Subitted to JAPA

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INTENTIONAL ATTUNEMENT: MIRROR NEURONS AND THE NEURAL UNDERPINNINGS OF INTERPERSONAL RELATIONS

Neuroscientific research has unveiled the neural mechanisms mediating between the multilevel personal experiential knowledge we hold of our lived body, and the implicit certainties we simultaneously hold about others. Such personal body-related experiential knowledge enables our intentional attunement with others, which in turn constitutes a shared manifold of intersubjectivity. This "we-centric" space allows us to understand the actions performed by others, and to decode the emotions and sensations they experience. When observing others we do not just "see" an action, an emotion, or a sensation. Side by side with the sensory description of the observed social stimuli, internal representations of the body states associated with these actions, emotions, and sensations are evoked in the observer, "as if" he/she would be doing a similar action or experiencing a similar emotion or sensation. A direct form of "experiential understanding" is achieved by modeling the behaviors of others as intentional experiences on the basis of the equivalence between what the others do and feel and what we do and feel. This modeling mechanism is embodied simulation. Mirror neurons are likely a neural correlate of this mechanism. The implications for psychoanalysis and psychopathology of this perspective are discussed.

INTRODUCTION

In this paper we would like to use recent advances in neuroscience in order to clarify some theoretical issues in human development and interpersonal relations. Freud, as a neurologist and within his *Zeitgeist*, always tried to find the biological foundations of his theoretical edifice (libido, for example, was never meant by him as a metaphor, and his metapsychology was simply *biology* [e.g., see Rubinstein, 1952-83; Holt, 1989]). We believe that recent discoveries on the neural underpinnings of interpersonal relations might help in clarifying – of course not in a definitive way, ours being only one contribution among others – also some theoretical issues still under discussion, and contribute at theory building in psychoanalysis, especially regarding the theme of intersubjectivity. In the final section we will discuss some implications for psychoanalytic theory and practice.

We will focus on the discovery of mirror neurons, done in the early 1990s. As will be spelled out later, mirror neurons were originally discovered and described in the macaque monkey's premotor cortex (Gallese et al., 1996; Rizzolatti et al., 1996). They fire both when the monkey executes goal-related actions and when it observes similar actions being executed by others. There is evidence that a similar system – possibly even in a more sophisticated way – exists in humans.

This discovery allows for a better conceptualization of areas such as empathy, identification with others, child development, knowing others' intentions, the autistic dimension in psychoses, and

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This work was supported by MIUR and, as part of the European Science Foundation EUROCORES Programme OMLL, was supported by funds to Vittorio Gallese from the Italian CNR and the EC Sixth Framework Programme under Contract no. ERAS-CT-2003-980409.

possibly theory of therapy. The main purpose of our paper is to show that this discovery also has wide implications for psychoanalysis. First of all the central idea that simulation, or a form of mirroring, i.e., the reproduction within oneself – and even from early stages of life, hours from birth – of a state that matches that of the caregiver, can help at better understanding concepts such as internalization, identification, etc., in other words concepts that in the past, without knowledge of their neural underpinnings, have been charged with being purely metaphorical or "metapsychological". The individual has a likely innate, preprogrammed ability to internalize, incorporate, assimilate, imitate, etc., a state of another person, and the underpinning of this ability is neural mirroring. But, most importantly, in the context of early development, this disposition likely needs to be complemented, for its fuller expression and functioning, by an adequate behavior from the caregiver, a behavior that interacts consistently, in a predictable and meaningful way, with the developing infant.

If the mind of the infant, indeed, mirrors the mind of the caregiver, the qualities of the latter are of course of paramount importance. But the infant-caregiver interaction is characterized by a greater complexity because, as Fonagy & Target (1996a, 1996b, 2000) have shown within the context of their studies on self reflective function, the ability on the part of the mother to think and react as correctly as possible to the infant's mental state (his/her intentions, affect states, etc.) will allow the infant to build the ability to understand his/her own mental states as well as those of others (see also Fonagy et al., 2002). As Gergely & Watson (1996) have shown, the caregiver functions as a "social biofeedback" (a "socio-feedback", we could say), in the sense that the infant adjusts his/her emotions by monitoring the reactions of the mirroring caregiver, and, for example, assigning meaning to an emotion or a somatic perception by observing the mother's affective responsiveness. This bespeaks for the crucial role of the caregiver in building the quality of the infant's psychic structure. In fact, it has been hypothesized that inadequate mirroring will cause various mentalization deficits with consequences in adult life such as borderline psychopathology (feeling of emptiness, identity diffusion, lack of empathy, aggression and impulsivity due to mentalization deficits, and so on).

The paper will be structured as follows. We will start by reviewing the psychoanalytic understanding of interpersonal relations. We will then discuss some empirical data from infant research, showing the crucial importance for cognitive development of the early constitution of a shared we-centric space, what has been defined the "shared manifold of intersubjectivity" (Gallese, 2001, 2003a, 2003b, 2005). We will then introduce recent neuroscientific data on the mirror neuron system. We will show that the same neural circuits involved in action control and in the first person experience of actions, emotions and sensations are also active when witnessing the same actions, emotions and sensations of others, respectively. We will propose that the functional mechanism at the basis of the double activation pattern of those neural circuits is "embodied simulation", which, in turn, produces an interpersonal "intentional attunement" (see Gallese, 2004, 2005). The relevance of this perspective for psychoanalysis and psychopathology will finally be discussed.

PSYCHOANALYSIS AND INTERPERSONAL RELATIONS

Unquestionably, one of the most important developments that has characterized the psychoanalytic movement in the last decades is a renewed interest in interpersonal relations and in the conceptualizations of the relationship between Self and others. This development has taken many forms, both as a critique of the Freudian view on motivation and as an expansion or reformulations of traditional, "classical" psychoanalytic viewpoints. Terms such as "relational" or "interpersonal" psychoanalysis, "two-body psychology", "intersubjectivity", and so on, have become widespread, while traditional psychoanalysis has often been charged with being "positivistic", "objectivistic", or too dependent on an outdated XIXth century science, with the result that some authors have openly spoken of the need for a "new paradigm". One difficulty rests in the definition of the various terminologies that

have been used to refer to this new paradigm, since they often refer to poorly defined areas of investigation, intertwined with each other, in continuous change.

Surely it is a fact that in the course of the twentieth century several movements or theoretical innovations have occurred within psychoanalysis all aiming at correcting or modifying what seemed to be an erroneous conception of the relationship between the subject and the environment. Freud's view, in fact, explicitly implied a sort of inherent contrast between the ego (at that time used as synonymous of Self) and outside reality, in the sense that the ego was conceived as inimical to reality, the latter conceived as an obstacle, with a frustrating role in itself. Behind this conception there was a particular view of motivation based on libido theory that implied a discharge of energy in order to restore equilibrium. Drive discharge was supposed to relieve tension, and the object was a mere instrument and not desired as such (with a play on words about psychoanalytic jargon, we could say that "object" relations were "narcissistic" relations; see Migone, 1994, 1995b p. 26). Much has been written about the crisis of this metapsychology (e.g., Gill & Holzman, 1976), and a critique of some of its concepts appeared already in the 1940s (e.g., Kubie, 1947) and increasingly since the 1960s (e.g., Holt, 1965; Ellenberger, 1970; Gill, 1977; Sulloway, 1979). Several attempts were made to correct this original flaw, with many psychoanalytic researchers trying new solutions and overcoming an understandable resistance due to their loyalty to what were perceived as fundamental aspects of the psychoanalytic identity.

It seems to us that it was Hartmann (1937) who first really tried to correct the Freudian view of the relationship between the subject and the environment: we are referring here not only to Hartmann's concept of an autonomous area of conflict-free cognitive functioning (which, incidentally, left the Freudian concept of drive intact), but also to his concept of "adaptation" to the environment, which implies a theory of the relationship with the environment that gives the latter an important role in itself. Incidentally, it would be interesting here to investigate why Hartmann's concept of adaptation is often so easily forgotten by many current interpersonal theorists in their attempt at theory building (Migone, 2004) – perhaps the overall theoretical structure of Ego Psychology within which this concept originated was too heavy a burden so that many chose to throw away the baby with the bath water.

