ENACTING INTERSUBJECTIVITY

PAVING THE WAY FOR A DIALOGUE BETWEEN COGNITIVE SCIENCE, SOCIAL COGNITION AND NEUROSCIENCE

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ORAL SESSION

POSTER SESSION

INVITED SESSION 1

ENACTIVE COGNITION, TOWARDS AN EMBODIED APPROACH TO THE STUDY OF MIND

INTERSUBJECTIVITY WITH FACIAL IMMOBILITY

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The congenital condition Möbius Sequence (or Syndrome) has many variable features, from gaze palsy, tongue tethering and small jaw to clumsiness and hand maldevelopment. But its cardinal impairments are the functional absence of cranial nerves VI and VII, leading to an inability to abduct the eyes and an absence of facial expression. Poor speech and sometimes hearing can also be present. Examples of the consequences of these for the lived experience of Möbius will be given. Neonatal facial imitation does not occur and this may affect early bonding. Later, the visible difference can lead to teasing and a withdrawal from a social world. Poor coordination of face and body, and endless visits to surgeons, dentists and doctors, led one child with Möbius to withdraw from an embodied existence (since her body let her down) to inhabit a more cerebral, introspective and less social world. Adults with the condition have also described this. Some have suggested an excess incidence of autism and learning difficulties with Möbius. However other, more recent, studies in adults with Möbius dispute this and suggest that the pervasive embodied difficulties which hamper interpersonal relatedness and emotional expression may lead people to conflate somatic impairment with psychological ones.

Some with Möbius describe reduced experience of some emotional experience as children and its subsequent emergence late, through conscious up-regulation of gesture and prosody and through social imitation. The incidence and causes for this are unclear, but it could point towards the importance of embodied expression for experience and the need for social feedback. Though understanding of the experience of those with Möbius is important for its own sake and for medical and (life long) psychosocial support, its wider relevance is in showing what our faces do and how intersubjectivity is dependent on embodied expression through the face.

INTERSUBJECTIVITY AS A SOCIALLY EMBODIED AND DISTRIBUTED PHENOMENON

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There is an intense and ongoing debate concerning the nature and kinds of intersubjectivity within cognitive science and related disciplines. The still common and dominant view in cognitive science suggests that agents relate to each other in much the same way as they relate to other parts of the external world, i.e., by having more or less explicit internal representations of each other, which then are manipulated internally. In contrast, *embodied* and *distributed* versions of social interaction and cognition emphasize the way social cognition is shaped by the embodied agent's interactions with the surrounding social and material world.

My intention with this paper is to describe and illustrate how our everyday abilities for intersubjective engagement and interaction are grounded in socially *distributed* and *embodied* actions, functioning as a basis for mutual sharing of experience in joint activities. The paper consists of three main parts. Firstly, I describe how the distributed cognition approach can be complemented with recent finding in socially embodied cognitive science in explaining intersubjectivity. Although embodied cognitive science pays attention to both the socio-cultural embedding of cognitive processes and their bodily basis, current theories of embodiment need to move beyond the present emphasis on the individual's interactions, to interactions *between agents and their social environment.* The distributed cognition framework shows how some cognitive processes rather are properties at the system level than cognitive properties on the level of the individuals who participate in the actual situation. The emphasis in distributed cognition is, however, more on the socio-relational side rather than on the embodied side of the interactivist coin. Indeed, by using the distributed cognition system perspective as the unit of analysis, it functions as an appropriate approach of illustrating how intersubjectivity is enacted when embodied agents are co-operatively engaged in meaning-making activity.

Secondly, I present an analysis of a real-world interaction between

two co-operative participants showing how deeply and profoundly meaning-making activity emerges from socially embodied and distributed actions that form complex and intertwined organizations of embodied actions and experience.

Finally, I discuss the implications of considering intersubjectivity from socially situated, distributed, and embodied practices. From this perspective, intersubjectivity is a complex, distributed and coordinated dynamical process that usually encompasses a range of socially embodied experience and actions such as gesture, speech, body posture and orientation, the activation of neural resonance systems (mirror neurons, shared neural representations) and culturally situated practices for being in and interacting with the world.

INTERSUBJECTIVITY: DO WE KNOW IT WHEN WE SEE IT?

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These are heady times for the study of the mind, or perhaps more accurately, post-heady times. The resurgence of interest in concepts like intersubjectivity is occurring while a growing number of researchers are becoming increasingly sceptical about explanations of purposeful activity that rely on centralized control and single causes. The investigation of intersubjectivity and its relation to other conceptually connected phenomena such as consciousness of self and other, the lived body and affectivity can, and perhaps should, be understood in the context of this much broader ground-swell of related concerns. Despite this apparent shifting of ground, many developmental and comparative psychologists continue to claim that particular inner states or simple adaptations are causally responsible for differences between younger and older human infants, and human infants and other primates who perform similar or in some cases manifestly identical acts. For example, the debates between Tomasello, Povinelli and their colleagues pivot in large part on the relative influence of such mechanisms. Although the intersubjective capabilities of humans and other apes continue to merit sustained empirical attention, the extent to which inner states or adaptations should be taken to be the causes of purposeful activity is no simple matter. And the increasing interest of many researchers in concepts such as intersubjectivity, embodiment, distributed/situated cognition and developmental systems seems to herald a shift away from seeing mental capacities as private, individual, simple efficient causes of behaviour to something far more complicated and far less in-the-head that has often been theorized. In a complementary vein, population genetic level explanations of psychological functions are being taken to task by evolutionary developmental psychological approaches (evo-devo), the latter of which is inherently systems-oriented and suspicious of simple, single cause genetic explanations. However, although contemporary comparative work has found that capabilities which have often been historically understood to be uniquely human are proving harder to separate from those of some other species, it hasn't occurred to many that they should also be suspicious of

the views of the relation between mind and behaviour at play. In this presentation, I compare the development of intersubjectivity in human and nonhuman primates and argue that unproductive conceptions of mind may be the wellspring for many of the debates that occur in the field. I give examples to show how the notion of a static, encapsulated mind has impeded social cognitive research and I suggest more fruitful ways to broach these phenomena.

"THE POSSIBILITY OF SOCIALITY PRESUPPOSES A CERTAIN INTERSUBJECTIVITY OF THE BODY"

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The title is a quotation from Zahavi (2001), discussing Husserl's arguments for the necessity of bodily experience for intersubjectivity. The concept of intersubjectivity has become highly prominent in interdisciplinary studies of the mind (e.g. Thompson, 2001; Bråten, 2007; Zlatev, Racine, Sinha, & Itkonen, 2008). In the most general terms, it can be understood as *the sharing of experiential content (e.g. feelings, perceptions, thoughts, linguistic meanings) among a plurality of subjects.* Such "sharing" can take different forms, some more immediate, while others more mediated by higher cognitive processes, e.g. what Barresi and Moore (2008) call "understanding" as opposed to "simply sharing". Thus, intersubjectivity is not only more inclusive than constructs such as "theory of mind" and "mentalizing" (Baron-Cohen, 1995), but offers a qualitatively different perspective on social cognition. In brief, this perspective – with roots in the phenomenology of Husserl and his followers (Husserl, 1999 [1907]), the philosophy of Wittgenstein (Wittgenstein, 1953) and socio-cultural tradition in developmental psychology (Vygotsky, 1978) implies that human beings (and possibly some other "higher species") are primordially connected in their subjectivity, rather than functioning as "monads" who need to "infer" that others are also endowed with experiences and mentalities that are similar to their own.

Importantly, the sharing of experiences is not only, and not primarily, on a cognitive level, but also (and more basically) on the level of affect, perceptual processes and conative (action-oriented) engagements and is based on bodily interaction (e.g. empathic perception, imitation, gesture and practical collaboration). Finally, crucial cognitive capacities are initially social and interactional, and the specifics of human development are characterized by a process of gradual transfer of inter personal to intra-personal modes of thought through a process known as "internalization" or "appropriation".

Invited Session 2

MIND IN INTERACTIONS, TOWARDS A COGNITIVE SOCIALNESS

METACOGNITIVE DEVELOPMENT IN EARLY INFANCY

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Recent research suggests that social interaction enhances early cognitive development. Primary intersubjectivity is attached an increasing importance for the young infant's growing awareness of others and emerging sense of self, and is held to provide the developmental basis for later mindreading abilities. On similar grounds, it might be argued that primary intersubjectivity provides the basis for later metacognitive capacities. Metacognition concerns the subject's implicit and explicit access to his or her own cognitive states, in judgments of knowing or learning, feelings of knowing, uncertainty monitoring, categorization, evaluation, decision-based action, etc. It permits the monitoring and control of states and processes involved in the acquisition and processing of information about the subject itself and its environment. Intuitively, looking for precursors to metacognition in the young infant's capacity for social interaction makes sense. We probe this intuition by evaluating the following exploratory hypothesis:

(H) The capacity for metacognition has its origin in the dyadic interaction between infant and caregiver during the infant's first months in life.

Given that (H) belongs to a domain that has been extensively studied and generated a lot of data, its predictive power and usefulness may at a preliminary stage be determined without empirical studies. We first elaborate (H) in terms of primary intersubjectivity, the deliberate sharing of experiences between infant and caregiver. It eventually takes the form of turn-taking, the reciprocal and spontaneous sequencing of behaviour in time. We describe it as a monitoring-and-control game that infants play with adults to acquire fundamental regulatory skills such as inhibitory and attentional control and that offers learning-by-doing. Mentalization theory provides an alternative interpretation of (H) in terms of affect regulation. It emerges when the infant learns about the dispositional content of its affective expressions by observing their behavioral consequences in others, so-called affect-mirroring. The two interpretations disagree about the nature of the mechanism by

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which the social environment causes metacognition to emerge and the relative importance of attention and affect for the emergence of metacognitive skills. An intermediary position is sketched that ascribes the regulation of affect and attention a crucial role for the development of metacognition. We suggest that metacognition is procedural and process-reflexive in infancy, denying that is a form of metarepresentation (cf. Proust, 2003).

IMPLICATIONS OF THE ENACTIVE DEFINITION OF THE SOCIAL

HANNE DE JAEGHER[1], EZEQUIEL DI PAOLO[2]

Most approaches to social cognition define their subject matter only implicitly, if at all. We have proposed an enactive approach to social cognition based on ideas of autonomy and sense-making (De Jaegher & Di Paolo, 2007; 2008) that centres on the process of interacting as a special form of coupling. Accordingly, not all forms of coupling between individuals are social, but only those that engender a closed network of patterns of coordination and thus instantiate an autonomous dynamics, without destroying the autonomy of the interactors. This definition captures a difference between social cognition and other forms of sense-making: the fact that the other cannot be fully constituted by our own cognitive activity, and that her sense-making in turn affects us directly, and constrains ours. This also loosens the link between the intentions of the individual interactors and the process of interaction – we may engage in interactions unwittingly, and their course may turn out differently from that which we intended.

The definition is not limited to the problem of understanding the other (the sole concern of most approaches to social cognition today), but opens up an unbiased scope for research that includes a multiplicity of topics such as trust, violence, relationships, tact, narratives, friendship, group dynamics, joint action, solidarity, etc. Some of these issues can be readily framed on the basis of our definition (e.g, coercion implies a significant reduction of the autonomy of one of the interactors, trust involves a submission to the other's autonomy, and so on).

Our definition of social interaction favours a spatiotemporal contiguity and contingency between interactors and does not make explicit the possibility of a mediation through macro-social factors. There is a sense in which interesting phenomena such as removed understanding of social scenes, appreciation of collective dynamics, etc. are closer to other forms of cognitive engagements than to the participatory sense-making we propose as characteristic of social cognition. While my actions are affected by the world economy and in turn contribute (infinitesimally) to it, I engage with such social institutions in a similar way to how I engage

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with my non-social world, i.e., mostly as an individual cognizer. Is this also what happens in the 'removed' witnessing of social events (for instance, in a film) where the coupling between the event and the observer is not even bidirectional? It is important to distinguish between *social understanding* (an understanding done socially) and understanding of social events. We see the latter as a developmental outcome of the former. The 'removed' understanding of social events implies not so much a simulation of a situation in which one is not present, but rather an expansion of the virtual dimension already part of sense-making into the direction of including a virtual other. In simulation we transport ourselves into the other's situation or into him (thereby foregoing the other's alterity), whereas in our proposal we engage with a virtual other, a skill that develops out of self-directed participatory sense-making à la Vygotsky (a self-distancing that mobilises the alterity in ourselves). This possibility developmentally links engaged and removed forms of social cognition. In this sense the understanding of a social situation is an outcome of a history of knowing how to interact with others and with ourselves.

INTERSUBJECTIVITY IN ATYPICAL DEVELOPMENT

FRAN HAGSTROM

The role of intersubjectivity in the development of communication and cognitive development is of particular importance to scholars and practitioners who work in the area of atypical development. Lack of or limited intersubjectivity has been associated with cognitive delays through a number of studies over the last decade. As a result, intersubjectivity is now considered a diagnostic key, the tracking of which contributes to documentation of developmental change. Unfortunately, intersubjectivity and human development are both more complex and dynamic constructions than can be measured in a quick, straightforward manner.

Understanding intersubjectivity through the lens of atypical development can provide insight about modes of communication and means of sharing intentions that may be less obvious to neurotypical individuals.

Atypical developments may begin as early as six months gestational age; however, it is usually identified by lags or differences that occur within the first two years of life. In other words, development is recognized as atypical when children do not act on or in the world with other people and things in expected ways. For individuals who manifest atypical development from early in life onward, personally experienced development, including the progression of intersubjectivity, is typical.

The child does not experience herself as being or acting differently. Atypical (for the expectations of others) is typical (for the individual). In such instances, it is reasonable to suspect that intersubjectivity may be embodied differently or even be problematic or indiscernible for social others.

Our goal as researchers is to find ways to document typified atypical intersubjective interactions.

Sociocultual perspectives on cognitive development are grounded in cultural and communicative experience, both of which are focal to the emergence and increased complexity of intersubjectivity.

A sociocultural position on typical-atypical development will be

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elaborated and linkied to intersubjectivity using Trevarthen's position on mediated (secondary) intersubjectivity and Wertsch's position on mediated action. Case study material will be used to trace intersubjective change in children with autism, a neurodevelopmental disorder in which communication is the focal impairment.

INTER/SUBJECTIVITY IN COMMUNICATION: BETWEEN PHENOMENOLOGY AND SITUATEDNESS

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AGENCY

A mind is the phenomenal control system of an agent. An agent is a conscious organism who lives in a situation, striving continuously to make it more to its liking. The situation is a dynamical landscape of meanings, that is, a subjective, open, and changeable experience of the world; in the case of the human species, of oneself in the world. Meanings are relational: they result from the interaction between the dynamics of the world and those of the agent's mind; each meaning depends on, and in turn contributes to, the dynamics of the overall situation. For an agent to act is to interfere with the spontaneous dynamics of the world in some crucial joint, altering it so to try and improve the situation.

COMMUNICATION

A social agent is one whose possible actions include the intentional interference with other agents' situations. Mentalist communication occurs when an agent overtly tries to interfere with another's situation, possibly letting him to do the same in reverse. Overtly means that a partial understanding of the other's situation becomes part of each agent's situation, so that each understands, accepts, and acknowledges the other's attempts to interfere with her situation.

Communication thus becomes a circular and cooperative interference in each other's situation. Part of the evolution of each agent's situation is therefore subject to the scrutiny and the partial control of the other. This also accounts for various social phenomena, including face and politeness. The whole process is only possible between agents capable of mindreading and of externalizing a description of aptly selected features of their situations.

Mindreading is the ability to dynamically represent another individual's mental dynamics, so to be able to understand, predict and interfere with his situation.

COMMUNICATIVE ACTIONS

Communicative actions are the external result of the processes outlined; whatever an agent interprets as an overt attempt to interfere with her situation (including silence where something else is expected) bears a communicative meaning.

The semantic relations that an agent entertains with her situation may be divided into epistemic, motivational, and intentional; analogously, the modifications that an agent may induce in another's situation also belong to the same categories. Communication requires the collaboration of both the agents involved.

INVITED SESSION 3

NEUROLOGICALLY LINKED, TOWARDS A NEUROSCIENTIFIC ENDORSMENT

COORDINATION IN MUSICAL ENSEMBLES: ADAPTIVE TIMING AND ANTICIPATORY CONTROL

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Musical ensemble performance showcases the human capacity for temporally precise yet flexible interpersonal coordination. Ensemble musicians maintain synchrony in the face of large-scale tempo changes, expressively motivated deviations in local tempo, and random variability in timing. Despite these irregularities, a seemingly infinite number of isochronous and non-isochronous temporal structures can be synchronized, either in rhythmic unison or via the interlocking of complementary rhythms. The neurocognitive mechanisms that mediate these varieties of musical synchronization are specialized for entrainment, adaptive timing, and anticipatory action control. Entrainment occurs when neural timekeepers in separate individuals become phase locked, thus functioning as a 'shared clock' for the ensemble. Adaptive timing is facilitated by mutual error correction processes that enable these timekeepers to remain entrained across changeable conditions. Anticipatory control processes allow musicians to predict the time course of each others' actions by running internal simulations that trigger mental images of upcoming sounds and associated body movements. Adaptive timing and anticipatory control are related in the sense that accurate predictions reduce the need for error correction. Two factors that modulate this relationship are familiarity with the music (which affects auditory imagery) and familiarity with the instrumental technique of one's co-performers (which affects motor imagery). As familiarity with musical style or structure decreases, anticipatory auditory imagery — which is driven partly by covert vocal articulator activity - presumably moves from the inner singing of well-defined pitches to articulatory gestures that are relatively distant approximations of musical sounds. As familiarity with another's instrumental technique decreases, motor imagery presumably progresses from instrument specific executive movements to relatively general forms of body motion such swaying, rocking, and expressive gesturing. It is proposed here that such reductions in the specificity of anticipatory

control processes are accompanied by increases in the sensitivity of the error correction processes that underlie adaptive timing. This tradeoff will be discussed with reference to musical contexts that differ in terms of the degree to which performers are familiar with each others' instruments and the music that they are playing.

MIRRORING AND UNDERSTANDING ACTION

CORRADO SINIGAGLIA

ABSTRACT
Though the existence of a mirror system for action is widely accepted, its mechanism and function are still controversial. It was originally held that the primary function of the mirror mechanism is to enable an individual to understand the actions performed by others, by directly matching the sensory with the motor representations of those actions. Recently, however, it has proposed that mirror activation cannot be construed in terms of a mechanism that directly matches observed and executed motor acts, but must be based on a purely visual reconstruction of action, so that the primary mirror function would not be to understand other's actions, but to emulate them. The aim of this paper is to refute this argument, showing that it is mostly based on a partial reading of the functional properties of mirror neurons as well as on a biased construal of both action and action understanding.

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LOOKING FOR MYSELF: MULTISENSORY INTEGRATION ALTERS RECOGNITION OF ONE'S OWN FACE

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How do I know the person I see in the mirror is really me? Is it because I know the person simply looks like me, or is it because the mirror reflection moves when I move, and I see it being touched when I feel touch myself? We formally addressed, for the first time, the interaction between a transient sense of self based on current multisensory inflow, and a more permanent sense of self-identity based on the representation of one's own face by quantifying the specific contribution of multisensory integration for self-face recognition in normal adult participants. Synchronous tactile stimulation while watching another person's face being similarly touched produced a bias in recognising one's own face, in the direction of the other person included in the multisensory experience. Asynchronous visuo-tactile stimulation did not show this effect. Overall, participants accepted as self-stimuli faces that were more extensively morphed, showing that synchronous multisensory integration has a significant effect on self-face recognition.

ORAL SESSION

RECIPROCITY, COMMUNICATION AND COLLECTIVE ACTION

GABRIELLA AIRENTI

ABSTRACT

In this paper I discuss the role of sharedness in intersubjectivity from a developmental point of view. I argue in favor of a distinction between reciprocity in communication and collective action, maintaining that only the first is a peculiar feature of humans since their birth. My argument is based on the discussion of recent studies presenting experiments with children and chimpanzees. I suggest that establishing a distinction among communication, collective action and shared action is the only way to give account of the basic difference existing between human and nonhuman primates concerning intersubjectivity. My conclusion is that the bases of human intersubjectivity are also the cognitive bases of communication.

Keywords: communication, collective action, reciprocity

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1. INTRODUCTION

In recent years two trends of research, previously separated have converged on a common topic. On one side there is the work of developmental psychologists interested in explaining how young humans develop an attitude toward intersubjectivity. On the other side there is the work of the researchers who try to understand what makes the difference between humans and nonhuman primates. This turn of research is due to the work of Tomasello and his collaborators who, after years of investigation with young children and chimpanzees have come to the conclusion that what makes the difference between human and nonhuman primates is precisely the attitude towards shared action which, according to them is typically human (Tomasello & Racoczy, 2003; Tomasello et al., 2005). It must be noted that this result due to years of experimental studies corroborates what in a theoretical way had already been stated by Premack and Premack (1994) who considered sharedness the feature that makes the distinction between humans and other primates as well as the basis for cultural transmission.

This point of view is profitable because it allows to progress in the elaboration of the concept of sharedness. Sharedness has been placed at the center of human interactions by many authors who attribute to it different functions. In the following I shall present some of these positions in order to clarify the concept of sharedness.

Discussing sharedness as it appears in action and communication, I will argue in favor of a distinction between collective action and reciprocity, maintaining that only the second is a peculiar feature of human beings since their birth.

2. FROM ACTION TO SHARED ACTION

To clarify what lies behind the concept of sharedness it is useful to reconstruct how Tomasello and his collaborators have "discovered" shared intentionality. In their quest of what makes the difference between human and nonhuman primates their first candidate has been intentionality. The main hypothesis at that time was that the crucial point is the link between imitation and intentional action. Children since nine months have a comprehension of others as intentional actors. This is at the basis of human cultural transmission from one generation to the other by the so-called ratchet effect. The fact that children since a precocious age are able to understand others as intentional agents allows them to perform imitative learning both regarding object-directed actions and the use of communicative symbols. To see the other as an intentional agent is the first step in the development of the concept of person whose successive developments will be to see others as mental agents and then as reflexive agents (Tomasello, Kruger, & Ratner, 1993; Tomasello, 1999). Primates do not acquire the concept of person as an intentional agent and do not perform imitation. This does not allow the transmission of knowledge that is constitutive of societies.

The results of research in the last years have led Tomasello and his collaborators to revise their position and to support the conclusion that the comprehension of intentionality is not sufficient to characterize cultural cognition. In fact different studies have shown that nonhuman primates have a rather interesting comprehension of intentional action (Tomasello, Call & Hare, 2003). In particular, it has been shown that in experimental situations chimpanzees understand attempted and accidental actions, i.e. actions that do not attain the expected result (Call et al., 2004). Moreover, chimpanzees understand that perception has an influence on action. It has been shown that in a situation of competition for food a subordinate individual tried to get food that was visible only to it and ignored food that was visible both to it and to a dominant individual (Hare et al., 2000; Hare, Call, & Tomasello, 2001). If primates have these abilities and still they do not produce a social engagement, this means that the difference has to be sought el-

sewhere. Nonhuman primates may have an intense social activity but are not motivated to share with their conspecific as it is the case for human beings since a very precocious phase in their life. Human beings have not only intentionality but also shared intentionality (Tomasello & Racoczy, 2003; Tomasello et al., 2005). In this way the work of Tomasello rejoins the classical philosophical position opposing individual intention and collective intention (see for instance, Gilbert, 1989; Searle, 1990; Bratman, 1992; Tuomela, 1995). According to this point of view humans have two different mental states, intentions and - taking Searle's terminology - *we-intentions.* These are causal in performing individual actions and collective actions, respectively. Tomasello's work finds in ontogenetic development the appearance of we-intentions. In this view what is shared is the intentionality of action. This is what makes the distinction between humans and other primates.

An objection to this point of view is that it still underestimates the possibilities of primates regarding collective action. In fact, as we have seen, experimental research has already extended significantly the possibilities we can attribute to primates in terms of individual action. As regards collective action, the common view has been that primates are able to act in situations of competition, but not to collaborate. But even this truth is now challenged. There is a simple version of collective action that implies to coordinate with others to pursue a common goal, i.e. to use others to extend one's own capacities. In an experimental situation pairs of chimpanzees had to coordinate to retrieve a weighted box too heavy for only one of them (Povinelli & O'Neill, 2000). This experiment proved that at given conditions collaboration was possible, i.e. when both the chimpanzees were experienced in the task. In fact in this case they succeeded, while in the case of pairs formed by an experienced subject and a naive one the experienced partner made no attempts to solicit help or to teach the adequate procedure to the other. Moreover, in non-human primates observed in the wild it has been shown that competition and cooperation are interrelated (Muller & Mitani, 2005). Chimpanzees have been observed coordinating and synchronizing their behaviors in hunting situations and also shifting roles and anticipate each other behaviors (Boesch, 1994). Primatologists have discovered in chimpanzees practices of meat exchange among males and have explained these practices as dictated by the search of coalitionary support (Mitani & Watts, 2001). This shows that in the wild forms of cooperation are not only possible but also have a fundamental part in ruling

the chimpanzees' societies. It must be added that, according to most primatologists, for social tasks fieldwork observations are more relevant than experimental results (Boesch, 2005). Recently the skill to collaborate has been at least partly proven also in an experimental setting with semi-free-ranging chimpanzees. The chimpanzees understood when to attain a goal a collaborator was necessary and chose the partner who had previously proven more effective (Melis, Hare, & Tomasello, 2006).

The more sophisticated are the experiments the subtler becomes the distinction between human and nonhuman primates as regards the comprehension of action, and of collective action particularly. Recent experimental research and fieldwork seem to show that collaboration and then collective action is possible in chimpanzees not only in competition situations but also to achieve a goal together. So if we follow Tomasello, sharing intentions are at the origins of cultural cognition. However, sharing intentions cannot coincide with the intentions underlying simple cooperation on pain of loosing the distinction between humans and other primates. Therefore, I will argue that there is another form of sharedness that does not coincide with collective action and is characteristic of human interactions.

3. COOPERATION AND RECIPROCITY

Let us come back to sharedness studied both from an experimental point of view and through the analysis of observations made in the fieldwork. Werneken, Chen and Tomasello (2006) have shown the difference between young children and chimpanzees that participated to an experiment where the tasks required collaboration with an adult competent partner. Both children 18-24 months of age and chimpanzees achieved the coordination requested to collaborate. The important difference was that the children were motivated not only by the goal but also by cooperation itself. This was shown by the fact that when the children attained the goal, which was to retrieve a toy, they put again the toy in the previous position to start the game again.

Matsuzawa (2007) has studied the development of chimpanzees raised by their biological mother with the Participation Observation method. With respect to the problem we are discussing he maintains that the children have the intrinsic motivation to copy the mother's behavior. But a simple gesture that is so common in humans, the child who responds to her mother's behavior of feeding her trying in turn to put food in the mother's mouth, has

never been registered in infant chimpanzees. He concludes that reciprocity may be the fundamental difference between humans and chimpanzees.

We find in the mentioned works two key concepts that can be used to define sharedness, i.e. *cooperation and reciprocity*. To analyze them in more detail may be useful to better understand what characterizes human interactions.

In fact cooperation has been designed within philosophy of language as the concept describing the bases of human interactions. Humans are rational beings and to pursue their goals they have to cooperate. So cooperation is a principle of general rationality (Kasher, 1976, 1982). It can be performed by collective action or by that particular form of collective action that is communication. To explain the cooperation principle that in his view is at the basis of human communication, Grice (1975, 1978) explicitly mentions a situation where two persons are acting together. To communicate, in his example, is the same case of two persons mending a car. There is a common goal to which the participants cooperate, both doing the part they have been assigned in the most adequate way. This is true even if their ultimate goals can be completely divergent. For instance, one of them can look forward the car being mended only to flee with it.

On a similar position is Searle. He defines social behavior, of which communication is an instance, as dependent on a mental state that he calls *collective intentionality*. When two persons do something together, like to push a car or speak, collective intentions take the place of individual intentions that normally cause action. In this case each actor performs her action as part of a shared action (Searle, 1990). Collective intentionality causes cooperation. According to this point of view people cooperate even in situations of conflict or competition. Two persons who insult each other at a party realize a form of higher-level cooperation, in the same way that two players in competition cooperate in participating to a match. Therefore, for Searle the use of language is part of human action, which has two dimensions, an individual and a collective one. For these two dimensions the mind provides for two different primitive mental states, intentions and collective intentions.

Thus the definition of cooperation within the philosophy of language is an engagement to make one's part in an activity shared with others and communication is one of these possible activities. The stress put on the actors' engagement clearly indicates that we are within the field of rational action.

Let us focus now on the concept of *engagement.* What is engagement in this acceptation? Engagement is to have the explicit plan to do one's part of a cooperative action. In the famous example of a music ensemble, the violin plays her score because she knows that someone else will play the alto and the cello scores of the same trio. The quality of the result or the way it may be acquired are not relevant. The result can be the product of long sessions of coordination. Moreover, in principle it is possible to imagine that there is no difference in the performance of the violin playing alone or playing with her partners. What distinguishes a collective action is that every participant intends to do her part to attain a common goal and hold the belief that the others too do their part and share the same intentions and beliefs (Clark, 1996). Collective action is then the product of an agreement that has been stipulated before the action or is included in a conventional situation known to the participants. For instance, everybody knows the sequence of actions to be performed in a supermarket to check out.

This is not the case for chimpanzees. As both experiments and fieldwork show they make collective actions because coordination with others simply proves useful to attain specific goals. Their behavior shows that they have expectations on others' behavior. There is no reason to interpret their action as guided by reciprocal engagement.

What about children? Very young children should be in the same situation of chimpanzees, since they have not stipulated explicit agreements leading to shared actions. Actually, this is not the case. Even infants behave, in a different way with respect to chimpanzees. To shed light on this point it is interesting to examine what happens in their first months. As it appears in various studies on infants, they establish interactions with adults very precociously. More precisely they establish interactions with adults before nine months, i.e. before the appearance of language and before the comprehension of intentional action. Trevarthen (1977) has well described these interactions calling them *interactions without object.* They are the implementation of intersubjectivity *per se.* Let us try to clarify what this means. A six-month-old infant is not able to communicate about a specific meaning. However, the infant is able to perform her part in interactions with adults using gestures, sounds, and face expressions. The works that more clearly explain the infant's contribution to these interactions are the studies on interruption. It has been proven in experimental settings with 6/12-weeks-olds that if the adult during an interaction averts

her attention, the infant will try to recuperate it (Tronick, Als & Adamson, 1979; Murray, & Trevarthen, 1985). In particular, in Murray and Trevarthen (1985) it was shown that not only infants acknowledged the interruption but also that they distinguished between a "natural" interruption when the researcher distracted the mother and the unnatural situation in which the interruption consisted in the mother suddenly presenting a blank face. While in the first case there was only a reduction of positive excitement, in the second situation the infants appeared disturbed passing from protest to signs of distress and finally to withdrawal. But there was a third experimental condition that is particularly interesting. In this case the mother and the infant were in two separate rooms and they interacted viewing each other in a life-sized video image immediately before them. After some minutes of normal interaction, the communication was perturbed showing mother's behaviors that occurred in a previous time and were not correlated with the present infant's behavior. While during live communication the infant behaved as in normal face-to-face interactions, in the replay phase the reaction of the infant was one of distress similar to the reaction shown in the blank phase situation. This third condition has been utilized also to study the effect of perturbed interactions on mothers. In this case it was the mother who unknowingly was presented with her infant's reaction to her previous behavior and then unrelated with her current one. Several mothers remarked that the interaction was odd and all of them changed their communication focusing more on their own experience than on the infants' one (Murray & Trevarthen, 1986).

These results show that infants, when participating to their first interactions already have the ability to acknowledge:

- what an interaction is

    and

- what counts as an interruption.

