane for a youngster to lick (Fig. 2 (middle)), based on de Waal’s (1996) photo record in his book on *Good Nature*.

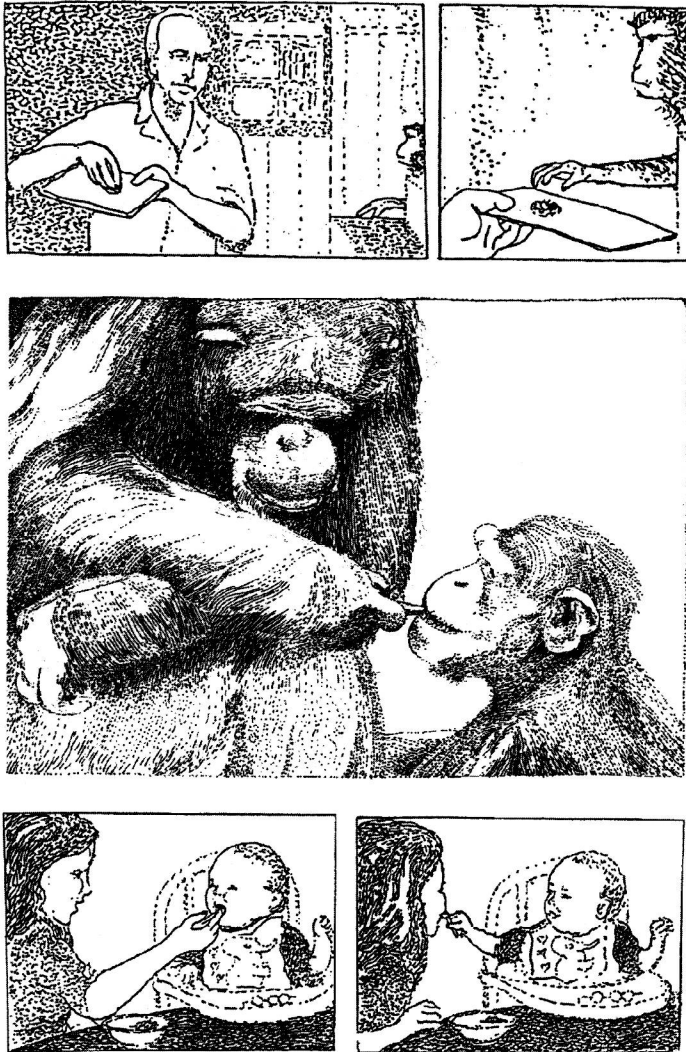


Figure 2. Illustrations of (in)take of food inviting participant perception

Perception of another's grasping or taking in food invites in the observer participant perception as if the observer were a virtual co-author, simulating the other's grasping or intake of food.

(Top) The original mirror neurons experiment: When the macaque monkey observes the grasping of a piece of food and when grasping the food by itself, there is a grasp-specific pre-motor neurons discharge in both cases involving the activation of mirror neurons. Now, Ferrari et al. (2003) report the findings of mouth mirror neurons in the monkey ventral pre-motor cortex, referred to in Part II of the present volume.

(Middle) Adult female chimpanzee feeds a piece of a sugar cane to an unrelated juvenile at the Yerkes field station, based on photo by Frans de Waal (*Good Natured*, Harvard U Press 1996: 136f.) who presents his 'Russian Doll' model of empathy in this volume (3).

(Bottom) As his big sister takes in the spoon with food offered by her baby brother (11 3/4 month) he reveals by his opening his own mouth his other-centred participation in her food-intake (as recorded by Stein Bråten 1996). Drawings, similar to the top and bottom illustrations also appeared in S. Bråten (Ed., 1998: 108, 122), and in Stamenov and Gallese (Eds., 2002: 281), and are returned to in this volume (7).

In Figure 2 we see various illustrations of (in)take of food inviting participant perception, including the original macaque monkey experiment in which single premotor neurons firings were recorded (Fig. 2 (top) drawing adapted from di Pellegrino et al. 1992; Bråten 1998: 122), entailing the discovery of what later aptly were labelled “mirror neurons”. We also see demonstrated by the chimpanzee (Fig. 2 (middle)) rudiments of the capacity to hand out or give (which the monkey would be lacking). In turn, the younger chimpanzee’s licking may very well have elicited empathy and invited participant perception in the older provider, albeit not in the nature of manifesting by mouth movements other-centred participation, such as exhibited by the 11-month old infants (Fig. 2 (bottom right)).

On Part II: Relating intersubjectivity in humans to the discovery of mirror neurons

The same year that the proceedings of the first Theory Forum symposium were published, portraying the original macaque experiment (Bråten (Ed.) 1998: 122, similar to the top illustration in Fig. 2), Rizzolatti and Arbib (1998) published their seminal paper “Language within our grasp”, identifying indirect evidence of a mirror neuron system in the human brain and relating *inter alia* to Liberman’s motor theory of speech perception. That had been partly anticipated (in a Centre of Advanced Study lecture in the Norwegian Academy the preceding year) by this prediction:

... if by way of experimental procedures the neural basis supporting egocentric perception and the neural basis sensitized to support allocentric perception are uncovered in humans, then I would expect that neural systems, perhaps even neurons, sensitized to realize altercentric perception will be uncovered in experiments designed to test and disconfirm this expectation. (Bråten 1997, 1998: 122–123)

Now, while no studies entailing recording of single neurons, can or have been done on humans, all the indirect neurophysiological evidence afforded (reported and examined *inter alia* by Rizzolatti et al. 2002: 37–59; cf. also contributions by Ferrari and Gallese, by Hari, and by Fadiga and Craighero (this volume (4–6)), indicates that an adapted and sensitized mirror neuron system is the most likely candidate for partial neurosocial support of intersubjective attunement in humans, including participant perception.

