Original Paper

Psychopathology

Psychopathology 2003;36:171–180
DOI: 10.1159/000072786

Received: October 16, 2002
Accepted after revision: March 3, 2003

The Roots of Empathy: The Shared Manifold Hypothesis and the Neural Basis of Intersubjectivity

Vittorio Gallese

Dipartimento di Neuroscienze, Sezione di Fisiologia, University of Parma, Parma, Italy

Key Words
Empathy · Intersubjectivity · Shared manifold hypothesis · Mirror neurons · Phenomenology · Autism · Schizophrenia

Abstract
Starting from a neurobiological standpoint, I will propose that our capacity to understand others as intentional agents, far from being *exclusively* dependent upon mentalistic/linguistic abilities, be deeply grounded in the *relational* nature of our interactions with the world. According to this hypothesis, an implicit, prereflexive form of understanding of other individuals is based on the strong sense of identity binding us to them. We share with our conspecifics a multiplicity of states that include actions, sensations and emotions. A new conceptual tool able to capture the richness of the experiences we share with others will be introduced: the *shared manifold* of intersubjectivity. I will posit that it is through this shared manifold that it is possible for us to recognize other human beings as similar to us. It is just because of this shared manifold that intersubjective communication and ascription of intentionality become possible. It will be argued that the same neural structures that are involved in processing and controlling executed actions, felt sensations and emotions are also active when the same actions, sensations and emotions are to be detected in others. It therefore appears that a whole range of different 'mirror matching mechanisms' may be present in our brain. This matching mechanism, constituted by mirror neurons originally discovered and described in the domain of action, could well be a *basic* organizational feature of our brain, enabling our rich and diversified intersubjective experiences. This perspective is in a position to offer a global approach to the understanding of the vulnerability to major psychoses such as schizophrenia.

Introduction

We are social animals. The pervasive social habits of primates are likely the result of a very long evolutionary path, in that these habits are patently not peculiar to primates. They are indeed diffuse across species as spaced apart in evolutionary time as humans and ants. Social interactions play different roles according to different modalities in different species. Nevertheless, transversal to and at the basis of all social species and all social cultures, of whatever complexity, is the notion of *identity* of the individuals within those species and cultures. As humans, we implicitly 'know' that all human beings have 4 limbs, walk in a certain way, and act in peculiar ways. Identity is articulated on many different levels of complexity. It can be subjected to increasingly complex tests

KARGER

Fax + 41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com

0254–4962/03/0364–0171$19.50/0

Accessible online at:
www.karger.com/psp

Vittorio Gallese
Dipartimento di Neuroscienze, Sezione di Fisiologia
University of Parma, Via Volturno 39
IT–43100 Parma (Italy)
Tel. +39 0521 903879, Fax +39 0521 903900, E-Mail vittorio.gallese@unipr.it

in which different species might score differently, but it is nevertheless the membership fee all individuals have to pay in order to self-guarantee the sense of belonging to a larger community of other organisms. Identity is so important within a group of social individuals because it enables them with the capacity to better predict the consequences of the future behavior of others. This capacity, in turn, contributes to optimize the employment of cognitive resources by reducing the 'meaning space' to be mapped. Identity contextualizes content by reducing the number of possible information units our brain is supposed to process.

There are indeed at least 2 types of identity to be explained: (1) the identity we experience as *individual* organisms, by means of which the self is uniquely individuated (i-identity), and (2) the identity we experience in *other individuals*, by means of which the self is identified within a larger community of other beings (s-identity).

Yet, the dominant view in contemporary cognitive science is to reiteratively put most efforts in clarifying what are the formal rules structuring a *solipsistic* mind. A much less effortful and deep inquiry is devoted to investigate, on the one hand, what triggers the *sense of identity* that we experience in our relations with the 'other' selves populating the world we live in, and to clarify, on the other hand, how a disruption of this intersubjective social identity might engender psychosis.

Meltzoff and Moore [1977, 1997; Meltzoff, 2002] showed that newborns as young as 18 h are perfectly capable to reproduce mouth and face movements displayed by the adult they are facing. Meltzoff and Brooks [2001] have convincingly suggested that the 'like me' analogy between infant and caregiver is *the* starting point for the development of (social) cognition. This analogy process proceeds in a bidirectional way. Infants use the observed behavior of their human partners as a mirror to gain more knowledge about themselves. But the same process works also the other way around: it enables infants to know about the others.

In the present paper, I will concentrate on the functional aspects and the neural underpinnings of s-identity. The point I want to make is that beside – and likely before – the explicit ascription of any intentional content to others, we entertain a series of 'implicit certainties' about the individuals we are confronting with. These certainties deal with our implicit knowledge about other individuals, encompassing the way they look, the way they act and, ultimately, the way they feel and think. These implicit certainties are constitutive of the intersubjective relation, and contribute to the sense of oneness, the sense of identity with the other, which basically makes s-identity possible.

It is this sense of identity that enables the possibility to ascribe *any* content to the individual we are interacting with. Our possibility to see or think that we are different from other living and nonliving objects is determined by our capacity to entertain i-identity. But i-identity depends in a constitutive way on the development of s-identity, which enables the possibility to entertain a meaningful dialogue with others.