The question is then how do they get this knowledge from. In fact there is no necessity to think that this is an explicit knowledge. What the infants react to is the *format* of the interaction, i.e. *alternation:* any gesture, sound of one of the participants is responded to by other gestures, sounds, etc. (Airenti, 2001). If this is not the case there has to be a good reason. The fact that the partner has started an interaction with someone else is a reason. On the contrary, for the infant a sudden blank face is distressing. The infant responds like an adult would do. What is interesting is that

to perform this completely normal behavior there is no necessity to perform this completely normal behavior there is no necessity to understand a specific meaning. The compliance or not to the format of interaction is sufficient. But the previous experiments tell us something more. In fact, alternation is not sufficient to denote the situation. Would the infant be able to acknowledge only reactions in a frame of alternation, any reaction should be acceptable. Actually, the infant is not satisfied if the response is taken in the repertoire of her mother's responses but unrelated with her current behavior. As we have seen, submitted to the same conditions the mother too finds the situation incomprehensible and disturbing. Therefore there is a quality of the response that has to be attuned to the actor's behavior (Murray, 1998). From this fact, it follows that to the feature of alternation another feature has to be added. We can denominate it *reciprocity*. The example mentioned before gives us an idea about what reciprocity means: when the mother puts food in the child's mouth, the child in turn will try to put food in the mother's mouth. Or if the mother tickles the child, the child will try to tickle the mother. This form of reciprocity starts very early and is perceived as a condition of successful interaction. In adults' communication we expect that others respond to the point and in this case meaning is involved. In the precocious interactions we can see that before real communication is possible, the format of reciprocity is already established. It is not easy to define what characterizes reciprocity in this sense. Trevarthen refers to expressive reciprocity (Trevarthen, 1998). Other authors consider that the main point is the mutual attunement of emotions (Stern, 1985; Hobson, 2002).

I would suggest that regarding at the problem in a more formal way, we can formulate the hypothesis that the reciprocal response has both to contain something of the behavior to which it responds and something new. Let us consider what happens in imitation. Reciprocal imitation is an important part of precocious interactions. Imitation is the simplest way to establish intersubjectivity because nothing is required except for the ability to express emotions by face expressions. Imitation in the context of reciprocity, not imitation alone characterizes the behavior of mother/infant pairs. Actually, imitation is performed not simply mimicking the other's expression, but introducing little variations. For instance, often mothers repeat the infant's gestures exaggerating them. Likewise, from one expression another similar or opposite can come out. Again, we can find here the pure format of what later will become real communication. In adult communication the

partner has to acknowledge comprehension and to answer. The mother who finds her infant odd in the experiment does not find these two features in her infant's response.

4. COLLECTIVE ACTION AND COMMUNICATION

The previous considerations lead us to an alternative point of view with respect to the one expressed by Tomasello. Tomasello thinks that shared intentionality establishes continuity in child's development from dyadic exchanges to collaboration. In fact, we can argue that an intrinsic motivation to reciprocity exists, which is specifically human and not linked to purposeful action and it appears in the first months. If instead of taking as the turning point the ninth month when the interpretation of intentional action and triadic exchange develop, we consider the preceding phase, we can see that the fundamental difference between humans and other primates emerges in the first months when children show their motivation to relate with others before action and cooperation are possible. Seen from this stance collaboration in action and sharedness due to the motivation to be related to another human follow two different paths.

Therefore, we can distinguish between two different ways to see the development of intersubjectivity. One considers that there are different phases. One early phase, before nine months, characterized by sharing behavior and emotions followed by a phase at around nine months where goals are shared and preluding to the possibility of collaborative engagement. According to this view the child that in the first phase just responds to behavior and emotions afterwards becomes able to understand action and to share goals with others. Thus, the first phase is overcome from the subsequent ones. The point of view I propose is different. Humans are endowed with a specific attitude to mutually interact. This attitude manifests itself in the first months and overstays all life long. This means that, contrary to the classical position that one finds in the philosophy of language, we can define communication separately from collective action. Communication is not just a form of collective action. We can change the formal features that we attribute to communication. Within philosophy of language the line of reasoning is that of logical derivation. In this perspective, communication derives its features from the features of rational action. This implies two major consequences. One is that to communicate the ability to acknowledge others' mental states is necessary; the other is that it is impossible to comprehend what does the infant in the first

interactions (Airenti, 2003). I think that we should look instead to what characterizes precocious interactions, i.e. interactions realized not only before the development of language but also before the development of the comprehension of the intentionality of action. At that stage we find three main features defining communication. It must be noted that these features are independent of action and language. Moreover, they do not disappear with development. What is in place since first interactions is the format of communication. We can define this format as follows:

- participants share attention on each other's acts
- the modality of interaction is alternation
- the acts must follow the frame of reciprocity

These features must be simultaneously present to characterize an interaction as communicative.

We can now try to respond to three possible objections. A first objection could possibly be that these characteristics are too simple to define communication. I think that to this it can be answered that even if this framework is simple, it is sufficient to discriminate between humans and other primates. It has been shown that primates are able to attract others' attention on their own acts to obtain assistance, but they are unable to share attention to show reciprocity when there is no specific goal to attain (Gomez, 1998). Moreover, this basic schema gives account of the fact that while the sophisticated forms of communication require language and the ability to understand others' mental states, there are simpler forms of communication. These forms are typical of infant/adult interactions and sometimes they are used also by adults when a particular intimacy allows it.

A second objection could be that it is not proven that communication is separated from collective action. In fact, considering only what happens after nine months one could say that what is shared is always action. But if you look at what happens earlier it is clear that sharedness is at the basis of interactions before the child acknowledges the intentionality of action. In humans the possibility to share actions is preceded by sharedness as a basis for communication. For humans not all collective actions are communicative. When the only interest is in the result, the action even if realized in concurrence with others, is not communicative and no sharedness is involved. In the case of primates there is the possibility to act collectively but no shared action is possible because there is no basic communicative intent.

A third objection could be that there is no necessity to postulate continuity between infant and adult communication (Airenti, 2004). As we have seen a possibility is to postulate that simple forms of interactions are replaced by more and more developed ones. Actually, what is characteristic of precocious interactions is that the format is performed without the necessity of meaning. This is what happens in the experiment mentioned before where children of 18/24 months, after having retrieved a toy, put the toy where it was before to start the game again. In adults the possibility exists to have interactions where no meanings are involved but the only goal is to confirm or establish relatedness. This can be realized either by gestures, smiles, sounds, precisely as infants - and adults in relation with infants – do, or using language. Examples are the perfectly interchangeable utterances performed when for any reasons one is compelled to stay with unknown people (lift, doctor waiting room, etc.), or desires to comfort someone in distress, and so on. In adults exchanges as in children's ones not any possible response is accepted within the format of reciprocity. Things are made more difficult by the fact that while infants have interactions with a very limited number of people, adults interact with many possible partners. Thus what counts as an acceptable response depends on the background constructed by all the preceding interactions (Airenti, 2005).

5. ENGAGEMENT AND RECIPROCITY

We can now come back to the concept of engagement. As we have seen, this concept is generally used to designate two different phenomena, i.e. to explain both the involvement of infants in interactive situations and of adults in collective actions. The hypothesis I present here is that the two situations are fundamentally different. In fact infants involved in interactions with adults are experimenting the first basic forms of communications. In this sense communication is characterized as the intention to be in interaction with the other whether or not a specific meaning is present. Communication is a form of intersubjectivity. On the contrary, as far as action is involved we have two possibilities. One is that one actor just happens to have the occasion to profit of the action of someone else. If my neighbor is entering the front door before me, she will probably keep the door open for me to come in. We do not have a shared intention. We just adjust our actions. In this case the motivation is typically human, politeness. In the majority of situations, on the contrary, when two people

do something together they share the intention to attain a specific goal. This can be very simple as lifting up an object too heavy for one person or more complex as in the case of musicians trying to perform a good interpretation of a trio. In this case there is the mutual engagement that each one will perform the part of the task she has been assigned.

Therefore, we can contrast two models. In the classical model we have two situations: individual actions, which are caused by intentions vs. collective actions (including communication), which are caused by we-intentions and imply mutual engagement. Collective actions are the manifestation of cooperation.

I propose an alternative model. Three kinds of action are possible, individual action, caused by individual intention, collective actions, which are caused by individual intention plus expectations about others' actions, and shared actions. A collective action can fail even if one of the individual actions has been completely performed. The failure can be due to two different reasons. Either one of the actors does not perform her part, or the cooperation is not sufficient to achieve the goal, for instance the weight is too heavy also for two persons. Shared actions require mutual engagement. Often the other's engagement is attributed on the basis of a presumed common interest to achieve the goal. Sometimes, to be sure that an actor will participate to a shared action an explicit engagement is requested, a promise, for instance or, even more formally, a contract.

Communication is a different form of interaction. Caused by communicative intention (Airenti, Bara, & Colombetti, 1993), it implies sharedness and has reciprocity as a condition. In case of failure, the failure of attaining reciprocity implies the failure of communication. This is because the acts of the participants take their pragmatic meaning only as part of the shared situation of reciprocity. If the partner does not acknowledge a communicative act, the act is not accomplished. This is why the non-response situation is far more distressing than any negative answer.

If we accept these theoretical distinctions, the differences that we observe among infants, adults and chimpanzees become clear. Adults may perform according to all the possibilities we have just described. Chimpanzees participate to individual actions and collective actions without engagement, relying on the expectation of others' actions. They do not have communicative exchanges. They can attract the attention of others' to obtain their help but they do not perform their actions within the reciprocity frame.

Infants have only the communicative intention and they afterward develop the comprehension of the intentionality of action and later the comprehension of collective intentionality.They do not use explicit engagement in cooperation till rather late.

In conclusion collective intentionality does not make the difference between young humans and chimpanzees. What makes the difference is reciprocity, which infants develop very early in life and that is the fundamental aspect of intersubjectivity all life long.

6. CONCLUSIONS

Humans are social beings and they develop their relationships with others since very early in life. If this is an obvious fact for everybody, there are many questions that are still open to discussion. In particular, three problems are controversial: Which are the bases of human intersubjectivity? Is it possible to distinguish human intersubjectivity from the relations that nonhuman primates establish with their conspecifics? Finally, is there continuity between the precocious forms of intersubjectivity and the more developed ones of the adult? In this paper I have suggested that the infants not only share emotions with their caregivers, but also already apply a cognitive format that is the basic structure of all communicative interactions. It is this format, based on reciprocity that constitutes the continuity between precocious and adult interactions. How this format can be compelling for humans is shown by the fact that it is imposed any time a possible interaction is conceived even with animals, plants or objects. In fact, anthropomorphism, this odd phenomenon where we see humans for instance proposing deals or asking for excuses, to their pets or even to objects of everyday use, like a car or a coffee-maker, becomes more explicable if we postulate that even in these cases humans use the only format they have at their disposal (Airenti, 2007). I have then argued that the bases of human intersubjectivity are also the cognitive bases of communication (Airenti, in press). To cooperate with others in view of attaining a common goal is a very different way to interact. This kind of interaction is based on collective action and it is common to human and nonhuman primates.

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EMPATHY BETWEEN PSYCHOLOGY, NEUROSCIENCES AND PHENOMENOLOGY: PSYCHOPATHOLOGICAL, CLINICAL AND THERAPEUTIC ASPECTS FROM AN INTERSUBJECTIVE PERSPECTIVE

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ABSTRACT

Rediscovering empathy, as a basic phenomenon of human experience in certain strictly scientific fields, fosters the meeting between neuroscience and phenomenology. This represents a challenge to all those psychologists and psychiatrists who do not trust the dimension of feeling. It is a challenge for them to accept the lived experience as a research area. Phenomenological psychopathology can be more useful in the daily clinical practice of psychiatry and psychology, centered essentially on the interpersonal contact between the clinician and the patient. The development of empathy in a strong intersubjective perspective is the background of several therapeutic approaches, for example group-existential analysis (Gruppen-Daseinsanalyse) with psychotics and addicts and severe personality disorders, based upon the shared experience of "betweenness".

Keywords: psychology, psychiatry, neuroscience.

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1. WHAT DOES EMPATHY MEAN FOR PSYCHOLOGISTS?

Psychologists have often shown a spontaneous antipathy towards empathy. But this antipathy towards empathy is not just a pun: words play with each other only if they have something that simultaneously joins and separates them. The element in common between anti-pathy and em-pathy is the pathos: many psychologists feel that there's something wrong in feeling, something that you cannot accept[1]. The refusal of empathy has deep roots, which

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[1] In psychoanalysis, for example, an "alarm signal" (Basch, 1983) towards emphatic understanding has been developed. Hartmann (1964) was already suspicious of

are not always rational but can be found written in the history of psychology. The difficulties met along the path towards the acknowledgment of psychology as a science, ended up causing a defense to the bitter end, also resisting the changes in epistemological standards. All the vicissitudes met by the concept of empathy in psychology reveal that there is no agreement on the meaning of this term[2]. From Titchener (1909, 417) - who identified empathy with "the process of humanizing objects, and reading or feeling ourselves inside them" - to the latest research on mind-reading, each definition reflects the outlook of the theoretical background they belong to. Empathy takes the shape of its temporary holder each time. For example, we can find it among the personality traits, described in operational terms through particular social behaviors and estimated by scales which specify the quantity of empathy "contained" in each individual. But even within the same field, the measurement instruments differ both in the definition of the theoretical construct and in measurement methods. Tests on empathy have been divided into three categories (Bonino et al., 1998): tests evaluating cognitive aspects, tests evaluating affective aspects and multi-dimensional tests. Crumbling the phenomenon of empathy seems to depend on its reduction in terms of theoretical outlook, and especially on the meta-theoretical premises which take for granted the separation between cognitive and affective spheres. In

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what he regarded as "impressionistic" knowledge and, in the same way, psychologists kept considering empathy as an inaccurate and unreliable approach to others. Somebody even coined the term "ecpathy" (Gonzalez de Rivera, 2004) which would mean a sort of counter-empathy, of resistance to feeling, needed by psychoanalysts in order to avoid all damage caused by emotional relationships with patients. Although it is really rare that psychoanalysts and psychotherapists refer to empathy (Clark, 2006, p. 42), in other psychological fields it is even rarer. An essay (Albiero & Matricardi, 2006) investigating the destiny of empathy in psychology revealed that due to its evasive and fleeting nature, empathy has very soon been forgotten by psychologists, but has kept on intriguing only "the followers of minor knowledge niche".

[2] Psychoanalysis presents inconsistent meanings too. The term Einfühlung occurs only 12 times in the complete works of Freud. In the Standard Edition it has been translated only 3 times with the term "empathy" (Pigman, 1995), while the Italian version always translates it with the term "identification". Kohut, the theorist who most discussed empathy, first (1984) considered it as "the capacity to think and feel oneself into the inner life of another person" and later (1959) as a "professional" instrument for acquiring knowledge, which needs to be controlled by the secondary rational process. Other authors' tendency of assimilating different concepts within the theoretical background, often end up confusing empathy with other concepts, such as projective identification.

this way empathy becomes a measurable trait, an ability, a form of information transmission, a process of mediation or of cognitive decentralization, an emotional activation, and so on. As proof of this situation, many works (Bohart & Greenberg, 1997; Batson et al., 2005) quote more or less long lists about the different meanings or uses of the term "empathy". After the experience has been taken to pieces, one just has to put it back together applying the ordinary "multifactorial" formula.

2. THE EXPERIENCE OF EMPATHY

 In recent years, the phenomenon of empathy has become central to those scientific research areas which once were remote from this sort of typically "psychological" subjects. We wish to quote just two especially significant examples: the work of Varela on neurobiology (Varela & Shear, 1999; Petitot, Varela, et al.,1999; Varela, 2000) and the research on mirror neurons carried out by Rizzolati (2005; Rizzolatti, Fogassi, & Gallese, 2001, 2006; Rizzolatti & Sinigaglia, 2007) and Gallese (2001, 2003, 2005, 2006, 2008). Both cases are characterized by the resumption of the phenomenological method launched by Husserl and by the results of his analysis. What brings together these two apparently different fields is their essentially radical attitude, which considers lived experiences as a valid and properly scientific source of knowledge (Armezzani, 2009). Husserl's purpose was to establish a new scientific area with no distinction between science and philosophy. He wanted to do it through a rigorous method, which - by a decisive and radical discard of theories – leads to "things themselves". He had expected to have a good reception of this project, especially in the psychological field, the one he called "the decision field". On the contrary, one century later, his suggestion has been received precisely by those basic sciences which psychology struggled to emulate, at the risk of refusing lived experience or mutilating its feeling. The analysis of the other's experience - carried out by Husserl in his second book of 'Ideas' (1913-1928), in a series of texts edited with the title 'On the Phenomenology of intersubjectivity' (1973), and in his 'Fifth Cartesian Meditation' (1950) - unveils the *Einfühlung* phenomenon as the essential acknowledgement of the other as an *analogon*, as a term of possibility, not just for intersubjective exchanges, but for the very position of an objective world. The studies carried out by his pupil, Edith Stein (1917), made clear the deep nature of this phenomenon for which "we realize" the other's experience, "we render present the other's lived

experience", by means of an intentional act which goes beyond mere observation or cognition. Finally, Merleau-Ponty (1945) got to the hearth of the matter underlining the role of corporeity in the perception of others. Following Husserl, he showed the *chiasmus* (1964, p. 147) between the sentient and the sensible within our own bodies: "My hand, while it is felt from within, is also accessible from without, itself tangible, for my other hand". This experience of the ambiguity of the body, called by Husserl (1950) "alien belonging" and "immanent transcendence", reveals a "lived duality" in my own core. There is an otherness internal to the embodied self and this experience is a crucial precondition for empathy. As Thompson and Zahavi (2007, p. 82) comment: "When my left hand touches my right, or when I perceive another part of my body, I experience myself in a manner that anticipates both the way in which an other would experience me and the way in which I would experience an other."

So the embodiment plays a crucial role in grounding relational experience. Nowadays this role is largely recognized by cognitive sciences (Thompson & Varela, 2001; Schwoebel & Coslett, 2005, Gallagher, 2005; Overton, Müller, & Newman, 2008; Morganti, Carassa, & Riva, 2008). A review of social neuroscience (Adolphs, 2007) shows that the organization of the neuronal structure is closely linked with embodied interactions and that there is an association between impaired somatic sensation of one's own body and impaired ability to judge other people's emotions.

Such findings confirm that "empathy is a multifaceted experience rooted in the spontaneous and involuntary resonance of two living bodies with each other" (Thompson, 2007, p. 165). Although it is based on perception and can involve inference, "it is not reducible to some additive combination of perception and inference (...). Rather, in empathy, we experience the other directly as a person" (Thompson, 2001, p. 16).

When Varela was studying empathy as a neurobiologist, he didn't think about a feeling or a particular kind of understanding, but about the essential form of our "being with the others", about the "fact of being structurally conceived for having relations with our congeners, with individuals belonging to the same species" (Varela, 2001). And this statement comes from phenomenological grounds: "It is one of the most impressive discoveries of the phenomenological movement to have quickly realized that an investigation of the structure of human experience inevitably induces a shift towards considering several levels of my consciousness as inextri-

cably linked to those of others and to the phenomenal world in an empathic mesh". (Varela, 1996, p. 347). That's the reason why, as stated by Gallese (2006, p. 193) "today significant aspects of the phenomenological thought find a clear confirmation in the results obtained by the neuroscientific researches on intersubjectivity". Maybe "hard sciences" turn to phenomenology because "phenomenology is a hard thought", which proposes a radical reflection about "the way we are" (Gallese, 2006, p. 315). When we put ourselves in this radical attitude, we aren't satisfied by well-developed theoretical models, by multifactorial claims or by the sum of bio-psycho-social components. This is the challenge for psychology: accepting experience as a research area, without forgetting, during the following processes, where they all comes from and without building more or less rational defensive walls against the evidence.

3. EMPATHY IN CLINICAL PRACTICE FROM A PSYCHOPA-THOLOGICAL POINT OF VIEW

 The shift from the case - the objective case, the 'interesting' case - to the person indicates the slow, difficult journey, obstructed by many prejudices which have accumulated in medical culture and even in medical circles. As a result this concept of "case" has been something which has always conditioned us deeply[3]. Binswanger (1942) sustained that the optimism of knowledge consists in believing that the problem of psychiatry can be resolved or will be

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[3] In psychiatry, more than a century ago, the long wave of positivist thinking, which at that time was in a strange and awkward juxtaposition to the Romantic movement, allowed a great flourishing of experimental medicine (following the model of natural sciences) and this was an extremely positive factor for medicine in the late 19th century. It permitted one, however, to entertain rash suggestions of a reductionism which could be easily erected as a system by clinicians who were epistemologically unprepared and unready. The alienist clinician was therefore influenced by the naturalistic environment of the worst Lombrosian type, to the extent of objectifying the other. That reification of the other person, of the sick person, ended by forcing the suffering person completely into the anonymity of the category of objects, both in an etio-pathogenetic and nosological sense. In this area the famous Griesingerian thesis on mental illness as a brain disease, which dates from 1863, becomes wrongfully absolutized from the point of view of radical medicalization of a man suffering psychologically or having disturbed behavior. On the other hand, we cannot but recognize the fecund horizon of naturalistic psychiatry, which today is giving important results in biological psychiatry and in neuropsychology. We cannot a priori minimize or negate these results, just as we should take good care of not over-emphasizing them in an absolutely undeserved and unworthy manner.

resolved only by following the naturalistic hypothesis. Here we are dealing with an act of faith which is possible only if one is not aware that the human being is characterized by "life" *(Leben)* or by his natural being only unilaterally. According to Binswanger (1942), it is necessary to fully understand characterization as human-presence-in-the-world *(Menschliche Dasein)* as is the need to historicize himself. Psychiatry and psychology are therefore basically human sciences: they are the sciences of human existence which can relate to medicine, but not only to medicine. Human existence is not only nature, but also culture and history. It is the Husserlian Crisis, the famous Crisis of European Science (1936), that is one of the fixed points, the cornerstone on which the opening up of psychology and psychiatry towards the rediscovery of intentionality of the conscience, the concept of world-of-life, or lived world *(Lebenswelt)* is based. It is this very working from the concepts of Crisis, this opening up of the intersubjective relationship and of the embodiment that enabled Merleau-Ponty (1945) to demonstrate the importance of the concept of the lived body. It is possible to perceive a bipolar tension between nature and existence, between the 'case' objectified in biological parameters (in scales and scores, in extremely subtle biochemical, psycho-immunitary, neuropsycho-endocrinological pathways, published in international papers) and the 'case' met here and now in its singular reality, which is unrepeatable and irreducible. As clinicians we have to say of the individual sick person: "he is depressed, he is the depressed person, he is that depressed person". We are, however, not only observers, we are co-protagonists in an event which is co-existential: "esse est co-esse" (being is being-with) (Marcel, 1937).

The clinician must therefore be a chameleon of methods (in methods, not chameleon like in structure) also because he, in his daily practice, meets the other person in his ambiguity between nature and existence, but always as a partner, never reducible to a clinical case. In reality, this leads us to conceive consciousness as intentionality and even before Husserl, it was Brentano (1874), who, not far from the University where Griesinger worked, said that consciousness is always intentional consciousness, that is, it is always consciousness of something (aboutness). Here is the whole revolutionary meaning for psychiatry and psychology when we say that the 'I' always puts itself in relation to someone or something. Led back to its roots, that is to say that the 'I', even in its widest metapsychological sense, does not fully cover the reality of human

existence and it is this which Heidegger (1927) expresses with the concepts of *Wirzeit* (the time of us) and *Ichzeit* (the time of me). This constitution of the "us" leads inevitably to the constitution of the other. And this is an unavoidable option for psychiatry and psychology: the necessity to construct a phenomenology of the intersubjectivity, going beyond the phenomenology of the 'I', for which we are all indebted to Husserl. In this field, which is propaedeutic, for every psychiatric clinical procedure, the 'I think' should be replaced by 'we exist'. A 'we exist' in which the encounter reveals the other person to me not as an object, but as a concrete singular existence. And this must be emphasized, because in daily life, the 'we' which the phenomenologist encounters more often is the 'we' of indifference, a sort of cold, opaque, empty 'we': the 'we' of 40 passengers pressed together in a bus, the 'we' of human relationships in the social environment, the impersonal 'One' of daily existence. Having understood this necessity in the relationship, the centrality of the 'with' reveals all the depth of what will become the Buberian (1937) assertion, for whom the fundamental fact of human existence is man with man, that is, human relationships. Having understood this, we should widen our subject matter to include the problem of the clinician-patient relationship, in particular in the world of psychotherapy with its dialogical dimensions. This is basically the moment in which one realizes one's own 'ipseitas' in co-existential ways. The problem of reciprocity and participation is expressed here in its entirety and demonstrates how existing is also participating according to the interpersonal foundation of psychological consciousness. On such a foundation, the encounter is not to be understood only and simply as a "being-with" *(Mit-sein)*, that is, as an indefinite anonymous and impersonal series of daily returning to the other, which we always meet, but as a being-with-the-other, faithful to the insuppressible dialectic structure of the encounter *(Begegnung, Rencontre)* (Callieri, 2007).

At this point the objectivated case, where we started out from, is transformed into alter-ego. The anthropological development, which derives from this dialectic and which tends to wedge itself between two poles made up of the anguish of the single person and the passion of existence, leads us to examine again in a completely different light, new subjects of primary importance in every psychopathology which then becomes human science: restlessness, awareness of guilt, solitude, envy, shame, courage, expectation, hope, nostalgia, love.

4. EMPATHY AND GROUP-EXISTENTIAL ANALYSIS: PHE-NOMENOLOGICAL BACKGROUND

One of the most important ideas of phenomenology is the deep union between the subject, other people and the world-of-life. This idea offers an enormous potential of transformation, which is very useful in the clinic and in treatment[4] of everyday contact with patients affected by psychoses, addiction and personality disorders. Central to this approach is the group-experience lived in a phenomenological perspective Unlike classical existential analysis (*Daseinsanalyse*, Binswanger, 1942), this approach (Di Petta, 2006) widens the application of phenomenology beyond the analyst-patient pair to a group of persons made up of therapists and patients together, in which both feel themselves as human-beings-in-the-world. Consequently the emotional atmosphere is extremely intense. The "epochè" is the preliminary condition of this setting. The lived experiences mix freely, without expressed interpretations, in a totally emotional context. The lived experience recalls another lived experience, becomes another lived experience, and looks for another lived experience. The lived experience, here (including delusional or hallucinatory experiences), has its intentionality (aboutness). These experiences in the emotional context of phenomenological group freely mix with each other, producing change and transformation in all participants. The passage from initial negative emotions to final positive emotion in each group session is crucial: from helplessness to hope, from pain to light, from aloneness to intimacy of nearness. The function of the therapist is to give a sense to this experience. Thus empathy, in this way, is a truly lived intersubjective dimension that is meaningful, made up of pain and pleasure, helplessness and happiness, aloneness and nearness, anger and friendship: these are the "fundamental affective positions" (Heidegger's *Befindlischkeit*, 1927). This idea of a plural phenomenology (being-we-in-the-cure), a realization of Binswanger's weness-which-loves (*Die liebende Wirheit*, 1942) in an emotional group made up of therapists and patients together, is applied in a public context of cure. This phenomenological approach among some of these lost existences has become a sort of way

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[4] During the last century psychiatry and psychology have lost their unity. Actually we used to have three basic approaches in mental disorders: social, biological and psychological. These models don't pay attention to internal experiences of patients as persons at all.

out, all together, through cure, towards freedom and the world. It is essential to adapt a philosophical level of Husserl's ideas from one hundred years ago to the therapeutic field, in the "here and now" of the intersubjective encounter. What is it possible to achieve with one's bare hands relying entirely on one's own experience with phenomenology in the treatment of patients who have dropped-out of conventional treatment? The phenomenological background has been extremely useful especially in a close encounter (face-to-face) with the patient respected more as a real person and not just as another clinical case[5], a sort of "sight zero" phenomenology?[6] In this conception what we feel about another person is the ground of our own existence: to start from a common emotional land in which we can find our lost parts, in which we can give to others the parts they have lost and which we can find in our own internal experience. The possibility to search and find these parts which are still alive. In many cases the human sense of identity is lost even where positive psychotic symptomatology does not exist. In these cases the only way to survive is to be born in the self of another person, on the basis of the other person's emotional, affective dimension. So the phenomenological group experience comes into being, in which the ideas of Husserl's phenomenology

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[5] This phenomenological approach to group therapy is quite different from the psychoanalytical approach to group therapy. In fact it is based on consciousness and not on the unknown. The phenomenologist sees the essence of phenomena, doesn't use interpretation, whereas the psychoanalyst is more interested in recording the hidden meanings beyond the phenomena. In the atmosphere of the phenomeno-logical group the emotional dimension is fundamental and of greater importance than words and rational conversation. Another point of difference compared to psychoanalysis is the complete involvement of the therapist as a human being in the emotional dimension of the group, in the same way and at the same level as the patient. The therapist here is not outside the group, but completely inside. Both therapist and patient leave their roles and are in the phenomenological group as human beings body-to-body, existence-to-existence, as persons who love, cry and feel without the barrier that exists between clinician and their patient. From being one next to another and from being one in front of another to being one with another.

[6] This is a military metaphor. When the enemy is very near, a telescopic sight is useless, guns are utilized with "sight zero", the fight is man to man. Optic devices are, here, the metaphor of the complicated metapsychological models, which support other psychotherapy models. The engagement between therapist and patient, in this case, is short, quick and direct. The other man is here, in front of you, in visual contact, consciousness to consciousness. All is here and now, between me and you. From man to man. In this condition many clinicians avoid their patients and patients feel a paradoxical failure of encounter.

(1913-1928), Jaspers's (1913) and Schneider's (1959) psychopathology and Binswanger's existential analysis (1942) have become therapeutic experience.

5. THE EXPERIENCE OF EMPATHY IN GROUP-EXISTENTIAL SESSIONS: INTERSUBJECTIVITY AS "BETWEEN-NESS".

The experience shared by therapists and patients, session after session, is characterized by focusing consciousness on one's own internal experience, searching for the lost structure of one's own being-in-the-world *(In-der-welt-sein)*: the encounter between one's own self and another one, the rebirth of one's own existential movements, finding one's self and losing one's self and finding one's self again. An endless game of swapping and changing the intimate parts of one's own self[7]. Group participation is open; anyone from anywhere is admitted to this experience. The initial silence within the group is total. The leader can feel the emergence of the anxiety of waiting in this silence. The therapist in a group existential session is in search of a starting point from somewhere within his own personal experience in order to begin the group therapy. He finds the concrete intersubjectivity of the participants as betweenness within the experience of his consciousness about the world of life *(Lebenswelt)*. This has specific color, form, smell and sound.

He can see the profiles of the faces, he can see the eyes, the bodies of everyone. He speaks with simple words about his own lived experience, what he has in his heart and he uses words from his heart. He does not interpret anything[8], he looks for the form and the sense of the lived experience. He is the clinician, the group leader, but, at same time, he is the first patient of the group. He talks about what he is feeling authentically as an ordinary human being at that moment: his anger, his pain, his tiredness, his shame, his guilt. This "bracketing" *(epochè)* of his being a clinician has helped him to discover himself as a human being in contact with

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[7] Lack of preselection; free accessibility into the group unrestricted by rigid rules; less structured actions, the presence of addicts, psychotics and normal people side by side; assumption of the space and time of addicts (here and now) as group time: all the above elements make up the particular group atmosphere.