The second major revision or adjustment of classical Freudian theory (see Eagle, 1992) was object relations theory, i.e., the English school of psychoanalysis originated in the 1930s with the works of Suttie, Fairbairn, and others. At the core of object relations theory is the idea that not all motivation is sexual (or derived from primary drives such as libido, aggression, hunger, etc.). Rather, our interest in and seeking of objects are primary and autonomous motives. In the words of the oft-quoted *dictum* by Fairbairn (1952, p. 137), «libido is not pleasure seeking but object seeking», which means that interpersonal relationships have and independent and autonomous status, an importance on their own. This line of thought evolved in the "middle group" (Winnicott and others), and especially in Bowlby's attachment theory, which opened an entire line of research that generated a huge body of empirical research both by psychoanalytic and academic investigators. Among other findings, attachment research showed evidence of the importance of a secure attachment for the development of psychic structures and representations that, for example, allow appropriate exploratory behavior in the child, with obvious developmental and clinical implications (for an investigation on the relationship between psychoanalysis and attachment theory, see Fonagy, 2001).

Also, many other important developments occurred, and here they can only be briefly mentioned because they are not the focus of this paper. Some of these developments occurred simultaneously in the United States, thanks to the pioneering work of Sullivan (actually earlier, since Sullivan wrote his first important papers in the mid 1920s): the interpersonal or "culturalist" tradition of the Washington School of Psychiatry went in the same direction, valuing the importance of other people and of the environment in shaping the individual (although in a more concrete and less "intrapsychic" way than the English school).

Later on, in the early 1970s, we saw Kohut's Self Psychology storming the psychoanalytic movement, suggesting a clear break with classical drive theory and assigning a fundamental role to the object for human development (he emphasized concepts such as empathy, optimal attunement, "transmuting internalization", etc.). Subsequently, in rapid succession, various developments converged such as the following: Kernberg's attempt at synthesizing – although from a more classical viewpoint – Kleinian approach and Ego Psychology into an "object-relations theory"; relational psychoanalysis led by Mitchell and others who, so to speak, assimilated the English school so that it could enrich the post-Sullivanian movement in his attempt at integrating the role of object relations understood as inner representations (as in Fairbairn and other English authors) and as "real" relationships (as in Sullivan and other American interpersonalist analysts); infant research, that gave an extraordinarily important impetus to theoretical revision on development, on motivation, and on pre-symbolic Self and object representations within mother-child interaction; a more recent trend is the intersubjective approach by Storolow and others, with its critique of objective knowledge and its emphasis on shared experience (these ideas seems undoubtedly an echo of earlier, philosophical positions – think for example of Heidegger's notion of "being with" [*mit-sein*], where the subject cannot exist, or even be thought of, without being connected to the other).

We should also mention the studies on countertransference, that occurred much earlier (as early as in the 1920s [see Deutsch, 1926], as well as in Jung, and officially in the 1950s with the oft-quoted paper by Heimann [1950], paving the way to the "relational" conception of the transference (see also, to this regard, Sandler's [1976] concept of "role responsiveness"); strictly related, we should mention the importance attributed to projective identification (Ogden, 1982; Sandler, 1988; Migone, 1995a) that from Kleinian quarters rapidly conquered the interest of the entire psychoanalytic movement for its usefulness in understanding the relational aspects and mutual influence of the two analytic partners (as well as of the child-caregiver dyad and other close relationships).

We could go on with this overview, with which we wanted simply to give an idea of some of the vicissitudes of psychoanalytic theory building in the last century, and of the efforts made by many analytic pioneers in trying to build, change, and improve our understanding of mental functioning starting form Freud's insights on unconscious mental life.

The great emphasis on the status of interpersonal relations in shaping the development of the individual surely could be explained also as a reaction to their previous neglect due to traditional drive theory, but, as every reaction or oscillation of the pendulum of psychoanalytic ideas, it runs the risk of unduly de-emphasizing the role of internal forces: this is a danger feared by many authors who – correctly, in our opinion – remain loyal to Freud's theoretical effort at building a general psychology in which man could be linked to nature as well as to nurture. Purely relational approaches, in fact, pose serious philosophical questions concerning the problem of ontology.

This circularity between Self and object somehow reminds us of the "hermeneutic circle" (Heidegger, 1927; Gadamer, 1960), in the sense that one member of the dyad influences, gives meaning, or "creates" the other in a sort of hall of mirrors, but at a closer look this process does not seem to be hermeneutic at all: in fact, in the process of interpretation of the inner world of the infant, the caregiver can be *more or less correct* in identifying the infant's *objective* state (somatic or otherwise). In a radical view of the concept of hermeneutic circle, instead, there is virtually no "objective" state on either side, with the risk, so to speak, of becoming a vicious circle.

Leaving these considerations aside, we can say that the discovery of mirror neurons is not a discovery of a new clinical phenomenon, but simply of the possible neural mechanism with the potentiality of shedding light on clinical phenomena. Of course in the history of psychoanalysis there have been several intuitions that have anticipated the understanding now allowed by this discovery of neural mirroring.

The major forerunners of this mirroring process are Bion (1962), Winnicott (1967), and also Stern (1985), and their contributions are so well know that there is no need here to describe them in detail.

Briefly, Bion, with the concept of *alpha* function, developed a theory by which the maternal *rêverie* can allow the containment of the child's raw thought elements that will be transformed and later utilized by the child who will be able to build his/her thinking apparatus. Winnicott clearly spoke of the importance of the "good enough mother's" mirroring the child, who in this way can be recognized, seen, and hence find himself in the eyes of the mother. In Stern's concept of attunement the mother responds to the child not simply by imitating him/her, but transcending, alluding to aspects of the underlying shared feeling, introducing "theme variations" and adding new transmodal stimuli.

At a closer look, however, there are other forerunners in the history of psychoanalysis that should be mentioned, especially if we think of the concept of mirroring in a wider and also intrapsychic way. Let's not forget that Freud's attempt was to build a complete theory of mind, especially in its intrapsychic functioning. For example, few year before the conceptualization of the structural model in which, so to speak, the mind is differentiated in parts that observe each others, he said that «in the ego gradually a particular structure develops, able to oppose itself to the rest of the ego, a structure with the purpose of self-observation» (Freud, 1919). This self-observing structure, which will become the superego, is itself the result of an earlier internalization, the internalization of the caregiver that gradually will function as an autonomous guiding structure within the mind. Later Sterba (1934) conceived the therapeutic "splitting of the ego" in analysis as an aspect of self reflection, peculiar to the human being. And we should not forget Lacan's (1936) "mirror stage", during which the 8-10 months old child acquires the total image of the Self. In more recent times, also Kohut, with the concepts of "mirror transference" and "transmuting internalization", underlined the importance of "self-object" in the construction of the Self, thanks to the analyst's empathy. All these conceptualizations, very different from each other and coming from diverse theoretical orientations, point to the importance of the object (whether external or internally represented) in mirroring the self as a fundamental way of structuring the inner world.

SELF-OTHER IDENTITY AND INFANT RESEARCH

Let us now examine some data form infant research. Several developmental psychology studies have shown that the capacity of infants to establish relations with "others" is accompanied by the registration of behavioral invariance. As pointed out by Stern (1985), this invariance encompasses unity of locus, coherence of motion, and coherence of temporal structure. This experience-driven process of constant re-modeling of the system is one of the building blocks of cognitive development, and it capitalizes upon coherence, regularity, and predictability. Identity guarantees all these features, henceforth its high social adaptive value.

Anytime we meet someone we do not just "perceive" that someone to be, broadly speaking, similar to us. We are implicitly aware of this similarity, because we literally embody it. Meltzoff & Brooks (2001) have convincingly suggested that the analogy between infant and caregiver is *the* starting point for the development of (social) cognition. One of the major contributions to a new understanding of human social cognition has been provided during the last decades from the research of developmental psychology. During the course of infancy and childhood, we all heavily rely on interactions with our caregivers and with other individuals to learn how to cope with the world. Developmental psychology, by providing an enormous amount of data, has literally revolutionized our way of looking at newborns and infants as cognitive agents. These results have shown, among other things, that at the very beginning of our life we almost immediately inter-act with others by *reproducing* some of their behaviors.