The posited important role of social identity relations in constraining the cognitive development of our mind provides a strong motivation to investigate from a neuroscientific perspective the functional mechanisms at its basis and their neural underpinnings.

Before presenting empirical evidence in support of my hypothesis, it is necessary to clarify what are the conditions under which the neuroscientific level of description would appear reasonably apt to support it. The following conditions should do the job: (1) evidence of a neural representation format capable of achieving sameness of content in spite of the multiple and different modes of presentation by means of which content might be originated by its referents; (2) indifference of the representational format to the peculiar perspectival spaces from which referents project their content. In other words, indifference to self-other distinctions, and (3) persistence of the same representational format also in adulthood.

I will analyze from a neuroscientific perspective what are the functional mechanisms at the basis of the 'implicit certainties' enabling intersubjective relations, and what might be the neural mechanisms underpinning them. I will discuss the reviewed neuroscientific results in relation to the notion of empathy, which, after several decades of almost complete oblivion, has forcefully reappeared in the contemporary debate on human cognition. After a concise and forcefully partial historical review, I will provide an 'enlarged' account of empathy that will be defined by means of a new conceptual tool: the *shared manifold* of intersubjectivity. The shared manifold is conceived as a multidimensional, 'we-centric' shared space, and can be characterized at the phenomenological, functional and subpersonal level.

I will propose that it is by means of this shared manifold that other human beings can be recognized to be similar to us, thus 'bootstrapping' imitation, interindividual communication, and intentionality detection. I will conclude with a discussion of the theoretical relevance of this hypothesis to psychopathology, by suggesting that a disruption of the shared manifold of intersubjectivity might

be related to the vulnerability to major psychoses such as schizophrenia, particularly for what pertains to its autistic aspects.

The Neurophysiology of Interactions

Recent neurophysiological evidence forcefully points to a crucial role played by *interactions* in shaping, defining and constraining the representational aspects of the dynamic interplay between organisms and environment. I will now introduce the neural properties of a sector of the premotor cortex of macaque monkeys studied in our lab for more than 20 years.

The rostralmost sector of the ventral premotor cortex of the macaque monkey controls hand and mouth movements [Rizzolatti et al., 1981, 1988; Kurata and Tanji, 1986; Hepp-Reymond et al., 1994]. This sector, which has specific histochemical and cytoarchitectonic features, has been termed area F5 [Matelli et al., 1985]. A fundamental functional property of area F5 is that most of its neurons do not discharge in association with elementary *movements*, but are active during *actions* such as grasping, tearing, holding or manipulating objects [Rizzolatti et al., 1988].

What is coded in F5 is not simply a physical parameter of movement such as force or movement direction, but rather the relationship, in motor terms, between the *agent* and the *object* of the action. F5 neurons are activated only *if* a particular type of agent-object relational interaction is executed until the interaction leads to a different state of the agent (e.g. to take possession of a piece of food, to throw away an object, to break it, or to bring it to the mouth). Particularly interesting in this respect are grasping-related neurons that fire any time the monkey *successfully* grasps an object, regardless of the effector employed, be it any of his two hands, or the mouth, or both [Rizzolatti et al., 1988, 2000].

The independence between the nature of the effector involved and the end-state that the same effector is supposed to attain constitutes an *abstract* kind of means-end representation. Thus, we have a neural representational format that generalizes across different instances in which a particular successful end-state of the organism (the goal) can be achieved. To spell it in terms of information theory, the conceptual narrower state has been reached by getting rid of useless, redundant information; for example, the load of information about *all* the dynamic patterns under which an intentional action can still be characterized. We can envisage it as the dawning of more sophisticated *conceptual* articulations to come [Gallese, in press].

Beyond purely motor neurons, which constitute the overall majority of all F5 neurons, area F5 also contains 'visuomotor' neurons. Among them, there are neurons that discharge when the monkey *observes* an action made by another individual and when it *executes* the same or a similar action. We called them 'mirror neurons' [Gallese et al., 1996; Rizzolatti et al., 1996a, 2001].

Mirror Neurons and Interpersonal Relations

Mirror neurons require, in order to be activated by visual stimuli, an interaction between the action's agent (human being or a monkey) and its object. Control experiments showed that neither the sight of the agent alone nor of the object alone were effective in evoking the neuron's response. Similarly, much less effective were mimicking the action without a target object or performing the action by using tools. We have proposed that mirror neurons may constitute a neural mechanism *enabling implicit action understanding* [Gallese et al., 1996; Rizzolatti et al., 1996a].

Neurons responding to the observation of complex actions, such as grasping or manipulating objects, had been previously described by Perrett and coworkers [Jellema and Perrett, 2001] in the cortex buried within the superior temporal sulcus (STS). These neurons, whose visual properties are for many aspects similar to those of mirror neurons, could constitute the source of visual information of mirror neurons. The STS region, however, has no direct connection with area F5, but has links with the anterior part of the inferior parietal lobule (area PF or 7b), which, in turn, is reciprocally connected with area F5 [Matelli et al., 1986; Rizzolatti et al., 1998]. Area PF, or 7b, is located on the convexity of the inferior parietal lobule. Area PF, through its connections with STSa on the one hand, and F5 on the other hand, could play the role of an 'intermediate step' within a putative cortical network for implicit action understanding, by feeding to the ventral premotor cortex visual information about action as received from STSa.