[8] The concept of the form of the lived experience here is crucial. He sees this form and his consciousness constitutes it. It is even clearer in his mind. The form of lived clarifies itself.

other human beings. After having spoken, after he has looked everyone in the face, he invites everyone to do the same thing: to say what they feel, to speak about their own internal experience, here and now, anything at all. He invites everyone to utilize any form of expression: mouth, hands, eyes, the whole body. The atmosphere becomes more and more pregnant after each patient speaks. If anyone needs help in order to express themselves, he helps them. If anyone is unable or unwilling to express themselves, he leaves them in their dimension of emotional silence. It is important to say only what one feels not what one thinks. During this first circle of experiences, the therapist understands who is emotionally ready to meet with another. Now there are two chairs, which were already placed in the middle of group. What are they waiting for? The encounter. The sensations, the moods, the emotions expressed are all in the air. Who will sit in the centre of the group? Who will encounter whom? Who wants to open himself towards the other? If nobody presents himself, the leader chooses. He calls. He invites. Two profiles of men slowly come out of the circle towards the centre of the group. They sit in front of each other. Two persons, meet who knew nothing of each other before. They hold each other's hands and they look into each other's eyes. Their words are very simple: "What do you feel?". The rest of the group listens in silence. A collective warming spreads to all participants. If anyone in the centre of the group needs help, someone stands up and sits behind that person and puts his hands on his shoulders in order to support him. The therapist tries to be in tune with the living experience of the two persons who are in the centre of the group. Sometimes the persons in the centre of the group change. Slowly the atmosphere changes and becomes more positive. Pain and anguish are replaced by hope and brightness. The group continues at this point with another circle of experiences. All the participants speak about their group feelings. At the end of the group session everyone can feel empathy. The therapist concludes speaking about his lived experience. The mix of pain, anger and helplessness results in relief. At the end of the group experience it is evident that not even heroin is able to calm anyone more than a warm hug between two human beings and that life itself is a greater excitement than cocaine.

6. CONCLUSION AND PERSPECTIVES
In conclusion, the correspondence between the basic intuitions of phenomenologist's and neuroscientific findings, well exemplified

by Varela and Gallese's works, suggests the human intersubjective experience is situated at an inner and neuralgic level, which is the pre-condition of cognitive ability to attribute mental states to an other individual. At long last phenomenological accounts of intersubjectivity are seen not only as a philosophical topic, but as a basis for developing a new research attitude closely linked with human-presence-in-the-world. In the clinical area this attitude gets to the heart of the problem of the clinician-patient relationship. Both clinician and patient can meet if the former has discovered the original intersubjectivity in his own experience after bracketing his own prejudices toward the lived experience of empathy. This requires a true and precise work of intentional consciousness and require its embodiment as condition for enactment.

The phenomenology of intersubjectivity is waiting to be constructed not only in a theoretical sense, but in daily practice, following a path full of obstacles, which needs existential responsibility of the clinician. In fact, intersubjectivity remains a radical philosophical problem for those who have come after Husserl. It must be added that no one has to confront this problem in such a peremptory way as the clinician. The body becomes the central intermediary of this intersubjectivity in the sense that the body makes the encounter with the other person possible, as embodiment of its subjectivity. The application of existential analysis to groups of psychotic patients or addicts is a natural extension of phenomenological findings and can lead us to unexplored and stimulating perspectives which, in turn, lead to a closer psychotherapy of particularly difficult patients, based upon the lived experience of empathy.

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ADOLESCENT DEVELOPMENT OF THE NEURAL PROCESSING OF SOCIAL EMOTIONS

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ABSTRACT

Social emotions, such as guilt and embarrassment, are here defined as emotions which require the representation of another's mental state. This is in contract to the basic emotions, such as visceral fear and disgust, which do not. In this fMRI study (Burnett et al., in press), we investigated the development between adolescence and adulthood of the neural processing of social emotions. Nineteen adolescents (10–18 years) and 10 adults (22–32 years) were scanned while they imagined scenarios in which either a social or a basic emotion would be felt. In both age groups, anterior rostral medial prefrontal cortex (MPFC), a brain region involved in mental state representation, was activated during social versus basic emotions. However, adolescents activated a lateral part of MPFC for social versus basic emotions whereas adults did not. Relative to adolescents, adults showed higher activity for social versus basic emotions in left temporal pole, a brain region thought to be involved in semantic representations of social objects, or 'social scripts'. These results show that the neural processing of social emotion shifts subtly between adolescence and adulthood. While MPFC is activated during social emotion in both age groups, adolescents recruit anterior (MPFC) regions more than do adults, and adults recruit posterior (temporal) regions more than do adolescents. Combined anatomical, functional and social cognitive studies are needed to ascertain to what extent this shift is due to developing social cognitive strategies, or neuroanatomical maturation.

Keywords: Theory of mind, social cognition, adolescent development, emotion

1. INTRODUCTION

Adolescence is a period of social and psychological development during which social awareness and behaviour undergoes profound change (Eisenberg & Morris, 2004; Brown, 2004). One possible underlying cause of these cognitive changes is the anatomical development in brain areas involved in social cognition, including the medial prefrontal cortex (MPFC) and the posterior superior temporal sulcus at the temporo-parietal junction (pSTS/TPJ) (Giedd et al., 1999; Sowell et al.,1999a,b; Gogtay et al., 2004).

Together with temporal lobe structures such as the amygdala and temporal poles, these regions constitute a 'social brain' network for understanding and interacting with conspecifics (Brothers, 1990; Adolphs, 1999; Frith & Frith, 2003; Frith, 2007). In humans, successful interaction with conspecifics requires the ability to represent mental states such as beliefs, feelings and desires ('mentalising') (Frith & Frith, 2003; Saxe & Kanwisher, 2003). Mentalising tasks consistently activate anterior rostral MPFC, pSTS/TPJ and temporal poles (Frith & Frith, 2003; Saxe & Kanwisher, 2003; Frith, 2007). Mentalising is also needed to experience social emotions (Olsson & Ochsner, 2008), which include guilt, embarrassment, shame and pity. In order to feel embarrassment, for example, you must represent someone else's belief that you have acted foolishly. In contrast, basic emotions such as disgust and fear only require the awareness of one's own somatic state. When adults reflect upon social emotions such as guilt and embarrassment, components of the social brain network involved in mentalising are active, including anterior rostral MPFC (Shin et al., 2000; Berthoz, Armony, Blair, & Dolan, 2002; Takahashi et al., 2004; Moll et al., 2002; Moll, Zahn, de Oliveira-Souza, Krueger, & Grafman, 2005). The ability to describe situations in which a social emotion will be experienced emerges at around age seven (Harris, Olthof, Terwogt, & Hardman, 1987). By adolescence, the experience of social emotion permeates everyday social exchange (Zeman, Cassano, Perry-Parrish, & Stegall, 2006; Elkind & Bower, 1979). However, recent structural imaging research has demonstrated that the neural structures that underlie social emotion processing and mentalising, in particular MPFC, undergo considerable development during adolescence. Several studies have reported an increase in white matter volume and decrease in grey matter volume in this region during adolescence (Giedd et al.,1999; Sowell et al., 1999a,b; Gogtay et al., 2004). Whether there are concurrent changes in the neural processing of social emotion during adolescence has not previously been investigated. Recent studies looking at other aspects of mentalising have reported differential activity within the social brain network in adults versus adolescents (see Blakemore, 2008, for review). For example, thinking about one's own intentions was found to recruit anterior rostral MPFC more strongly in adolescents (aged 12-18) than in adults (aged 22-38) (Blakemore, den Ouden, Choudhury, & Frith, 2007). In contrast, adults activated posterior regions (right STS) more than did adolescents when thinking about intentions. A similar developmental shift in brain activity was found with a task

based on decoding communicative intentions (Wang, Lee, Sigman, & Dapretto, 2006). When adolescents (aged nine to 14) and adults (aged 23-33) judged whether a series of ironic communications were sincere or not, adolescents showed stronger activation of anterior rostral MPFC than did adults. Adults activated posterior regions including the superior temporal and fusiform gyri more. Thus, these studies both showed evidence that MPFC activity during social cognition tasks decreases between adolescence and adulthood, while activity in the temporal lobes shows the opposite developmental pattern. The current fMRI study (Burnett et al., in press) was designed to investigate whether a comparable developmental trajectory takes place for the neural correlates of social emotion processing. We scanned 19 adolescents (aged 10-18) and 10 adults (aged 23-32) as they read a series of sentences that were designed to elicit either a social emotion (guilt or embarrassment) or a basic emotion (disgust or fear). We predicted that thinking about social versus basic emotion scenarios would activate components of the social brain network, including anterior rostral MPFC, in both age groups (Moll et al., 2002, 2005; Takahashi et al., 2004). We further predicted that adolescents would activate MPFC more for social compared with basic emotion than adults would, as has been found in previous developmental studies of mentalising (Wang et al., 2006; Blakemore et al., 2007). The social and basic emotion scenarios pertained either to the self or to another person (the participant's mother) (see section 2.2.2). We included this additional factor for two reasons. First, in adults, there is a difference in neural activity when thinking about emotion in the first versus third person perspective (Ruby & Decety, 2004). Second, a recent developmental fMRI study (Pfeifer et al., 2007) has shown that the neural correlates of self/other semantic knowledge retrieval (deciding whether statements such as "I like reading," apply to the self, or to Harry Potter) differentially activate components of the mentalising network in adults compared to adolescents. Specifically, self versus other retrieval was associated with greater activity in the MPFC in adolescents, and greater activity in the lateral temporal cortex in adults. Because we were specifically interested in these brain regions, we decided to use self/other versions of each emotional scenario to investigate whether a similar developmental pattern would be seen for self/other processing of emotional scenarios. Our choice of participants' mother as the protagonist in the "other" condition was motivated by a need to select an "other" who would be distinct from the self,

but sufficiently familiar to participants that they would be able to adopt her emotional perspective (cf. Ruby & Decety, 2004). To investigate how similar each participant perceived herself to be to her mother, participants completed two versions (self and mother) of the NEO-V Factor Personality Inventory. The absence of group differences in this measure indicates that any group differences in brain activity between the self and other condition was not due to group differences in the perceived similarity of participants' mothers to themselves.

2. EXPERIMENTAL METHODS

2.1 Participants

19 female adolescents (10.83 - 18.17 years; mean = 14.8), and 10 female adults (22.92 - 31.83 years; mean = 26.41), with no history of psychiatric or neurological disorder, took part in the study. Participants were all female, in consideration of the significant gender differences in the neuroanatomical changes that take place during adolescence (Giedd et al., 1999) which may impact on neural processing. Written informed consent was obtained prior to the study from all adult participants, and from a parent or guardian of participants younger than 18. The study was approved by the UCL National Hospital for Neurology and Neurosurgery Ethics Committee. To ensure a consistent level of intelligence between groups, the Wechsler Abbreviated Scale of Intelligence (WASI, Harcourt Assessment, Inc., 1999) was administered to participants. Mean ($\pm$ SD) full scale IQ (FSIQ) was 115.52 ($\pm$ 6.63) for the adolescent group and 111.14 ($\pm$ 14.10) for the adult group. An independent samples t-test revealed that there was no significant difference in FSIQ between groups (t (22) = -1.052, P > 0.3). Three adult participants did not complete the WASI, but since they had completed university-level education their level of intelligence was judged to be comparable to that of the other participants.

2.2 Experimental design

The fMRI experiment was split into two 12 min sessions. Within each session, each participant underwent 277 scans. We employed a 2 x 2 x 2 mixed factorial design, comprising within-subjects factors emotion (social versus basic) and protagonist (self versus other), and between-subjects factor group (adolescent versus adult). Participants read 144 emotional sentences describing social

or basic emotion scenarios pertaining either to the self or to their mother (see Table 1 for examples of scenarios). After reading each scenario, participants rated to what extent the protagonist would feel a given emotion, on a discrete rating scale from 1 (not at all) to 4 (very much), using a button box.

Table 1. Examples of social (embarrassment, guilt) and basic (disgust, fear) emotion scenarios from the self condition

Emotion	Sentence
Social: Embarrassment	"Your dad started doing rock 'n' roll dances in the supermarket" "You were quietly picking your nose but your friend saw you" "You tripped over in front of a boy you liked" "Your friend said you had a wet patch on your backside all the way home" "Your were eating with your friend and you dribbled down your top"
Social: Guilt	"You laughed at a quiet girl you know and it made her sad" "You laughed when your friend told you she was feeling upset" "You pretend to be sick so you don't have to visit your gran" "You joined in when people were laughing at your best friend" "You lied to your dad when you wanted to go out with your friend"
Basic: Disgust	"Your friend was vomiting next to you and you could smell it" "You were in your friend's garden and you ut your hand in slimy cat poo" "You saw a big hairy fly laying eggs on your friend's lunch" "Your dad told you that the fridge was infested with maggots" "You saw a pile of rotting guts near the dustbin at your friend's house"
Basic: Fear	"Your friend screamed that there was a wasp inside your jumper" "An angry dog was barking and running towards you and your friend" "You suddenly woke up as someone screamed by your bed" "Your dad slammed on the brakes as a lorry hurtled towards you" "You were with your friend and a creature ran up your neck"

2.2.1 Emotion factor

Each scenario featured either a social emotion or a basic emotion. The social emotions were embarrassment and guilt, and the basic emotions were disgust and fear. The emotion sentences were taken from a pilot in which adolescent and adult participants rated their emotional response to a series of emotion sentences in a questionnaire. Sentences that were rated highly by both age groups were chosen for use in this fMRI study. In addition, the sentences were designed to maximize the difference in mentalising between social and basic conditions. Therefore, the basic emotion sentences featured immediate, visceral disgust- and fear-evoking situations. Both social and basic scenarios featured the protagonist plus one other person. This ensured that the difference between the social and basic emotion conditions was the need to take into account another person's mental state, not the mere presence of another person in the scenario.

2.2.2 Protagonist factor

The protagonist in each scenario was either the participant (self) or the participant's mother (other). The same emotional sentences were used for the self and other conditions. We ascertained that all participants had a living, healthy mother. The mean (plus the range) word length, and the number of clauses, was equated between all emotion conditions and both protagonist conditions. Sentences were presented in blocks of three. Participants had 9 secs to read silently, imagine and rate their response to each emotion sentence. The experiment was blocked by emotion and protagonist such that within a block, all three scenarios featured the same emotion (disgust, embarrassment, fear or guilt) and the same protagonist (self or other). At the start of each block, a 1 sec cue screen informed participants which emotion and which protagonist the proceeding three sentences would feature. Each 12 min session of the fMRI experiment contained 24 emotion blocks, each lasting 28 secs. Condition order was fully randomised. In addition there were two 28 sec visual fixation blocks per session, occurring one third and two thirds of the way through each of the two sessions. Stimulus presentation was programmed in Cogent (www.vislab.ucl.ac.uk/Cogent/index.html) running in Matlab 6.5, which recorded participant responses. Prior to scanning, all participants completed a practice session consisting of four scenarios from each of the emotions. The sentences used in the practice task did not appear inside the scanner.

2.3 Participants' perceived similarity to mother

To quantify any age-related differences in participants' perceived similarity to their mothers, which might cause between-group differences in brain activity in the protagonist condition, participants' perceived similarity to their mothers was quantified by administering two separate versions of the NEO-V personality questionnaire (Costa & McCrae, 1991), after the scanning session. The two questionnaires were identical except that in one version participants answered personality questions about themselves, while in the other version they answered the same questions about their mother.

2.4 Data acquisition

A 1.5T Siemens Sonata head MRI scanner was used to acquire both 3-D T1-weighted fast-field echo structural images and multi-slice T2*-weighted echo-planar volumes with blood oxygenation level dependent (BOLD) contrast. Each functional brain volume was composed of 33 3-mm axial slices with a 1.5mm gap and in-plane resolution of 3*3 mm, angled at 30° to cover the whole brain and minimize signal dropout from the facial sinuses. Repetition time was 3 s. Functional data were acquired in two scanning sessions of approximately 12 min each, in which a total of 554 volumes were acquired, or 277 scans per session. The acquisition of a T1-weighted anatomical image occurred after the two functional scanning sessions for each participant. The total duration of scanning was approximately 35 mins per participant.

2.5 Data analysis

Behavioural and fMRI data were analysed by collapsing the four emotions disgust, embarrassment, fear and guilt into two emotion conditions, social and basic. This was because our hypothesis related to differential neural effects of social versus basic emotion, not to the neural effects of specific emotions. Behavioural data (emotion ratings) were analysed with the SPSS statistical package. Main effects of emotion and protagonist in both groups, as well as two- and three-way interactions between emotion, protagonist and group, were analysed using mixed model repeated measures ANOVA with within-subjects factors emotion and protagonist and between-subjects factor group. We used a significance threshold of $P < 0.05$. Imaging data were analysed using SPM2 (http://www.fil.ion.ucl.ac.uk/spm). The first six functional image volumes from each run were discarded to allow for T1 equilibrium effects, lea-

ving 542 image volumes per participant. Preprocessing included rigid-body transformation (realignment) and slice timing to correct for head movement and slice acquisition delays. The images were then stereotactically normalised into the standard space defined by the Montreal Neurological Institute (MNI) template using the mean of the functional volumes, and smoothed with a Gaussian filter of 6mm full-width at half maximum to increase the signal-to-noise ratio and to facilitate group analyses. The time series for each participant were high-pass filtered at 128 s to remove low-frequency drifts. The analysis of the functional imaging data entailed the creation of statistical parametric maps representing a statistical assessment of hypothesised condition-specific effects (Friston et al., 1994), which were estimated with the General Linear Model. The effects of interest were the four scenario block types (2 emotion * 2 protagonist) and the visual fixation blocks. We also modelled the six realignment parameters as effects of no interest, in order to account for possible group differences in head movement. Each component of the model served as a regressor in a multiple regression analysis for each participant. The resulting parameter estimates for each regressor at each voxel were then entered into a second level analysis where 'participant' served as a random effect in a within-subjects ANOVA, enabling population inferences to be made. The main effects and interactions between conditions were specified by appropriately weighted linear contrasts, and determined using the t-statistic on a voxel-by-voxel basis. Statistical analysis at the second level was performed for each group separately to examine the main effects of all scenarios versus fixation, the main effects of emotion (social > basic, basic > social) and protagonist (self > other, other > self), and the interactions between emotion and protagonist ([self social > self basic] – [other social > other basic]; [other social > other basic] – [self social > self basic]). To compare directly group differences in activation to emotion and protagonist, we looked at two-way interactions between group and emotion, and between group and protagonist, using the appropriate contrasts. Finally, we looked at the three-way interactions between emotion, protagonist and group. Statistical contrasts were used to create an SPM{t}, which was transformed into an SPM{Z} and thresholded at $P < 0.05$ (corrected on the basis of the theory of random Gaussian fields for multiple comparisons across the whole brain volume examined). We report regions that survive correction at $P < 0.05$, as well as activations within regions we had an a priori hypothesis on and

which survived small volume correction (SVC; 12 mm radius sphere unless otherwise specified) at $P < 0.05$. These regions were MPFC (Gilbert et al., 2006; Blakemore et al., 2007, 8 mm), pSTS/TPJ (Frith & Frith, 2003; Aichhorn, Perner, Kronbichler, Staffen, & Ladurner, 2006), temporal pole (Blakemore et al., 2007, 8 mm) and precuneus (Blakemore et al., 2007) for social versus basic emotion; anterior insula (Moll et al., 2002) and inferior frontal gyrus (Moll et al., 2005) for basic versus social emotion; postcentral gyrus for self versus other (Ruby & Decety, 2004); and the medial frontopolar gyrus, left STS, left temporal pole, posterior cingulate gyrus and the right inferior parietal lobule for other versus self (Ruby & Decety, 2004).

3. RESULTS

3.1 Behavioural data

3.1.1 Emotion ratings

Participants rated to what extent the protagonist of each scenario would feel a given emotion, on a discrete rating scale from 1 (not at all) to 4 (very much). Mixed design, repeated measures 2x2x2 ANOVA showed that mean emotion ratings did not differ between groups (F $(1, 26) = 0.60$; $P > 0.4$) (see Table 2). There were no significant two- or three-way interactions between age group and the factors emotion and protagonist (all $P > 0.2$). For both groups, basic emotion scenarios were given higher ratings than social emotion scenarios ($F(1,26) = 9.44$, $P < 0.01$), and other scenarios were given higher intensity ratings than self scenarios ($F(1, 26) = 4.47$, $P < 0.05$).

Table 2. Mean and standard deviation of the emotion ratings (from 1 to 4), by group (adult, adolescent), emotion (social, basic) and protagonist (self, other). Ratings for basic emotions were significantly higher than for social emotions. However, there were no significant group differences and no significant interactions.

Emotion	Protagonist	Group	Mean	Std. Deviation
Social	Self	Adult	2.98	0.349
		Adolescent	2.94	0.397
	Other	Adult	3.34	0.343
		Adolescent	3.07	0.514
Basic	Self	Adult	3.16	0.283
		Adolescent	3.11	0.417
	Other	Adult	3.29	0.395
		Adolescent	3.24	0.427

3.1.2 Perceived self-mother difference

Data were not available for one adult participant. For the remaining participants, perceived self-mother difference (PSMD) scores were computed by calculating the square root of the summed squared self-mother differences for all five dimensions of the NEO-V 'self' and 'mother' personality questionnaires. This yielded PSMD scores ranging from 5.57 to 37.03 (mean (± SD) = 20.34 ± 9.14). A median test of the PSMD scores revealed no difference between adult and adolescent participant groups (?2 = 0; P > 0.99). Linear regression revealed no relationship between age and PSMD score (r2 = 0.009; P > 0.6).

3.2 Functional imaging data

Data from both imaging runs of one adolescent participant, and one run of a second adolescent participant were excluded due to excessive head movement (> 5 mm). We report group-level activations in hypothesised regions that survived SVC at P < 0.05.

3.2.1 Main effect of sentences vs. visual fixation

In both adult and adolescent groups, the main effect of all scenarios vs. visual fixation resulted in expected activation of visual and motor areas, as well as areas involved in reading (Figure 1).
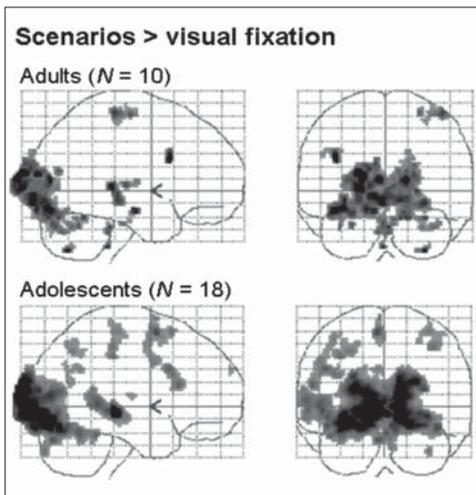
Figure 1. Main effect of scenarios versus visual fixation in adult and adolescent groups (adult image shown at P < 0.05, fully corrected across the whole brain, with minimum spatial extent = 10 voxels; adolescent image shown at P < 0.01, fully corrected across the whole brain, with minimum spatial extent = 10 voxels).

3.2.2 Main effect of emotion for each group separately

In the adult group, the main effect of social emotion (social > basic) resulted in activation of anterior rostral MPFC, left pSTS/TPJ and the left temporal pole (Table 3, Figure 2). In the adolescent group, the main effect of social emotion (social > basic) resulted in activation of anterior rostral MPFC, left and right pSTS/TPJ and the precuneus (Table 3, Figure 2). The main effect of basic emotion (basic > social) did not yield any significant activations in either group.
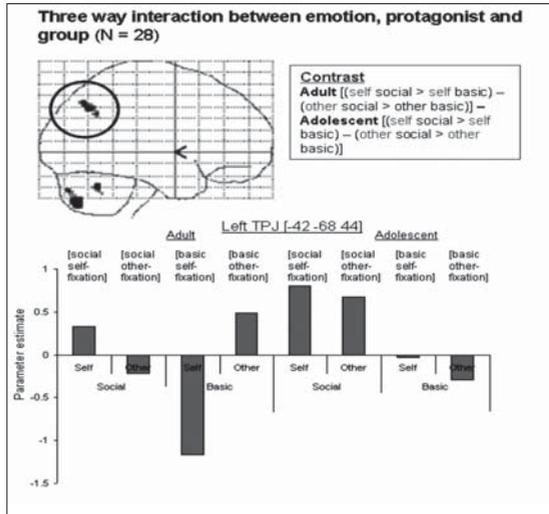
Figure 2. Three way interaction between emotion, protagonist and group in left TPJ, shown at P < 0.001 on a sagittal glass brain projection. Parameter estimates are shown (minus fixation). This region of left TPJ is most active in adult self-social emotions and other-basic emotions, and in adolescent self- and other-social emotions.

Table 3. MNI co-ordinates, Z-values and cluster size (in mm3) for regions of activation in the main effect of emotion, the interaction between emotion and group, the main effect of protagonist, the interaction between protagonist and group, and the three-way interaction between all three factors.

| Contrast	Region of activation	MNI co-ordinates	Z value	Size in mm³ at P<0.001
Emotion: social>basic	*Adults*			
	Anterior rostral MPFC	-14 44 2	3.82	96
		4 48 18	3.56	216
		6 42 12	3.28	*(part of above cluster)*
	Left pSTS/TPJ	-56 -62 28	3.48	32
	Left temporal pole	-36 8 -30	3.43	24
	Adolescents			
	Anterior rostral MPFC	-10 52 18	4.13	1600
		-6 62 22	4.03	*(part of above cluster)*
		-4 50 28	3.64	*(part of above cluster)*
		-18 42 16	3.65	128
		-4 52 -8	3.43	64
		-16 48 34	3.37	40
	Precuneus	-4 -56 28	4.64	1360
		14 -56 34	3.49	*(part of above cluster)*
		-4 -62 40	3.32	64
	Left TPJ	-38 -66 42	4.00	2032
		-48 -62 36	3.98	*(part of above cluster)*
		-38 -62 32	3.62	*(part of above cluster)*
	Right pSTS/TPJ	44 -48 28	3.31	40
Interaction between emotion and group	*[Adult (social>basic) – adolescent (social>basic)]* Temporal pole	-40 -6 -26	3.43	32
	[Adolescent (social>basic) – adult (social>basic)] Left lateral anterior rostral MPFC	-16 42 20	3.39	32
Protagonist: self>other	*Adolescents* Left postcentral gyrus	-24 -40 52	4.32	112
Interaction between emotion and protagonist [(Self social >self basic)-(other social > other basic)]	*Adults* Left TPJ	-42 -66 40	3.83	264
	Antero-dorsal MPFC	14 42 36	3.38*	5
	Adolescents Antero-dorsal MPFC	14 38 44	3.29*	8
Interaction between emotion, protagonist and group	*(For contrast, see figure 5)* Left TPJ	-42 -68 44	3.60	264
		-52 -58 34	3.50	40
* = active at P < 0.001, uncorrected				

3.2.3 Interactions between group and emotion

To identify differences in brain activity to social vs. basic emotion between groups, we tested for significant interactions between group (adult, adolescent) and emotion (social, basic).

3.2.3.1 [Adult (social > basic) – adolescent (social > basic)]

This analysis revealed a cluster in left temporal pole (Table 3, Figure 3). Inspection of the parameter estimates (Figure 3), as well as inclusive masking (with adult social > basic), showed that this region was activated more to social than to basic emotion in adults, and more to basic than to social emotion in adolescents.
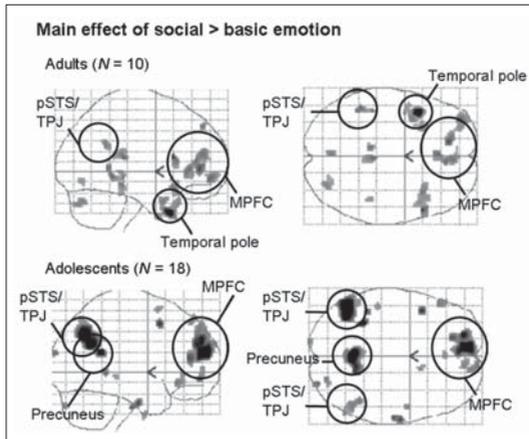
Figure 3. Main effect of social emotion (social > basic) in both groups. Sagittal and transverse glass brains showing average group activation for adults and adolescents. Shown at P < 0.005; minimum spatial extent = 10 voxels; smoothed with a filter of 6mm full width at half-maximum at the second level.

3.2.3.2 [Adolescent (social > basic) – adult (social > basic)]

A cluster in left lateral anterior rostral MPFC (Table 3, Figure 4) was activated by the contrast [adolescent (social > basic) – adult (social > basic)]. Inspection of the parameter estimates (Figure 4), as well as inclusive masking (with adolescent social > basic), showed that this region was activated more to social than to basic emotion in adolescents, and more to basic than to social emotion in adults.
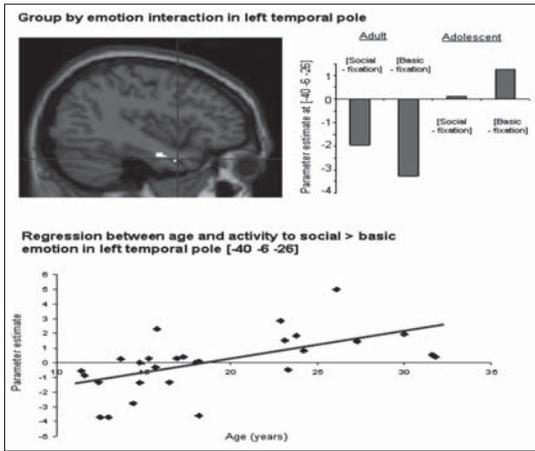
Figure 4. Interaction between group (adult, adolescent) and emotion (social, basic): activity in left temporal pole ([-40 -6 -26]) resulting from the contrast [adult (social > basic) - adolescent (social > basic)], shown at P < 0.005 projected onto a sagittal T1 image, with crosshair at [-40 8 -30]; graph showing parameter estimates in left temporal pole for social emotion minus fixation and basic emotion minus fixation, in both groups; positive correlation between age and adjusted BOLD signal in left temporal pole ([-40 -6 -26]) in the contrast [social > basic] (r = 0.572; P < 0.001).

3.2.4 Main effect of protagonist

In the adult group, the main effect of self (self > other) did not yield any significant activations. In the adolescent group, the main effect of self (self > other) resulted in activation of left postcentral gyrus (Table 3). The main effect of other (other > self) did not yield any significant activations in either the adult or the adolescent group.

3.2.5 Interactions between protagonist and group

No brain regions showed a significant interaction between protagonist and group.

3.2.6 Interactions between emotion and protagonist

To identify differences in brain activity to social vs. basic emotion which differed as a function of protagonist (self, other), we tested for significant interactions between emotion (social, basic) and protagonist (self, other), in both groups.

3.2.6.1 Adult [(self social > self basic) - (other social > other basic)]

The adult group activated left TPJ in this contrast (Table 3; Figure 5, top left). At a less stringent threshold (P < 0.001 uncorrected),

the adult group activated an antero-dorsal portion of MPFC for this contrast (Table 3; Figure 5, top left). Inspection of the parameter estimates, as well as inclusive masking (with social > basic for self only; and basic > social for other only), showed that the MPFC region was more active in self-social emotions than in any other condition (Figure 5, bottom left). In contrast, left TPJ was more active in self-social emotions and other-basic emotions than in the other conditions (shown in the graph in Figure 6).
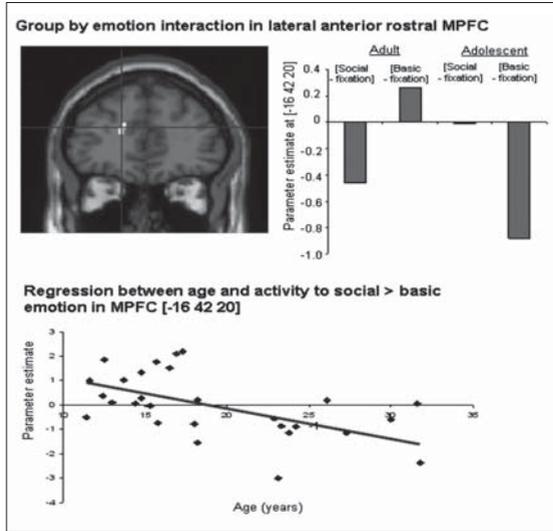
Figure 5. Interaction between group (adolescent, adult) and emotion (social, basic): activity in MPFC ([-16 42 20]) resulting from the contrast [adolescent (social > basic) - adult (social > basic)], shown at P < 0.005 projected onto a sagittal T1 image, with crosshair at [-16 42 20]); graph showing parameter estimates of activity in the MPFC for basic emotion minus fixation and social emotion minus fixation, in both groups; negative correlation between age and adjusted BOLD signal in MPFC ([-16 42 20]) in the contrast [social > basic] (r = 0.541; P < 0.005).
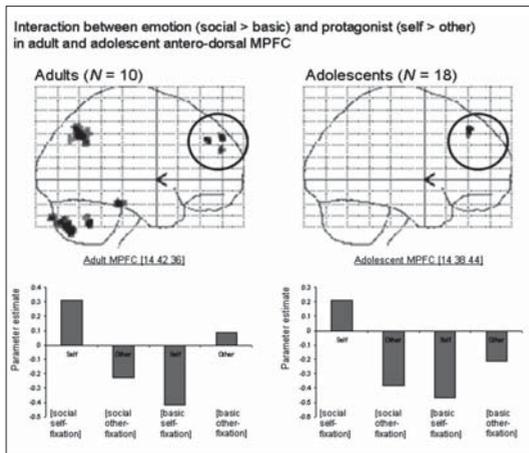
Figure 6. Adult and adolescent activity in MPFC in the contrast [(self social > self basic) - (other social > other basic)], shown at P < 0.005 on sagittal glass brain projections. The adult interaction in left TPJ, containing the region showing a three-way interaction, can also be seen. Parameter estimates for the interaction between emotion and protagonist (all minus fixation) in MPFC in adults and adolescents are shown. This antero-dorsal region of MPFC is most active in self-social emotions.