The seminal study of Meltzoff & Moore (1977) and the subsequent research field it opened (see Meltzoff & Moore, 1997; Meltzoff, 2002), showed that newborns as young as 18 hours are perfectly capable of reproducing mouth and face movements displayed by the adult they are facing. That particular part of their body replies, though not in a reflex-way (see Meltzoff & Moore, 1977, 1994), to

movements displayed by the equivalent body part of someone else. More precisely, this means that newborns set into motion, and in the "correct" way, a part of their body they have no visual access to, but which nevertheless matches an observed behavior. To put it crudely, visual information is transformed into motor information. This apparently innate mechanism has been defined "active intermodal mapping" (AIM; see Meltzoff & Moore, 1997). Intermodal mapping defines a "supramodal act space" (Meltzoff, 2002) which provides representational frames not constrained by any particular mode of interaction, be it visual, auditory, or motor. Modes of interaction as diverse as seeing, hearing or doing something must therefore share some peculiar feature making the process of equivalence carried out by AIM possible. The issue then consists in clarifying the nature of this peculiar feature and the possible underlying mechanisms. The relational character intrinsic to the interaction between any biological system and its environment appears to be a good candidate. Our environment is composed of a variety of lifeless, more or less compliant forms of matter, and of a variety of "alive stuff", whose peculiar character is more and more focused by the infant's immature eye. Individuals confront themselves with all possible kinds of "external" objects, in virtue of their peculiar status of biological systems, thus by definition constrained in their peculiar "modes of interaction" (see Gallese, 2003a).

Any interaction requires a modeling system implementing a control strategy. Interestingly enough, control strategies share with modes of interaction the relational character. Control strategies are intrinsically relational in that they model the interaction between organism and environment, in order to optimize the interaction.

But a model is indeed a form of representation. This step allows a relation of interdependence, if not superposition, between modeling behavior and representing it (see Gallese, 2000b, 2003b). This relation holds for both organism-object and organism-organism modes of interaction. This relation is established at the very onset of our life, when a full-blown self-conscious subject of experience is not yet constituted. Yet, the absence of a subject doesn't preclude the presence of a primitive "we-centric space", a paradoxical form of intersubjectivity without subjects. The infant shares this space with others. They are "internalized" by the organism because they are a "projection" of modeling strategies presiding over the interactions they are part of. The physical space occupied by the bodies of the adult-others is "hooked up" to the body of the infant to compose a blended shared space. In a way, it is as if the mother, who creates and holds the fetus within her body during pregnancy, continues to hold and create the child in his/her first months and years of life, being both biologically and culturally connected in fundamental ways. This intersubjective process continues for the entire life span for every human being, with the difference that it becomes much richer and multifaceted, due to the wider range and meaning of interpersonal relations in the course of development.

What are the role and fate of this peculiar shared space in the course of cognitive development? The shared blended space enables the social bootstrapping of cognitive and affective development because it provides an incredibly powerful tool to detect and incorporate coherence, regularity, and predictability in the course of the interactions of the individual with the environment. The shared space is paralleled by perspectival spaces defined by the establishment of the capacity to distinguish self from other, as long as self-control develops. Within each of these newly acquired perspectival spaces information can be better segregated in discrete channels (visual, somatosensory, etc.) making the perception of the world more finely grained. The concurrent development of language probably contributes to further segregate from the original multimodal perceptive world, single characters or modalities of experience. Yet, the more mature capacity to segregate the modes of interaction, together with the capacity to carve out of the blended space the subject and the object of the interaction, do not annihilate the shared space.

The shared intersubjective space doesn't disappear. It progressively acquires a different role: to provide the self with the capacity to simultaneously entertain self-other identity and difference. Once the crucial bonds with the world of others are established, this space carries over to the adult conceptual faculty of socially mapping sameness and difference ("I am a different subject"). Within intersubjective

relations, the other is a living oxymore, being just a different self. Our proposal is that social identity, the "selfness" we readily attribute to others, the inner feeling of "being-like-you" triggered by our encounter with others, are the result of the preserved shared we-centric space. Self-other physical and epistemic interactions are shaped and conditioned by the same body and environmental constraints. This common relational character is underpinned, at the level of the brain, by neural networks that compress the "who-done-it", "who-is-it" specifications, and realize a narrower content state, a content that specifies what kinds of interaction or state are at stake. This narrower content is shared just because, as we have learned from developmental psychology, the shareable character of experience and action is the earliest constituent of our social life.

The posited important role of identity-relations in constraining the cognitive development of our mind provides a strong motivation to investigate from a neuroscientific perspective the functional mechanisms (and their neural underpinnings) at the basis of the self-other identity. This will be the focus of the next sections.

THE MIRROR NEURON SYSTEM FOR ACTIONS IN MONKEYS AND HUMANS: EMPIRICAL EVIDENCE

About ten years ago a new class of premotor neurons was discovered in the macaque monkey brain. These neurons discharge not only when the monkey executes goal-related hand actions like grasping objects, but also when observing other individuals (monkeys or humans) executing similar actions. They were called "mirror neurons"[1] (Gallese et al., 1996; Rizzolatti et al., 1996a). Neurons with similar properties were later discovered in a sector of the posterior parietal cortex reciprocally connected with area F5 (PF mirror neurons; see Rizzolatti et al., 2001; Gallese et al., 2002).

The observation of an object-related hand action leads to the activation of the same neural network active during its actual execution. Action observation causes in the observer the automatic activation of the same neural mechanism triggered by action execution. It has been proposed that this mechanism could be at the basis of a direct form of action understanding (Gallese et al., 1996; Rizzolatti et al., 1996a; see also Gallese, 2000, 2001, 2003a, 2003b, 2004; Gallese et al., 2004; Rizzolatti et al., 2001; Rizzolatti & Craighero, 2004).

Further studies carried out by the same group of researchers of the Department of Neuroscience of the University of Parma corroborated and extended the original hypothesis. It was shown that F5 mirror neurons are also activated when the final critical part of the observed action, that is, the hand-object interaction, is hidden (Umiltà et al., 2001). A second study showed that a particular class of F5 mirror neurons, "audio-visual mirror neurons", can be driven not only by action execution and observation, but also by the sound produced by the same action (Kohler et al., 2002).

More recently, the most lateral part of area F5 was explored where a population of mirror neurons related to the execution/observation of mouth actions was described (Ferrari et al., 2003). The majority of these neurons discharge when the monkey executes and observes transitive, object-related ingestive actions, such as grasping, biting, or licking. However, a small percentage of mouth-related mirror neurons discharge during the observation of intransitive, communicative facial actions performed by the experimenter in front of the monkey ("communicative mirror neurons"; Ferrari et al., 2003). Thus, mirror neurons seem to underpin monkeys' social facial communication.

[1] This paper is exclusively focused on the relationships among the mirror neuron system, embodied simulation and the experiential aspects of intersubjectivity For sake of conciseness, many other issues related to mirror neurons and simulation will not be addressed here. The vast literature on the mirror neuron system in humans and its relevance for theory of mind, imitation and the evolution of language is reviewed and discussed in several papers (Gallese & Goldman, 1998; Rizzolatti & Arbib, 1998; Rizzolatti et al., 2001; Gallese, 2003a; Metzinger & Gallese, 2003; Rizzolatti & Craighero, 2004; Gallese et al., 2004). For an analysis of the role played by embodied simulation in conceptual structure and content, see Gallese & Lakoff, 2005.

Several studies using different experimental methodologies and techniques have demonstrated also in the human brain the existence of a mirror neuron system matching action perception and execution. During action observation there is a strong activation of premotor and parietal areas, the likely human homologue of the monkey areas in which mirror neurons were originally described (for a review, see Rizzolatti et al., 2001; Gallese, 2003a; Rizzolatti & Craighero, 2004; Gallese et al., 2004). Furthermore, the mirror neuron matching system for actions in humans is somatotopically organized, with distinct cortical regions within the premotor and posterior parietal cortices being activated by the observation/execution of mouth, hand, and foot related actions (Buccino et al., 2001).

A recent brain imaging study, in which human participants observed communicative mouth actions performed by humans, monkeys and dogs, showed that the observation of communicative mouth actions led to the activation of different cortical *foci* according to the different observed species. The observation of human silent speech activated the *pars opercularis* of the left inferior frontal gyrus, a sector of Broca's region. The observation of monkey lip-smacking activated a smaller part of the same region bilaterally. Finally, the observation of the barking dog activated only extrastriate visual areas. Actions belonging to the motor repertoire of the observer (e.g., biting and speech reading) or very closely related to it (e.g., monkey's lip-smacking) are mapped on the observer's motor system. Actions that do not belong to this repertoire (e.g., barking) are mapped and henceforth categorized on the basis of their visual properties (Buccino et al., 2004).