In a new series of experiments, we therefore decided to better clarify the nature and the properties of such a cortical matching system in the monkey brain. The results of this study showed that about one third of the PF-recorded neurons ('PF mirror neurons') responded both during action execution and action observation [Gallese et al., 2001]. All PF mirror neurons responded to the observa-

tion of actions in which the experimenter's hand(s) interacted with objects. Similarly to what was observed in F5, PF mirror neurons neither responded to object presentation nor to observed actions performed using tools. Observed mimed actions evoked weaker, if any, responses.

What these experiments show is that the 'mirror' system, matching action observation on action execution, is not a prerogative of the premotor cortex, but also extends to the posterior parietal lobe. On the basis of these findings, it appears that the sensorimotor integration process supported by the F5-PF frontoparietal cortical network instantiates an 'internal copy' of actions utilized not only to generate and control goal-related behaviors, *but also* to provide – at a prereflexive and prelinguistic level – a meaningful account of behaviors performed by other individuals.

Several studies using different methodologies have demonstrated the existence of a similar mirror matching system also in humans [Fadiga et al., 1995; Grafton et al., 1996; Rizzolatti et al., 1996b; Cochin et al., 1988; Decety et al., 1997; Hari et al., 1998; Iacoboni et al., 1999; Buccino et al., 2001]. Brain imaging experiments in humans have shown that during hand action observation, a cortical network composed by sectors of Broca's region, premotor cortex, STS region, and posterior parietal cortex is activated [Grafton et al., 1996; Rizzolatti et al., 1996b; Decety et al., 1997; Decety and Grèzes, 1999; Iacoboni et al., 1999; Buccino et al., 2001].

Given the homology between monkey's area F5 and Broca's region [Matelli and Luppino, 1997], it appears that even a part of the human brain traditionally considered to be unique to our species, nevertheless shares with its nonhuman precursor area a similar functional mechanism. In other words, Broca's region appears to be not only involved in speech control, but also, similarly to monkey's area F5, in a prelinguistic analysis of others' behavior.

A recent brain imaging study [Buccino et al., 2001] showed that when we observe goal-related behaviors executed with effectors as different as the mouth, the hand or the foot, different specific sectors of our premotor cortex become active. These cortical sectors are those same sectors that are active when we perform the same actions. Whenever we look at someone performing an action, beside the activation of various visual areas, there is a concurrent activation of the motor circuits that are recruited when we ourselves perform that action. Although we do not overtly reproduce the observed action, our motor system becomes nevertheless active *as if* we were executing that very same action that we are observing.

According to this perspective, to perceive an action is equivalent to internally simulate it. This *implicit, automatic,* and *unconscious* process of embodied simulation enables the observer to use his/her own resources to penetrate the world of the other without the need of explicitly *theorizing* about it [Gallese and Goldman, 1998; Goldman and Gallese, 2000; Gallese, 2001]. A process of implicit, prereflexive action simulation automatically establishes a direct implicit link between agent and observer. Action is therefore a suitable candidate principle enabling social bonds to be initially established.

Self-Other Identity and Shared Multimodal Content

So far, I have presented neuroscientific evidence demonstrating that in *adult* individuals (both monkeys and humans), a mirror matching neural mechanism enables to represent content independently for the self-other distinction, thus satisfying the last two posited criteria to empirically ground my working hypothesis. The first criterion, however, namely sameness of content regardless of the *specific quality* of the mode of presentation of the referent originating it, has not yet been addressed.

In a recent study, we have investigated whether in the monkey premotor cortex there are neurons that discharge when the monkey makes a specific hand action and also when in *hears* the corresponding action-related sounds. The results showed that the monkey premotor cortex contains neurons that discharge when the monkey *executes* an action, *sees* or just *hears* the same action performed by another agent. We have defined these neurons 'audiovisual mirror neurons' [Kohler et al., 2001, 2002; Keysers et al., in press]. They respond to the sound of actions and discriminate between the sounds of different hand or mouth transitive actions, compatible with the monkey's natural behavioral repertoire. Audiovisual mirror neurons, however, do not respond to other similarly interesting sounds such as arousing noises, or vocalizations of monkeys and other animals. The actions whose sounds evoke the strongest responses when heard also trigger the strongest responses when observed or executed. It does not significantly differ at all for the activity of this neural network if matter of facts of the world such as noisy actions are specified at the motor, visual or auditory level.

Such neural mechanism enables to represent the end-state of the interaction, the content of the representation, independently from its different modes of presentation:

sounds, images, or willed effortful acts of the body. All modes of presentation of the event are blended within a circumscribed, informational lighter level of semantic reference.

Most importantly for our quest for a neural correlate of intersubjective identity, *sameness of content is shared with different organisms.* This shared semantic content is the product of modeling the observed *behavior* as an *action* with the help of a matching equivalence between what is observed or heard and what is executed. Thus, mirror neurons instantiate a *multimodal* representation of organism-organism relations. They map this multimodal representation across different spaces inhabited by different actors. These spaces are blended within a unified common *intersubjective* space, which paradoxically does not segregate any subject. This space is *we-centric*.