3.2.6.2 Adolescent [(self social > self basic) - (other social > other basic)]

At a less stringent threshold (P < 0.001 uncorrected), the adolescent group showed activity within a similarly antero-dorsal region of MPFC for this contrast (Table 3; Figure 5, top right). Inspection of the parameter estimates, as well as inclusive masking (with social > basic for self only; and basic > social for other only), showed that the MPFC region was more active in self social than in any other condition (Figure 5, bottom right).

3.2.6.3 Adult and adolescent [(other social > other basic) - (self social > self basic)]

No brain regions were significantly active for this contrast, in either group.

3.2.7 Three-way interaction between emotion, protagonist and group

Left TPJ (MNI co-ordinates [-42 -68 44]; Z = 3.60, P < 0.05 SVC; Figure 6, top left) was significantly active in the three-way interaction between protagonist (self > other), emotion (social >

basic) and group (adult > adolescent). Activity in this region was driven by the main effect of social > basic emotion in adolescents, whereas the adult group showed the same pattern as in the interaction between emotion and protagonist (Figure 6, bottom). The opposite contrast with respect to group (adolescent > adult, social > basic, self > other) did not yield any significant activations.

3.3 Regression between age and activation to social > basic emotion

Whole-brain linear regression analysis revealed that activity to social > basic emotion was positively correlated with age in the left temporal pole (MNI co-ordinates [-40 -6 -26]; r = 0.572; P < 0.001; Figure 3, lower panel). Activity in the contrast social > basic emotion was negatively correlated with age in the left lateral anterior rostral MPFC (MNI co-ordinates [-16 42 20]; r = 0.541; P < 0.005; Figure 4, lower panel).

4. DISCUSSION

This fMRI study (Burnett et al., in press) investigated the neural correlates of social emotion processing in adults and in adolescents. When participants imagined social versus basic emotion scenarios featuring either themselves or their mothers, both adults and adolescents activated anterior rostral MPFC. However, there was an interaction between group and condition in lateral anterior rostral MPFC such that the adolescent group activated this region more than did adults for social relative to basic emotions. The adult group activated a region of the left temporal pole more for social relative to basic emotions.

4.1 Brain activations associated with social emotion in both groups

Social emotions, in contrast to basic emotions, require the ability to represent people's mental states (mentalising). In other words, social emotions require insight into the mental states of other people (Olsson & Ochsner, 2008) – whether they are physically present, imagined, or perhaps represented by the concept of societal norms (Moll et al., 2005). For example, guilt is experienced when one believes that one's actions warrant disapproval or punishment, or that they have caused harm to another individual. In the current study, both adults and adolescents activated brain regions known to be involved in mentalising, namely MPFC and pSTS/TPJ (Frith & Frith, 2003; Saxe & Kanwisher, 2003; Amodio & Frith, 2006), during social versus basic emotion processing.

An anterior, rostral sub-region of MPFC (MNI 'y' co-ordinates from 30 to 60; 'z' co-ordinates from 0 to 40) is activated by adult participants during a wide range of tasks that involve mentalising (Amodio & Frith, 2006; Gilbert et al., 2006). It has been proposed that the cognitive role of MPFC in these tasks is to decouple mental states from physical reality (Frith, 2007). An alternative, but not necessarily incompatible explanation of the role of MPFC in mentalising tasks is that it represents the motivational relevance of social behaviours (Moll et al., 2005). The current results do not distinguish between these possibilities. Several previous studies have demonstrated activity within the anterior rostral MPFC in adolescents during mentalising tasks (Wang et al., 2006; Blakemore et al., 2007; Moriguchi et al., 2007). Our data are also in agreement with fMRI studies of social emotion in adults, which have reported activity within MPFC (Berthoz et al., 2002; Moll et al., 2002; Takahashi et al., 2004). The current result extends our understanding of the neural correlates of social emotion processing to the adolescent population.

Adults and adolescents also activated pSTS/TPJ for social versus basic emotion, with activity greater on the left than on the right. The left TPJ is consistently activated during mentalising tasks, and is thought to play a role in reasoning about the beliefs of others (Frith & Frith, 2003; Saxe & Kanwisher, 2003; Samson, Apperly, Chiavarino, & Humphreys, 2004). The pSTS/TPJ is also activated during mentalising in adolescents (Blakemore et al., 2007; Moriguchi, Ohnishi, Mori, Matsuda, & Komaki, 2007). Activity within this region in the current study may be related to the need for representing or reasoning about other people's beliefs when imagining social versus basic emotion situations.

4.2 Differences in social emotion processing between adults and adolescents

While both age groups activated anterior rostral MPFC for social versus basic emotion, a more lateral part of anterior rostral MPFC was activated for this contrast by the adolescent group, but not by the adult group. This region was contiguous with the region activated by adolescents in the main effect of social versus basic emotion. Activity to social versus basic emotion at this locus was also negatively correlated with age. Our results therefore suggest that, as well as showing greater activity than adults within parts of MPFC for social versus basic emotion, adolescents also activate a greater volume of MPFC for social emotion processing. The current

result is consistent with recent developmental neuroimaging studies looking at other aspects of social cognition, such as thinking about how intentions cause behaviour (Blakemore et al., 2007) and understanding the intended meanings of sarcastic remarks (Wang et al., 2006). These studies demonstrated an age-related decrease in activity in anterior rostral MPFC, in a similarly lateral dorsal location to that found in the current study (see Blakemore, in press, for meta-analysis). Our result is also consistent with studies that report more extensive activation of PFC in adolescents compared with adults for non-social tasks (e.g. Durston et al., 2006).

The left temporal pole demonstrated a significant group by condition interaction (Figure 3) such that the adult group showed more activation in this region than did adolescents for social versus basic emotion processing. Activity to social versus basic emotion in the left temporal pole was also positively correlated with age. The temporal poles are thought to store abstract social knowledge (Funnell, 2001; Zahn et al., 2007; Frith, 2007). Therefore the current result suggests that adults might use social semantic knowledge when thinking about guilt and embarrassment situations. This hypothesis needs to be tested by developing novel behavioural measures of the different cognitive strategies used in social emotion situations (Poldrack, 2008).

4.3 Brain activations associated with self/other processing

In the current study, participants imagined the emotion scenarios either from a first person (self) or a third person (mother) perspective. This additional factor was included because a previous study in adults showed that neural activity to emotion differs between self and other perspectives (Ruby & Decety, 2004). In this study, thinking about emotion from a first person versus third person perspective resulted in activation in right postcentral gyrus in adolescents. Activation of this region is consistent with previous studies (Ruby & Decety, 2004; Decety & Grezes, 2006), and may be related to imagining the sensory consequences of emotional scenarios.

4.4 Interactions between social emotion and self/other processing

A region of MPFC showed a significant interaction between protagonist and emotion, in both groups. This region of MPFC was similarly located in both groups, and was more antero-dorsal than the main foci of activation to social versus basic emotion.

Inspection of the parameter estimates for this region revealed that, in both groups, antero-dorsal MPFC was most active to social emotion in the first person perspective.

We also found a significant region of activation in the left TPJ for the three-way interaction between emotion, protagonist and group. Although the left TPJ was more active for social versus basic emotion in the adolescent group, the adult group showed highest activation of this region for basic emotion in the third person perspective and for social emotion in the first person perspective. The role of this brain region in thinking about others' beliefs has been highlighted in adult neuroimaging and lesion studies (Frith & Frith, 2003; Samson et al., 2004). The differential recruitment of left TPJ in adults and adolescents in the current study may indicate that different cognitive strategies are being used for the attribution of social and basic emotions to self and other (although see Poldrack, 2008). For a given emotion, left TPJ seems to differentiate better between self and other in adults than it does in adolescents. A possible interpretation of these data, which has been proposed elsewhere (Moriguchi et al., 2007) and which needs to be investigated using behavioural paradigms, is that adolescents rely more heavily on a simulation-based strategy when imagining another person's emotional response than adults do. It is notable that this difference in brain activity occurred despite a lack of group difference in perceived self-mother similarity (see Results).

4.5 Role of MPFC in social cognitive development

An interesting perspective on the role of MPFC in social cognition has recently been raised in the adult lesion and neuroimaging literature. While MPFC is robustly activated by mentalising tasks, and adults presenting with MPFC lesions usually show mentalising deficits (Frith & Frith, 2003; Rowe, Bullock, Polkey, & Morris, 2001; Stuss, Gallup, & Alexander, 2001; Gregory et al., 2002), there is one report of an individual who suffered extensive bilateral MPFC damage during adulthood but who was unimpaired on mentalising tasks (Bird, Castelli, Malik, Frith, & Husain, 2004). The MPFC is not recruited when adults make semantic discriminations among abstract social concepts, such as 'brave' or 'stingy' (Zahn et al., 2007). Rather, this task activates the superior temporal poles. In addition, a small number of social emotion studies in adults fail to find MPFC activation, but do find activity within other regions of the social brain network such as STS and tempo-

ral poles, and in more ventral and/or anterior prefrontal regions such as the frontopolar and orbitofrontal cortex (Takahashi et al., 2007; Moll et al., 2005). The current study, as well as previous studies, found greater MPFC activity in adolescents than in adults for social cognition tasks (Blakemore et al., 2007; Wang et al., 2006; Pfeifer et al., 2007). This suggests that MPFC activity to a particular social cognition task may lessen with age. Reasons for this could include the accumulation of social experience and the use of alternative cognitive strategies, resulting in less requirement for MPFC activation. This hypothesis needs to be tested with behavioural paradigms designed to tease apart the different cognitive strategies used for social processing. Alternatively or additionally, increased co-ordination between components of the social brain network due to anatomical brain development (Paus et al., 1999; Durston et al., 2006; Kuhn, 2006) may play a role. Further work is needed on the development during adolescence of the cognitive strategies used for understanding people. For example, we do not know whether the type of mentalising needed for social emotion understanding changes with development. It may be the case that a more explicit mentalising process is needed to learn about social emotions initially, but that more scripted, heuristic or intuitive strategies are employed later on (Haidt, 2001). Novel social cognition tasks which dissociate the cognitive sub-processes involved in social understanding are needed to address this issue: in other words, tasks which bring us closer to establishing an ontology of social cognition (Price & Friston, 2005; Poldrack, 2008). Work is also needed to investigate developmental patterns of activity during social cognition tasks across the brain, rather than simply looking at the relative magnitude of activation within particular neural structures of interest. This should be done by implementing analyses of functional and effective connectivity. It would be relatively straightforward to begin to do this using existing fMRI datasets. Studies looking at the development of functional/effective connectivity in non-social domains have recently been published (resting state: e.g. Fair et al., 2008; go/no-go: e.g. Stevens et al.). We are currently using psychophysiological interaction (PPI) analysis to look at functional connectivity within this social emotion dataset (Burnett & Blakemore, in press.).

Also needed are multi-modal studies which assess functional activity/connectivity, neuroanatomical maturity, and behavioural indices of social cognition within the same paradigm. Only by conducting

studies such as these will questions begin to be answered regarding the functional significance of changes in neural activity to social cognition tasks, such as the frontal-to-temporal shift in activity to social emotion reported here.

4.6 Conclusion

This fMRI study shows that the neural processing of social emotion from a first and third person perspective develops between adolescence and adulthood. Although components of the social brain network including MPFC were active in both groups, adolescents activated lateral rostral MPFC more for social versus basic emotion whereas adults did not. Adults activated left temporal pole more for social versus basic emotion than did adolescents. These results indicate that the neural processing of social emotion continues to develop between adolescence and adulthood, such that the predominant activity moves from anterior (MPFC) to more posterior (temporal) regions with age. Further work is needed to ascertain how this is related to neuroanatomical development within social brain regions, and to changes in cognitive strategy resulting from developing social ability and experience. Finally, our study was conducted only with female participants; whether there are gender differences in social emotion processing and its development is an empirical question.

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I FEEL WHAT I SEE, IF THE OTHER IS SIMILAR TO ME

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ABSTRACT

In the present paper we present a new form of visuo-tactile integration specifically linked to the body, i.e. the Visual remapping of touch effect. This effect consists of a modulation of tactile perception on one's own body when observing the body of others being touched. Here we present a new experimental paradigm to quantify this effect: near-threshold tactile perception on the face was measured when subjects observed different visual stimuli being touched or not by fingers. Using this paradigm, we found that the strength of visual remapping of touch varies systematically as a function of the similarity between the observed and the observer's face: tactile perception was maximally enhanced when viewing the image of one's own face being touched, intermediate when observing another person's face and null when observing an object. In addition, the effect is modulated by the physical (e.g. ethnical membership) characteristics of the observed face. Indeed, the effect was stronger when viewing a face of another person belonging to the same ethnic group as the observer, compared to viewing the face of a member of a different ethnic group. An interesting insight from these new results is that a basic form of visuo-tactile integration also incorporates information about self-perception and social categorization of others.

Keywords: Self/Other, multisensory integration, body representation.

Visual and tactile information interact with each-other, especially when both sensory channels convey information about the same source, that is the body. In the present paper we will review data concerning one form of visuo-tactile integration specifically linked to the body, i.e. visual remapping of touch and we will consider how such basic form of multisensory integration also incorporates information about self perception and social categorization of others. Vision can influence primary levels of tactile processing (see Spence & Driver, 2004 for a review) and, in particular, visual information pertaining to the *body* seems specially effective in modulating tactile sensation (Tipper, Lloyd, Shorland, Dancer, Howard, & McGlone, 1998; Kennett, Taylor-Clarke & Haggard, 2001). In addition, also visual information about *touch on a part of the body* can affect tactile perception. Observing touch

on another person's body activates brain regions involved in tactile perception, even when the observer's body is not directly stimulated (Keysers, Wicker, Gazzola, Anton, Fogassi, & Gallese, 2004; Blakemore, Bristow, Bird, Frith, & Ward, 2005; Ebisch, Perrucci, Ferretti, Del Gratta, Romani, & Gallese, 2008). However, this activity does not induce a tactile perception when observing touch on the body of others. An interesting exception is the case of some synaesthetic subjects (i.e., visuo-tactile synaesthetes), who experience tactile sensation when they see other people's bodies being touched (Banissy & Ward, 2007). Because, in synesthetes, brain activity induced by observation of touch is greater than in non-synesthetes (Blakemore et al., 2005), it is possible to hypothesize that the different perceptual experience between synaesthetic and non-synaesthetic subjects might reflect different degrees of activation induced in the tactile system by visual information. A previous study (Serino, Pizzoferrato, & Làdavas, 2008) from our laboratory shows that if perceptual thresholds are experimentally manipulated, viewing touch can modulate tactile experience in non-synesthetes as well. Subjects watched a movie showing their own face (self condition), another person's face (other condition), or a house (house condition). Human fingers either touched (touch condition) or simply approached (no-touch condition) the image, on the right, the left, or both sides. In order to test touch around perceptual threshold, we set stimulus intensity such that the tactile stimulus was stronger on one cheek than on the other. In dual-stimulation condition, the stronger stimulus usually extinguishes the weaker one, because the competition between the two spatial positions. Subjects were instructed to press a button with the hand corresponding to the side where they felt the tactile stimulus (see Figure 1, upper panel).
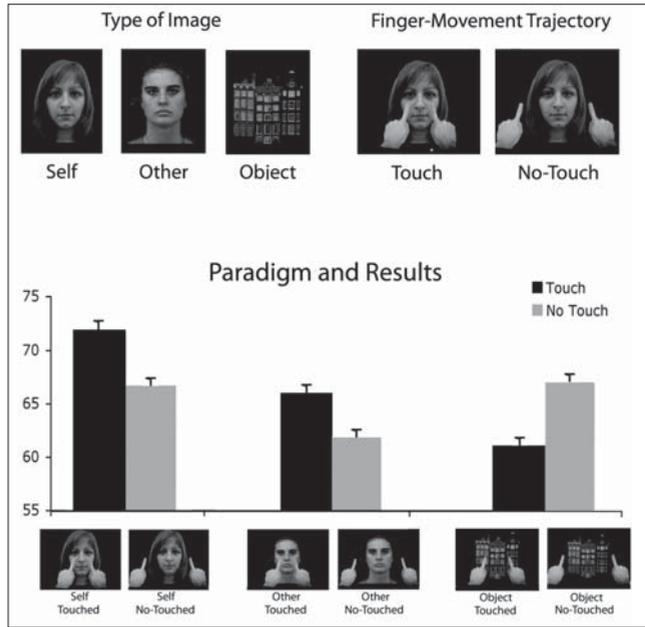
Figure 1. Upper panel: *Experimental paradigm* measuring Visual remapping of touch. Subjects receive either unilateral (left or right) or a bilateral tactile stimulus on their cheeks, and are instructed to report the side, or sides, of stimulation. Concurrently they are required to pay attention to screen in front of them showing a movie where an image is touched, or only approached, by human fingers, on its right, left or both sides. In this sample, illustrating the experimental set-up by Serino et al., (2008) the shown image was the subject's own face, another person's face or an object, namely the picture of a house.

Lower panel: *Results.* Visual information enhances tactile perception on the subjects' face: this effect is specific for viewing a human face being touched, and not present when the face is only approached, or when an object is shown. The effect is maximum for viewing one's own face (Serino et al., 2008).

The results showed that when observers saw a face being touched by hands, rather than a face being merely approached by hands, there the detection of sub-threshold tactile stimuli on their own faces was enhanced, i.e. perception of bilateral tactile trials increased. This effect was specific to observing touch on a body part, and was not found for touch on a non bodily stimulus, namely, a picture of a house (see Figure 1, lower panel). Thus, observing touch can activate the tactile system, and if perceptual thresholds are manipulated, such activation can result in a behavioural effect

also in non-synaesthetes; multisensory integration, in this case visuo-tactile integration, is maximum when unimodal information per sè is not sufficient to drive a clear percept (for a review, see Làdavas, 2008). These findings suggest that the mechanism underlying the effect of observation of touch on tactile processing in synaesthetes and non-synesthetes is the same; the difference between these groups might be only that sensitivity to the effect is stronger in synaesthetes. We have called this effect *Visual Remapping of Touch (VRT)* (Serino et al., 2008).

Another interesting result found in the previous study was that the effect was stronger when subjects viewed their own faces rather than another person's face. This self-other difference suggests that visual remapping of touch increases if the observer's body and the observed body match. In order to re-map a sensation from one sensory modality, namely vision, to another sensory modality, namely touch, the remapping is probably favoured if the two modalities share a common reference system, that is, the same body. The improvement of tactile perception for viewing the self suggests that such enhanced activity due to self-related visual information might cross-modally modulate the processing of tactile information: when the match between the observer and the observed body is stronger, the visuo-tactile resonance is greater. In a series of further experiments, we studied how visual information about the body modulates visuo-tactile integration. Visual information about the body is critical in every-day life and in social interactions. Images of the body provide *physical* information about oneself and conspecifics (Rumsey & Harcourt, 2005; Schilder, 1935). This information is crucial in determining similarity between self and others, and to categorize individual as similar or dissimilar to the self. Such categorization might affect intersubjective communication and relationships with others (Gallese, 2001). For instance, when viewing another person, physical features of his/her face immediately contribute to define whether that person belongs to one's own ethnic group or to a different ethnic group. Might this ethnic categorization of others influence the way in which visual information about touch is remapped onto one's own body? Specifically, does visual remapping of touch vary when viewing others belonging to one's own or to another ethnic group?

To study this issue, Caucasian and Maghrebian subjects were asked to observe a face, while they received sub-threshold tactile stimuli on their own face (Serino, Giovagnoli, & Làdavas, in press), set as

in Serino et al.'s (2008) study. In different conditions, the shown face was similar or dissimilar to that of the observer, i.e. belonging to the same or to a different ethnic group, respectively. If visual remapping of touch depends on the *ethnic similarity* between the observed and the observer's body then tactile perception should be boosted when people observe touch directed towards a member of their own ethnic group than when they observe touch directed towards a member of a different ethnic group. That was actually what we found: tactile detection of bilateral stimuli was enhanced when Caucasian observers viewed a Caucasian face compared to when they viewed a Maghrebian face, and the effect was exactly reversed for Maghrebian observers. Importantly, this effect was specifically related to the observation of touch, and was not due to a general arousal effect depending on observing different faces. Indeed no-tactile modulation in relationship to ethnic membership was found when participants viewed a face being merely approached by human fingers, but not being touched. Thus ethnic similarity between the self and other bodies modulates visual remapping of touch.

It is interesting to note that at the end of the experiment, we also asked our participants to judge for pleasantness the faces they had seen during the tactile task. No difference was found when Caucasian and Maghrebian observers judged the pictures of other unknown Caucasian and Maghrebian persons. Although ethnic membership did not affect explicit judgments towards individual of different ethnic groups, the effect of ethnic membership did affect the visual remapping of touch effect, showing that a sensation seen on another body is remapped onto one's own body if the other is similar to oneself. Taken together these findings suggest that visual remapping of touch is a quite automatic process, which is modulated by high-order representations of the self and other, but acts independently of explicit judgment towards others.

When an individual observes the face of another, he/she automatically categorizes it as belonging to the same or to a different group as the observer: face to face interaction is indeed a crucial aspect of group representation (Lickel, Hamilton, Wieczorkowska, Lewis, Sherman, & Uhles, 2000). It is well known that in-group versus out-group categorization influences one's own judgments and behaviors towards others (see for reviews Hewstone, Rubin, & Willis, 2002; Brewer & Brown, 1998). Recent evidence suggests that in-group out-group categorization modulates automatic activation of approach or avoidance behaviors toward others (Castelli,

Zogmaister, Smith, & Arcuri, 2004; Paladino & Castelli, 2008). This mechanism might have a great impact for survival and therefore might have been selected through evolution (Allport, 1954): the human species has evolved relying on cooperation between individuals from small, strongly interconnected groups (e.g., Krebs & Denton, 1997), most of the time in competition with members of different groups. The results from the experiments presented in this paper suggest that this basic form of self-other and in-group out-group categorization also appears in multisensory integration between touch and vision. Visuo-tactile interaction underlying visual remapping of touch can be viewed as a basic, primitive form of empathy towards the other.

This form of empathy might be important for social interaction and inter-subjectivity. During social interactions, we try to understand other's thoughts, feelings, sensations etc... In particular, remapping visual information about touch on the body of other onto one's own body might be functional to understand what the other is feeling (Gallese, 2003; Ebisch et al., 2008). In this way, the observer and the observed share a common representation of tactile sensation. (Decety & Chaminade, 2003). An analogous mechanism might act in case of a multiplicity of states, such as emotions, pain or thoughts. It is reasonable to hypothesize that the more the other is similar to the self, the more this sharing is effective and more information can be inferred from such mechanism. The present finding that visual remapping of touch is maximum when viewing similar others, strongly supports this view and suggests that inter-subjectivity might be more automatic in case of interpersonal relationships between members of the same ethnic group. Future studies should investigate whether such automatic ethnical bias can be compensated by other more "cognitive" top-down factor, such as knowledge about others. In summary, observing touch on a body induces a remapping of tactile input onto the observer's tactile system, resulting in an enhanced ability to perceive a tactile stimulus. The amount of enhancement depends of the similarity between the body of the observer and that of the observed: the effect is maximum for observing one's own body; when observing the body of others, the effect is stronger to the extent that the other body is perceived as similar to the self. Similarity here is defined in terms of physical features of the body, such those shared between members of the same ethnic group.

The neural mechanism underlying this effect is yet to be explored. Neuroimaging studies show that observing touch modulates the

activity of primary (Blakemore et al., 2005) or secondary soma-tosensory (Keysers et al., 2004; Ebisch et al., 2008) regions. This enhanced somatosensory activity might potentially boost tactile perception, in that a pre-activated somatosensory system might become more sensitive to detect incoming sensory events. Indeed, it is well known that tactile sensitivity is determined by the response of neurons in primary somatosensory cortex (Mountcastle, Talbot, Sakata, & Hyvärinen, 1969; de Lafuente & Romo, 2005). In the present paper, we show that tactile perception, as measured with our tactile confrontation paradigm, is modulated by quite elaborated levels of visual processing, such as the identity, or even the ethnic appearance, of a shown face. Such complex analysis of visual information cannot be computed within somatosensory cortices, but could be computed in high-order visual and associative cortices. For instance, Uddin and colleagues showed that neural activity in parietal (inferior parietal lobe) and frontal (inferior frontal gyrus) areas is specific (or is more activated when) for viewing one's own face compared to viewing the face of another person (Uddin, Kaplan, Molnar-Szakacs, Zaidel, & Iacoboni, 2005; Uddin, Iacoboni, Lange, & Keenan, 2007). Furthermore, Mitchell and colleagues identified functionally discrete sub-regions of medial-prefrontal cortex, which differently process information about others as a function of how similar for socio-political views another person is perceived to be to oneself (Mitchell, Macrae, & Banaji, 2006; Jenkins, Macrae, & Mitchell, 2008). These prefrontal and parietal regions might be critical to link visual information about a face with the self. The same regions might directly project to somatosensory cortices to modulate visual remapping of touch. Future research will shed light upon the dynamics of the neural mechanism underlying visual remapping of touch.

In the present paper we have described one type of visuo-tactile interaction that we called visual remapping of touch. This effect shows how visual information derived from observing a body being touched is integrated within the one's own somatosensory system to improve tactile perception. An interesting insight from our new results is that such basic form of multisensory integration also incorporates high-level information about the observed body, such as categorization of others as similar or dissimilar to the self.

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DO I CARE FOR OTHERS' MONEY AS MUCH AS FOR MY OWN? PLAYING THE ULTIMATUM GAME TASK IN BEHALF OF A THIRD-PARTY

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ABSTRACT

Classical economical theory sees rejections of unfair offers by people playing the Ultimatum Game (UG) as "irrational". Recent studies suggested that these are triggered by negative emotions, such as frustration (Sanfey et al., 2003; van't Wout et al., 2006) and by the urge to punish those who made the offers (Fehr & Gachter, 2002). Another account postulates that rejections are instead "rational" according to the rules of social exchange reasoning, in that they will increase the chance of future players to receive fair offers (Zamir, 2001). We tested these two accounts by employing healthy participants in modified version of the UG in which players knew that their putative rejections were not harming those who made offers. The analysis of skin conductance responses shows that this task was significantly less emotionally arousing than the traditional UG game. However, unfair offers were rejected at a comparable rate in both the classical and modified versions of the Ultimatum Game. In light of these results, theories holding rejections as triggered by emotional arousal and by the urge to punish who made the offers should be re-discussed; in fact, our data suggest that the emotional response might be triggered whenever one's own interest is at stake, and is not the ultimate cause of this behavior. We believe instead that any offer leading to an unfair distribution of money within the group is sufficient to trigger a rejection and, therefore, that psychological mechanisms which account for social exchanges dynamics might be better candidates for explaining this behavior.

Keywords: Economical Decision-Making; unfairness; altruistic punishment; frustration; skin conductance.

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1. INTRODUCTION

Social interpersonal exchange is an ancient and cross-culturally universal feature of many species including insects, high-level primates and humans (e.g., Hamilton, 1964a, 1964b; Trivers, 1971). In most of its expressions, interpersonal exchange results

in the ability to assign social credit or blame for shared outcomes and to act appropriately according to these assignments (Tolmin et al., 2006; Trivers, 1971): for instance, people might identify and encourage those behaviors which maximize the aggregate welfare and discourage those who lead to unfair distributions of goods.

In recent years, the study of interpersonal exchanges has become a prominent issue in both experimental psychology and cognitive neuroscience. Indeed, studies employing behavioral techniques have shown that reasoning in a context of social interpersonal exchanges diverge from reasoning in other domains. For instance, studies investigating conditional reasoning revealed healthy volunteers as uneasy at understanding conditional rules (e.g., "if P then Q"), as less that 30% of the interviewed people were able to identify their possible violation ("P and non-Q" – e.g., Watson & Johnson-Laird, 1972). However, more than 65% of the interviewed people were able to solve the task if the conditional rules were expressed as social contracts (e.g. "If John takes this *benefit*, he must pay this *price*") and their violations as a cheating behavior (e.g. "John takes this *benefit*, without paying this *price*" – e.g., Cosmides, 1989; Gigerenzer & Hug, 1992; Platt & Griggs, 1993; see also Stone et al., 2002).

Another example of reasoning in a context of social interpersonal exchanges is provided by the Ultimatum Game (UG) task. In this task, one player (the *proposer*) makes offers to a second player (the *responder*) of how to split an amount of money given by the experimenter; the *responder*, in turn, can either accept or reject the offer. If the responder accepts, the money will be divided as the *proposer* has decided, otherwise both players will end up with nothing. Classical economical theories posit that, to maximize his/her own gain, the *responder*, following the principle that "few is better than nothing", should always accept every offer. However, the behavioral findings clearly show that he rejects offers which favor the *proposer* too much, and that he/she considers unfair (Bolton & Zwick, 1995). Importantly, this behavioural pattern has also been observed in both the single-shot UG, in which the two players interact only once, and in the covered UG, in which the *proposer* is not informed about the *responder*'s reaction (Abbik, Sadrieh, & Zamir, 1999; Zamir, 2001), and therefore rejections lose their role as negotiating tools.

One plausible interpretation of the behavioural pattern is that people behave irrationally, as they are driven by negative emotions and by the desire to punish the *proposer*. According to one

of these theories, punishment, even if costly and yielding no direct benefit for the *responder* (as in the case of covered UG), is used to penalize the *proposer*'s selfish behavior (Fehr & Gachter, 2002). It has been suggested that the irrational rejection might be caused by negative emotions, such as frustration, that drive participants to punish rather than making an utilitarian choice (Pillutla et al., 1996; Fehr & Gachter, 2002). Consistently with this view, Sanfey et al. (2003) have recently associated the rejection of unfair offers with an increase of both the neural activity in anterior insula, traditionally correlated with feelings of anger and disgust (Calder, Lawrence, & Young, 2001; Phillips et al., 1997), and the skin conductance response (van't Wout, Kahn, Sanfey, & Aleman, 2006), as a measure of emotional activation (Boucscein, 1992). Another plausible interpretation states that the *responder*'s rejections, although irrational according to the classical economical theory as they do not increase the chance of having better offers in the remaining part of the experiment, are rational according to the rules of social exchange reasoning, in that they discourage unfair behavior of future *proposers* and, therefore, increase the overall gain of the population of the *responders* (Zamir, 2001).