The involvement of the motor system during observation of communicative mouth actions is also testified by the results of a *Transcranic Magnetic Stimulation* (TMS) study by Watkins et al. (2003), in which they showed that the observation of communicative, speech-related mouth actions facilitate the excitability of the motor system involved in the production of the same actions.

ACTION OBSERVATION AS ACTION SIMULATION

The mirror neuron system for action is activated both by object-related and communicative actions. When a given action is planned, its expected motor consequences are forecast. This means that when we are going to execute a given action we can also predict its consequences. The action model enables this prediction. Given the shared sub-personal neural mapping between what is acted and what is perceived – constituted by mirror neurons – the action model can also be used to predict the consequences of actions performed by others. Both predictions (of our actions and of others' actions) are instantiations of embodied simulation, that is, modeling processes.

The same functional logic that presides over self-modeling is employed also to model the behavior of others: perceiving an action is equivalent to internally simulating it. This enables the observer to use her/his own resources to experientially penetrate the world of the other by means of a direct, automatic, and non-conscious process of simulation.

Embodied simulation automatically establishes a direct experiential link between agent and observer, in that both are underpinned by the same neural substrate. The stimuli whose observation activates mirror neurons, like a grasping hand, its predicted outcome, and the sound it produces, all consist of the specific interaction between an agent and a target. It is the agentive relational specification to trigger the mirror neurons' response. The mere observation of an object not acted upon indeed does not evoke any response in mirror neurons. Furthermore, the effector-target interaction must be successful. Mirror neurons respond if and only if an agentive relation is practically instantiated by an acting agent, regardless of his/her being the observer or the observed. The agent parameter must be filled. Which kind of agent is underspecified, but not *unspecified*. Indeed, not all kinds of agents will do. The abovementioned brain imaging experiment on communicative actions shows that only stimuli consistent with or closely related to the observer's behavioral repertoire are effective in activating the mirror neuron system for actions (Buccino et al., 2004).

To summarize, action observation constitutes a form of embodied simulation of action. This, however, is different from the simulation processes occurring during motor imagery. The main difference is what triggers the simulation process: an internal event – a deliberate act of will – in the case of motor imagery, and an external event in the case of action observation. This difference leads to slightly different and non-overlapping patterns of brain activation (see Gallese, 2003a, 2003b). However, both conditions share a common mechanism: the simulation of actions by means of the activation of parietal and premotor cortical networks. It has been proposed that this simulation process may constitute a basic level of experiential understanding, a level that does not entail the explicit use of any theory or declarative representation (see Gallese et al., 2004; Gallese, 2004, 2005).

MIRRORING EMOTIONS AND SENSATIONS

Emotions constitute one of the earliest ways available to the individual to acquire knowledge about its situation, thus enabling a reorganization of this knowledge on the basis of the outcome of the relations entertained with others. The coordinated activity of sensory-motor and affective neural systems results in the simplification and automatization of the behavioral responses that living organisms are supposed to produce in order to survive. The integrity of the sensory-motor system indeed appears to be critical for the recognition of emotions displayed by others (see Adolphs, 2003; Adolphs et al., 2000), because the sensory-motor system appears to support the reconstruction of what it would feel like to be in a particular emotion, by means of simulation of the related body state. The implication of this process for empathy should be obvious.

A recently published *functional Magnetic Resonance Imaging* (fMRI) study showed that experiencing disgust and witnessing the same emotion expressed by the facial mimicry of someone else, both activate the same neural structure – the anterior insula – at the same overlapping location (Wicker et al., 2003). This suggests, at least for the emotion of disgust, that the first- and third-person experiences of a given emotion are underpinned by the activity of a shared neural substrate. When we see the facial expression of someone else, and this perception leads us to experience *that* expression as a particular affective state, we do not accomplish this type of understanding through an argument by analogy. The other's emotion is constituted, experienced and therefore directly understood by means of an embodied simulation producing a shared body state. It is the activation of a neural mechanism shared by the observer and the observed to enable direct experiential understanding. A similar simulation-based mechanism has been proposed by Goldman & Sripada (2004) as "unmediated resonance".

Let us focus now on somatic sensations as the target of our social perception. As repeatedly emphasized by phenomenology, touch has a privileged status in making possible the social attribution of lived personhood to others. "Let's be in touch" is a common clause in everyday language, which metaphorically describes the wish of being related, being in contact with someone else. Such examples show how the tactile dimension can be intimately related to the interpersonal dimension.

New empirical evidence suggests that the first-person experience of being touched on one's body activates the same neural networks activated by observing the body of someone else being touched (Keysers et al., 2004). Within SII-PV, a multimodal cortical region, there is a localized neural network similarly activated by the self-experienced sensation of being touched, and the perception of an external tactile relation. This double pattern of activation of the same brain region suggests that our capacity to experience and directly understand the tactile experience of others could be mediated by embodied simulation, that is, by the externally triggered activation of *some* of the same neural networks underpinning our own tactile sensations. A similar mechanism likely underpins our experience of the painful sensations of others (see Hutchison et al., 1999; Singer et al., 2004).

INTENTIONAL ATTUNEMENT, EMBODIED SIMULATION, AND EMPATHY

Various mirror neurons matching systems mediate between the multimodal experiential knowledge we hold of our lived body, and the *implicit certainties* we simultaneously hold about others. Such body-related experiential knowledge enables a direct experiential understanding of the actions performed by others, and of the emotions and sensations they experience. Our seemingly effortless capacity to conceive of the acting bodies inhabiting our social world as *persons* like us depends on the constitution of a shared meaningful interpersonal space. This "shared manifold" (see Gallese, 2001, 2003a, 2003b, 2004, 2005) can be characterized at the functional level as embodied simulation, a specific mechanism, likely constituting a basic functional feature by means of which our brain/body system models its interactions with the world. Embodied simulation constitutes a crucial functional mechanism in social cognition, and it can be neurobiologically characterized. The mirror neuron matching systems represent the sub-personal instantiation of embodied simulation.

When we confront the intentional behavior of others, embodied simulation generates a specific phenomenal state of "intentional attunement". This phenomenal state generates a peculiar quality of familiarity with other individuals, produced by the collapse of the others' intentions into the observer's ones. By means of embodied simulation we do not just "see" an action, an emotion, or a sensation. Side by side with the sensory description of the observed social stimuli, internal representations of the body states associated with these actions, emotions, and sensations are evoked in the observer, "as if" he/she would be doing a similar action or experiencing a similar emotion or sensation.

The sharp distinction, classically drawn between the first- and third-person experience of actions, emotions and sensations, appears to be much more blurred at the level of the neural mechanisms mapping it. The gap between the two perspectives is bridged by the way the intentional relation is functionally mapped at the neural-body level. Any intentional relation can be mapped as a relation between a subject and an object. The mirror neuron matching systems described in this paper map the different intentional relations in a compressed fashion, which is neutral about the specific quality or identity of the agentive/subjective parameter. By means of a shared functional state realized in two different bodies that nevertheless obey to same functional rules, the "objectual other" becomes "another self".

Of course, embodied simulation is not the only functional mechanism underpinning social cognition. The same actions performed by others in different contexts can lead the observer to radically different interpretations. Social stimuli can also be understood on the basis of the explicit cognitive elaboration of their contextual perceptual features, by exploiting previously acquired knowledge about relevant aspects of the situation to be analyzed. Our capacity of attributing false beliefs to others, our most sophisticated mind reading abilities, likely involve the activation of large regions of our brain, certainly larger than a putative – and neo-phrenological – domain-specific Theory of Mind Module. Embodied simulation and the still poorly understood more sophisticated mentalizing cognitive skills, however, are not mutually exclusive. Embodied simulation, probably the most ancient mechanism from an evolutionary point of view, is experience-based, while the second mechanism can be characterized as a "detached" cognitive description of an external state of affairs. It might well be the case that embodied simulation scaffolds the propositional, language-mediated mechanism. When the former mechanism is not present or malfunctioning as in autism (see below), the latter can provide only a pale, detached account of the social experiences of others (see Gallese et al., 2004).

THE MANY SIDES OF SIMULATION

The notion of simulation is employed in many different domains, often with different, not necessarily overlapping meanings. Simulation is a functional process that possesses a certain representational content, typically focusing on possible states of its target object. For example, in motor control theory, simulation is characterized as the mechanism employed by forward models to predict

the sensory consequences of impending actions. According to this view, the predicted consequences are the simulated ones.