The shared intentional space underpinned by the mirror matching mechanism is not meant to identify an agent and an observer: as organisms, we are equipped with plenty of systems, from proprioception to the expectancy created by the inception of any activity, capable of telling self from other. In other words, when we act, a series of neural networks come into play that are *not activated* when we simply witness the behavior of others (i.e. the neurons of the primary motor cortex and the purely motor neurons of premotor cortex). The shared space instantiated by mirror neurons simply blends the interactive individuals within a shared implicit semantic content. The self-other identity therefore preexists *and* further parallels the self-other dichotomy.

As convincingly shown by developmental psychology, the self-other analogy is heavily relying on action and action imitation, but is not confined to the domain of action. It has a global dimension, which encompasses all aspects defining a life form, from its peculiar body to its peculiar affect [Stern, 1985]. This global dimension implies a broad range of 'implicit certainties' we entertain about other individuals, all contributing to compose our global shared experiential dimension with others. I will recompose all these multidimensional articulations of the self-other relationships within an integrated neuroscientific framework, by introducing a new conceptual tool: the shared manifold of intersubjectivity.

Self-Other Identity and Empathy

The self-other identity goes beyond the domain of action. It incorporates sensations, affect and emotions. The affective dimension of interindividual relations has very early attracted the interest of philosophers, as it was recognized as a distinctive feature of human beings. In the eighteenth century, Scottish moral philosophers identified our capacity to interpret the feeling of others in terms of 'sympathy' [Smith, 1759]. But it is only during the second half of the nineteenth century that these issues have acquired a multidisciplinary character, being tackled in parallel by philosophers and by the scholars of a new discipline, psychology.

Empathy is a later English translation [Titchener, 1909] of the German word 'Einfühlung'. It is commonly held that Einfühlung was originally introduced by Theodore Lipps [1903a] into the vocabulary of the psychology of aesthetic experience, to denote the relationship between an artwork and the observer, who imaginatively project himself/herself into the contemplated object.

But the origin of term is actually older. As pointed out by Prigman [1995], Robert Vischer [1873] introduced the term in 1873 to account for our capacity to symbolize the inanimate objects of nature and art. Vischer was strongly influenced by the ideas of Lotze [1858], who already in 1858 proposed a mechanism by means of which humans are capable of understanding inanimate objects and other species of animals by 'placing ourselves into them' (sich mitlebend ... versetzen').

Lipps [1903b], who wrote extensively on empathy, extended the concept of Einfühlung to the domain of intersubjectivity, which he characterized in terms of *inner* imitation of the perceived movements of others. When I am watching an acrobat walking on a suspended wire, Lipps [1903b] notes, *I feel myself so inside of him* (ich fühle mich so in ihm'). We can see here a first suggested relation between imitation ('inner' imitation, in Lipps' words) and the capacity of understanding others by ascribing them feelings, emotions and thoughts, a relation that will be reinstated by Husserl [1966; Depraz, 2001a].

Phenomenology has further developed the notion of Einfühlung. A crucial point of Husserl's thought is the relevance he attributes to intersubjectivity in the constitution of our cognitive world. Husserl's [1973, 1977] rejection of solipsism is clearly epitomized in his fifth Cartesian Meditation, and even more in the posthumously published 'Ideen II' [1989]. The other is apprehended by means of a primitive holistic process of 'pairing' ('Paarung'): the self-other identity at the level of the body enables an intersubjective transfer of meaning to occur. From the very onset of life, subjectivity *is intersubjectivity* [Depraz, 1995, 2001b].

Einfühlung is conceived as an intentional form of perception by analogy. Furthermore, it is through a 'shared

experience' of the world, granted by the presence of other individuals, that objectivity can be constituted. According to Husserl, the body is the primary instrument of our capacity to share experiences with others [Sheets-Johnson, 1999]. What makes the behavior of other agents implicitly intelligible is the fact that their body is experienced not as material object ('Körper'), but as something alive ('Leib'), something analogous to our own experienced acting body.

From birth onwards, the precategorical 'Lebenswelt', the world inhabited by living things, constitutes the playground of our interactions. Empathy is deeply grounded in the experience of our lived body, and it is this experience that enables us to directly recognize others not as bodies endowed with a mind but as *persons* like us. Persons are rational individuals. What we now discover is how a rationality assumption can be grounded in bodily experience. According to Husserl [1989], there can be no perception without *awareness of the acting body.*

The relationship between action and intersubjective empathic relations becomes even more evident in the works of Edith Stein [1964] and Merleau-Ponty [1962]. Edith Stein, a former pupil of Husserl, in her book *On the Problem of Empathy* [1912/1964, English translation], clarifies that the concept of empathy is not confined to a simple grasp of the other's feelings or emotions. There is a more basic connotation of empathy: the other is experienced as another being as oneself through an appreciation of *similarity.* An important component of this similarity resides in the *common experience of action*. The common experience of action, thus, turns out to be a building block of s-identity.