These two accounts – although never mentioned in literature as antithetic one to another – generate different predictions. Indeed, the former account postulates that rejections are driven by (1) *proposer*'s unfair treatment enhancing the *responder*'s emotional arousal and (2) the *responder*'s being aware that his choices are harmful for the *proposer*. Thus, no rejections should be seen in a modified version of the UG in which none of these assumptions are met. This is not the case of the second account, according to which any offer leading to an unfair distribution of money within the group should be rejected. We tested our prediction by measuring skin conductance response while participants played as *responders* in a modified version of the UG. In one condition, they carried out the classical UG, whereas, in a second condition, they were told that both *proposers* and *responders* were playing in behalf of a third-party. Thus, in the latter condition, neither the *proposer*'s offers addressed directly the *responder*'s payoff, nor *responder*'s choices addressed directly the *proposer*'s payoff. Our assumption (confirmed by the analysis of skin conductance responses) is that responder's emotional arousal should be significantly lower when playing in behalf of a third-party than in the classical UG. Thus, the account according to which rejections and negative emotions are causally related (Fehr & Fischbacher, 2002; Sanfey et al., 2003;

van't Wout et al., 2006) predicts that such a putative decrease in skin conductance response during the third-party, together with the awareness that the *proposer* cannot be punished by the *responder*, should lead a similar decrease in the rate of rejections. On the other hand, the account positing rejections as rational according to the rules of social exchange reasoning predicts that, irrespective of the amount of emotional arousal measured by the skin conductance response, participants should exhibit the same amount of rejections when playing in behalf of a third-party than in the classical UG.

2. METHODS

Thirty-one healthy Italian volunteers (20 females), who ranged in age from 18 to 35 years (M=23.56, SD=3.90), took part in the experiment. They were required to play as *responders* in a modified version of the UG in which they either accepted or rejected the offers the *proposer* made, following the classical rules explained above. Before starting the game, they were introduced to a collaborator of the experimenter, who pretended to play as the *proposer*, in order to strengthen the illusion of playing against a human adversary, whereas they were actually playing against a computer. They were told that the opponent had been given a number of 10 euros bank notes and would have made offers on how to split each of these bank notes. At each trial offers could range from 1 to 5 euros out of 10. Furthermore, participants were informed that, in one condition, they and their opponent would play for themselves (consistently with the classical UG), whereas, in a second condition, they would play on behalf of those players acting as *proposer* and *responder* in the upcoming testing session. In order to make our task compatible to the single-shot UG, participants were told that the opponent would not have received any feedback until the very end of the experiment, when they have both been informed on how much each of them had gained, depending on the choices they had made; in this way, they knew rationally that they could not affect the opponent's behaviour through their rejections. In addition, they knew that a percentage of the money split on behalf of third parties would be given to next players; they were also informed that, following the same principle, their starting stakes were percentages of the money that previous players have split on their behalf. To control for the social interactive nature of the UG, participants performed a control task (Free Win [FW] task) in which they either accepted or rejected a variable amount of money given by the computer (1-5 euros). As in the case of

the UG, they could have decided for themselves or on behalf of the next participant. If they accepted the offer, they/the third party would have received that amount, otherwise they/the third party would receive nothing. This yields to a 2*2*5 design with task (UG *vs.* FW), target *(myself vs. third-party)* and gain (1-5 euros) as within-subjects factors. Participants were informed that their compensation for participating in the experiment would be proportional to the amount of money gained during the myself condition. Moreover, they knew that a percentage of the money split on behalf of third parties would be given to next players; they were also informed that, following the same principle, their starting stakes were percentages of the money that previous players had split on their behalf. Irrespective of their performance on the task, participants received the same amount of money as compensation. During the experimental session the offer appeared on the screen for five seconds, followed by a six-second blank screen. Participants were required to respond by button press, highlighted on the computer keyboard, as soon as the question "Do you accept?" appeared on the screen, where it lasted for two seconds. The inter-trial interval was averaged around 11 seconds, to allow skin conductance to return to its baseline. All 20 conditions, each of which were repeated four times, were randomized through the experiment, with duration of approximately 32 minutes (80 trials * 24 seconds of trial duration). Skin conductance was recorded during the whole experiment using a pair of prewired 8 mm Ag/AgCl electrodes, attached to the distal phalanx surfaces of the index and little finger of the non-dominant hand. The electrode pair was excited with a constant voltage of 0.5 V and the conductance was recorded using a DC amplifier with a low pass filter set at 64 Hz and a sample frequency of 256. Values of skin conductance were automatically transformed to microsiemens values by the Procomp Infinity System and further analyzed using Ledalab 2.1.3 freeware software (Benedek & Kaernbach, 2008). A phasic increase in conductance of 0.05 µS or more was counted as a Skin Conductance Response (SCR). Our analysis focused on the average phasic increase in the four seconds prior to the moment in which subjects were instructed to provide a response.

3. RESULTS

For each subject, and for each condition, the rejection rate and the average phasic increase in conductance were calculated across all 4 repetitions, and used in a 2 (TASK: UG, FW) x 2, (TARGET:

myself, third party) x 5 (GAIN: 1, 2, 3, 4, 5 Euros) Repeated Measures ANOVA as implemented in SPSS 11.5 Software. The analysis of Rejection Rates revealed a significant main effect of TASK (MSE = 2336.51, $F(1, 30) = 58.96$, p < .001, $\eta_p^2 = .66$), with the UG eliciting a larger amount of rejections (myself: 37.26 ± 3.89%;third-party: 40.54 ± 4.64%) than the FW (myself: 5.32 ± 2.12%; third-party: 12.83 ± 3.64%). The TASK x GAIN interaction was also found significant (MSE = 544.065, $F(4, 120) = 39.67$, p < .001, $\eta_p^2 = .57$), reflecting low offers being rejected significantly more than the high offers in the UG and not in the FW. Polynomial contrasts revealed that the difference between UG and FW changed linearly across all gain levels (MSE = 1030.95, $F(1, 30) = 78.09$, p < .01, $\eta_p^2 = .72$).

The analysis of SCRs revealed a significant TASK x TARGET interaction (MSE = .012, $F(1, 30) = 6.24$, p < .05, $\eta_p^2 = .17$), reflecting the largest phasic increase in skin conductance whilst playing the UG for oneself (0.14 ± 0.02 µS), with respect to the UG on behalf of a third-party (0.11 ± 0.02 µS), or to the FW (myself: 0.11 ± 0.02%; third-party: 0.13 ± 0.02%). None of the remaining effects of the ANOVAs were found to be significant

4. DISCUSSION

We have investigated the nature of "irrational" rejections during the Ultimatum Game by having participants perform a modified version of the paradigm in which they were asked to play for themselves or on behalf of a third party. Our analysis of the conditions in which participants played for themselves confirmed all previous findings associated with the classical UG task: first, we replicated the well-documented pattern of accepting fair offers and increasing the rate of rejection as offers become less fair (Bolton & Zwick, 1995; Roth, 1995; Guth, Huck, & Muller, 2001; Sanfey et al., 2003); this pattern was not found in the control task, in which participants had to either accept or reject money given by the computer, supposing that, even though the *responder*'s personal gain is the same, the perception of an unfair division drives him/her to reject unfair offers choosing the so called non-utilitarian or "irrational" solution. Secondly, skin conductance data show that, when participants played for themselves, the UG elicited a larger emotional arousal than when played the FW task.

More importantly, the analysis of SCRs revealed a TARGET*TASK interaction, which reflects a significant increase of SCRs associated with the UG (but not the FW), when their own interests (but not

that of others) were at stake. The fact that playing the UG for oneself is more emotionally arousing than the other three conditions, confirm our initial assumption that the amount of negative emotions elicited by the UG is smaller when one's own payoff is not directly at stake.

If rejections are not utilitarian in nature, as they are driven by negative emotions and by the desire to punish the *proposer* (Sanfey et al., 2003; van't Wout et al., 2006), these should not be found (or should be found in a lesser degree) whilst playing the UG in behalf of a third party as (1) participants are aware that their putative rejection is not affecting the *proposer*'s payoff and (2) this condition is less emotionally arousing. Our analysis of the rejection rates go against this prediction: indeed no TARGET*TASK interaction was found to be significant, as in the case of the analysis of SCRs, but the TASK main effect was, reflecting the amount of rejections associated with playing the UG for both targets (myself: 37%; third-party: 40%) being significantly larger than the amount of rejection associated with the FW task (myself: 5%, third-party: 12%). In light of our results, the account according to which rejections are irrational responses, driven exclusively by emotions and by the desire to punish the proposer, needs to be reconsidered. An alternative explanation for the *responder*'s behavior can be related to the notion of context dependent fairness proposed by Zamir and colleagues (Winter & Zamir, 2005; Zamir, 2001), according to which the sense of equity may change depending on both the person engaged in the social exchanges dynamic, and the nature of this dynamic. Winter and Zamir (2005), for instance, reported a modified version of the UG in which the *proposer* played with virtual-*responders* which could be either much more tolerant or unforgiving to unfair offers than real human *responders*. They found that the *proposers* quickly adapted their behavior to the virtual-*responders*, by behaving unfairly with the tolerant and fairly with the unforgiving *responders*. This is similar to what happens in the Dictator Game (Forsythe, Horowitz, Savin, & Safton, 1994; Bolton & Zwick, 1995), in which the *proposer* cannot have his offers rejected by the *responder* and, therefore, behaves far less fairly than in the UG. All these observations suggest that in the UG *proposers*' behavior is directly affected by the tolerance to unfairness he expects in the *responder*. Thus, rejections in the UG are indeed rational in that, although they do not increase the *responder*'s chance of having better offers in the remaining part of the experimental session, they lead the *proposers* to play fairly

and, in turn, to an increase the overall gain of the population of the *responders* (Zamir, 2001). Such behavior is not predicted by classical economical theory, which is based on the assumption (present in the experimental instructions of many experiments, but less frequently believed by participants) that player's choices have effects which are limited to the experimental session (Zamir, 2001). The account according to which the *responder*'s rejections are utilitarian is in agreement with our behavioral results. In our study, participants were told prior to the experiment that their starting stakes depended on how previous players had decided to split the money; it is therefore likely that they felt part of a group in which cooperation led to a maximization of everyone's gain. Thus the participants' prosocial behavior showed when they rejected the unfair offers on behalf of the third party, might reflect the will to strengthen the public good for the population of the *responders* (Zamir, 2001). This is also consistent with studies of social psychology in which participants decided give up some money in order to punish other's unfair behavior, even when their payoffs are not directly affected by a violation of fairness (Fehr & Fischbacher, 2004).

This account is in agreement also with our psychopshysiological data, in that it does not predict that the rejection rates are associated with an increased emotional response. Emotions do play a role in the UG, as demonstrated by previous studies (Sanfey et al., 2003; van't Wout et al., 2006) as well as by the present study when participants played in the myself condition (i.e. the classical version of the UG). However, the dissociation we have reported here between the physiological and the behavioral pattern when participants performed the task in the third-party condition, implies that emotions are not always the key mechanism underlying the *responder*'s rejections. The emotional response might be triggered whenever one's own interest is at stake, and not the ultimate cause of this behavior.

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THE OPEN BODY

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ABSTRACT

In this paper we characterize the body as *constitutively open.* We first consider the notion of bodily openness at the basic level of its organic constitution. This will provide us a framework relevant for the understanding of the body open to its intersubjective world. We argue that the notion of "bodily openness" captures a constitutive dimension of intersubjectivity. Generally speaking, there are two families of theories intending to characterize the constitutive relation between subjectivity and intersubjectivity: either the self is considered as (1) being constituted prior to, and as a condition of, its potential relation to the outside (intersubjective) world, or, contrastively, (2) the self is considered as being constituted *as a result* of its (intersubjective) relations with the outside world. Here, we pursue a conciliatory path, as we intend to show that these two positions are not necessarily in opposition to each other. But how can selfhood/subjectivity be both and at the same time primary and secondary, relative to otherness/intersubjectivity? Stated thusly, the question seems to border on incoherence but our intention here is to reconsider it in a framework that allows for the dissolution of this opposition. In particular, we will characterize the *relational autonomy* of the self: neither fully enclosed "inside" nor fully dissolved in or determined by what's "outside", the bodily self is best characterized by its fundamental "openness", which we will explore in a framework where *autonomy and relationality* are not contradictory but co-constitutive dimensions.

In the first section, we introduce the notions of "relational autonomy" and "openness" at the most basic level, i.e. the organic constitution of the body. We then specify the links we intend to tie between the organic and the intersubjective modes of being of the body. This then allows us to exploit the notions of "relational autonomy" and "openness" to better characterize bodily intersubjectivity. We conclude by considering the implication of our view for the understanding of the constitutive relation between subjectivity and intersubjectivity

Keywords: relational autonomy, organic constitution of the body, developmental psychology, enacted intersubjectivity, co-constitution of self and others.

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1. INTRODUCTION

In this paper we characterize the body as *constitutively open.* We first consider the notion of bodily openness at the basic level of its organic constitution. This will provide us a framework relevant for the understanding of the body open to its intersubjective world. We

argue that the notion of "bodily openness" captures a constitutive dimension of selfhood and intersubjectivity. Generally speaking, there are two families of theories intending to characterize the constitutive relation between subjectivity and intersubjectivity: either the self is considered as (1) being constituted *prior to*, and as a condition of, its potential relation to the outside (intersubjective) world, or, contrastively, (2) the self is considered as being constituted *as a result* of its (intersubjective) relations with the outside world.

Descartes' formulation of the autonomy of the nonphysical *cogito* is perhaps the most vivid and well-known example of the first position. More recently, the phenomenologist Michel Henry (1973) has developed a radically internalist conception of subjectivity as pure non-relational interiority: a passive self-affection or *ipseity* said to be ontologically independent of any form of *alterity* (for extensive discussion and criticism, see Zahavi, 1999). Even more recently, Galen Strawson has argued for a "Pearl View" of the self. We are, Strawson argues, sequences of single, self-sufficient, "ontically distinct" mental things (or subjects of experience) that are nevertheless distinct from that which we experience as well as all other things. But as a "thing", Strawson insists that the self is nevertheless part of "a set of neuron-and-neurotransmitter-(etc)-constituting atoms or fundamental particles in a certain state of activation" (Strawson, 1999, p. 21). Others argue that the self is identifiable with the brain itself (Brooks, 1994) or with the neural mechanisms underwriting the brain's self-representational capacities (Churchland, 2002). The common thread of these disparate views is that the self is in some important sense *autonomous*, that is to say, dissociable from the rest of the world. Put differently, subjectivity is not essentially intersubjective; the self is not determined by otherness.

With respect to the second position, George Herbert Mead's model of the social self is a prominent philosophical example. According to Mead, "The self is something which has a development; it is not initially there, at birth, but arises in the process of social experience and activity, that is, develops in the given individual as a result of his relations to that process as a whole and to other individuals within that process" (Mead, 1934, p.135). A more recent view along these lines is developed by Daniel Dennett. According to Dennett (1992), the self is a locus of personal and public narratives—a "center of narrative gravity", in other words, ultimately constituted by the stories that it tells and has told about

it. A consequence of this view is that the self is really "an abstract object" or a "theorist's fiction" always constructed after-the-fact. Like Mead, Dennett's narrative self is wholly a product of its social world, essentially constituted by intersubjectivity and otherness (i.e., shared linguistic practices and narrative structures). In short, this model of the self is *relational* all the way down.

Here, we reject the validity of this contrastive opposition. Instead, we pursue a conciliatory path, and intend to show that these two positions are not necessarily in opposition to each other. But how can selfhood/subjectivity be both and at the same time primary and secondary, relative to otherness/intersubjectivity? Stated thusly, the question seems to border on incoherence. Our intention here is to reconsider it in a framework that allows for the dissolution of this opposition. In particular, we will characterize the *relational autonomy* of the self: neither fully enclosed "inside" (e.g., the cogito or neural structures) nor fully dissolved in or determined by what's "outside" (e.g., social relations or linguistic/narrative structures), the self is instead a bodily self best characterized by its fundamental "openness", which we will explore in a framework where *autonomy* and *relationality* are not contradictory but co-constitutive dimensions.

In the first section, we introduce the notions of "relational autonomy" and "openness" at the most basic level, i.e., the organic constitution of the body. We then specify the links we intend to establish between the organic and the intersubjective modes of being of the body. This allows us to exploit the notions of "relational autonomy" and "openness" to better characterize the bodily self and intersubjectivity. We conclude by considering the implication of our view for the understanding of the constitutive relation between subjectivity and intersubjectivity. However, note that we do not intend to describe in any detail how the outer realm plays a constitutive role within the self. This is so because the present paper intends to be programmatic. We assume that the theoretical description here developed is the necessary basis to then develop further empirical investigations of how the physical and social environments are, respectively, involved in particular cases of self-constitution.

2. THE ORGANIC OPEN BODY

2.1. Self-constitution

Our characterization of bodily openness at the organic level

draws extensively on the work initiated by Francisco Varela and Humberto Maturana and pursued by Evan Thompson. To start with, the following definitions will be useful. A "system" can be defined as a "collection of related entities or processes that stands out from a background as a single whole…" (Thompson, 2007, p. 39). A system is said to be "autonomous" when it is "a self-determining system, as distinguished from a system determined from the outside" (Id., p. 37). "An autonomous system… is defined by its endogenous, self-organizing and self-controlling dynamics" (Id., p. 43). The notion of *autopoiesis* (from the Greek: *auto* for "self" and *poiesis* for "production") is meant to characterize the autonomy of living systems. An autopoietic system "embodies a circular process of self-generation…and…continually re-creates the difference between itself and everything else" (Thompson, 2007, p. 99; See also Varela, 1979; Maturana & Varela, 1980). The autopoietic unity is self-sustaining (as it actively maintains its own organization) through self-renewal (as it actively renews its own material constituents).

Varela and Thompson exploit these notions to define an "organic self", following the lead of Jonas for who "the introduction of the term 'self,' …indicates the emergence, with life as such, of *internal identity* – and so, as one with that emergence, its *self-isolation* too from all the rest of reality" (1966, pp. 82-83; our emphasis). For Thompson, too, autopoietic processes allow the "self-production of an *inside*" (Id., p.79; our emphasis) and "an autopoietic system is …an individual in a sense that begins to be worthy of the term *self*" (Id., p. 75, see also p. 48). This view is quite radical and we do not intend to defend it here (but see Legrand, 2004. To remain neutral on this issue without confusing system and self, we will talk about "system/self"). We believe that, whether or not one assumes such conception of organic selfhood, the notion of autopoietic autonomy can be relevantly exploited to clarify the issue at stake here, i.e., bodily openness.

Note that (contrary to our current aim, but as italicized in the previous paragraph) emphasis is often put on the "inside" that is constituted autopoietically; fairly so, since without such an inside that differentiates itself from the rest by self-generating a boundary, there would be no living system/self at all. However, this does not suffice to define the system/self as merely an inner realm. In fact, such characterization would miss the specificity of autopoietic self-constitution. To better understand the latter, let us consider the notion of "structural coupling".

2.2. Structural coupling

The notion of "structural coupling" captures the constitutive openness of the living organism to its surrounding world. Since it involves the perpetual renewal of the system/self's constituting material, the process of autopoietic constitution relies on its openness to its surrounding world. Therefore, "the relation of the organism to its material substance is of a double nature: …Dependent on their availability as materials, it is independent of their sameness as these… the organic form stands in a dialectical relation of *needful freedom* to matter (Jonas, 1966, p.80). *For this very reason,* the relation of the organism to the outside world where matter is to be found is, as well, as relation of needful freedom.

Understanding in its specificity the reliance of self-constitution on the outside world involves a reappraisal of the paradigm of input-output informational systems. Here, information is not reified "into something that preexists 'out there'" (Thompson, 2007, p. 186). Rather, the idea is that "autonomous systems …enact an environment inseparable from their own structure and actions" (Id., p. 59). At the organic level, the relation of the living organism to its world is not adequately conceived of as the mere ingestion of nutriments which are ready to be consumed. Rather, the "informational stimulus is not equivalent to the physical stimulus. The latter is definable independently of the organism; the former is not. The informational stimulus is the stimulus as informed by (the form or structure of) the organism" (Id., p. 69). Therefore, the relation with the outer realm should not be confused with a relation with an already constituted outside environment. Rather, the "outer" information relevant for autopoietic self-constitution is not determined independently of this very process of self-constitution. The outer world is characterized by the organism processing it, according to the "vital significance" of the stimulus for the organism in question.

2.3. Inner realm

On this basis, and as underlined above, the emphasis has mostly been put on the "inside" of the autopoietic system/self. To better understand the status given to this "inside", let us quote at length Varela (1992):

"the living system must distinguish itself from its environment, while at the same time maintaining its coupling…. Now, in this dia-logic coupling between the living unity and the physico-chemical

environment, t*he balance is slightly weighted towards the living since it has the active role in this reciprocal coupling.* In defining what it is as unity, in the very same movement it defines what remains exterior to it, that is to say, its surrounding environment. A closer examination also makes it evident that this exteriorization can only be understood, so to speak, *from the "inside"*: the auto-poietic unity creates a perspective from which the exterior is one, which cannot be confused with the physical surroundings as they appear to us as observers, the land of physical and chemical laws simpliciter, devoid of such perspectivism" (p. 7; emphasis altered).

The "slightly weighted" balance described here by Varela is cha-racterized by Thompson in a more radical way: "although inside and outside are dynamically co-emergent, they do not share the same symmetrical relation. As Moreno and Barandiaran [2004, p. 17] explain: "the (self) generation of an inside is ontologically prior to the dichotomy in-out'" (Thompson, 2007, p. 79). But there is a tension here. For how would such ontological priority of the "inside" cohere with the characterization of the autopoietic system as *structurally coupled* to its environment?

2.4. Constitutive openness

Rather than giving too much weight to the inside, we wish to insist on the "dialogical", bi-directional, reciprocal relationship between self and world. We choose to focus on the inseparability of the "inside" and "outside" by interpreting the "outside" as playing a genuine constitutive role. This is not to say that the role played by the inside and the outside are entirely symmetrical. The dissymmetry at stake, however, involves no ontological prioritizing of inside over outside.

If you wish, think of it as dissolving the chicken-egg dilemma: to the question "which comes first?" the current framework replies "both". Instead of picking-up information in an independent external environment, the system/self "shapes" its world by enac-ting relevant "information" inseparable from the self-constituting system itself; conversely, this process of self-constitution is itself inseparable from the world in which it occurs (Varela et al., 1991; Thompson, 2007).

To clarify: this approach is not meant to contradict autopoiesis as defined in a Varelian fashion and as we understand it. The diffe-rence between Thompson's approach and ours is mostly a matter of focus. We argue that what the autopoietic view is attempting to

achieve, i.e., the grounding of a genuine concept of autonomy as self-constitution, is misconceived if it is thought to contradict the process of structural coupling and the constitutive openness related to it. Of course, a view of autopoietic systems as being "made externally" would be a contradiction in terms. But the two radical views assuming either purely independent constitution or pure heteronomy are not the only options, and we oppose to them both a process of constitution through "relational autonomy", which we take to be faithful to autopoiesis as originally defined. Indeed, it is clear from the very notion of autopoiesis that the system/self defined here is *not* self-enclosed. Rather, otherness is correlative of selfhood (Thompson, 2007, p. 49). The "self-isolation" defined by Jonas thus "cannot mean outright independence from the world" (Id., p. 150). Rather, Jonas himself insists on the constitutive "transcendence of life": "life is turned outward and toward the world in a peculiar relatedness of dependence and possibility… its self-concern… is essential openness for the encounter of outer being. Thus "world" is there from the earliest beginning…" (1966, p. 84). Likewise, Varela characterizes the autopoietic system/self by its "operational closure" but it should be clear that "the qualification "operational" emphasizes that closure is used in its mathematical sense of recursivity, and *not* in the sense of closed*ness* or isolation from interaction, which would be, of course, nonsense" (Varela, 1992, p.10). Therefore, "it is essential to understand that the idea of *closure* does not contradict that of openness. Closure doesn't mean a closed system" (Rudrauf et al., 2003, p. 28. See also Thompson, 2007, p. 45, p. 448).

One may agree that an autopoietic system is open while balking at considering that it is *constitutively* open. However, that would miss the specificity of the structural coupling characterizing autopoietic processes. Again, such coupling involves that the autopoietic unit is not first constituted to be related to the outer realm only secondarily. Rather, the autopoietic unit is constituted *by* being related to the outer realm, hence the notion of what we term "relational autonomy". "Autonomy" comes from the Greek auto for "self" and *nomos* for "law". An autonomous being is thus defined as self-governing and independent We argue here that biological systems (like organisms, persons, etc.) are both constitutively open and autonomous. We thus propose to conceive of a form of autonomy which is relational. Biological systems are relationally autonomous in that they are constituted by their bodily openness without thereby losing their autonomy. The notion of "relational

autonomy" is not redundant with the notion of "autonomy" since the latter means independence while the former, importantly, involves dependence. We therefore intend here to reconcile the notions of constitutive relationality and autonomy. Conceiving of the notion of relational autonomy involves cutting across the divide between inner and outer realms since, in this framework, the inner realm cannot be defined without its domain of interaction with the outer realm.

To further clarify: We take here the term "constitution" in its etymological meaning, i.e., the Latin cum for "together" and statuo for "the fact to establish". Hence, an act of constitution corresponds to an act organizing the relationships between the different components (i.e., constituents) of a given unit. Constituents are elements/states/processes that are constitutive of the unit in question. Constituents cannot be merely defined negatively: to determine whether a given element/state/process is constitutive of a given unit, it is not enough to check whether this element/state/process is necessary for the unit to survive as such, since some elements/states/processes are necessary without being constitutive (e.g., H2O is necessary for the survival and functioning of biological organisms but is not constitutive of personhood). What matters for determining whether a given element/state/process is constitutive of a given unit is whether this element/state/process is *specific* to the given unit. The specificity of the element/state/process is defined by (1) its necessity and (2) its exclusivity (Ruby & Legrand, 2007; Legrand & Ruby, in press). A unit U is constituted by a given element E if E is specific to U, i.e., if E does not characterize non-U (exclusivity) and if changing or losing E would amount to changing or losing U and/or its distinction from non-U (necessity). For example, as described above, it is thought that autopoietic processes constitute living units (Jonas, 1966; Maturana & Varela, 1996; Thompson, 2007): autopoiesis does not characterize non-living entities (exclusivity) and a rupture of autopoiesis amounts to death (necessity). On this basis, we argue here that openness is constitutive of the biological body. Such openness does not characterize non-biological machines (exclusivity) and bodily closeness is incompatible with biological bodily processes (necessity). Following the same line of thought, we will now argue that a specific form of bodily openness is constitutive of intersubjective encounters. Such bodily openness characterizes intersubjective encounters, while it does not participate to non-intersubjective encounters (exclusivity) and bodily closeness di-

srupts intersubjective encounters (necessity). Space does not allow us to detail here the effects of bodily closeness and the forms of non-intersubjective encounters. We will rather focus on the way bodily openness characterizes intersubjective encounters.

To state it differently, according to our reading of the notion of "autopoiesis", an autonomous system/self is constituted *jointly* by its inner organization and its openness. Here, we will assume the former (inner organization), and will focus on the examination of the latter dimension (openness). In what follows, the characterization of autonomous system/self as structurally coupled, i.e., constitutively open to its surrounding world, will be exploited beyond the organic level that we considered up to now. In particular, we will export the notion of *relational autonomy* to the field of intersubjectivity. In this field, the idea that selfhood is an inner realm or inner dimension of being is either assumed or rejected. Here, we argue that the self is an autonomous being but we avoid enclosing it within an inner realm by connecting this inner dimension with its co-constitutive counterpart: openness.

3. FROM ORGANIC RELATIONAL AUTONOMY TO INTERSUBJECTIVITY

As argued above, the body is organically open. This open body, we will now argue, is fundamentally an openly *intersubjective body*. Before spelling out what this means, a word needs to be said about the bridge we intend to cross between the organic and the intersubjective orders. Our point is not to reduce the social order to the organic one, nor to generalize organic processes to the social domain. Our aim is more modest. We intend to argue that the body, both as organic and as intersubjective, is open in a way that can be better understood through the reading of the notion of relational autonomy offered by the theory of autopoiesis. We acknowledge that the immersion in an intersubjective environment involves an "identity generation underdetermined by metabolism" (Di Paolo, 2009). In an intersubjective domain, forms of selfhood and subjectivity emerge which otherwise do not if the world is not lived intersubjectively. According to the very notion of structural coupling (see above), any modification of the outer domain (e.g., from a solitary to an intersubjective world) impacts the inner organization of the system/self in ways allowing the latter to actually relate to this new environment (Jonas, 1966, pp. 106-7). We thus do not advocate that intersubjectivity is constitutive of bodily openness but rather that bodily openness is constitutive of

intersubjectivity. We return to the issue of intersubjective constitution in the concluding section.

Our motivation is to propose a conception of intersubjectivity in a naturalistic, non-reductionist framework. The most basic requirement for this to happen is to consider that the understanding of organic self-constitution proposed above, and the conception of intersubjectivity that we will propose below, are reciprocally constraining: one order should not violate what is viable for the other order. The simplest way to see that two orders are compatible with each other is to detect that they are characterized by equivalent dimensions. As we saw above, at the organic level, the body is constitutively characterized by its openness; we thus now need to check whether an equivalent dimension of bodily openness constitutes intersubjectivity. In this non-reductionist approach, we consider that the body cannot be fully understood by conceiving it merely as a physical organism; nor is it exhaustively categorized as a lived, subjective perspective on the world, over against a world of physical things and other subjects. Rather, it is both of these. In this sense, the living body has a unique "two-sidedness". As phenomenologically sensitive thinkers such as Husserl, Kitaro Nishida, Sartre, and Merleau-Ponty (among others) have insisted, the body is an organism embedded *in* the world as well as a subjective perspective *on* the world. Our concern in what follows is to explore how this two-sidedness is opened up within our intersubjective engagements.

4. THE INTERSUBJECTIVE OPEN BODY

4.1 Bodily intersubjectivity

Let us exploit a suggestive remark by Merleau-Ponty as a platform to expose our view. This passage serves to clarify several ways that the open body is an intersubjective body—a perceiving, acting, and feeling body-in-relation. Merleau-Ponty writes:

I experience my own body as the power of adopting certain forms of behavior and a certain world, and I am given to myself merely as a certain hold upon the world; now, it is precisely my body which perceives the body of another, and discovers in that other body a miraculous prolongation of my own intentions, a familiar way of dealing with the world. Henceforth, as the parts of my body together comprise a system, so my body and the other's are one whole, two sides of one and the same phenomenon…" (1962/2003, p. 412).

For our purposes, we can take two lessons from this rich passage. The first concerns the intermingling of embodiment and intersubjectivity: "it is precisely my body which perceives the body of another". As psychologist Peter Hobson notes, it appears that, developmentally, we come into the world automatically recognizing that "a person is the kind of thing with which one can feel and share things, and the kind of thing with which one can communicate… We have a basic response to expressions of feeling in others—a response that is more basic than thought" (Hobson, 2002, p.59-60). Before we acquire the multiple concepts or folk psychology underlying a "theory of mind" (Premack & Woodruff, 1978), we are first coupled to other subjects by a more primitive relation of "interaffectivity" (Stern, 1993, p.210). This interaffectivity is rooted in our bodily relatedness to others. Intersubjectivity, the ability to understandingly relate to others, is first and foremost an embodied skill; it is not primarily detached mind-reading but interactive bodily practices (Gallagher, 2001, 2008). We will return to this issue below with the discussion of data from developmental psychology.