In philosophy of mind, on the other hand, the notion of simulation has been used by the proponents of Simulation Theory of mind reading to characterize the pretend state adopted by the attributer in order to understand others' behavior (see Gordon, 1986, 1995, 2000, 2005; Goldman, 1989, 1992a, 1992b, 1993a, 1993b, 2000, 2005; Gallese & Goldman, 1998; Goldman & Gallese, 2000).

Here we employ the term "embodied simulation" as an automatic (in the sense that it is obligatory), non-conscious, and pre-reflexive functional mechanism, whose function is the modeling of objects, agents, and events. Simulation, as conceived of in the present paper, is therefore not *necessarily* the result of a deliberate and conscious cognitive effort, aimed at interpreting the intentions hidden in the overt behavior of others. Before being that, embodied simulation is a basic functional mechanism of our brain. However, because it also generates representational content, this functional mechanism seems to play a major role in our epistemic approach to the world. It represents the outcome of possible actions, emotions, or sensations one could take or experience, and serves to attribute this outcome to another organism as a real goal-state it is trying to bring about, or as a real emotion or sensation it is experiencing.

Successful perception requires the capacity of predicting upcoming sensory events. Similarly, successful action requires the capacity of predicting the expected consequences of action. As suggested by an impressive and coherent amount of neuroscientific data (for a review, see Gallese, 2003a; Gallese & Lakoff, 2005), both types of predictions seem to depend on the results of pre-reflexive and automatically driven neural states, functionally describable as simulation processes.

To what extent embodied simulation is a motor phenomenon? According to the use we make of this notion, embodied simulation *is not conceived of as being exclusively confined to the domain of motor control*, but rather as being a more general and basic endowment of our brain. It applies not only to actions or emotions, where the motor or viscero-motor components may predominate, but also to sensations like vision and touch. It is mental because it has content. It is embodied not only because it is neurally realized, but also because it uses a pre-existing body-model in the brain realized by the sensory-motor system, and therefore involves a non-propositional form of self-representation.

WHY THIS MATTERS TO PSYCHOANALYSIS

During the last two decades, social cognition has become the challenging empirical target of neuroscientific research. This fact not only represents a major turn in the history of the scientific study of brain functions, but it also enables the possibility of establishing a dialogue with a discipline like psychoanalysis, which from the very beginning put psychological development and interpersonal relations at the center of its clinical practice and research agenda. Neurophysiology, by investigating neurons, instantiates a sub-personal level of description. However, this epistemic strategy provides knowledge that can be used to better understand the personal level of description.

Neuroscience and psychoanalysis are indeed partly tackling the same issues (see Solms & Turnbull, 2002; Karlsson, 2004). The results of neuroscientific investigation, as those reviewed in the present paper, broaden the possibility of establishing a dialogue between our disciplines. The development of interpersonal relationships, their role in shaping the acquisition of a full-blown self-conscious self and of social intelligibility, and their pathological disruptions represent possible targets for an interdisciplinary research agenda. We would like to briefly focus on three clinical issues for which the present proposal on intentional attunement and its functional/neural underpinnings may be relevant: schizophrenia, borderline disorders, and the autistic syndrome. These of course are only three examples among many.

All of our social transactions depend on mutual understanding. Simultaneously, however, interpersonal intelligibility is accompanied by the capacity of establishing clear-cut boundaries, carving

out a "self" from the "outside world". Being "oneself" is experienced as being similar to other selves, while simultaneously experiencing its unique character. In some forms of schizophrenia self and other are not anymore mutually interrelated, but they tend more and more to diverge and crystallize into segregated, incomprehensible and impenetrable realms. In spite of this lack of interpersonal relatedness, the Self can experience dramatic loss of its boundaries, as epitomized by Schneider's (1955) positive symptoms such as thought-insertion, auditory hallucinations, and delusion of action control. Social and individual identity appear to be both disrupted. The problem of psychopathology is therefore to reconcile these different psychotic articulations within a coherent explanatory frame.

Schizophrenia, as pointed out by Terenius (2000), has been so far an elusive target for research. Furthermore, the current DSM-IV (American Psychiatric Association, 1994, pp. 285-286) inspired operational diagnostic criteria provide a much clearer picture of what schizophrenia *is not* than of what *it is*. A possible reason accounting for this elusiveness could be the fact that a comprehensive account of schizophrenia – but the same could be said of all psychoses – implies an understanding of the human mind. Any serious attempt at understanding cognition, emotions and language, devoid of a "global perspective", is doomed to failure. This challenging enterprise requires an integrative approach. We believe the same to hold true for schizophrenia. It follows that a global approach to schizophrenia cannot but incorporate the same multiple levels of explanation that we adopt when trying to build a coherent account of cognition, language, and affective behavior.

This is by no means a new idea, however. In his seminal monograph *La Schizophrénie* Minkowski (1927) wrote that we cannot fully understand schizophrenia unless we are able to frame it within a thorough account of the structure of subjectivity. Autism, the incapacity to be attuned with the world, according to Minkowski (1927), constitutes the basic clinical essence of schizophrenia. Minkowski developed an original intuition of his mentor Bleuler, who wrote that many schizophrenic patients cut themselves off from any contact with the external world (see Bleuler, 1911). The core problem of schizophrenics is, accordingly, their lack of «vital contact with reality» (Minkowski, 1927, p. 98), viewed as an incapacity to "resonate with the world", to establish meaningful bonds with other individuals. The contact with reality is loosened or completely lost not only with respect to the transactions with the social world, but also from the first-person perspectival point of view.

Schizophrenia as "lack of resonance", as a disorder of empathy, has been a constant theme in the reflections of phenomenological psychiatry. Blankenburg (1971) characterizes the autistic dimension of schizophrenia as a global crisis of "common sense", the incapacity to pre-reflexively grasp the meaning of the world, a world that looks terribly unfamiliar and strange to the schizophrenic's eyes. Parnas & Bovet (1991) have argued that schizophrenic autism derives from a transformation of the structure of subjectivity in its tripartite dimensions: self-awareness, intentionality and intersubjectivity. A lack of attunement would be at the origin of the incapacity of many schizophrenics to draw a coherent and meaningful picture of their social world.

More recently, Parnas, Bovet & Zahavi (2002, p. 133) argue that in schizophrenics «experience is more observed than lived», most likely because of the incapacity to attain a «non-reflective, tacit sensibility, procuring a background texture or organization to the field of experience». This is exactly the same level of experiential, non-propositional understanding of the world of interpersonal relations, which we have been characterizing throughout the paper

The "lack of attunement" hypothesis of phenomenological psychiatry is highly consonant with the picture we presented here. A disruption of the multilevel simulation processes characterizing the shared manifold might be a possible cause of "defective intentional attunement" in many schizophrenic patients. The ineffable nature of schizophrenics' estrangement is just a negative sign of their core problem. There are no words or propositions available to describe what healthy individuals directly and pre-verbally experience. If the mechanisms enabling us to constitute the implicit certainties we normally entertain about the world do not function properly, we are left in need of purposively attributing a sense to a world that looks totally foreign (delusion could be an example).

In borderline psychopathology, too, there are several features that could be considered clinical derivatives of the disruption of simulation processes, although in a nuanced way and perhaps more in the affective realm. Think of many clinical features that are so typical of borderline patients, such as dissociative symptoms, feelings of depersonalization or disturbances of the sense of reality (while reality testing, which is altered in the psychoses, is relatively intact), identity disturbances and instability of Self and object representations, and in general the various deficits of mentalization and reflective function (for a more detailed discussion of borderline psychopathology in this context, see, among others, Fonagy & Target [2000], who have made interesting hypotheses on the consequences in adult life of lack of empathic attunement between caregiver and child).

Where the disruption of simulation processes appears to show the most devastating effects is in the autistic syndrome of children. The autistic syndrome is a severe and chronic developmental disorder, characterized by social and communicative deficits and by a reduced interest in the environment, towards which restricted and often stereotyped initiatives are taken (Dawson et al., 2002). To be an autistic child means, with variable degrees of severity, to be incapable of establishing meaningful social communications and bonds, to establish visual contact with the world of others, to share attention with the others, to be incapable of imitating others' behavior or to understand others' intentions, emotions, and sensations.

We would like to briefly focus on some of the early onset symptoms. Towards the end of the first year of life, autistic children experience difficulties or even the impossibility of orienting on the basis of cues provided by others. They are incapable of sharing attention with others, incapable of reacting in a fashion that is congruent with others' emotions. They are also highly impaired in recognizing human faces or in displaying imitative behaviors. All of these early manifestations of autism share a common root: the cognitive skills required to establish meaningful bonds with others are missing or seriously impaired.