As Edith Stein [1964] points out, if the size of my hand were given at a fixed scale, as something predetermined, it would become very hard to 'empathize' with any other types of hand not matching these predetermined physical specifications. However, we can perfectly recognize children's hands and monkeys' hands as such despite their different visual appearance. Furthermore, we can recognize hands as such even when all the visual details are not available, even despite shifts of our point of view, and even when no visual shape specification is provided.

Indeed, even if all we can see are just moving light-dot displays of people's behavior, we are not only capable to recognize a walking person, but also to discriminate whether it is ourselves or someone else we are watching, or if the walking person is cheerful or depressed and sad [Cutting and Kozlowski, 1977]. Since in normal conditions we never look at ourselves when walking, this recognition process can be much better accounted for by a mechanism in which the observed moving stimuli activate the observer's motor schema for walking, than solely by means of a purely visual process. This seems to suggest that our grasp of the meaning of the world does not *exclusively* rely on its passive visual record, but is strongly influenced by action-related sensorimotor processes.

Merleau-Ponty [1945/1962, English translation] in the *Phenomenology of Perception* writes:

> The communication or comprehension of gestures come about through the reciprocity of my intentions and the gestures of others, of my gestures and intentions discernible in the conduct of other people. It is as if the other person's intention inhabited my body and mine his.

Self and other relate to each other, as they both represent opposite extensions of the same correlative and reversible system *self/other*. The observer and the observed are part of a dynamic system governed by *reversibility rules*.

As shown in the previous sections, the shared intersubjective space in which we live since birth continues to constitute a substantial part of our semantic space. When we observe other acting individuals, therefore facing their full range of *expressive* power (the way they act, the emotions and feelings they display), a meaningful embodied interindividual link is automatically established.

The discovery of mirror neurons in adult individuals shows that the very same neural substrate be activated when some of these expressive acts are both executed and perceived. Thus, we have a *subpersonally instantiated* common space. It relies on neural circuits involved in action control.

The hypothesis I am putting forward here is that a similar mechanism could also underpin our capacity to share feelings and emotions with others. My proposal is that sensations and emotions displayed by others can also be 'empathized', and therefore *implicitly* understood, through a mirror matching mechanism.

The Shared Manifold Hypothesis

So far, I have emphasized that the constitution of s-identity is a driving force for the cognitive and psychic development of more articulated and sophisticated forms of intersubjective relations. I have also proposed that the mirror matching system could be involved in enabling the constitution of this identity. I think that the concept of empathy should be extended in order to accommodate and account for *all* different aspects of expressive behav-

ior enabling us to establish a meaningful link between others and ourselves. This 'enlarged' notion of empathy opens up the possibility to unify under the same account the multiple aspects and possible levels of description of intersubjective relations.

As we have seen, when we enter in relation with others, there is a multiplicity of states that we share with them, which I defined earlier as 'implicit certainties'. We share emotions, our body schema, or our being subject to somatic sensations such as pain. A comprehensive account of the richness of contents we share with others should rest upon a conceptual tool capable to be applied at all these different levels of description, while simultaneously providing their functional and subpersonal characterization.

I will introduce this conceptual tool as the *shared manifold* of intersubjectivity [Gallese, 2001]. I posit that it is by means of this shared manifold that we can recognize other humans being similar to us, thus being capable to constitute s-identity. It is just because of this shared manifold that intersubjective communication, social imitation and ascription of intentionality become possible. The shared manifold can be operationalized at three different levels: (1) a phenomenological level; (2) a functional level, and (3) a subpersonal level.

The *phenomenological level* is the one responsible for the sense of similarity, of being individuals within a larger social community of persons like us, which we experience any time we confront ourselves with other human beings. It could also be defined as the *empathic* level, provided that empathy is characterized in the 'enlarged' way I am advocating here. Actions, emotions and sensations experienced by others become *implicitly meaningful* to us because we can *share* them with others.

The *functional level* can be characterized in terms of '*as if* modes' of interaction enabling models of self-other to be created. The same functional logic is at work during both self-control and the experience of others' behavior. Both are models of interaction, which map their referents on identical relational functional nodes. All modes of interaction share a relational character. At the functional level of description of the shared manifold, the relational logic of operation produces the self-other identity by enabling the system to detect coherence, regularity, and predictability, independently from their situated source.

The *subpersonal level* is instantiated as the level of activity of a series of mirror matching neural circuits. The activity of these neural circuits is, in turn, tightly coupled with multilevel changes within body states. I have proposed that mirror neurons instantiate a supramodal intentional shared space. My hypothesis is that analogous neural networks might be at work to generate supramodal emotional and sensitive shared spaces [Goldman and Gallese, 2000; Gallese, 2001]. The shared spaces allow us to appreciate, experience, and implicitly and prereflexively understand the emotions and the sensations we take others to experience.

It should be clarified that the shared manifold of intersubjectivity does not entail that we experience others *as* we experience ourselves. The shared manifold simply enables and bootstraps mutual intelligibility. Thus, self-other identity is not all there is in intersubjectivity. As noted by Husserl [1973], if this were the case, others could not anymore be experienced as such [Zahavi, 2001]. On the contrary, it is the *alterity* of the other that grounds the objective character of reality. The quality of our 'Erlebnis' of the 'external world' and its content are constrained by the presence of other subjects that are intelligible, while preserving their alterity character. An alterity which, as we have seen, is present also at the subpersonal level, instantiated by the different neural networks coming into play when *I* act with respect to when *others* act.