The second point we wish to extract from Merleau-Ponty's words concerns the bi-directional relation entertained by self and others though the encounter of their body. The expressive body of the other is implicitly recognized as "a miraculous prolongation of my own intentions". My relation to another is robustly *bodily* in that it involves a kind of "bodily resonance".[1] I experience others by interacting with *their* body as well as by experiencing *my own* bodily reaction to others' presence/behavior. The expressive gestures of another person (e.g., broad smile, clenched fist, or expectant posture) are not only perceived as conveying intersubjectively salient information, such as that person's mood or particular emotional states at that moment. Beyond this, these gestures elicit bodily (affective) reactions and are experienced as marking motor possibilities for *my own* action—possibilities that I can actualize in virtue of my having the sort of body that I do, and in virtue of

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[1] This way of putting things clearly echoes the notion of "motor resonance" one finds in the mirror neuron/shared representations literature (Rizzolatti & Sinigaglia 2007). Our use of this term differs, however: the "motor resonance" discussed in the mirror neuron literature is active at the neuronal (i.e., subpersonal) level and thus cannot be spoken of as a structure of consciousness with which we are concerned here.

my implicitly[2] experiencing that the body I have can also do the things it experiences another person's body doing. In this sense, the other's body resonates with my own and conversely: my and others' body are coupled at the behavioral and experiential levels. As Merleau-Ponty puts it, "my body and the other's are one whole, two sides of the same phenomenon" in ways which remind the structural coupling of inner and outer realms at the organic level (described above). Like at the organic level, what matters here is that bodily openness is bi-directional. On the one hand, the open body is poised to perceive, feel, explore and respond in emotional ways to the people it encounters. On the other hand, the behavior, attention, and expressiveness of other people disclose the bodily subject to herself as a bodily subject, a subject capable of inte-racting with and being responsively affected by the world and by other people. The form of the intersubjective body's "responsive comportment" thus opens up the bodily self in its two-sidedness: that is, as both object (i.e., a concrete organism in a physical world) and subject (i.e., a lived body). To use the terminology introduced above: this mode of poised and responsive inhabitation within the social world involves the bodily self as an autonomous being (characterized by its subjective experience) who is, at the same time, relational (characterized by its encounter with others)[3].

4.2. Affective openness to others

The body's intersubjective structure emerges from its sensorimotor-affective openness to a world inhabited by other subjects. By labeling this form of openness "sensorimotor-affective", we are intentionally stressing the tight link between perceiving, acting and feeling. When we understandingly engage with another person, perception and affect are both co-present as two intermingled aspects of a single coherent process. To engage with another person "understandingly" is simply to interact with another as an em-bodied and emotional agent, and to interact with their expressive behavior in a way suggesting that I implicitly recognize them as

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[2] By this we simply mean that these action-potentials of the body are immediately known without the agent having to reflect on them in any second-order way.

[3] There are two additional points worth noticing in Merleau-Ponty's quote, but we will not develop them here: first, the idea that I primarily experience my body in the world (Legrand, 2007), secondly, the idea that I experience others by sharing a common world with them (De Preester, 2008).

possessing a unique emotional life that I can engage with and, to a certain extent, manipulate by calibrating my own embodied responses to their expressive behavior (e.g., by smiling and laughing coyly, or by frowning and sneering menacingly). Remember that at the organic level, the organism does not pick up information which is already pre-determined out there (see above the notion of "structural coupling"), but rather enacts such information as a function of its vital significance. Likewise here, we do not first perceive the movements, actions, intentions, and utterances of another person as neutrally-given information and only later develop affective/emotional interpretations and felt responses to them. Rather, our intersubjective engagements are always given with a certain affective coloring, however subtle it may be. In other terms, intersubjectivity is enacted in resonance with bodily subjectivity: according to the affective relevance of others' state for the bodily state of the subject himself. This affective saturation allows us to intuitively and meaningfully engage with other subjects as embodied and intersubjectively embedded subjects with minds, experiences, and emotions similar to our own. Jointly to the encounter with others based on the experience of both their body and one's own, it is crucial to underline that, reciprocally, one's experience of one's own body is itself mediated by others. This is best evidenced by the feeling of shame or shyness. Recent evidence suggest that such "relation emotions" are present very early in infancy (from two-month old; see Reddy, 2008) and "emerge because we have relations …not internal states…[but] ways of beings with the other person" (Reddy, 2005, p. 202). Her observations have led Reddy to argue that "Being self-conscious might leave us not with images of the self but instead with images of the things and people that stirred the 'self-conscious' feelings or thoughts" (Ibid). In this view, "interpersonal awareness… is not seen as one in which a "self-contained" self, as it were, engages with a "self-contained" other" (Draghi-Lorenz et al., 2001, p. 295). Rather, self and others are "coupled" in ways which lead them to enact each other's bodily states. In this sense, intersubjectivity is constitutively bodily, and this is made possible by the fact that the body is constitutively open.

4.3. Empirical evidence from developmental psychology

Much work in developmental psychology indicates that the body is open in an intersubjectively-sensitive way even from birth. A look at some of these findings will assist in characterizing the open

intersubjective body. Consider the fact that neonates appear to be almost immediately capable of intentionally imitating a range of facial, vocal, and gestural expressions (Meltzoff & Moore, 1977, 1983, 1997; Kugiumutzakis, 1985, 1999).[4] They can even do so after a delay, and work to improve their imitative abilities with practice (Meltzoff & Moore, 1994). Moreover, neonates recognize imitative episodes as instances of meaningful interpersonal interaction. They intentionally imitate gestures and vocalizations to complete the communicative dialectic inaugurated by the bodily gestures and vocalizations of the model they are imitating (Kugiumutzakis, 1999). By 15 days, infants seem to take pleasure from the sustained interest—the attentiveness and self-exertion, in other words—required for imitation (Kugiumutzakis et al., 2006, p.167). This capacity for genuine (i.e., intentional, as opposed to reflexive) imitation was traditionally thought not to appear until the age of 8-12 months. Indeed, it was assumed that since infants lack folk psychological concepts such as "self", "other", "beliefs", "desires", "communicative intentions", etc., they are incapable of attributing any sort of genuine interpersonal or communicative significance to episodes of imitation. Minimally, being able to attribute false beliefs to another has been taken to be the benchmark of having developed a theory of mind, that is, the ability to understand another person as a psychological being harboring beliefs and desires relevantly similar to one's own. Without such a theory, mindreading remains unattainable. Therefore, since intentional imitation involves the ability to recognize another's gestures as meaningful intentional imitation is simply too cognitively complex an activity to be undertaken by the developmentally immature neonate. We should note that this presupposition stemmed from a wide-spread and well-established tendency to dramatically underestimate the neonate's native capacity for genuine intersubjective engagement. As Colwyn Trevarthern underlines, it was long assumed "that the mind of the infant is incoherent, with undefined perceptions and incapable of contributing to communication, except to solicit help reflexively for biological functions" (Trevarthen, 1992, p.121). However, there are now strong reasons to doubt this "blooming and buzzing confusion" model of the early infant's world. Despite obvious constraints relative to the developmental immaturity of

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[4] For a brief review of infant imitation research, see Nadel and Butterworth (1999).

their perceptual systems, neonates and young infants nevertheless exhibit the intersubjectively-significant forms of bodily poise and responsiveness mentioned earlier. They can and indeed do initiate various preparatory movements intended to bring about other-directed bodily practices which indicate their self-aware, intentional efforts to participate in intersubjective engagements (Trevarthen, 1992, pp.133-135). This suggests that even newborns and very young infants are able to intentionally mobilize the sensorimotor resources of the open body to meaningfully engage with others. This "embodied attending" (Downing, 2000, p.256) to an intersubjectively significant context precedes the formation of a folk psychology or theory of mind. Rather, it has the form of a skill that is a function of the body's sensorimotor-affective openness. Bodily imitation is only one example of such skillful and self-aware interpersonal engagement. This early imitation soon takes on a more robust form as the infant becomes more adept at intersubjective exchanges. A premature infant at 30 weeks' gestational age can complement a partner's expression, such as an affectionate vocal greeting, with an emotionally appropriate response (e.g., a smile) (Trevarthen, 1992, p. 145). By two months, if not even earlier, infants can engage in "proto-conversations" (Bateson, 1971) consisting of "extended bouts of mutual gaze, turn-taking, cooing, showing lip and tongue movements, waving of arms, turning wrists and extending fingers"; in short, "they seem to experience our conversational acts as communication and must respond expressively" (Reddy & Trevarthen, 2004). Around this time they also begin to exhibit coyness, shyness, and embarrassment; a bit later they become capable of teasing others and showing off to call attention to themselves (Reddy & Trevarthen, 2004; Reddy, 2008). The upshot of these findings is that, long before they master any theory of mind, neonates and infants are active bodily participants within intersubjective engagements. They exhibit the embodied skills needed for modulating both the responses of their interlocutor (e.g., doing things to encourage or discourage further interaction), as well as their own affective responses to these embodied engagement (e.g., throwing themselves more fully into playful situations, or bashfully withdrawing and becoming shy or embarrassed). This mobilizing of the sensorimotor-affective open body to modulate another's affective states while simultaneously regulating one's own states speaks to the "bi-directional regulation" (Beebe, 2003) at the heart of our interpersonal engagements, which are founded on a shared body-to-body coordination. From the start neonates are

active and self-aware participants within intersubjective contexts, equipped with "(a) embodied skills for the "sending" of emotion to another person; (b) skills for the "receiving" of emotion from the other; (c) skills for "negotiating" such exchanges; and (d) skills for using shared affective states jointly to disclose aspects of the world" (Downing, 2000, p.263). Once again, such skills involve the bodily self as an autonomous being (characterized by its subjective experience) who is, at the same time, relational (characterized by its encounter with others).

5. INTERSUBJECTIVELY AUTONOMOUS

The question that opens up here is the following: is this intersubjective opening of the body coincidental or constitutive? First of all, note that our reliance on developmental psychology and on the earliest stages of intersubjective encounter is meant not only to provide empirical arguments supporting our thesis but also to underline both that the body is intersubjectively relevant and that, additionally, intersubjectivity is bodily relevant from birth on. This already indicates that bodily intersubjectivity is not an add-on but that it is, rather, basic and primary. Interestingly, this point is compatible with the idea that the body is intersubjectively open in a constitutive way. This is a strong claim that we will not spell out in full details here. Just to scratch the surface of the issue at stake, let us clarify that we advocate here a conception of the self as multi-layered. In the present context, this implies that at least some of its dimensions are not intersubjectively constituted (for example, one can presumably feel one's body proprioceptively even if there is no other person involved at all). But the question remains: is the dimension of the self which is factually intersubjective constitutively or contingently intersubjective? More specifically, is the open body interacting with others constitutively or contingently intersubjective? The most we can do here is to dismiss a (classical but flawed) reply which involves dissociating the organic from the intersubjective: these two dimensions of embodiment would belong to two different orders, organized according to different principles (again, a radical form of such a view would be a Cartesian dualism). Accordingly, the organic and intersubjective orders are simply neighbors constituting complementary but quite disconnected dimensions of the body. As should be clear by now, we do not favor such dualistic view, since we intend to remain faithful to a naturalistic (non-reductionist) approach. As explained above, the notion of autonomy is not incompatible with the notion

of openness and we believe that it is fruitful to understand both organic and intersubjective bodily openness as relying on *different* implementations of the *same* organizational principle, namely, relational autonomy. To clarify, we do not want to argue that each and every form of selfhood is constituted intersubjectively but rather that selfhood is constituted by its bodily openness, be it at the organic level or at the intersubjective level.

Like the organic system/self constitutes itself (its own inner space) by being structurally coupled with its external world, so does the subject when living in a world populated with others. It is by being related to others that the subject constitutes its mode of being at this level. This formulation, however, may be misleading. We are not saying that self-constitution at the experiential level is a result of prior intersubjective encounters. Conversely, we are not stating either that intersubjective encounters are the result of prior self-centered subjective experiences. What is misleading in these two (opposite) considerations is their way of considering the issue at stake in terms of "result". Doing so necessitates to first of all conceive of subjectivity (or more generally: inner realm) and intersubjectivity (or more generally: outer realm) as two separable or even separate orders, only one of which being "the first" to be constituted and giving the key for the constitution of the second one. Such "unplugging" of subjectivity (or more generally: inner realm) and intersubjectivity (or more generally: outer realm) is precisely what the current framework avoids. Self and world are not first separated to be then integrated to each other. The "who's first?" question is thus dissolved: not one, not two, self and others penetrate each other co-constitutively through the coupling of their open body.

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EMPATY, OUTWARDNESS AND EMPATHY PERSONAL DISTRESS: -A PILOT STUDY-

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ABSTRACT

According to phenomenological tradition we consider empathy a basically prereflexive experience of another as an embodied subject of experience like oneself. However, empathy is a complex neuropsychological ability strictly linked with complex intersubjective processes, therefore involving conscious-reflexive cognition as well.

According to Dziobek et al. (2008) two main approaches have been used to study empathy: First one focuses on cognitive empathy or the ability to take the perspective of another person and to infer his mental state (Theory of Mind). The second approach emphasizes emotional or affective empathy (Eisenberg & Miller, 1987) defined as an observer's emotional response to another person's emotional state. To the best of our knowledge empathy has been studied mostly within psychopathological subjects. The nature of empathy as a process with at least partially dissociated sub-components becomes evident (Blair, 2005).

Our purpose in this paper is to verify whether healthy subjects show different ways of empathizing according to their personality style. Previous researches on the topic demonstrated a connection between personality styles and the recruitment of different neural networks as a consequence of exposure to emotional stimuli. As a measure of empathy we administered the Interpersonal Reactivity Index -IRI- (Davis, 1980). Different personality styles have been evaluated by the administration of Personality Style Questionnaire (QSP; Picardi et al., 2003).

We expect that high levels of outwardness positively correlate with emotional empathy. Outwardness is a measure of the tendency to focus on a frame of references that predominantly uses an externally anchored coordinate system, i.e. contexts or persons, to discriminate among own internal emotional states. Specifically, we found a correlation between high levels of IRI "Personal Distress Scale" and outward personality style. Interestingly, we also found a positive correlation between PD sub-scale and field-dependent participants. Results show that as much as a person's emotional domain depends by evaluation of others, the more a person is sensitive to emotional empathy.

Keywords: empathy, psychopathology, Personality Styles.

1. DEFINING EMPATHY

Empathy is a polysemic notion: *"There are probably nearly as many definitions of empathy as people working on the topic"* (De Vignemont & Singer, 2006). According to phenomenological tradition we consider empathy - or *Einfühlung* - a basically prereflexive experience of another as an embodied subject of experience like oneself. Recent works on mirror neurons system (MNS) lead neuroscience to build up a coherent phenomenological conceptual framework about the nature of empathy. In his work (2008), Gallese asserts that the other's emotion is constituted and directly understood by means of embodied simulation producing an "as-if" experience engendered by a shared body state. It is the body state shared by observer and observed that enables direct understanding.

According to this approach, a common underlying functional mechanism—embodied simulation—mediates our ability of sharing the meaning of actions, feelings and intentions with others, thus grounding our identification with others.

However, empathy is strictly linked with complex intersubjective processes, therefore involving conscious-reflexive cognition. Social emotions like envy and gloating (Shamay-Tsoory et al., 2008) necessarily involve super-ordinate cognitive abilities. Therefore, Preston and de Waal (2002) have argued that "empathy [is] a super-ordinate category that includes all sub-classes of phenomena that share the same mechanism. This includes emotional contagion, sympathy, cognitive empathy, helping behavior, etc." (p. 4). Another position, assumed by Blair (2005), point out that "empathy" subsumes a variety of dissociable neurocognitive processes.

Three main divisions, each reliant on at least partially dissociable neural systems, will be identified: cognitive (the individual representation of the internal mental state of another individual), motor (occurs when individual mirrors the motor responses of the observed actor) and emotional empathy (dissociable in two forms: the response to the emotional display of others and the response to other emotional stimuli). According to Dziobek et al. (2008) two main approaches have been used to study empathy: First one focuses on cognitive empathy or the ability to take the perspective of another person and to infer his mental state. This ability could be assimilated to Theory of Mind (ex.: Kohler, 1929; Baron-Cohen & Wheelwright, 2004). The second approach emphasizes emotional or affective empathy (Eisenberg & Miller, 1987) defined as an observer's emotional response to another person's emotional state.

Finally, other researchers suggest a multi-dimensional approach that considers emotional and cognitive empathy as two separate but related constructs (Davis, 1980; 1983).

By a neuropsychological perspective, Theory of Mind, emotional empathy and motor empathy do share a degree of anatomical overlap in superior temporal regions. Theory of Mind seems related to acitivity in anterior paracingulate cortex, the temporal-parietal junction and inferior temporal cortex. Inferior Frontal Gyrus (IFG) seems crucial for a correct functioning of emotional empathy (Shamay-Tsoory et al., 2008). For a review about neuroanatomical components of the different constructs of empathy see Blair (2005). Interestingly, a recent research (Minio-Paulello et al., 2008) on Asperger's subjects observation of other's pain demonstrates absence of embodied empathy in Asperger Syndrome (AS). This research provides neurophysiological evidence for reduced empa-thic sensorimotor resonance although AS competences in affective qualities of imagined pain was similar to control participants. This could be an evidence to the nature of empathy as a process with at least partially dissociated sub-components.

Finally, in a review on this topic by Singer (2006), it is proposed that even though T.o.M. and empathy are often used as syno-nyms in the literature, they represent different abilities that rely on different neuronal circuitry. ToM refers to human ability in understanding mental states such as intentions, goals and beliefs, and relies on structures of the temporal lobe and the pre-frontal cortex, while empathy refers to our ability to share the feelings (emotions and sensations) of others and relies on sensorimotor cortices as well as limbic and para-limbic structures. In his review, the autor sudgest

"It is further argued that the concept of empathy as used in lay terms refers to a multi-level construct extending from simple forms of emotion contagion to complex forms of cognitive perspective taking. Future research should investigate the relative contribution of empathizing and mentalizing abilities in the understanding of other people's states. Finally, it is suggested that the abilities to understand other people's thoughts and to share their affects display different ontogenetic trajectories reflecting the different developmental paths of their underlying neural structures. In par-ticular, empathy develops much earlier than mentalizing abilities, because the former relys on limbic structures which develop early in ontogeny, whereas the latter rely on lateral temporal lobe and pre-frontal structures which are among the last to fully mature".

2. EMPATHY AND PSYCHOPATHOLOGY

Every impairment of the ability in sharing another person's inner life causes inevitably a diminished ability to relate with others human beings, producing a deficit in social functioning. The link between empathy and psychopathology will be at first described according to three major syndromes: Pervasive Developmental Disorders (Autism and Asperger Syndrome), Psychopathy, and Alexithymia (ALEX).

2.1. Autism and Pervasive Developmental disorders

Autism is a severe develompmental disorder. The main criteria for the diagnosis in DSM-IV-r can be syntetized as a qualitative impairment in social comunication, and restricted and repetitive patterns of behaviors and interests. With respect to empathy dy-sfunction in autism, several studies demonstrate Theory of Mind impairment (es.: Hill & Frith, 2003). Neuroimaging studies have reported reduced activation in three brain critical regions for mentalization in healty subjects (the temporal poles, temporal-parietal junction and medial prefrontal cortex; Castelli et al., 2002). Motor empathy is reasonable impaired in autistic subjects for clear evidence of their deficit of imitation. With respect to emotional empathy is still difficult to affirm autistic subjects are effectively impaired. Several studies have found emotional deficit in autistic subjects but it is reasonable that these researches have used complex cognitive emotions requiring the representation of the mental states of others (es.: Bormann-Kischkel et al., 1995). Recently, Minio-Paluello, Baron-Cohen et al. (2008) have explored whether people with Asperger Syndrome differ from neurotypical control participants in their empathic corticospinal response to the observation of others' pain. Briefly, corticospinal excitability recorded from the specific body part that is vicariously affected by the observed painful stimulation is reduced in neurotypical subjects. Using a single-pulse transcranial magnetic stimulation (TMS) Minio-Paluello et al., outline that AS subjects do not di-splay significative sensorimotor contagion, that is no significant reduction of corticospinal excitability.

However, Hamilton et al. (2007) reported that children with autistic spectrum disorders, despite their deficit in ToM tasks, have no impairments on a complex performance on a gesture recognition task, even though all of these tasks are thought to rely on the classical motor MNS in healthy subjects. In addition,

autistic people showed lowered MNS-related neural activity than normative controls when observing emotional facial expressions (Dapretto et al., 2006) and meaningless hand movements (Williams et al., 2006) as well as lower neural activity on a ToM task as above mentioned. Indeed, Hamilton et al. (2007) proposed that the classical MNS involved in object-directed hand movements is intact in autistic people, though other MNS components (e.g., regarding emotional recognition) are impaired.

On the other way round, in a research by Dziobek et al. (2008), authors by using a new photo-based measure to assess empathy multidimensionally - Multifaceted Empathy Test (MET) -, have found that while individuals with AS are impaired in cognitive empathy, they do not differ from controls in emotional empathy. Level of general emotional arousability and socially desirable answer tendencies did not differ between groups. Internal consistency of the MET's scales ranged from .71 to .92, and convergent and divergent validity were highly satisfactory.

2.2. Psychopathy

A psychopathology often considered as symptomatically specular to Asperger is Psychopathy. This psychopathology shows significant impairment in emotional empathy but normal processes in cognitive empathy

As Blair (2005) points out psychopathy is a developmental disorder, usually appearing in early childhood and continuing throughout the lifespan. Individuals with psychopathy are marked by pronounced emotional (considerably reduced empathy and guilt) and behavioral disturbance (criminal activity and violence). Psychopathy can be considered one of the prototypical disorders associated with empathic dysfunction. Reference to empathic dysfunction is part of the diagnostic criteria of psychopathy. There are no indications of Theory of Mind impairment in individuals with psychopathy. Three out of four studies assessing the ability of individuals with psychopathy on Theory of Mind measures have reported no impairment. As noted above, the clinical description of psychopathy includes reference to a lack of empathy. This description has been substantiated empirically. Individuals with psychopathy show reduced vicarious conditioning; i.e., reduced autonomic responses to stimuli associated with the distress of another individual. In addition, both adults with psychopathy and children with psychopathic tendencies show reduced autonomic

responses to the sad expressions of others. Several studies have examined the ability of individuals with psychopathy to recognize the facial or vocal emotional expressions of others. In short, the empathic dysfunction shown by individuals with psychopathy appears relatively selective. Individuals with psychopathy are impaired when processing fearful, sad (in adulthood, if responsiveness is indexed by skin conductance responses (SCRs), in childhood whether by SCR or recognition score), and possibly disgusted expressions. No study has yet reported that individuals with psychopathy show impairment for the processing of angry, happy or surprised expressions.

2.3 Alexithymia

Another psychopathology that has been correlated with empathies impairment is alexithymia (ALEX), (Moriguchi et al., 2007; 2008). Although the concept of alexithymia was originally used to describe the characteristics of psychosomatic patients, recently it has been used to refer to deficits in emotional functioning in broader populations (ex.: Taylor & Bagby, 2004). Infact, because awareness of Self emotional states is a prerequisite to recognizing such states in others, alexithymia - difficulty in identifying and expressing one's own emotional states - should involve some impairment in empathy.

Using functional magnetic resonance imaging (fMRI), Moriguchi et al., (2007) compared an ALEX group with healthy subjects for their regional hemodynamic responses to the visual perception of pictures depicting human hands and feet in painful situations. Subjective pain ratings of the pictures and empathy-related psychological scores were also compared between the 2 groups.

The ALEX group showed less cerebral activation in the left dorsolateral prefrontal cortex (DLPFC), the dorsal pons, the cerebellum, and the left caudal anterior cingulate cortex (ACC) within the pain matrix. The ALEX group showed greater activation in the right insula and inferior frontal gyrus.

Furthermore, alexithymic participants scored lower on the pain ratings and on the scores related to mature empathy. In conclusion, the hypofunction in the DLPFC, brain stem, cerebellum, and ACC and the lower pain-rating and empathy-related scores in ALEX are related to cognitive impairments, particularly executive and regulatory aspects, of emotional processing and support the importance of self-awareness in empathy. Interestingly, ALEX group scored lower on the Interpersonal Reactivity Index (IRI)

scales assessing "perspective taking" and "empathic concern," suggesting that they were less able to take the perspective of another and had less empathy but, on the other hand, alexithymics had significantly higher "personal distress" scores on the IRI. In a subsequent research, Moriguchi et al. (2008) measured the hemodynamic signal to examine whether there are functional differences in the mirror neuron system's (MNS) activity between participants with ALEX and without ALEX, in response to a classic MNS task (i.e., the observation of video clips depicting goal-directed hand movements). Both groups showed increased neural activity in the premotor and the parietal cortices during observation of hand actions. However, activation was greater for the ALEX group than the non-ALEX group. Furthermore, activation in the left premotor area was negatively correlated with perspective-taking ability as assessed with the IRI. By following these results, authors suggest that the stronger MNS-related neural response in individuals scoring high on ALEX is associated with their insufficient self-other differentiation.

Authors's investigations demonstrate that, although ALEX itself refers to deficiencies in emotional self-awareness, it is often marked by a lack of understanding of the feelings of others. ALEX has been repeatedly found in broad spectrum of psychiatric disorders (e.g., substance use disorder, post-traumatic stress disorder, and dissociative disorders). At the same time, it is noteworthy that there is a considerable group of psychiatric disorders characterized by ALEX involving deficits in the recognition of feelings belonging to the self and identification with others, such as autism and Asperger Syndrome (AS), schizophrenia, and borderline personality disorder. These disorders are characterized by reduced self-other distinction and immature empathy, such as higher self-oriented personal distress or emotional contagion. Furthermore, recent studies utilizing functional neuroimaging revealed that individuals with ALEX have reduced mentalizing capability, cognitive empathy, and perspective-taking ability. These results point to common components in the recognition of the self and others; therefore, ALEX involves impairments both in self-awareness and also in understanding the perspective of others at a higher cognitive level.

3. EMPATHY AND PERSONALITY

Until now, individual differences in empathizing have been described as a consequence of psychopathology (ex.: Asperger, Psychopathy, ALEX, etc.). Although these researches cannot be

summarized into a clear conceptual framework for empathy, we try to point out some experimental evidences.

Empathy is a upper-ordinate category that includes different sub-classes of phenomena. This includes emotional contagion, sympathy, cognitive empathy, helping behavior, etc. (Preston & de Waal, 2002). By following these authors, the different sub-classes of phenomena share the same basic mechanism. Gallese (2008) asserts that a common underlying functional mechanism—embodied simulation—mediates our ability of sharing the meaning of actions, feelings and intentions with others, thus grounding our identification with others. Furthermore, Blair (2005) considers these phenomena as neurocognitive dissociable modules. By the way, is yet to be demonstrated that:

- a) Those sub-classes of phenomena compose a continuum pathway of a single ability, being embodied simulation and ToM the continuum extremes;
- b) It is not clear how different forms of empathy are neurologically dissociable, that is, how they share common and different neural networks.

Authors found some researches on the relation between empathy and personality traits, for example psychometric studies on the relation between personality inventories vs. empathy scales (es.: Johnson et al., 1983). Interestingly, some researches have evaluated how different personality styles are associated with differential modulation of brain activity during explicit recognition of fearful and angry facial expressions (Rubino et al., 2007). Authors found that different personality styles are associated with differential modulation of brain activity during explicit recognition of fearful and angry facial expressions.

The supporting theory of personality is the cognitive post-rationalist one (Arciero & Guidano, 2000). Results can be shortly summarized: Inward subjects (whose identity is more focused on the inner experience and around control of environmental threat) recruit greater neuronal resources in medial prefrontal cortex (mPFC) compared to outward subjects (subjects, whose identity is more focused on external referential contexts and much less around control of threatening stimuli). MPFC activity is associated with cognitive aspects that are closely intertwined with emotional processing. In a previous study, Bertolino, Arciero et al. (2005) found that aspects of personality style are rooted in biological responses of the fear circuitry associated with processing of environmental information.

4. A PRELIMINARY STUDY ON DIFFERENT WAYS OF EMPA-THIZING ACCORDING TO INWARDNESS-OUTWARDNESS PERSONALITY DIMENSIONS

4.1. The rationale

Our aim was to verify whether healthy subjects show different ways of empathizing according to their personality style. As a measure of empathy we administered the Interpersonal Reactivity Index (IRI) (Davis, 1980; 1983; 1996). The IRI consists of four scales, each measuring a distinct component of empathy: 1) Empathy Concern, feeling emotional concern for others; 2) Perspective Taking, cognitively taking the perspective of another; 3) Fantasy, emotional identification with characters in books, films etc.; 4) Personal Distress, negative feelings in response to the distress of others. Different personality styles have been evaluated with the Personality Style Questionnaire (QSP) (Picardi et al., 2003). QSP is based upon Guidano's post-rationalist theory (Guidano, 1991; Arciero & Guidano, 2000) as later modified by Arciero (2006). Personality styles are grouped into four clusters, respectively: obsessive-prone, dap-prone, depressive-prone, phobic-prone. By following post-rationalist theory, obsessive-prone and dap-prone are outward personality styles, that is, they are more focused on a frame of references that predominantly uses an externally anchored coordinate system, i.e. contexts or persons, to discriminate among own internal emotional states. The other group, composed by depressive-prone and phobic-prone, are inward personality styles, that is, they are more focused on the inner frame of references that predominantly uses a body-centered coordinates system: they focalize primary on emotions starting with visceral activation to evaluate the events in the world (for example fear). Inward and outward personality styles are on the dimensional continuum inwardness-outwardness. The four main personality styles can be grouped into another pathway by following Witkin theory of field dependence/independence cognitive styles (Witkin et al., 1977). That is, a cognitive style characterized by the propensity to differentiate perceptual and other experiences from their backgrounds or contexts, a person with a weak propensity of this kind being field dependent and a person with a strong propensity field independent. We expected no relevant empathy impairment, meseaured on IRI-scoring, because participants are healthy subjects. Anyway we expected some correlation between self-report scores on IRI and QSP ones. Foremost, we expected outward subjects to score high level of emotional empathy in IRI's

subscale. Our hypothesis comes from previous mentioned studies on alexithymic empathy impairment (Moriguchi et al., 2007; 2008) and, partially, on Asperger subjects (AS) (Minio Paulello et al., 2008). IRI's Personal Distress (PD) subscale, taps the tendency to experience self-oriented distress and discomfort in response to somebody else's distress or misfortune. PD scores may in fact be even higher in AS than control participants. Alexithymic participants showed lower pain ratings than non-alexithymics. They scored lower on the IRI scales assessing "perspective taking" and "empathic concern," suggesting that they were less able to take the perspective of another and had less empathy. Alexithymics scored lower on the SCI scales of "cognitive," "problem solving," and "positive reappraisal," indicating that they were less likely to use these approaches to manage emotional stimuli. On the other hand, alexithymics had significant higher "personal distress" scores on the IRI's PD subscale. This higher score is associated with the alexithymic group greater activation than the non-alexitimic group in parietal and premotor areas, that is, participants with alexitymia activated more parts of their sensory and motor cortices (i.e., bodily regions) than control participants in response to emotional video clips, including the left precentral gyrus (BA4), temporal subgyral lobe, right parietal lobe (BA7), and medial/superior frontal gyrus (BA6), which suggests their over-activated sensorimotor components. This study is consistent with findings in terms of the overactivity in motor-related system in individuals with alexitymia. In his article about this topic Moriguchi (2008) conclude: *"Our results also suggest that individuals with ALEX may stagnate in a basic and primitive level of mentalizing, and that ALEX is related to an immature state of inferring the mental state of others without sufficient self-other differentiation. This may leave individuals with ALEX to be prone to being affected by others, leading to deficiencies in emotional regulation."* As mentioned above, we expected, on the one hand, that high levels of outwardness, the tendency to focus on a frame of references that uses an externally anchored coordinate system (i.e. persons) to discriminate among own internal emotional states, positively correlate with levels of personal distress as scored in PD subscale. On the other hand, we expected no relevant correlation in the inward group. Infact, inward group is more focused on the inner frame of references that predominantly uses a body-centered coordinates system; that is, they focalize primary on emotions starting with visceral activation to evaluate the events in the world.

5. METHODS, PARTICIPANTS, PROCEDURES AND MATERIALS

Our group included 27 subjects between the ages of 30 and 36 years. All subjects spontaneously participated at the experiment and they were randomly extracted from different kinds of postgraduate or specialization courses curricula.