Ferrari and Gallese (this volume (4)) present monkey data on grasping and holding neurons, lip-smacking neurons, and lips protrusion neurons. Examining the potential of the mirror neuron system for actions in humans, they compare behavioural studies on synchrony and imitation in human and nonhuman primates, and addresses questions concerning primary and secondary intersubjectivity re-

lated to the mirror neuron system. Their pointed question concerns which neural mechanisms that may underpin our capacity to capture others' living experiences just by watching them, a construction built up in order to respond and re-act very early in life, such as attested by documentation of infant intersubjectivity and alter-centred participation. Ferrari and Gallese posit that the mirror neuron system, together with other mirroring neural clusters outside the motor domain, constitute the functional mechanism at the basis of intersubjectivity, and which they consider to entail embodied simulation. By that they mean an automatic, unwitting and pre-reflective functional mechanism, the function of which is to model objects, agents, and events. By means of such embodied simulation we are intentionally attuned to others.

The phylogenetic gap between advanced tertiary intersubjective capacities for simulation of mind and the mirror neurons discharge in macaques is of course huge, even though a partial basis for participant perception are afforded by the impressive capacity for mirror neurons discharge in the macaque upon sight of another's grasping act and upon own execution of a similar grasping act (Fig. 2 (top)). In the ventral premotor cortex of the monkey (area F5) there are neurons that discharge both when the monkey performs a specific hand action and when it observes an individual making a similar action. The strength of mirror neurons discharge even varies with the action context in which the perceived grasp act is embedded; there is a stronger discharge when the food is seen to be grasped and put in the mouth, than when it is seen to be grasped and put in a bucket (Fogassi et al. 2005:662). And then, in connection with a seminar of mine at the Human Physiology Institute in Parma, Vittorio Gallese showed me the design with a screen which hides from the sight of the monkey the endpoint of the experimenter's hand grasping the object, allowing only the beginning of the reaching and grasping act to be visible. And yet, even that evokes mirror neurons discharge. This supports the point made by Ferrari and Gallese on embodied simulation. Is it not only a demonstration of the activation of mirror neurons upon observation of parts of another's partly hidden act, but an indication of the macaque's being able to rudimentary simulate the completion of that partly hidden target-oriented act. This may be seen to resemble the kind of simulated completion, albeit at a higher layer of intersubjectivity, that the 18-month old toddlers are doing when exposed to the experimenter who fails to pull the dumbbell apart in Meltzoff's behavioural re-enactment design (cf. Meltzoff & Brooks this volume (9)).

In the proceedings of the Hanse Institute symposium, Stamenov (2002: 249–271), with a view upon prerequisites for linguistic competence, questions attempts to account for “higher cognitive capacities of humans” with reference to the mirror neuron discovery (cf. also Stamenov & Gallese 2002:7) because even though they have access to mirror neurons, macaques cannot engage in language, or simulate another's mind. True, not only are such higher-order modes of intersubjectivity

beyond their capacities; there are limitations even in bodily capacities for reciprocal resonance and co-movements in the mutual sense of primary intersubjective attunement. While the macaque is able to resonate with grasping (like in Fig. 2 (top)), it is likely to be unable to resonate with an act of giving, since it cannot do what is done by the chimpanzee (Fig. 2 (middle)), who in turn is unable to participate in the kind of face-to-face exchange that is demonstrated by the 11-month old in Fig. 2 (bottom), because that would have required a frame of reference shift in such a face-to-face situation (cf. the contributions by Bråten, and by Billard & Arbib in Stamenov & Gallese (Eds.) 2002:273–294, 343–352). Such a mirror reversal is returned to by Bråten, this volume (7). Still, we may say that exposure to a manual reaching act, or even to mouth grasping act, such as reported by Ferrari and Gallese, evokes in the macaque a unilateral mode of internal resonance that partly matches that target-oriented act, manifested by the discharge of the same pre-motor neurons that are activated upon own execution of that unilateral target act. And then, when an object is grasped and then eaten, there is a stronger discharge than when an object is grasped and then thrown in a bucket. Even though this is an unilateral target oriented acts, not embedded in bilateral give-and-take interactions (such as specified for human by Bråten 2002:290n.), such experiments demonstrate a primate basis for the kind of phylogenetic adaptation of mirror neurons systems that may afford part of the neurosocial support of participant perception in human, even infants (cf. also Bråten & Gallese 2004).

Reporting from her experimental studies with her co-workers on human mirroring systems related to the mirror neurons discovery, Riitta Hari (this volume (5)) raises questions *inter alia* about the potential support of predictions and attribution of goals in social interaction, such as predicting another's doing or saying – predicting the opponent's move in sport, or completing the speaker who has difficulties in finding the right words, neither of which deserves the term 'true imitation'. (Detailed examples of such participant predictions are given in Chapter 7 (this volume) in terms of other-centred participation). While pointing out that true imitation is likely to require action understanding and to entail learning of new motor actions, Hari distinguishes true imitation from mere release of stereotypic motor patterns, and from facilitation of actions that are already in the observer's motor repertoire, e.g. in spectators watching an athletic performance. For mirroring systems studies of the brain basis for social cognition and dynamic interaction, Hari emphasizes the combination of the temporal accuracy of magnetoencephalographic (MEG) recordings with the fine resolution of magnetic resonance imaging (fMRI). One of the MEG studies reported from was applied to hand movements; when the subject stretched the right arm and hand towards a manipulandum, ending the movement with a pinch of the tip, and when an on-line similar movement was observed, both Broca's region and the primary mo-