No systematic attempt has been produced so far to experimentally test this hypothesis. Yet, there are clues that it might be not so ill founded (for a review of pertinent recent neuroscientific literature, see Gallese [2001, 2003]. New experiments both on monkeys and humans are just being started in our lab to empirically test this hypothesis.

Psychopathological Implications

As human beings, we constantly seek for a balanced equilibrium between the need to express our individuality and uniqueness, and the necessity to follow the social 'rules' dictated by our highly structured society. All our social transactions depend on mutual understanding. Simultaneously, however, the interpersonal intelligibility is sided by the capacity of the self to establish clear-cut boundaries demarcating it from the 'outside world'. The self is therefore experienced as similar to other selves, but at the same time as unique. As we have learned at the beginning of the paper, in normal conditions in adulthood, s-identity is always paralleled by i-identity.

In 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 [Schneider, 1955], as epitomized by schneiderian positive symptoms such as thought insertion, auditory hallucinations, and delusion of action control. S-identity and i-identity appear to be both disrupted. The problem of psychopathology is therefore to reconcile all these different psychotic articulations within a coherent explanatory frame.

Schizophrenia, as pointed out by Terenius [2000], has so far been an elusive target for research. Furthermore, the current DSM-IV-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 derive from 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 to understand cognition, emotions and language, devoid of a 'global perspective', appears to be doomed to failure. This challenging enterprise requires an integrative approach. I believe the same to hold true for schizophrenia. From that 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.

However, this is by no means a new idea. In his seminal monography *La Schizophrénie* [1927], Minkowski 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 [1911], who wrote that schizophrenics cut themselves off from any contact with the external world. The core problem of schizophrenics is, accordingly, their lack of 'vital contact with reality' [Minkowski, 1927], 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 an empathic disorder, has been a constant theme in the reflections of phenomenologically inspired psychiatry. Blankenburg [1971] characterizes the autistic dimension of schizophrenia as a global crisis of 'common sense', an incapacity to prereflexively grasp the meaning of the world, a world which looks terribly unfamiliar and strange to the schizophrenic's eyes. Parnas and 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 schizophrenics to draw a coherent and meaningful picture of their social world. In a more recent paper, Parnas et al. [2002] 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'. It is exactly the same level of prereflexive, nonpropositional understanding of the world of interpersonal relations, which I have been characterizing throughout the paper, under the heading of 'shared manifold of intersubjectivity'.

More recently, along a similar phenomenologically inspired vein, Stanghellini [2000, 2001] pointed out that the interpersonal disorders observed in schizophrenic patients constitute a *fundamental aspect* of their psychosis. 'Defective attunement', the incapacity to engage oneself in meaningful relations with others, the impossibility to establish precognitive, noninferential, 'intuitive' interpersonal bonds, would represent a major feature of schizophrenia.

The 'defective attunement' hypothesis of phenomenological psychiatry is highly consonant with the picture I presented here. A disruption of the multilevel simulation processes characterizing the shared manifold might be a possible cause of 'defective attunement', or of a 'lack of common sense' in 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 implicitly and preverbally know. If the mechanisms enabling to constitute the implicit certainties we normally entertain about the world do not function properly, we are left in need to *purposively* attribute a sense to a world that looks totally strange.

The shared manifold hypothesis of intersubjectivity provides a general hypothesis that can be empirically tested at multiple levels both in healthy and psychotic individuals. A related theme, in my opinion worth being more carefully scrutinized, is the relationship between the physiopathology of the autistic aspects of schizophrenia and children autism. Furthermore, by emphasizing the *relational character* of the psychopathology of schizophrenia, this approach has the merit to disclose the possibility to establish a more insightful therapeutic bond with psychotic patients.

Acknowledgements

Preliminary and incomplete versions of this paper have been presented at the 11th World Congress of Psychiatry, Hamburg, Germany, 1999; at the International Workshop on 'Autism and Theory of Mind', Institut des Sciences Cognitives, Lyon, France, 2000; at the 31st Annual Meeting of the Jean Piaget Society, Berkeley, Calif., USA, 2001, and at the 7th Congresso Nazionale della Società Italiana di Psicopatologia, Roma, Italia, 2002. The author wishes to thank all audiences for their feedback. This work was supported by the Eurocores Program of the European Science Foundation, and by MIURST.

References

Bleuler E: Dementia Praecox oder Gruppe der Schizophrenien; in Aschaffenburg G (ed): Handbuch der Psychiatrie. Leipzig, Deuticke, 1911.

Blankenburg W: Der Verlust der natürlichen Selbstverständlichkeit. Ein Beitrag zur Psychopathologie symptomarmer Schizophrenien. Stuttgart, Enke, 1971.

Buccino G, Binkofski F, Fink GR, Fadiga L, Fogassi L, Gallese V, Seitz RJ, Zilles K, Rizzolatti G, Freund H-J: Action observation activates premotor and parietal areas in a somatotopic manner: An fMRI study. Eur J Neurosci 2001;13: 400–404.