All the subjects were asked to perform two different tests, the QSP (Personality Style Questionnaire; Picardi et al., 2003) and the IRI (Interpersonal Reactivity Index; Davis, 1980, Preston & de Waal, 2002). All the subjects performed the test sessions individually and no fixed times were given to fill the tests.

Two psychotherapists, with more than five years of clinical experience, evaluated each subject with a clinical interview in order to estimate the inwardness/outwardness dimension. Group assignment scored 100% agreement.

The IRI is a 28-item, 5-point Likert-type scale that evaluates four dimensions of empathy: Perspective-Taking, Fantasy, Empathic Concern, and Personal Distress. Each of these four subscales counts 7 items. The Perspective-Taking subscale measures empathy in the form of individuals' tendency to adopt, in a spontaneous way, the others' points of view. The Fantasy subscale of the IRI evaluates the subjects' ability to put themselves into the feelings and behaviours of fictional characters in books, movies, or plays. The Empathic Concern subscale assesses individuals' feelings of concern, warmth, and sympathy toward others. The Personal Distress subscale measures self-oriented anxiety and distress feelings regarding the distress experienced by others.

Table 1 - IRI item examples for each sub-scale

SUB-SCALES	ITEM EXAMPLE
Perspective-Taking	"I try to look at everybody's side of a disagreement before I make a decision"
Fantasy	"I really get involved with the feelings of the characters in a novel"
Empathic Concern	"I often have tender, concerned feelings for people less fortunate than me"
Personal Distress	"When I see someone get hurt, I tend to remain calm"

The QSP inventory is a 68 items self-evaluation questionnaire that evaluates the personality styles trough the 4 scales: Obsessive-

prone, Depressive-prone, Phobic-prone and Eating Disorder-prone dimensions (17 items for each subscale). Matching the single dimensions scores, it's also possible to obtain an estimation trough the Inwardness/Outwardness continuum and Field-dependent and Field-independent continuum (Arciero, 2006).

The answers, (same as in the IRI questionnaire) are on a 5-point Likert-type scale.

Table 2 – QSP Outward items example

ITEM	ITEM EXAMPLE
Item 11	"I try to understand what others think about me"
Item 24	"I'm often worried about the possibility that my opinions could be criticized by others"
Item 63	"My own partner jealousy makes me feel very special"

6. RESULTS

We carried out a Pearson correlation test between the QSP scores and the IRI scores. There was a high positive correlation between the DAP scores and the Personal Distress Scale scores. We didn't find any correlation between the DEP, FOB and OSS scores and the other IRI scale scores (Fantasy Scale, Perspective-Taking Scale, Empathic Concern Scale).
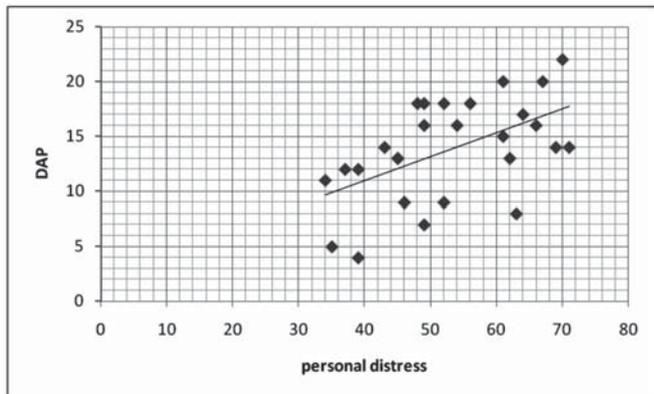
$(r = .537, N = 27, p < .001)$

Regarding the Outwardness/Inwardness dimensions we found a high positive correlation between the Outwardness dimension scores and the Personal Distress Scale scores.
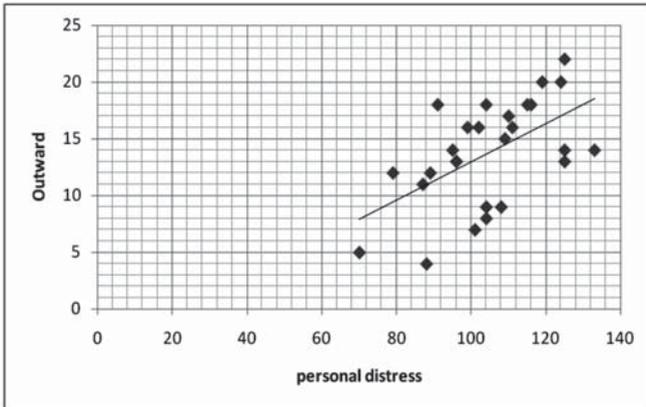
(r = .562, N = 27, p < .001)

Referring to the Field Dependent and Field Independent personality dimensions and the IRI scores, we found a high positive correlation between the Field Dependent dimension scores and the Personal Distress Scale scores.
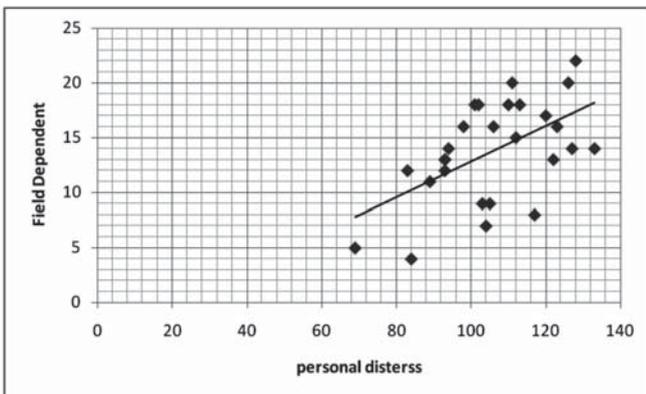
(r = .553, N = 27, p < .001)

7. DISCUSSION

Our hypothesis about correlation between Personal Distress (PD) sub-scale score and outwardness one has been confirmed. Participants with high score on outwardness personality dimension, measured by the Personality Style Questionnaire (QSP), have a correlate high score on PD sub-scale measured by the Interpersonal Reactivity Index (IRI). As more as person's emotional domain depends by evaluations of others (person and context), as much as the person is sensitive to emotional empathy (in a positive or negative way, depending upon the empathic stimuli). Outward participants show higher distress in front of negative empathic stimuli, because of their higher sensibility to other emotions. Interestingly, we found a positive correlation between PD sub-scale and field-dependent participants. As mentioned above, field-dependent subjects are characterized by a weak propensity to differentiate perceptual and other experiences from their backgrounds or contexts. Logically, these subjects have developed across life span a high intersubjective competences. By the way, our study is just a preliminary research with the intent to verify if emotional empathy correlate, in healthy subjects, with inwardness-outwardness dimensions of personality. As above described this correlation is to be deeper understood in the light of post-rationalist personality theory. We expect that further researches to be focused on the different ways people adopt to empathize, according to their personality style.

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THEORY OF MIND AND INTERSUBJECTIVITY: HOW TASK SOCIAL PARTNERS, ATTACHMENT REPRESENTATION AND CAREGIVING SETTINGS INFLUENCE MENTALIZATION

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ABSTRACT

The purpose of this study was to investigate the relationship between the development of Theory of Mind and the structural and socio-relational aspects of domestic and scholastic interactive contexts. In particular it explores the changes in ToM performance at the light of the use of specific social partners in ToM tasks, of the attachment representation, and of the children's past experience of caregiving contexts. One hundred thirty-one pre-school children (4 and 5 years), chosen on the basis of three different caregiving contexts (from 0 to 3 years: Home, Day-nursery, Family-time) were given two theory of mind tasks to assess understanding of mind and two versions of the Separation Anxiety Test (Family and School version) to assess attachment representations. Results show differences between performances at the two ToM tasks, highlighting the importance of social and relational factors in mind understanding. Moreover, although data confirm the existence of a link between the good quality of the representation of attachment and ToM performance, past contextual and relation-significant experiences seem to play a role in determining the specific characteristics of this link.

Keywords: theory of mind, attachment, caregiving contexts, intersubjectivity

1. THEORETICAL FRAME

The research on Theory of Mind (ToM) development have supplied many evidences to support the idea that the ability to understand both our own and other people's mental states can be relevant to the individual's social development. Several studies show that social and cultural factors would contribute to the development of ToM (e. g. Astington, 1999; Repacholi & Slaughter, 2003; Antonietti et al., 2006). The purpose of this study was to investigate the ToM development from a social and cultural perspective: it recognizes

a crucial importance to the role of intesubjectivity , assuming that the development of ToM abilities is a multilateral issue (Astington, 1999; Arranz et al., 2002; Jenkins et al., 2003). More specifically, this study aims to integrate and deepen the emergent evidence from 3 different spheres of research into ToM: 1) the role of significant social partners (caregivers) when they are used as characters into ToM tasks; 2) the possible influence of children's past experience of caregiving contexts (Home, Day-nursery, Family-time), 3) the link between the security of the attachment and ToM development. Age effect and interactions between these conditions will be also considered.

1.1 ToM tasks with a socio-affective connotation or emotional content.

One of the first attempts in using a new methodology (and therefore different context and situation) to explore ToM was made by Harris and his colleagues (1989): they asked whether children are able to forecast emotions correctly, bearing in mind simultaneously beliefs and desires (see also e. g. Bosacki & Astington, 1999; De Rosnay & Harris, 2002). They found that children between 3 and 7 years of age are progressively more capable to describe the emotional reactions of a person on the basis of a personal estimation of the situation, rather than on the basis of a objective evaluation of that own situation. The child progressively understands that the emotion depends on the relationship between desire and the "expected" reality, however in some cases what really happens can be very different from the "expected" one. Symons and his colleagues (1997) moved their focus from the classic false belief task (Wimmer & Perner, 1983; Perner & Wimmer, 1985) to a richer one, more respectful of the variety of elements which are usually implied in real situations. They substituted the deceptive box and the moved object with a human character or even a significant social partner, with the intention of implementing the interpersonal processes and make the test more real. They found that the presence of an emotionally relevant character does not affect 5-6 year children's ToM performance by itself; instead, the nature of the action played by this new character – autonomous and self-willed rather than based on external constrictions – has important repercussions. Symons & Clark (2000) verified that the performance of the 5-year-old children in the false belief task changes when the caregiver shows his/her intention of modifying his/her own position. In the same way Nguyen & Frye (1999)

investigate the understanding of mental states which characterize social interaction: they redefined the traditional task in terms of comprehension of desires, beliefs and emotions which come from the necessity to interpret a social situation in which characters' mental states interact. Children's performance seems to be influenced by the presence of multiple mental states: if 5 year-old children show a greater capacity of differentiation, 3 year-olds have trouble in understanding the desires, when the characters do not agree on them. Nguyen & Frye (1999) hypothesize that the capacity to recognize and manage the congruity or incongruity in characters' mental states forms the understanding of social situations. De Rosnay and colleagues (2004) explored ToM development using both a classic version of the false belief task (a simplified version of the dog-rabbit test of the experiment 2 from Harris et al., 1989) and the MIST (mother-infant separation task from De Rosnay & Harris, 2002). The MIST is a video-based task that aims to evaluate children's reactions to the departure of the mother together with the infant positive expectation that the mother is returning. De Rosnay and colleagues used two different versions of the MIST, based on high and low expressed emotion conditions. In the first one the principal character of the story (a child) is explicitly upset for the mother's departure; in the other one the child appears relaxed when the mother leaves. The results showed a gap between false belief and emotion understanding: children had a better performance in false-belief question than in emotion attribution. The results also showed that the absence of any negative reaction make the prediction of the principal character's emotion (but not of his/her false belief) easier.

1.2 ToM and attachment

The existence of a link between the theory of attachment and ToM has been proved by a substantial amount of scientific evidence. With regard to the mother's role, Symons and Clark (2000) showed that the child's performance in false belief tasks with reference to the caregiver at 5 years of age is predicted by the sensitivity and maternal distress shown when the child is 2. Meins and colleagues (1998) highlighted a significant relationship between the maternal sensibility (Ainsworth et al., 1971) measured when the child is 6 months old and his/her ToM ability measured with a variety of tests done between 45 and 55 months. In particular they focused on maternal mind-mindedness, – the mother's proclivity to consider her child like a person with a mind – and found out a link between this propensity and child's ToM performance.

Meins and colleagues (2003) showed further evidences to consider mind-mindedness – more than the general concept of maternal sensibility – and attachment security as possible predictors of ToM understanding. Considering the child's role, Fonagy and colleagues (1997) explored the correlation between the security of the attachment, measured with the separation anxiety test (Klagsbrun & Bowlby, 1976), and the competence of the children in ToM, measured using the belief-desire task (Harris et al., 1989) at a pre-school age and during the first few years at school. The results showed that the security of attachment is a significant concurrent predictor of the ability of mentalization. Meins and colleagues (1998) found out that the security of attachment measured by the Strange Situation procedure (Ainsworth & Wittig, 1969) is a predictor of the performance of the 4 year-old child in ToM (see also Meins et al., 2002; Sharp & Fonagy, 2008). De Rosnay and Harris (2002) verified the possible influence of the behaviour of affectively relevant people on the ability to understand emotions: in particular they used the MIST task to assess ToM, and the Separation Anxiety Test to measure the attachment security. The results confirmed a close connection between the quality of the attachment relationship and the child's ability of mentalization. Repacholi & Trapolini (2004) focused their attention on the attachment relationship and ToM in pre-school children in order to evaluate how the attachment may predict children's individual use of their social understanding across different relationships. The results showed that children with a less secure attachment had a lower ToM performance; moreover they also met more difficulties to reason about mother's beliefs than about stranger's ones (see Greig & Howe, 2001).

1.3 Development and professional day-care contexts

Life and job conditions drive always more often family to leave their child in day-care institutions, also when children are very young. In these new contexts children have the opportunity to establish new relationships both with caregivers and peers: these new patterns of arrangement may have different influences on the abilities - included ToM - which the children are developing. Belsky (2001) – in a recent review of fifteen years of contributes on developmental risk associated with early child care – stresses the importance of non-maternal child-care effects on child development, because he thinks that it is a valid and fundamental field of research for the child's well being. De Schipper and col-

leagues (2003) explored the relation between the quality of the centre of day care (measured in terms of flexible child care) and the children's socio-emotional functioning. They found that the stability of care plays an important role for the development of socio-emotional functioning; in this sense the day-care centre can definitely contribute to the stability of this construct. The NICHD Early Child Care Research Group Network (2003, 2008) underlined some interesting links between non-maternal child care experience in the child's first three years and mother-child interactions when children are older. In general they found positive relations between these two variables under certain conditions.

Spieker and colleagues (2003) tested both compensatory hypothesis (the mitigation of the adverse effects of insecure attachment on cognitive and language development, by providing children with a more stimulating environment) and lost resources one (the idea that out-of-home care would negatively affect secure children's ability development, see also Booth et al., 2003): they explored the possible link between child care and attachment security – on one side – and cognitive and language outcomes of low-income toddlers – on the other side. The results supported the compensatory hypothesis, but not the lost resources hypothesis.

Though literature have not closely considered non-maternal child care effects on mind understanding development yet, it appears quite evident the presence of a connection between non-maternal child care and the general child development, included child social functioning and competence.

2. AIMS

The aims of this study are: A) to explore possible links between children's performance in a ToM task with a social reference and a ToM task emotionally connoted; B) to inspect the possible influence on ToM development carried out by the contexts the child is exposed to in the period before going to the nursery school (from 3 to 6); C) to verify whether the quality of the attachment relationship is significantly associated with the ToM. Age effect and interactions between these conditions will be also considered.

3. METHOD

3.1 Participants

One hundred thirty-one Italian children (63 boys and 68 girls) from the first year (4-year-old group, average age: 3.9; range 3.2-

4.3) and from the second year (5-year-old group, average age 5.1; range 4.2-5.4) of the nursery school[1] participated in this study. The children were chosen on the basis of 3 different caregiving contexts experienced from the age of 0 to the age of 3: Day-nursery, Family-Time, and Home.

The Day-nursery is the classic Italian institution for the reception of infants between 0 and 3; in this context children can usually socialize under the supervision of teachers and/or professional personnel. The child's relatives are not commonly full present into the Day-nursery even if they are allowed and encouraged to stay with the child during the first weeks of attending in order to facilitate the child to familiarize with the new context and people. The family time is a service for infants between 0 and 3 which allows children to carry out communal activities together with relatives (mother, grandmother, etc.); in this context children have always the opportunity to start socializing with new people, but unlike the Day-nursery, the presence of a child's relative is constantly allowed. The Home is the familiar context: children between 0 and 3 who are cared at their own house, without the support of specific institution.

All the participants of this study belong to an average socio-economic and cultural level. Structural information were gathered using a specific questionnaire.

3.2 Procedure

The children were tested individually through two sessions in a quiet room of the school. Each session lasted 20-25 minutes, with an interval of 3-5 days between the two sessions. Before the assessment, a familiarization period was carried out.

The following tests were given to the children: 2 attachment relationship tasks – the family SAT (Liverta Sempio et al., 2001) and the school SAT (Liverta Sempio et al., 2001), the false belief task with social reference (adapted from Symons et al., 1997; Nguyen & Frye, 1999), and a belief-desire reasoning task (Harris et al., 1989). The order of presentation was randomized.

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[1] The nursery school is the institution for children from 3 to 6.

4. INSTRUMENTS

4.1 The belief-desire task (Harris et al., 1989)

We used the second type of the belief-desire tasks originally used by Harris and colleagues. The character of the story, an animal, is tricked by Mickey, a despite friend, who exchange the character's preferred food or drink with another desirable one. Child is asked about the character's feelings before and after discovering the substitution. Positive and negative emotions (happiness and sadness) are tested and emotion word order in asking questions is controlled. Therefore, four versions of the task (emotions X word order) were administered: two happiness versions which considers positive emotions, and two sadness versions which explores negative emotions. The belief-desire task has been used by Fonagy and colleagues (1997) to evaluate the possible relationship between the development of a ToM and the attachment security; it has been chosen because particularly appropriate for gathering the emotional component in understanding mental states. The coding system distinguishes between incorrect responses (0 points) and correct ones (1 point) both in the check questions and in the emotional forecast questions (sadness, happiness). The justification of predicted emotion questions have been codified following Harris and colleagues' criteria (1989). The scores obtained in the 4 versions which make up the belief-desire task were unified according to the emotion (for a minimum of 0 points and a maximum of 2): two scores were obtained, one relative to the performance with versions indicating the emotion of happiness and the other the emotion of sadness. A total score has been calculated from the sum of all the scores (for a minimum of 0 points and a maximum of 4).

4.2 First order false belief task with social reference (adapted from Symons et al., 1997; Nguyen and Frye, 1999)

This task has been specifically developed for this research: Symons and colleagues' task (1997) has been integrated with Nguyen and Frye's one (1999). The instrument by Symons and colleagues (1997), who substituted the unexpected transfer of an object with the unexpected transfer of a person, was integrated with the work by Nguyen & Frye (1999) who proposed an intentional Vs. unintentional unexpected change of activity as motivation of the caregiver's whereabouts The plot of the task has the following prerogatives: 1) a boy or a girl (depending on the sex of the examined child) has an interaction with his/her own caregiver. Two

caregivers, mother and teacher, as well as two contexts – family and school – are used; 2) the caregiver goes away explaining the reason for his/her absence, indicating the destination and promising to come back quickly: 3) unknown to the child, the caregiver changes his/her mind and moves to a different place.

The unexpected change can be determined by the caregiver's wishes or by an external factor (internal Vs. external situation). Four versions of the task (context X motivation of the unexpected change) were administered. The replies to the check questions about the reasons for the caregiver's absence and the false belief relative to the caregiver's whereabouts have been codified as incorrect (0 points) and correct (1 point).

The scores obtained with the four versions were sorted in pairs, according to the context and the motivation (for a minimum of 0 points and a maximum of 2). A total score was also calculated adding up all the four scores (for a minimum of 0 points and a maximum of 4).

4.3 Separation Anxiety Test

Family SAT (Liverta Sempio et al., 2001). Starting from the version used by Fonagy and colleagues (1997), the test was translated and updated by Liverta-Sempio et. al. (2001) using new photos and integrated with various aspects from the previous versions (Hansburg, 1972; Slough & Greenberg, 1990).

It is made up of 6 items which present and describe situations of separation from the parents (equally divided in number between medium and strong intensity): e.g. "The mother and father are going away for the weekend and leaving (the child's name) with the baby-sitter…(strong intensity); the mother is putting (the child's name) to bed and then leaves the room…(medium intensity)". For each item there are 3 questions: the first 2 are relative to the feelings (How do you think (the child's name) feels?/Why do you think (the child's name) feels (the sentiment indicated by the child)? The third is about the "coping" (What do you think (the child's name) will do?).

The coding system (Slough et al., 1988) brings to three scales: attachment index – the capacity to express vulnerability or need as far as the separation is concerned; self-confidence index – the ability to show self-confidence in coping with the separation; avoidance index – the degree of evasion in discussing the separation. These three dimensions can be combined, adding the attachment and self-confidence score to the inverse avoidance score, to obtain

a total score for the security of attachment (Fonagy et al., 1997).
School SAT (Liverta Sempio et al., 2001).
This test was developed on the basis of Family SAT, to evaluate
the anxiety of separation within the school context with reference
to the relationship with the teacher. The criteria of administra-
tion, as well as the coding system of the children's responses, are
derived from Family SAT.

5. RESULTS

We will report the results about the first order false belief task with
social reference and belief-desire task. Then we will consider the
relationship between these two tasks, as well as the possible diffe-
rences between caregiving contexts in terms of ToM performance
and the score obtained at the Family SAT and the School SAT.

5.1 ToM performance: a descriptive overview

Descriptive analyses show that the subjects' performance at the first
order false belief task with social reference is constant and therefore
apparently independent from the specific characteristics of the
different versions of the task. These results do not replicate Symons
and colleagues (1997) and Symons & Clark (2000) who found
an influence of caregiver's intentions on children performance.
Considering all the sample, results showed a strong polarization
of the performance at the first order false belief task with social
reference both for Family or School contexts, and for intentional
or unintentional motivation (respectively 44.7%, 45.5%, and
44.7%, 44.7% for the score 0, and 42.4%, 40.9%, and 41.7%,
40.9% for the score 2). On the contrary there was no polarization
for the performance at the belief-desire task. In both the emotional
contexts we found an increase of the percentage of subjects who got
1 point and obtained a medium performance (happyness version:
0 point: 48.5%; 1 point: 17.4%; 2 point: 34.1%): sadness version
(0 point: 44.7%, 1 point: 25.8% 2 point: 29.5%).
In accordance with Harris et al. (1989) – see also De Rosnay and
Harris (2002) – it seems that the emotional factor is not a facili-
tating factor; on the contrary it might hinder the correct passing
of the test itself.

5.2 Age and ToM

Within the 4 year-old age group we find a significantly higher per-
formance at the belief-desire task than at the false belief task with

social reference (t=2.30 df 61 p < .05). The tendency is reversed for the 5 year-old group (t=3.50 df 61 p < .01). These results support the idea of an age effect on the understanding of false belief but not on the processing of emotions based on beliefs (see for example De Rosnay and Harris, 2002). In fact an ANOVA with age as independent variable shows that there is no significant difference for the performance at the belief-desire task (F (1,130)=1.43 n.s.), while the performance at the false belief task with social reference differs significantly (F (1,130)=28.06 p < .001).

The social reference would influence the ToM understanding in a significant way (see also Marchetti & Gilli, 1995; Battacchi et al., 2005), whereas the processing of emotion would probably take longer to consolidate and, therefore, it interferes with ToM performance across the two explored ages.

5.3 Age, caregiving contexts, and ToM

The interaction between age and context shows some note-worthy differences.

The performance of 4 and 5 year-old children who experienced the Day-nursery is very similar to the general tendency found out for all the sample: the performance at the belief-desire performance is better than the peformance at the false belief task with social performance for the youngers (t=2.21 df 20 p < .05) while the difference is overturned for the olders (t=3.08 df 24 p < .05). For the children who experienced the Family-Time, significant differences persist only for the olders (t=2.06 df 20 p < .05), and they disappear for both of the age-groups when the children experienced the Home context. Thess data support the idea the context of life influences the development of the performance in the two ToM tasks considered.

5.4 Attachment, caregiving contexts and ToM

The 4-year-old children who experienced the Home context or the Family-Time obtained a significantly higher score at the Family and School SAT than children who experienced the Day-nursery (F(2, 59) = 6.284, p < .01; F(2, 59) = 6.094, p < .01).

An ANOVA of the performance in the ToM tasks with the Family SAT as an independent variable was carried out. The results show that children with secure and ambiguous attachment obtained a higher score at the false belief task with social reference than children with an insecure attachment. No significant differences

in the belief-desire task between the three groups of attachment were found.

Grouping the children on the basis of the caregiving contexts, an ANOVA of the performance at the ToM tasks with Family SAT as an independent variable does not show significant differences for the subjects who experienced the Family-Time. Instead among the children who experienced the Day-nursery, secure and ambiguous subjects had better results than insecure ones in the false belief task with social reference $(F(2, 43) = 3.785, p < .05)$; in particular the differences were found in the total score of the school versions $(F(2, 43) = 4.242, p < .05)$ and in the total score of the internal-motivation versions $(F(2, 43) = 5.011, p < .05)$. With reard to the children who experienced the Home context, the secure and ambiguous subjects did better in the two versions of the false belief task with social reference with the family context $(F(2, 43) = 3.953, p < .05)$ and in the happiness version of the belief-desire task $(F(2, 43) = 3.329, p < .05)$.

As for the School SAT as an independent variable, it seems that secure and ambiguous children who experienced the Family-Time had a significantly higher performance than insecure ones in all the tasks (except for the happiness version of the belief-desire task) (total score of the false belief task with social reference $F(2, 43) = 4.33, p < .05$; sadness version of the belief-desire task $F(2, 43) = 4.06, p < .05$). In the other two caregiving contexts the representation of the attachment quality with the school caregiver does not determine any significant variation as far as the given task performance is concerned.

6. DISCUSSION AND CONCLUSION

Our analyses on the performance at the false belief task with social reference show a polarization. The total success of a so consistent portion of the sample might be due to a general effect of the social component used in the task, even if no significant differences were found between the four versions used. The polarization, on the other hand, can be explained in terms of the acquisition of social routines which would help – when available – the child to manage contexts and situations; therefore, they would support the relationships and the explanation of the behaviour in terms of mental states (Marchetti & Gilli, 1995; Battacchi et al., 2005). According to Haslam and Fiske (2004), ToM ability would not be the unique component of our social capability. On the contrary ToM would be in many respects secondary to a wider relational

thinking, which would help people to mange relations among people rather than links among contents of other minds. In other words, we can imagine the existence of an indirect model to interpret behaviour—a model based on social routine interpretation of a series of motivational and relational dynamics which more frequently characterized the child's experiences. This explanatory outline, once acquired, would support a high level performance of the child in understanding the mental aspects which characterize events; these events would be similar to those presented in the false belief task with social reference. The lack of differences between the 4 versions of the task leaves open the question about the specific factors which would cause the general effect of facilitation for this task.

Marvin and Britner (1999) say that children, starting from the age of 3 – develop the ability to process some information (discrepancies between different points of view, the specificity of caregiver's goals, thoughts, and desires, past experiences like source of elements for interpreting the reality etc.) This emergent ability allows the child to establish a goal-oriented relationship with the caregiver. The children of our sample are plausibly developing this competence; they might be able to face the separation from the caregivers as presented in the false belief task with social reference; in fact it would be sufficiently explained and therefore approachable by the common sense of the previous life experiences. Then, they would be able also to process the task on the basis of the information recognizable from the story—that is to say what the child knows and thinks about his caregiver's movements.

Considering the performance in the belief-desire task (and in particular the sadness version), we had high percentage for the intermediate scores. The process of emotional components is a very complex activity, and their recognition seems to interact with the other social-relational dynamics involved in the context in which emotions are experienced. The possibility of making this connection seems to depend on the quality of the emotion: it would directly influence the ToM interpretation of the events. These results are coherent with the literature (e.g. Harris et al., 1989; De Rosnay & Harris, 2002): the emotional factor would hinder the correct passing of the test more than facilitate it.

The children's performance in false belief task with social reference increases significantly with age, whereas the improvement in the belief-desire task is much more restricted. The structure and the contents of the false belief task with social reference (e.g. a gre-

ater contextual family sense and/or a greater coherence with the consequent expectations) might be able to help the child in his/her ToM understanding, more than an important but exclusive focus on the emotional dynamics.

As for the caregiving contexts we found that the children who experienced the Day-nursery showed the same results for the ToM tasks found for the whole sample: if 4-year olds do better at the belief-desire task, 5-year olds have a significantly higher performance at the false belief task with social reference. This difference disappears when we look at the children who experienced the Home context. Children who experienced the Family-Time context show a difference at 4 years (and thus a better score at the belief-desire task). This trend can be interpreted in terms of support of significant affective-relational instances and ties. In this sense, the Day-nursery context seems to be the only one able to offer less support, as if introducing the child to a new context in which he/she has to establish a new relationship with a significant caregiver slows down the development of the ability to effectively coordinate various instances in interpreting social life and, in the final analysis, to interpret facts in terms of mental states. The lack of differences for the children who experienced the Home context is coherent with this interpretation: not only a greater stability of the maternal caregiver, but also a stronger definition of the contextual aspects could contribute to the development of ToM. The data concerning the Family-Time context group adhere to this viewpoint. In fact there is a difference only for the 4-year-olds. This context, which is intrinsically half-way between the Home and the Day-nursery, would better support the child in developing an emotional and affective competence than the Day-nursery context. Overall, it seems that these kind of results drive to focus on the pragmatic aspects of the day-care contexts. Caregivers of these centers should support relational needs of the child and his family, caring the delicate phase of the separation from parents and making the permanence in new spaces (and the establishment of new relationships) a useful opportunity of development for children (e.g. Spieker et al., 2003; Booth et al., 2003; NICHD Early Child Care Research Network, 2003; De Schipper et al., 2003).

As far as the attachment relationship is concerned, children who experienced the Day-nursery obtained significantly lower scores in the Family and School SAT total scale scores compared to children from the other two contexts. A premature exposition to new contexts and significant alternative relationships could interfere

with the development of relational competences. In the same way we can interpret the differences between the attachment groups at the ToM tasks. Considering the Family Sat, we found that the representation of the attachment seems to cause a variation in the ToM performance, above all for the children who experienced the Day-nursery. It is plausible that for the children who experienced the Home context and the Family-Time the past consistent relational and contextual experiences guarantee a better development in ToM. Considering the School SAT, the largest significant difference was found between secure/ambiguous children and insecure ones at ToM tasks, for the children who experienced the Family-Time. The Family-Time looks like an half-way reality between Home and Day-nursery: it does not favor the ToM and relational competence transition like Home context does, but, differently from the Day-nursery, it does not hinder the transition completely.

This study seems to confirm the existence of a close connection between social, emotional and relational factors in interpreting human behaviour using the ToM. However each of these elements, taken individually, does not apparently influence the child's ToM abilities to a great extent. Caregiving contexts seem to play a relevant role in this interactive equilibrium, contributing to the child's success to understand and mange intersubjectivity. Future studies may try to comprehend and deepen the specific mechanisms which regulate these interactions in order to identify the dynamics which consistently contribute to the development of the comprehension of intersubjectivity.

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SOCIAL GAMES BETWEEN BONOBOS AND HUMANS: EVIDENCE FOR SHARED INTENTIONALITY?

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ABSTRACT

Triadic social games are interesting from a cognitive perspective because they require a high degree of mutual social awareness. They consist of two agents incorporating an object in turn-taking sequences and require individuals to coordinate their attention to the task, the object, and to one another. Social games are observed commonly in domesticated dogs interacting with humans, but they have received only little empirical attention in nonhuman primates. Here, we report observations of bonobos *(Pan paniscus)* engaging in social games with a human playmate. Our behavioural analyses revealed that the bonobos behaved in many ways similar to human children during these games. They were interested in the joint activity, rather than the play objects themselves, and used communicative gestures to encourage reluctant partners to perform their role, suggesting rudimentary understanding of others' intentions. Our observations thus may imply that shared intentionality, the ability to understand and share intention with other individuals, has emerged in the primate lineage before the origins of hominids. Implications for intersubjectivity will be discussed.