Our hypothesis is that these deficits are to be ascribed to a deficit or malfunctioning of "intentional attunement". If it is true – as held throughout this paper – that at the basis of our social competence is *in primis* the capacity to constitute a directly shared interpersonal meaningful space, enabling us to establish a link with the multiple intentional relations instantiated by others, then it follows that a disruption of this shared manifold should be one core problem of the autistic mind. The incapacity to develop a full and comprehensive intentional attunement with the others implies, as a consequence, the development of an incomplete or malfunctioning shared manifold.

The lack of a full-blown intentional attunement will produce various and diversified cognitive and executive deficits, all sharing the same functional origin: a lack or malfunctioning of embodied simulation routines, likely underpinned by impairments in connectivity and/or functioning of the mirror neuron system. If our hypothesis is correct, the posited intentional attunement deficit should become manifest at the various levels of social cognition it normally underpins. A series of experimental data seems to suggest this to be the case.

A recent study investigating postural adjustments in autistic children has shown that, in contrast to healthy individuals, they use motor strategies basically relying on feed-back information, rather than on feed-forward modes of control. Such disturbance of executive control strategies prevent autistic children from adopting anticipatory postural adjustments (Schmitz et al., 2003). Given the functional characterization of forward models as simulation-based, it is difficult not to interpret these data as evidence of a simulation deficit. Such postural deficits are not intrinsically social, however, they stem from a disruption within the executive control domain of a functional mechanism – simulation – we proposed to be at the root of the constitution of a shared meaningful interpersonal space.

Two recent studies employing different techniques such as EEG and Transcranic magnetic Stimulation show that individuals with Autistic Spectrum Disorder (ASD) might be suffering an action simulation deficit induced by a dysfunction of their mirror system for action. The study by Oberman et al. (2005) showed that ASD individuals, at difference with healthy controls, did not show mu frequency

suppression over the sensorimotor cortex during action observation. The study by Theoret et al. (2005) showed that, again at difference with healthy controls, ASD individuals did not show TMS-induced hand muscle facilitation during hand action observation.

Another instantiation of simulation deficits in the autistic syndrome is exemplified by imitation deficits. Autistic children have problems in both symbolic and non-symbolic imitative behaviors, in imitating the use of objects, in imitating facial gestures, and in vocal imitation (see Rogers, 1999). These deficits characterize both high- and low-functioning forms of autism. Furthermore, imitation deficits are apparent not only in comparison with the performances of healthy subjects, but also with those of mentally retarded non-autistic subjects. According to our hypothesis, imitation deficits in autism are determined by the incapacity to establish a motor equivalence between demonstrator and imitator, most likely due to a malfunctioning of the mirror neuron system, or because of a disrupted emotional-affective regulation of the same system. Imitation deficits thus can be characterized as further examples of a disrupted shared manifold.

Let us now briefly turn to emotional-affective deficits. Several studies reported the severe problems autistic children experience in the facial expression of emotions and their understanding in others (Snow et al., 1988; Yirmiya et al., 1989; Hobson et al., 1988, 1989). Furthermore, Hobson & Lee (1999) reported that autistic children score much worse than healthy controls in reproducing the affective qualities of observed actions. All these deficits can be framed as affective attunement deficits, hence as further instantiations of a lacunose shared manifold.

Our proposal to interpret the autistic syndrome as an intentional attunement deficit is quite divergent, in certain respects, from many of the mainstream ideas concerning the origin of this developmental disorder. One of the most credited theories on autism, in spite of its different – not always congruent – articulations, posits that autism is caused by a deficit of a specific mind module, the Theory of Mind module, selected in the course of evolution to build theories about the mind of others (Baron-Cohen, Leslie & Frith, 1985; Baron-Cohen, 1988, 1995). One of the many problems with this theory – let alone its neo-phrenological after-taste – is that it can hardly be reconciled with what we learn from the reports of some high-functioning autistic individuals. What they claim (see Grandin, 1995) is that in order to understand how they supposedly should feel in given social contexts, and to understand what others supposedly feel and think in those same contexts, they must rely on detached theorizing. The world of others can be "pictorially" described and theoretically explained, but a direct experiential grasp of its meaningfulness is totally precluded. What these reports seem to suggest is that theorizing about the others' mind is not quite the basic deficit. Theorizing is the only compensating strategy available in the absence of more elementary and basic cognitive and affective skills enabling a direct experiential take on the world of others.

The shared manifold of intersubjectivity constitutes a general hypothesis on the experiential aspects of social cognition (see Gallese et al., 2004) that can be empirically tested at multiple levels, both in healthy and psychotic individuals (Gallese, 2005a, 2005b, 2005c).

DISCUSSION

In this final section, we discuss some implications of the mirror neurons discovery and related work for psychoanalytic theory and practice. In particular, we want to draw an analogy between on the one hand, what we will call the "Standard Model" of classical psychoanalysis and a "theory theory" account of how we understand another's mind (the latter being an understanding of another's mind based on concepts such as beliefs and desires); and on the other hand, between more recent models of psychoanalysis and a Simulation Theory account of our mind-reading ability. It would, indeed, be very surprising if the findings and debate regarding the basis for our mind-reading ability did not have implications for psychoanalysis insofar as the attempt to understand another's mind is at the heart of the psychoanalytic enterprise.

Although Freud (1900) wrote about the role of unconscious communication (i.e., communication between the unconscious of the patient and the unconscious of the analyst in understanding the patient) and although he referred to the role of the analyst's empathy (*Einfühlung*) and intuitions in understanding the patient, he did so in an unsystematic way, mainly in informal observations and comments about the treatment situation (Freud's [1912] advocacy of an analytic stance of "evenly hovering attention" in listening to the patient's free associations is relevant here insofar as such a stance would presumably minimize pre-set assumptions and facilitate unexpected intuitions). In his more systematic writings, Freud's basic approach to understanding the patient's mind rests primarily on theory based interpretations of the patient's productions (i.e., free associations, dreams). In this view, the patient's productions can be read as a "text" that needs to be deciphered and interpreted in order to be truly and expertly understood (and, indeed, some who viewed psychoanalysis as a hermeneutic discipline explicitly analogized between a written text and the psychoanalytic patient's free associations [e.g., Steele, 1979]). Such understanding is offered in the form of interpretation by the analyst-expert whose expertness is based on clinical experience, a training analysis, and theoretical knowledge that is based on a psychoanalytic theory of mind. We will call this the "Standard Model" of psychoanalytic treatment.

In order to carry out this task of «interpret[ing] and detect[ing] hidden elements in the patient's mind» (Cohen & Schermer, 2004, p. 581), the analyst needed to «remain emotionally immune to the temptations of countertransference» (p. 581) and to strive for «the objectivity of a neutral observer and the detachment of a surgeon» (p. 584). Furthermore, the insight generated by the analyst's interpretations was viewed as the main vehicle for therapeutic cure. We are aware that this description may be something of an over-simplification, but nevertheless believe that it represents a reasonably accurate schema of what can be called the "Standard Model" of classical psychoanalysis.

We are also aware that, in actual practice, many classical analysts undoubtedly relied on intuitions based on putting themselves in the shoes of the patient in order to gain understanding. However, this process was more a matter of personal talents and sensibilities and was not prominently and formally represented in the "Standard Model". To sum up, according to the "Standard Model", the patient's mind (his or her unconscious wishes, desires, motives, fantasies, conflicts, defenses, and so on) is understood by a neutral and objective observer primarily on the basis of a theory of how minds function. In this regard, there is a clear analogy between the "Standard Model" of classical psychoanalysis and a theory theory account (e.g., Carruthers & Smith 1996) of our general mind-reading ability. According to the latter, our understanding of another's mind is based on an implicit theory that accounts for people's behavior in terms of folk psychology concepts such as beliefs and desires. Indeed, it has been noted that, in certain respects, psychoanalytic theory can be understood as an extension of folk psychology insofar as it also attempts to account for behavior and experiences in terms of such concepts as beliefs and desires, albeit unconscious beliefs and desires (e.g., Carruthers & Smith 1996; Wellman, 1990).