Cochin S, Barthelemy G, Lejeune B, Roux S, Martineau J: Perception of motion and qEEG activity in human adults. Electroencephalogr Clin Neurophysiol 1998;107:287–295.

Cutting JE, Kozlowski LT: Recognizing friends by their walk: Gait perception without familiarity cues. Bull Psychon Soc 1977;9:353–356.

Decety J, Grèzes J: Neural mechanisms subserving the perception of human actions. Trends Cogn Sci 1999;3:172–178.

Decety J, Grèzes J, Costes N, Perani D, Jeannerod M, Procyk E, Grassi F, Fazio F: Brain activity during observation of actions. Influence of action content and subject's strategy. Brain 1997; 120:1763–1777.

Depraz N: Transcendence et incarnation. Le statut de l'intersubjectivité comme altérité à soi. Paris, Vrin, 1995.

Depraz N: Lucidité du corps. De l'empirisme transcendental en phénoménologie. Dordrecht, Kluwer, 2001a.

Depraz N: The Husserlian theory of intersubjectivity as alterology. J Consc Stud 2001b;8:169–178.

Fadiga L, Fogassi L, Pavesi G, Rizzolatti G: Motor facilitation during action observation: A magnetic stimulation study. J Neurophysiol 1995; 73:2608–2611.

Gallese V: The 'shared manifold' hypothesis: From mirror neurons to empathy. J Consc Stud 2001; 8:33–50.

Gallese V: The manifold nature of interpersonal relations: The quest for a common mechanism. Philos Trans R Soc Lond B Biol Sci 2003;358: 517–528.

Gallese V: A neuroscientific grasp of concepts: From control to representation. Philos Trans R Soc Lond B Biol Sci, in press.

Gallese V, Goldman A: Mirror neurons and the simulation theory of mind-reading. Trends Cogn Sci 1998;12:493–501.

Gallese V, Fadiga L, Fogassi L, Rizzolatti G: Action recognition in the premotor cortex. Brain 1996;119:593–609.

Gallese V, Fogassi L, Fadiga L, Rizzolatti G: Action representation and the inferior parietal lobule; in Prinz W, Hommel B (eds): Common Mechanisms in Perception and Action: Attention and Performance. Oxford, Oxford University Press, 2001, vol 19, pp 334–355.

Goldman A, Gallese V: Reply to Schulkin. Trends Cogn Sci 2000;4:255–256.

Grafton ST, Arbib MA, Fadiga L, Rizzolatti G: Localization of grasp representations in humans by positron emission tomography. 2. Observation compared with imagination. Exp Brain Res 1996;112:103–111.

Hari R, Forss N, Avikainen S, Kirveskari S, Salenius S, Rizzolatti G: Activation of human primary motor cortex during action observation: A neuromagnetic study. Proc Natl Acad Sci USA 1998;95:15061–15065.

Hepp-Reymond M-C, Hüsler EJ, Maier MA, Qi H-X: Force-related neuronal activity in two regions of the primate ventral premotor cortex. Can J Physiol Pharmacol 1994;72:571–579.

Husserl E: Das Kind. Die erste Einführung; in Fleischer M (ed): Analysen zur passiven Synthesis. The Hague, Martinus Nijhoff, 1966, vol 11, pp 604–608.

Husserl E: Cartesianische Meditationen und Pariser Vorträge. The Hague, Martinus Nijhoff, 1973, vol 1.

Husserl E: Cartesian Meditations (Cairns D, translator). Dordrecht, Kluwer Academic Publisher, 1977.

Husserl E: Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy. Studies in the Phenomenology of Constitution (cited as 'Ideen II'). Dordrecht, Kluwer Academic Publishers, 1989, vol 2.

Hutchison WD: Pain-related neurons in the human cingulate cortex. Nat Neurosci 1999;2:403–405.

Iacoboni M, Woods RP, Brass M, Bekkering H, Mazziotta JC, Rizzolatti G: Cortical mechanisms of human imitation. Science 1999;286: 2526–2528.

Jellema T, Perrett DI: Coding of visible and hidden actions; in Prinz W, Hommel B (eds): Attention and Performance. Common Mechanisms in Perception and Action. Oxford, Oxford University Press, 2001, vol 19, pp 356–379.

Keysers C, Kohler E, Umiltà MA, Nanetti L, Fogassi L, Gallese V: Audio-visual mirror neurones and action recognition. Exp Brain Res, in press.

Kohler E, Keysers C, Umiltà MA, Fogassi L, Gallese V, Rizzolatti G: Hearing sounds, understanding actions: Action representation in mirror neurons. Science 2002;297:846–848.

Kohler E, Umiltà MA, Keysers C, Gallese V, Fogassi L, Rizzolatti G: Auditory mirror neurons in the ventral premotor cortex of the monkey. Abstr Soc Neurosci 2001;XXVII:129.9.

Kurata K, Tanji J: Premotor cortex neurons in macaques: Activity of before distal and proximal forelimb movements. J Neurosci 1986;6: 403–411.

Lipps T: Grundlegung der Aesthetik. Bamburg, Engelmann, 1903a.