The "Standard Model" of psychoanalysis has come under much criticism from a number of directions, not all of which are relevant in the present context. For example, many seriously questioned whether insight generated by interpretations could legitimately be viewed as the primary curative agent of psychoanalytic treatment. The criticisms that *are* relevant in the present context have to do with the question of how the analyst comes to understand the patient's mind – and, by extension, how each of us comes to understand another person's mind.

As we will try to show, contemporary psychoanalysis has increasingly moved from a "Standard Model" account in which the neutral and objective analyst comes to understand the patient's mind on the basis of a general theory of mind, to a stance in which the analyst comes to understand the patient's mind through reflection on a range of personal, affectively tinged experiences, including partial identifications (i.e., putting himself or herself in the shoes of the patient) as well as "complementary" countertransference reactions (Racker, 1960) that may be elicited by the patient. In short, contemporary

psychoanalysis has, in effect, increasingly moved from a theory theory to a Simulation Theory account of how the analyst comes to understand the patient's mind (of course, this is not an all-or-none or either-or matter, but rather one of relative emphasis).

There are a number of relatively clear expressions of this trend in contemporary developments in psychoanalysis. One such expression can be seen in Kohut's (1984) Self Psychology, a central feature of which is the claim that the analyst's understanding of the patient is based on empathy and "vicarious introspection" – a term that clearly suggests that the analyst puts himself or herself in the shoes of the patient and thereby gains some understanding of the patient's experience, that is, what is going on in his or her mind. Indeed, Kohut (1977) *defines* – methodologically, at least – psychoanalysis as a discipline that gathers its data and achieves understanding of its "subject matter" through "vicarious introspection", that is, through taking the perspective of the other (for Kohut [1984], empathic resonance is both the primary method of understanding the patient as well as the primary agent of therapeutic cure). This is clearly a version of a Simulation Theory account of how one understands another's mind.

Perhaps the clearest expression of an implicit Simulation Theory operating in contemporary psychoanalysis is the central role assigned to *countertransference* (now "totalistically" defined as including the entire range of the analyst's cognitive and affective reactions to the patient [Kernberg, 1965]) in understanding the patient's mind. What is the link between an emphasis on countertransference and Simulation Theory? In its original meaning, countertransference referred to the analyst's personal reactions to the patient which, because they were personal and affective, departed from the ideal stance of objective neutral observer (recall Freud's analogy between the analyst and the surgeon), and therefore, necessarily reflected the analysts unresolved past conflicts and served to create blind spots and impediments to an objective understanding of the patient and to the work of the analysis.

In the new "totalistic" conception, not only is countertransference not viewed as an impediment, but as indispensable to understanding the patient. Indeed Gabbard (1995) has recently argued that recognition of the critical importance of the analyst's countertransference reactions as a useful guide to what is going on in the patient's mind constitutes the "common ground" of contemporary psychoanalysis, despite the presence of theoretical differences. What does this radical shift in how countertransference is understood signify and how is it related to our claim regarding a shift in contemporary psychoanalysis from a theory theory to a Simulation Theory account of how we understand another's mind?

The "totalistic" conception of countertransference is largely based on the recognition that the analytic situation necessarily entails interaction between analyst and patient and that, therefore, the analyst cannot be a "blank screen", a purely neutral and objective observer. To be in an interaction with another means that both parties react to each other. Just as the patient reacts to the analyst, so, similarly, does the analyst react to the patient. Further, in the "totalistic" conception of countertransference the analyst's reactions are viewed not as an impediment or a departure from an ideal "Standard Model", but as experiential cues that may help in understanding the patient. The mirror neurons discovery and related findings suggesting that "embodied simulation" automatically and reflexively occurs when we observe another's actions and emotional expressions would tend to support the general idea that the analyst's spontaneous thoughts and feelings may serve as a guide to what is going on in the patient's mind (incidentally, we should assume that also the reverse is also true, namely that the patient knows what is going on in the analyst's mind, unless the analyst hides himself as most as possible while at the same time continues to observe the patient, almost as if the analyst watches not from behind the couch but from behind a one-way mirror – or, so to speak, through the keyhole! This issue, of course, is relevant to the use of the couch as a technique).

The mirror neurons and related findings suggest that even the simple, seemingly passive, perception of another (particularly, of the other's actions and emotional expressions) often entails, at a

physiological level, inherently interactional processes – that is, "embodied simulation" of the other's actions and expressions (see Gallese, 2003a). In other words, when A is observing, say B's emotional expressions, there is an automatic, pre-reflexive "embodied simulation" in A of the brain processes that subserve B's behavior.

There is evidence that when people observe pictures of emotional facial expressions, they show spontaneous and rapid electromyographic responses in the facial muscles (and presumably, brain processes) that correspond to the facial muscles (and presumably, brain processes) involved in the observed person's facial expressions (Dimberg, 1982; Dimberg & Thunberg, 1998; Lundqvist & Dimberg, 1995; Dimberg, Thunberg & Elmehed, 2000). Further, if Ekman (1993, 1998; Ekman & Davidson, 1994) is correct, this process of automatic simulation may result in the observer experiencing a small dose of the emotion corresponding to the observed person's facial expression. Such "embodied simulation" constitutes a fundamental basis for our frequent automatic and immediate understanding of another (Gallese, 2003a). However, one can speculate that the observer's awareness of and reflection on his or her fleeting thoughts and feelings, that are the product of "embodied simulation", can further contribute to an understanding of what is going on in the observed's mind. But this, of course, is precisely the assumption that underlies the idea that reflection on his or her countertransference reactions can serve the analyst as a useful guide to understanding what is going on in the patient's mind. In short, we are describing a central aspect of the shift within psychoanalysis from a primary theory theory account to a primary Simulation Theory approach to understanding the patient's mind.

It is one thing to describe this shift from a theory theory to a Simulation Theory approach and another thing to evaluate its justification and validity. Psychoanalysis has long been characterized by excessive swings of the pendulum. Thus, the current intersubjective emphasis in psychoanalysis is, in part at least, a reaction against the inadequacies and limitations of the "Standard Model". However, one need not choose between *either* a theory theory *or* a Simulation Theory approach to understanding the patient. Both approaches are likely to generate certain problematic issues and to be characterized by certain limitations.

There are a host of questions and issues that need to be addressed in evaluating the applicability of a Simulation Theory approach to the psychoanalytic situation. For example, whereas the mirror neurons discovery and the findings described above refer to motor actions and emotional facial expressions, the analyst is perceiving and responding mainly to verbal material (as well as non-verbal cues) from the patient. The question here is whether perception of this kind of material is susceptible to the hypothesis of "embodied simulation" (Gallese, 2003a, 2005b). Preliminary results on the involvement of the motor system in language processing (Hauk et al., 2004; Tettamanti et al., 2005; Buccino et al., 2005; see also Gallese & Lakoff, 2005) seem to suggest that this could be the case.

As one of us has argued elsewhere (Eagle, 2000), although the analyst's countertransference reactions *may* serve as a guide to what is going in the patient's mind, it also *may not*. It may, rather, primarily reflect the analyst's own idiosyncratic history, biases, and, more in accord with the classical definition of countertransference, contribute to the analyst's blind spots. This possibility raises the general questions of individual differences in capacity for understanding as well as in failures of understanding. The work on "embodied simulation" discussed here speaks to general and basic foundations for intersubjectivity and empathy. However, we know that there are wide variations in people's (including analyst's) capacity for intersubjective communication and empathy. What are the sources of such individual differences? If "embodied simulation" is an automatic and universal process, how does one account for individual differences in understanding the other, including failures to understand another? Do failures occur at the "primary" or "lower" level of "embodied simulation"? That is, are some people characterized by deficiencies at this fundamental level – as is the case, in an obvious and extreme manner, with autistic individuals (Williams, Whiten & Singh, 2004)? Or, do deficiencies occur primarily at a "higher" level, for example in difficulties the observing individual has

in *reflecting upon* the inner cues that are universally generated by "embodied simulation" and other basic processes?

Turning to the questions of empathy, as noted, one expression of the shift to Simulation Theory in contemporary psychoanalysis is the primacy of empathy or "vicarious introspection" as the main tool for understanding the patient. However, the same or similar questions raised with regard to countertransference can also be raised in relation to empathy. We know that there are wide individual differences in capacity for empathy. What is the source of these differences? If automatic and reflexive "embodied simulation" is the foundation for empathic perspective taking (Gallese, 2003a, 2005b), do relative failures in empathic understanding reflect deficiencies at this foundational level or do they reflect instead deficiencies in one's ability to be aware of and reflect on cues that are generated at the level of "embodied simulation"?