Lipps T: Einfühlung, innere Nachahmung und Organempfindung. Arch Ges Psy. Leipzig, Engelmann, 1903b, vol 1.

Lotze H: Mikrokosmos. Ideen zur Naturgeschichte und Geschichte der Menschheit. Versuch einer Anthropologie, ed 6. Leipzig, Meiner, 1923, vol 2.

Matelli M, Camarda R, Glickstein M, Rizzolatti G: Afferent and efferent projections of the inferior area 6 in the macaque monkey. J Comp Neurol 1986;251:281–298.

Matelli M, Luppino G: Functional anatomy of human motor cortical areas; in Boller F, Grafman J (eds): Handbook of Neuropsychology. Amsterdam, Elsevier, 1997, vol 11.

Matelli M, Luppino G, Rizzolatti G: Patterns of cytochrome oxidase activity in the frontal agranular cortex of the macaque monkey. Behav Brain Res 1985;18:125–137.

Meltzoff A: Elements of a developmental theory of imitation; in Prinz W, Meltzoff A (eds): The Imitative Mind: Development, Evolution and Brain Bases. Cambridge, Cambridge University Press, 2002, pp 19–41.

Meltzoff AN, Brooks R: 'Like Me' as a building block for understanding other minds: Bodily acts, attention, and intention; in Malle BF, Moses LJ, Baldwin DA (eds): Intentions and Intentionality: Foundations of Social Cognition. Cambridge, MIT Press, 2001, pp 171–191.

Meltzoff AN, Moore MK: Imitation of facial and manual gestures by human neonates. Science 1977;198:75–78.

Meltzoff AN, Moore MK: Explaining facial imitation: A theoretical model. Early Dev Parenting 1997;6:179–192.

Merleau-Ponty M: Phenomenology of Perception (translated from the French by Smith C). London, Routledge, 1962.
Minkowski E: La schizophrénie. Psychopathologie des schizoides et des schizophrènes. Paris, Payot, 1927.
Parnas J, Bovet P: Autism in schizophrenia revisited. Compr Psychiatry 1991;32:7–21.
Parnas J, Bovet P. Zahavi D: Schizophrenic autism: Clinical phenomenology and pathogenetic implications. World Psychiatry 2002;1/3: 131–136.
Prigman GW: Freud and the history of empathy. Int Psychoanal 1995;76:237–252.
Rizzolatti G, Camarda R, Fogassi M, Gentilucci M, Luppino G, Matelli M: Functional organization of inferior area 6 in the macaque monkey. 2. Area F5 and the control of distal movements. Exp Brain Res 1988;71:491–507.
Rizzolatti G, Fadiga L, Gallese V, Fogassi L: Premoptor cortex and the recognition of motor actions. Brain Res Cogn Brain Res 1996a;3: 131–141.
Rizzolatti G, Fadiga L, Matelli M, Bettinardi V, Paulesu E, Perani D, Fazio G: Localization of grasp representations in humans by positron emission tomography. 1. Observation versus execution. Exp Brain Res 1996b;111:246–252.
Rizzolatti G, Fogassi L, Gallese V: Cortical mechanisms subserving object grasping and action recognition: A new view on the cortical motor functions; in Gazzaniga MS (ed): The Cognitive Neurosciences, ed 2. Cambridge, MIT Press, 2000, pp 539–552.
Rizzolatti G, Fogassi L, Gallese V: Neurophysiological mechanisms underlying the understanding and imitation of action. Nat Neurosci Rev 2001;2:661–670.
Rizzolatti G, Luppino G, Matelli M: The organization of the cortical motor system: New concepts. Electroencephalogr Clin Neurophysiol 1998;106:283–296.
Rizzolatti G, Scandolara C, Gentilucci M, Camarda R: Response properties and behavioral modulation of 'mouth' neurons of the postarcuate cortex (area 6) in macaque monkeys. Brain Res 1981;255:421–424.
Schneider K: Klinische Psychopathologie. Stuttgart, Thieme, 1955.
Sheets-Johnstone M: The Primacy of Movement. Amsterdam, Benjamins Publishing Co. 1999.
Smith A: The Theory of Moral Sentiments (1759; eds Raphael DD, Macfie AL). Oxford, Oxford University Press, 1976.
Stanghellini G: Vulnerability to schizophrenia and lack of common sense. Schizophr Bull 2000;26: 775–787.
Stanghellini G: Psychopathology of common sense. Philos Psychiatry Psychol 2001;8:201–218.
Stein E: On the Problem of Empathy (English translation). The Hague, Martinus Nijhoff, 1964.
Stern DN: The Interpersonal World of the Infant. London, Karnac Books, 1985.
Terenius L: Schizophrenia: Pathophysiological mechanisms – A synthesis. Brain Res Rev 2000;31:401–404.
Titchener EB: Lectures on the Experimental Psychology of Thought Processes. New York, Macmillan, 1909.
Vischer R: Über das optische Formgefühl: Ein Beitrag zur Ästhetik. In drei Schriften zum ästhetischen Formproblem. Halle, Niemeyer, 1873, pp 1–44.
Zahavi D: Beyond empathy. Phenomenological approaches to intersubjectivity. J Consc Stud 2001;8:151–167.