Cutting across a range of areas, there is evidence that we tend to assimilate experiences to our pre-existing schemas (referred to, variously, as transference, Bowlby's Internal Working Model [IWM], Stern's Representation of Interactions Generalized [RIG], and so on). What impact do these schemas have on processing at the level of "embodied simulation"? For example, when A perceives B's smile (or tone of voice) as friendliness do different processes at the fundamental level of "embodied simulation" become activated than when A perceives B's smile, say, as condescension or derision?

There is evidence that the capacity for empathy varies with degree of similarity between the observer and the observed. At what level does this similarity variable operate? Does it influence processes at the fundamental level of "embodied simulation"?

A critical factor that needs to be addressed in considering the role of simulation and empathy in the psychoanalytic situation is the fact that analysts presumably deal with the *unconscious* mental states of the patient. This raises the questions of what it means to be empathic with another's, say, unconscious wishes and desires. What does it mean to take the perspective of another in regard to the patient's unconscious mental states, particularly his or her ego-alien aspects? Schlesinger (1981) argues that psychoanalytic interpretations pertaining to the patient's unconscious, ego-alien aspects of himself or herself will, by definition, not be empathic insofar as they do not resonate with, indeed are inimical to, the patient's conscious experience. Can one "rescue" the role of empathy in relation to unconscious mental states by thinking of it as putting oneself in the shoes of another who is harboring certain wishes and desires, but also warding them off? (see Eagle & Wolitzky, 1997). These are only some of the issues and questions that arise when one elevates empathy or "vicarious introspection" as the primary tool for understanding the patient.

It is interesting to observe that the elevation of empathy as a primary tool in psychoanalysis has been accompanied by a markedly decreased emphasis on unconscious mental states. Thus, in Kohut's entire 1984 book (*How Does Analysis Cure?*) there is but one index reference to "unconscious" – a remarkable fact for a discipline that has traditionally identified unconscious processes as its central focus. This is not surprising, however, when one considers Kohut's emphasis, not only on empathy, but on "experience-near" concepts[2].

In an important sense, the concept of unconscious mental contents, particularly of warded off, ego-alien unconscious mental contents, is an experience-distant concept. Because they are not easily and directly accessible to conscious experience and because one does not, in any simple way, have first person "privileged access" to them, unconscious mental contents and processes are explicitly *inferred* by the observer (and sometimes, even by the agent himself or herself). Inferences are the kinds of

[2] It is interesting to observe that Kohut (1984) distinguishes between explanation and understanding, a distinction that has a long philosophical history. For example, central to the *Verstende* movement was the claim that in contrast to the physical sciences (*Naturwissenschaften*), which rely on theoretical explanation, the human sciences (*Geisteswissenschaften*) employ *verstehen* or understanding. It is clear that Kohut's distinction belongs to this European tradition.

things that are much more closely linked to *theory* explanations than to understanding arrived at through empathy[3].

Psychoanalysis is a peculiar discipline in that it employs concepts (e.g., wishes, desires) that, in their ordinary common sense and folk psychology context are clearly first person concepts, but, in the traditional psychoanalytic context, also function as third person concepts. That is, as *unconscious* wishes and desires, they are not experienced in a first person way, but rather function as external "forces". In that sense, an unconscious wish or desire is a hybrid concept (see Ricoeur [1965] for a discussion of the role of hybrid concepts of both impersonal force and personal agency in psychoanalysis). Although it employs the language of a *first person* statement – which lends itself to empathic understanding and taking the other's first person perspective – an unconscious wish or desire is a *theoretical* concept that plays a central role in *third person theoretical* explanation (see Rubinstein, 1952-83). It is not surprising, then, that as psychoanalysis has moved from a theory theory to a Simulation Theory approach, it has, concomitantly, also increasingly shifted from an emphasis on interpretation of unconscious mental contents to an emphasis on empathic understanding of experience-near mental states.

Up to this point, we have been discussing the implications of the mirror neurons and related findings for how one gains knowledge and understanding of the patient's mind. We want to turn now to the implication of these findings for *therapeutic action*. Recall that, for Kohut (1984), empathic resonance is not only a means of gaining knowledge of the patient's mind, but also a primary vehicle for *therapeutic cure*. That is, according to Kohut, the patient's repeated experience of empathic understanding by the analyst serve to "repair" self-defects. Why should this be the case and how does such "repair" come about? The mirror neurons and related processes of "embodied simulation" may contribute to an understanding of the nature of this process, since they provide a basic neurophysiological underpinning for one's primitive sense of "we-ness", of a sense of connectedness to others, of being like other beings with whom we interact (Gallese, 2003a, 2005b). The effects of a lack of sense of "we-ness" are striking, as, for example, can be seen in severe autism and schizophrenia. However, in a much more subtle fashion, a feeling of isolation, of a lack of affective connection, is an important aspect of many forms of psychopathology. Fairbairn (1952) identifies the tendency to relate to internalized objects as a central feature of psychopathology and virtually equates mental health with an ability to relate to real others – that is, as they actually exist rather than as they are created in one's fantasies. In an important sense, the latter is a solipsistic intrapersonal, pseudo-relating, whereas the former is truly interpersonal.

We want to speculatively suggest that the therapeutic situation provides opportunities for experiences of "embodied simulation" that may both enhance the patient's sense of "we-ness", that is, the sense of connection to the other and contribute to the feeling of self integrity. We begin with speculations on the possible role of "embodied simulation" in Self pathology.

Kohut has argued that Self pathology is primarily due to the individual's experiences of parental failures of empathic understanding. It is interesting to speculate how the work on "embodied simulation" might shed light on how this could come about:

(1) Say that the child (A) experiences a particular feeling state
(2) Caregiver (B) reacts to A
(3) A observes and reacts to B's reaction to him or her
(4) A's observation of B's reaction triggers automatic, pre-reflexive, simulation (of B's behavior) in A
(5) If B's reaction to A (in Step 2) is isomorphic with or attuned to A's feeling state (in Step 1), then the simulation processes automatically triggered in A (Step 4), when he or she observes B's reaction to him or her, will be *congruent* with his or her initial feeling state (in Step 1). This will not only contribute to A's

[3] In a symposium on the place of empathy in psychoanalysis, Schwaber (1981), an analyst who is strongly associated with Self Psychology, distinguishes between "inferential explanation" and empathic understanding.

sense of connectedness to B, but will also positively influence the development of A's sense of Self through contributing to the continuity and reinforcement of A's feeling states

(6) If B's reaction to A (in Step 2) is not isomorphic with or is misattuned to A's initial feeling (Step 1), then the simulation processes automatically triggered in A (Step 4), when he or she observes B's reaction to him or her, will be *incongruent* with his or her initial feeling state (in Step 1). This means that there will be a *disjunction* between A's initial feeling state (in Step 1) and his or her internalization (that is, the simulation processes triggered in A) of B's reaction to him or her. Such disjunction, one could speculate, threatens self-integrity by contributing to the development of what Winnicott (1960) calls a "false self" and what Fonagy *et al*. (2002) refer to as an "alien self" (the latter, very close in meaning to Fairbairn's [1952] concept of internalized object). Both the concepts of "false self" and "alien self" (as well as the concept of "internalized object") have in common the central idea that the individual has "imported" into the structure of the self (mirroring) reactions of the other that are incongruent with one's constitutionally and organically based "true" feeling states. It is natural for the infant to simulate the caregiver's reactions. However, if these simulations contribute to the formation of Self and if what is simulated is incongruent with the infant's feeling state, then he or she is internalizing or taking in, as part of the Self, representations that are incongruent with his or her own. Surely, this is what the terms "false self", "alien self", and internalized object basically mean

One can speculate that an interactional process similar to the steps described above goes on in the therapeutic situation. When the therapist's reactions to the patient are congruent with the latter's feeling state, that is, when the patient feels empathically understood, there is an enhancement of both his or her sense of connectedness to the other, and a validation of self.

The therapeutic situation can be partly understood as one that provides repeated opportunities for the patient to have "corrective emotional experiences" in which what he or she takes in from the other is congruent with his or her own feeling states. One way that this might come about, suggested by the work discussed in this paper, is through our automatic tendency to simulate others' affective reactions, particularly affective reactions to oneself.

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Keywords: mirror neurons, intentional attunement, intersubjectivity, embodied simulation, shared manifold, interpersonal relations, neuro-psychoanalysis, psychoanalysis, neurophysiology