Keywords: shared intentionality, social games, communicative signals, great apes

1. INTRODUCTION

From early childhood, human infants interact with others dyadically in coordinated, turn-taking play sequences, so-called social games (Trevarthen, 1979). As objects are integrated, these games become more complex and triadic, requiring coordination of attention both to a task and object and to one another (Ratner & Bruner, 1978). Triadic games have also been documented in interactions between dogs and humans (e.g. Mitchell & Thompson, 1993), humans and dolphins (Kuczaj & Highfill, 2005) and between dolphins (McBride & Hebb, 1948). In contrast, social games in non-human primates (hereafter primates) are almost always dyadic, rarely involve objects and if so usually in a competitive

way (Pellegrini & Smith, 2005). Apes sometimes show triadic engagement, but these interactions appear different from those observed in children, especially with regards to joint attentional episodes (e.g., Tomasello et al., 2005). Consistent with this view are recent results by Warneken and colleagues (2006), who compared the cooperative skills of children and human-raised chimpanzees in two problem-solving tasks and two triadic social games. In the social games, the adult human partner was instructed to suddenly stop participating to provoke the subject into responding in ways that might reveal their understanding of the cooperative nature of these games and the roles required. While most children tried to encourage the human playmate to resume his role by using communicative signals, this was never observed in the chimpanzees. One interpretation of these results is that primates may be interested in achieving individual goals, whereas children are also capable of pursuing shared goals (Warneken et al., 2006). It has been argued that such observations provide evidence for what might be a uniquely human form of social intelligence (Tomasello, et al., 2005), the ability to share intentions (Bratman, 1992). Shared intentionality refers to collaborative interactions in which participants (1) are mutually responsive to one another, (2) pursue a shared goal, (3) and coordinate their plans of action for pursuing the shared goal (Bratman, 1992). Here, we report observations of four bonobos (Pan paniscus), who engaged spontaneously in different types of triadic social games with human playmates. In line with previous methodology (Ross & Lollis, 1987), we deliberately interrupted these games to investigate if the bonobos encouraged the recalcitrant partner to perform her role by using communicative gestures.

2. METHODS

Study site: The sanctuary Lola ya bonobo houses about 50 wild born individuals of all age-sex classes in four enclosures, containing natural forests, water basins and numerous objects (e.g. balls). The two enclosures concerned in this study were 14 and 10 hectares woodland areas, which included 12 and 13 individuals respectively. Participants and data collection: Observations took place during February-April 2006, 6-7 days a week, for about 6-8 hours per day. Social games were initiated between three humans (SP, AK, and CP) and four bonobos: KD and ML (infants), LS (subadult female), and KW (adolescent male). In each case the human playmate tried to instigate a social game involving various objects on

an ad-libitum basis. Once a triadic interaction was established and was relatively stable, the human playmate suddenly and deliberately stopped the interaction. Interactions were filmed using a digital camcorder (Panasonic NV-GS 250). We recorded the number of gestural signals that individuals produced before and after the interruption. We defined gestures as expressive movements of limbs or head or body postures directed towards a recipient in a goal-directed and mechanically ineffective way, receiving a voluntary response (Pika, in press). Gestures were coded as intentionally produced, if accompanied by eye contact, and/or waiting after signal production; expecting a response (Pika, in press).

Table 1 lists the different gestures considered for this study.

Data analysis: SP coded all gestures from videotapes. Ten percent of all videotapes were recoded by a second observer. There was 80.0% agreement between coders concerning classification of gestures, using a Cohen's Kappa reliability test (Altmann, 1991).

Table 1. Communicative gestures produced by different bonobo individuals before and after disruption of triadic social games

BEG	Signaler outstretches her right or left hand with palm facing up toward the recipient.
GRAB	Signaler takes hold of the recipient with the whole hand; fingers are bent.
HEAD BOB	Signaler bows the head up and down toward the recipient.
OFFER	Signaler extends her arm with an object in her hand and holds it in front of recipient.
PALM OPEN AND CLOSE	Signaler outstretches her right or left hand with the inside facing sideways while opening and closing the hand.
PROTRUDED LIPS	Signaler sticks out her lips and upends her upper lip; the teeth are visible.
TOUCH	Signaler does a gentle and short (< 5 sec) contact using her flat hands, body part or feet.
STOMP WITH FOOT	Signaler brings the sole or heel suddenly and forcibly against or upon the ground, object, or walks in a pounding manner.
WIGGLE LEG	Signaler shakes the lower extremities from side to side in front of the recipient.

3. RESULTS

We observed four different triadic social games with four different bonobos interacting with a human playmate. When a game was deliberately interrupted (only the object splash game stopped naturally), individuals reliably produced gestures in an attempt to reengage the reluctant partner. All the observed gestures were part of the bonobos' natural repertoire (Pika et al., 2005).

Social game 1, "Hand-splash": This game was observed on two different days with the two infants. KD, sitting alone in the waterbasin, initiated the first game by splashing water with his legs. SP also splashed water, using her hand as the object of play. In response, KD approached SP, sat down next to her, while SP continued splashing more water. Then she abruptly stopped the game, leaving her hand in the water. KD responded by *grabbing* and *touching* her hand. SP splashed more water and then stopped the game for a second time, this time taking her hand out of the water. KD responded by *touching* SP's hand. SP did not react, and KD then *grabbed* her hand. SP responded by continuing the game a total of seven times (see supplementary video clip 1). No communicative gestures were recorded during the game but as soon it was interrupted the infant generated the gestural signals grab and touch. This game was also instigated three times with ML, who also used the gestures grab and touch as soon as the game was interrupted.

Social game 2, "Object-splash": This game occurred between SP, the infant KD, and a round, hard Makalakonki fruit. The interaction started when SP lifted the fruit out of the water and let it drop, producing a splash in the direction of KD. The floating fruit was retrieved by KD, carried to SP, and *offered* to her. SP took it and repeated the procedure. Again, KD went off to retrieve and *offer* the fruit to SP. The game was repeated four times until KD started interacting with a conspecific. KD only produced communicative gestures *(offer)* as soon as the game was interrupted.

Social game 3, "Fruit-ball: This game was observed on two different occasions between CP, the bonobo male KW, and a grapefruit. It started with KW playing with two grapefruits while facing CP through the wired mesh of the enclosure door. KW pushed both fruits through the door mesh, joggled, and rolled them on the ground. Accidentally, one fruit rolled out of reach. CP initiated an interaction by rolling it back. KW played with it, but then lost it again. Again, CP rolled it back. KW joggled it around, pulled it into the enclosure, and pushed it out with two feet, this time

letting it roll to CP. Then CP and KW rolled the fruit back and forth repeatedly. Suddenly CP stopped the game, and joggled the fruit in front of KW. KW looked at CP and used different gestures (*beg*, *stomp* against the door, *head bob*, *palm open and close*, *protruded lips*) until CP rolled the fruit back. The game went on for 10 minutes, interrupted two more times by CP. Each time KW looked at CP and subsequently used the gestures *head bob*, *palm open and close*, *protruded lips*, *respectively head bob*, *stomp*, *palm open and close*, *protruded lips* to reinstate the game (see supplemental video clip 2). In addition, the game was interrupted twice by other group members who tried to get the fruit or wanted to play with KW. KW played shortly with them, always protecting the fruit. Both times he returned and restarted the game with CP by rolling the fruit to him.

Social game 4, "Object-throw": This game was observed on three different days between the bonobo LS, the human playmate AK, and a nut. LS found a nut in the sand of the enclosure, stuck her hands through the door mesh and spontaneously threw it to AK. AK handed it back and LS threw it back to her. This time AK also threw it back to LS. After a few more iterations, AK suddenly stopped the game. LS first looked at her then performed a variety of gestures (*wiggle* her leg, *beg*; see supplemental video clip 3). Suddenly she found a different object, a yellow cap, and restarted the game by throwing it to AK. AK threw the nut back, but LS now preferred the cap. When AK stopped the game again, LS used different gestures (*wiggle* her leg, *protruded lips*, *beg*). Then AK restarted the game throwing back the yellow cap. On the second occasion, AK threw the cap, and LS threw it back. Then AK stopped the interaction and LS performed the gestures *protruded lips* and *beg*. Other animals then interrupted the game. On the third occasion, AK and LS played with a nut again. When AK stopped the game, LS *wiggled her leg* and *protruded the lips*. AK continued to play more rounds and then stopped the game again. This time LS used the gesture *beg* and *protruded her lips.*

4. DISCUSSION

We described four different social games played by four bonobos interacting with human playmates and different objects. Our observations showed that bonobos readily engaged in these kinds of triadic games, by playing different but complementary, inter-dependent, and parallel roles. These observations are in line with previous observations in some non-primate animals, particularly

dolphins (e.g. Kuczaj & Highfill, 2005) and dogs (e.g. Mitchell & Thompson, 1993). Similar observations have been described for primates, but they were anecdotal and restricted to language-trained and/or human-raised apes, who received extensive training (e.g. Crawford, 1937; Gomez & Martin-Andrade, 2002; Matevia et al., 2002). The bonobos of this study used gestures in a flexible way to achieve a social goal, namely to reengage a suddenly passive partner. Our results contrast with a recent comparative study on children and chimpanzees (Warneken, et al., 2006). In this study, upon encountering a reluctant partner, the chimpanzees immediately switched from a superficially social action to an individual attempt or complete disengagement. Contrarily, children tried to reorient the experimenter toward the game and his part in the cooperative interaction (Warneken, et al., 2006). The authors suggested that the children, but not the chimpanzees, had learned to form with others a joint goal and joint intentions for reaching that goal. Importantly, the chimpanzee results were used to argue in favor of a fundamental cognitive difference between humans and primates in terms of the ability to share intention. Our study suggests that it may be premature to draw firm conclusions about an animal-human difference in this cognitive domain. We are less pessimistic also because (a) in other paradigms chimpanzees have been observed to use communicative gestures to solicit reluctant partners (e.g., Crawford, 1937), (b) gorillas have been observed to initiate triadic games with humans (e.g., Gomez & Martin-Andrade, 2002), and (c) dog-human play may fulfill criteria for shared intentionality outlined before (Mitchell & Thompson, 1993). However, attempts at re-engaging a reluctant partner are only one observational criterion for shared intentionality, and may not represent the right tools to elucidate the underlying psychological processes. In addition, it might be argued that the described games may be familiar or ritualized between the bonobos and their human caretakers, suggesting that their behavior was the outcome of simple operant conditioning processes. We do not think that this is a valid interpretation because the *object-splash* and *object-throw* games were spontaneously invented and most likely novel to the infants. It could also be argued that the bonobos used the human playmates as simple tools to restart interesting events, rather than perceiving them as partners in a joint activity with a shared goal. Although this interpretation seems plausible for the games played by the infants, it is more difficult to defend in the case of the *object-throw* and *fruit-ball* game played by the

older individuals, in which both participants behaved as if they had joint and complementary goals. Crucially, the bonobos were not interested in gaining possession of the objects per se, but they used them to enable a joint social activity.

In sum, the bonobos' performance in these cooperative interactions resembled those of human children (e.g., Ratner & Bruner, 1978) and, following Bratman (1992), showed two crucial criteria for shared intentionality: the partners were *mutually responsive to one another;* and together they were pursuing a *shared goal*, the social game. Children may go a step further by coordinating their plans of action and joint intentions to allow role reversal. This requires that both participants understand and jointly attend to both roles of the interaction and implies a true understanding of communicative intentions: to help the other with the complementary role. The communicative attempts of the bonobos to restart the game seem to provide evidence that they understood and attended to both roles of the game, although they never attempted to take on the role of the human playmate, perhaps pointing to a crucial difference between apes and humans.

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THREE LEVELS OF INTERSUBJECTIVITY IN EARLY DEVELOPMENT

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ABSTRACT

The sense of shared values is a specific aspect to human sociality. It originates from reciprocal social exchanges that include imitation, empathy, but also negotiation from which meanings, values and norms are eventually constructed with others. Research suggests that this process starts from birth via imitation and mirroring processes that are important foundations of sociality providing a basic sense of social connectedness and mutual acknowledgement with others. From the second month, mirroring, imitative and other contagious responses are by-passed. Neonatal imitation gives way to first signs of reciprocation (primary intersubjectivity), and joint attention in reference to objects (secondary intersubjectivity). We review this development and propose a third level of intersubjectivity, that is the emergence of values that are jointly represented and negotiated with others, as well as the development of an ethical stance accompanying emerging theories of mind from about 4 years of age. We propose that tertiary intersubjectivity is an ontogenetically new process of value negotiation and mutual recognition that are the cardinal trademarks of human sociality.

Keywords: intersubjectivity, development, reciprocation, value negotiation.

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1. INTRODUCTION

In the general sense, the concept of *Intersubjectivity* captures the way a person understands and *relates* to another. It is the phenomenon by which we share experiences with one another. Intersubjectivity implies that there must exist a bridge between *my self-acquaintance and my acquaintance of others.* In this paper, we discuss these issues from a developmental perspective. We identify 3 levels in the early development of intersubjectivity, the third one corresponding to what we posit as the foundation and main constitutive element of human sociality. Specifically, we explore the development leading the young child from a capacity to imitate, a capacity that we share with many other animal species, to the emergence of negotiation and mutual recognition that we

propose are cardinal features of human sociality. The concept of *intersubjectivity* is a common notion used to capture the product of interpersonal interactions that emerge from infancy and by which children begin to understand others' thoughts and emotions. Traditionally, intersubjectivity has been associated with language communication. It was assumed that only conventional language could make intersubjectivity possible. In the last few decades, however, new empirical research forced to broaden the meaning of intersubjectivity and to clarify its underlying mechanisms in ontogeny. Even if language radically transforms human ways of communicating, much evidence now exists in the field of infancy showing that intersubjectivity is an important aspect of psychology from the outset development, long before children learn to speak (Trevarthen, 1979).

2. FOUNDATIONS OF INTERSUBJECTIVITY

The philosophical problem of intersubjectivity was first raised in the context of the internal private mind postulated by Descartes in the 17th Century. The Cartesian proposal is that "the only single mind that I can have direct access to is my own mind". This claim allowed the conclusion that our first self-experience is a purely mental and solipsist experience. This notion left wide open the question of how we eventually got to know the mind of others. The post-Cartesian standard question became "How do I know the mind of others?" In contemporary philosophy and cognitive sciences, various models are proposed to answer this question.

A cognitivist solution suggests that to have access to others' mind requires necessarily the sharing common representations and meanings that are essentially given by language and meta-representational abilities, in particular the ability to generate "theories of mind". Such theories of mind would be based on either pure hypothetico-deductive representations or "theory-theory"(Baron-Cohen, 1995; Leslie, 1991; Gopnik & Meltzoff, 1997) or on an embodied simulation and other mirror or built-in empathic systems (Gallese & Goldman, 1998; Goldman & Stripada, 2005; Gallese, 2007).

Some philosophers point to the limits and inconsistencies of such accounts to resolve the "others' mind" understanding issue that was left out by Descartes. In particular, there are good empirical reasons to think that above and beyond either theory-theory or simulation processes, *non-conceptual* (pre-theoretical and non simulation) processes might also underlie the apprehension, if not

understanding of other's mind (Gallagher & Zahavi, 2008) These processes would include the direct detection of perceptual features pertaining for example to the bodily movements, motor signature and embodied emotional expressions of others, particularly facial features detected from birth (Rochat, 2001). Gallagher (2005), for example, proposes that the understanding of others rests essentially on the detection of embodied interactive or interpersonal practices. Embodied interactive practices would constitute the primary access by which we understand others. Following Gallagher, from a very early age infants would be attuned to the way others choreographed with facial expressions and postures what they feel and what might be on their mind as they interact with them. This proposal would entail that infants are born perceptually prepared to capture and eventually develop a sense of shared experience, certainly not born simply caught up in solipsist experiences and passively shut off from their social world. From the start, there would be some awareness of others structured within some basic intersubjectivity framework. Contrary to the pioneer ideas proposed by early psychologists, infants are not born in a state of confusion or a-dualism in relation to either objects or people (Rochat, 2001).

Next, we describe how intersubjectivity seems to develop from birth and in the course of the first 4-5 years of life. We propose that from basics biological mechanisms that are innate, namely mirroring and imitation mechanism that are the necessary foundation of intersubjectivity, infants quickly develop intersubjective propensities that entail reciprocation and mutual recognition, both trademarks of human sociality.

We proposed elsewhere that the sense of shared experience and of shared values develops primarily in a process of *reciprocation* that goes beyond the process of imitation and mirroring as copying (Rochat & Passos-Ferreira, 2008b). If an innate inclination to copy and simulate the behaviors of others could provide a basic sense of social connectedness and mutual acknowledgment of being with others that are "like me", these innate processes are essentially not creative, leading nowhere in themselves. In a strict sense, imitation and mirroring are closed loop "tit for tat" systems. More processing is therefore needed to allow for the social construction of meanings that drive human transactions (Rochat & Passos-Ferreira, 2008b). If mirroring processes might enable individuals to bridge their subjective experiences via embodied simulation (Gallese, 2007), human inter-subjectivity proper develops from reciprocal social exchanges and the constant negotiation of values with others. Infants

and young children develop to become *Homo Negotiatus*, and not just to become *Homo Mimesis* (Rochat & Passos-Ferreira, 2008a).

3. LEVEL OF INTERSUBJECTIVITY

We distinguish levels of "inter-subjectivity" beyond the primary vs. secondary distinction introduced years ago by Trevarthen & Hubley (1978), Trevarthen (1979) and Bruner (1983). We review this development up to 5 years of age when children show explicit understanding of the mental states that drive others in their behaviors, beliefs, and decisions (i.e., "theories of mind" in Wellman, 2002).

This development leads the child from neonatal imitation to the development of reciprocation starting at 2 months of age. By two months infants already appear to transcend basic mirroring processes by manifesting first signs of reciprocation in face-to-face exchanges (primary intersubjectivity). They soon engage in triadic intentional communication with others about objects (secondary intersubjectivity, starting approximately 9 months) and eventually begin to negotiate with others about the values of things, including the self as shared representations (tertiary intersubjectivity, starting approximately 20 months). This development culminates with the ethical stance that children begin to take around their fourth birthday when they begin to manifest explicit rationale about what is right and what is wrong, as well as "theories" regarding the mind of others.

The notion of tertiary intersubjectivity was proposed some years ago by Trevarthen (2006). In Trevarthen's conception, the tertiary level is the first- and second-person reflective and recursive intersubjectivity, in the sense of communicative understanding mediated by meta-representations, and symbolic references to actual and fictional worlds of imagination or joint pretense. We shed light on another feature of this third level of intersubjectivity. We are not particularly interested in the evident linguistic aspect that structured this third level. We investigate what is the interactive structure involving child and second person. Not interested in the grammatical second person, an abstract objet, expressed by the words such as "you", "thy", "tu", "voce", we focus here on the "real" person the child is concretely interacting with and with whom he or she will negotiate values, meanings, status, and reputation.

There are various levels of social connectedness associated with this development in relation to context, behavioral index, putati-

ve underlying process and chronological age. We propose a *road map* that would take the healthy child, starting the second month, beyond the basic mirroring and imitative processes, toward reci-procation, social negotiation, and ultimately the sense of mutual recognition and the explicit moral sense.

Table 1.

	TYPE	CONTEXT	BEHAVIORAL INDEX	PROCESS	AGE
I	Mirroring	Face-to-face engagement	Imitation	Automatic simulation	birth
II	Primary Inter-subjectivity	Reciprocal dyadic exchanges	Proto-conversation, social expectations	Emotional co-regulation	2m.
II	Secondary Inter-subjectivity	Triadic exchanges about things	Joint attention; social referencing	Intentional communication and intentional co-experience	9m.
IV	Tertiary Inter-subjectivity	Triadic exchanges about the value of things	Self-recognition and embarrassment, use of possessives, claim of ownership, pro-social behaviors	Projection and identification of self onto others	20m.
V	Ethical stance	Decision regarding the value of things, what is right vs. wrong	Claim of ownership, sharing, distributive justice, theories of mind	Value negotiation with others, narration, meta-representation of reputation	From 4 y.
(This table is reproduced from Rochat & Passos-Ferreira, 2008b)					

3.1. Mirroring and Imitation

Imitation and mirror processes are important foundations for sociality, that entails the capacity to relate, interact and possibly re-present or simulate, hence "bridge" self with others' experience. These capacities, called *innate intersubjectivity* by Trevarthen, (2006) show that humans are born with an innate communicative competence given by biological mechanisms that have an impor-tant impact on learning, recognizing and thinking. In reproducing the behavior of others we create inter-subjectivity, bridging self

and others' experience as suggested by current simulationist theories that find validation in the discovery of mirror neurons. The basic mirror processes expressed at birth probably correspond to innate social binding mechanisms. They are basic resonance processes (Gallese, 2003) that allow the child, from the outset, to match self and others' experience. These mechanisms allow for a necessary starting state of implicit inter-subjective equivalence. Endowed with, and capable of such processes, infants from birth would automatically perceive others as "like them". This basic, obligatory perception would be mediated by sub-personal innate mirror mechanisms (i.e., neural mirror systems).

Developmental and comparative theorists see imitation as the basic mechanism, by which children develop empathy and the capacity to represent, think and speak. Imitation has also been considered for a long time as a mechanism by which children develop theories of mind, in addition to being the source of social connection and affiliation.

The idea that imitation or mimesis, and the ability to simulate are at the core of what distinguish humans from other animals is a recurrent theoretical proposal in philosophical, psychological, and comparative theories (Tarde, 1890/1993; Donald, 1991 Finnbongason, 1912). For Tarde (1890/1993), behaviors and ideas transmitted by imitation are not just copied as mirrors copy the world in their reflections. Imitation is active in the sense of being selective. It is intentional, not just a source of contamination by reproduction. Finnbogason (1912) laid down a theory on "sympathetic intelligence", that posits that performing a motor act or seeing it performed by a model can *de facto* be the same. This is a remarkable intuition of the current simulation and imitation theories in social cognition that now find neurobiological validation in the discovery of mirror neuron systems (Goldman & Sripada, 2005; Gallese et al., 2002; Meltzoff, 1995, 2007; Harris, 1992). For a long time theorists have seen in imitation a central mechanism driving the evolution of human societies and those abilities that set us apart as a species (e.g., complex abstract languages, explicit ethics, empathic feelings, technological inventions, cultural transmission). What these theories emphasize is that *imitation is not only a copying capacity; it is also a source of innovation.* It allows individuals to connect, build intersubjectivity and feel what other individuals feel.

Since the discovery of mirror neurons, imitation has been understood based on the mirror metaphor, as an automatic simulation

of others' behaviors. We suggest that mirror metaphor should be replaced by the dynamic, open ended, and relational concept of *reciprocation* (Rochat & Passos-Ferreira, 2008b). Human sociality is inseparable from sense of shared values. This sense arises from the interaction with others via complex "open" systems of reciprocation and negotiation. It cannot be reduced to early imitation and mirroring processes that are, in a strict etymological sense, "closed" systems, in themselves copying mechanisms like mirrors reflecting whatever is facing them. Taken literally, imitation thus stands for a system of direct reflection of what is out there, impoverishing of the process by which we actually relate and understand each other, a process that is in essence, selective and creative of new meanings (ideas, feelings, values) that arise from on-going social exchanges.

For human sociality to develop, imitation and mirroring processes need to be supplemented by an open system of reciprocation. The reflection arising from mirroring processes needs to be broken down and somehow by-passed. In early ontogeny, particularly starting the second month, mirroring, imitation, and other contagious emotional responses tend to become more subtly attuned to interactive others. This first social register of the neonate is by-passed in "proto" conversation with others, in the context of first reciprocal exchanges that form open, as opposed to closed, loop systems.

Imitation and mirroring processes are necessary but not sufficient mechanisms for children to develop inter-subjectivity and sociality. Human sociality (i.e., the inclination to associate with or be in the company of others) entails more than the equivalence and connectedness of perceptual experiences. It entails a sense of reciprocity that is more than the "like-me stance" or embodied simulation that researchers derive from early imitation (Meltzoff, 2007) or from the recent discovery of mirror neuron systems in the brain (Gallese et al., 1996; Rizzolatti et al., 1996; Gallese et al., 2002; Rizzolatti & Craighero, 2004; Fogassi et al., 2005; Goldman & Sripada, 2005).

3.2 Primary Intersubjectivity: From basic mirroring to reciprocation and social expectations

If imitation in the strict sense is a source of vicarious experiences that give individuals the opportunity to get "into the shoes of others" and possibly empathize with them, it is also a source of

discovery and learning. Children learn primarily via observational and imitative learning, rarely if not at all, via the explicit instruction that prevails in Western cultures (Odden & Rochat, 2004; Rogoff, 1995; Boggs, 1985; Lancy, 1996). What is important to note is that observational and imitative learning is *selective* and *intentional*. New skills are not just learned by accident, or rarely so, typically scaffold by more advanced individuals who transmit their skills and knowledge to the apprentice or novice learner (Lave, 1988; Rogoff, 1990), a process that contributes to cultural learning in general (Tomasello, Kruger, et al., 1993).

For novelty to emerge and knowledge to be transmitted via observation and imitation entails more than passive "random" and incidental learning. It entails *reciprocation* in the following basic sense. For learning to take place there is a mutual willingness on the part of the novice to observe the expert and on the part of the expert to be observed by the novice. Both protagonists meet in the reciprocal willingness to share attention toward each other, the novice observing the expert and the expert modeling for the novice. The reciprocal willingness to learn and to teach that is constitutive of imitative learning, when not purely incidental, makes the process break away from imitation in the strict sense of copying, mirroring or the direct "shadowing" of the other. Mutual attention and intention are involved. This is expressed in the reciprocal sharing of attention, each protagonist aware of and monitoring the other.

In this context, imitation becomes a source of selective transmission and learning, not just a mechanism by which individuals can create an inter-subjective bridge by simulating the subjective experience of others. It is a source of learning and novelty that is co-created, based on exchanges that are reciprocal.

The sense of reciprocity is expressed very early in the life of the healthy child. By two months, infants start to engage in face-to-face proto-conversations, first manifesting signs of socially elicited smiles toward others (Wolff, 1987; Sroufe, 1996; Rochat, 2001). Such emotional co-regulation and affective attunement are more than the mirroring process underlying neonatal imitation and emotional contagion evident immediately after birth (Meltzoff & Moore, 1977; Simner, 1971; Sagi & Hoffman, 1976). From this point on, infants express a new sense of shared experience with others in the context of interactive face-to-face plays, what Colwyn Trevarthen (1979) coined as "primary inter-subjectivity".

When infants start to engage in proto-conversation, they are quick

to pick up cues regarding what to be expected next from the social partner. In general they expect that following an emotional bid on their part, be it via a smile, a gaze, or a frown, the other will respond in return. Interestingly, adult caretakers in their response are typically inclined to reproduce, even exaggerate the bid of the child. If the child smiles or frowns, we are inclined to smile or frown back at her with amplification and additional sound effects. There is some kind of irrepressible affective mirroring on the part of the adult (Gergely & Watson, 1999).

The complex mirror game underlying social cognition does manifest itself from approximately 2 months of age and from then on, infants develop expectations and representations as to what should happen next in this context. The still-face experimental paradigm that has been extensively used by infancy researchers for over 30 years provides good support for this assertion (see the original study by Tronick, Als, Adamson, Wise, & Brazelton, 1978). Infants are disturbed when the interactive partner suddenly freezes while staring at them (Rochat & Striano, 1999). They manifest unmistakable negative affects, frowning, suppressing bouts of smiling, looking away and sometimes even starting to cry. In general, they become avoidant of the other person, presumably expecting them to behave in a different, more attuned way toward them.

This reliable phenomenon is not just due to the sudden stillness of the adult, as the infant's degree of negative responses varies depending on the kind of facial expression (i.e., happy, neutral, or fearful) adopted by the adult while suddenly still (Rochat, Striano, & Blatt, 2001). Also, it appears that beyond 7 months old, infants become increasingly active, rather than avoidant and unhappy, showing initiative in trying to re-engage the still-faced adult. Typically, they touch her, tap her, or clap hands to bring the still-faced adult back into the play, with an intense gaze toward her (Striano & Rochat, 1999).

Numerous studies based on this still-face paradigm and studies using the double video paradigm, in which the infants interact with his mother seen on a TV (Murray & Trevarthen, 1985; Nadel et al., 1999; Rochat, Neisser, & Marian, 1998), all show that early on, infants develop social expectations as to what should happen next or what should happen while interacting with others. The difficult question is what do these expectations actually mean psychologically for the child. What does it mean for a 2-month-olds to understand that if he smiles toward an individual, this individual should "normally" smile back at him? What does it mean that he

picks up the fact that amplified and synchronized mirroring from the adult is an invitation for more bouts of interaction?

One could interpret these expectations as basic, possibly sub-personal and automatic. Accordingly, face-to-face interactions are information-rich events for which infants are innately wired to pick up information, attuned and prepared from birth to attend to and eventually recognize familiar voices and faces (e.g., De Casper & Fifer, 1980; Morton & Johnson, 1991). From birth, infants would be attuned to perceptual regularities and perceptual consequences of their own actions, wired to prefer faces, human voices, and contingent events as opposed to any other objects, any other noises, or any other random events. Accordingly, this would be enough for young infants to build social expectations and manifest apparent eagerness to be socially connected as shown by studies using the still-face experimental paradigm or the double video system. But there is more than what meets the eyes of an "engineering look" at the phenomenon (Rochat, 2009). It is more than just mechanical and requires another, richer look to capture its full psychological meaning.

This proposal is based on evidence of developmental changes in the ways that children appear to connect with others and reciprocate. Infants rapidly go beyond mirroring and imitation to reciprocate with others in increasingly complex ways, adding the explicit social negotiation of *values* to the process. This development corresponds to the unfolding of primary and secondary (i.e., triadic exchanges of the infant with people in reference to objects in the environment by 7-9 months), and also a *tertiary* level of inter-subjectivity from at least 3 years of age.

3.3. Secondary Intersubjectivity: From reciprocation to joint attention

The sign of the emergence of the secondary intersubjectivity is the beginning of triadic interactions. At the secondary level, with the intentional communication about objects that emerges by 9 months via social initiatives and explicit bouts of joint attention, infants break away from the primary context of face-to-face exchanges. They become referential beyond the dyadic exchanges to include objects that surround the relationship. Social exchanges also include conversations about things outside of the relationship, becoming triadic in addition to being dyadic. Exchanges become object oriented or objectified, in addition to being the expression

of a process of emotional co-regulation. Infants now willfully try to capture and control the attention of others in relation to themselves via objects in the environment. At this point, however, the name of the game is limited to the sharing of attention just for the sake of it. Children measure the extent to which others are paying attention to them and what they are doing. They begin to check back and forth between the person and the object they are playing with (Tomasello, 1995); or they begin to bring an event to the attention of others by pointing or calling for attention to share the experience with them. However, such initiative ends there, and is typically not followed through in further conversation or co-regulation. For infants, secondary inter-subjectivity in triadic exchanges is a new means to control their social environment, in particular the proximity of others as they gain new degrees of freedom in roaming about the environment (Rochat, 2001). By becoming referential, infants also open the gate of symbolic development. They develop a capacity for dual representation whereby communicative gestures stand for and become the sign of something else (e.g., a pointing gesture as standing for a thing out there to be shared with others). Communication becomes intentional, transcending the process of emotional co-regulation and affective attunement that characterizes early face-to-face, proto-conversational exchanges (i.e. primary inter-subjectivity). Yet, it remains restricted to the monitoring of whether others are, or are not, co-experiencing with the child.

Nevertheless, with the emergence of intentional communication and the drive to co-experience events and things in the environment, infants learn and begin to develop shared meanings about things. To some extent, they also begin to develop shared values about what they experience of the world, but this development remains limited. For example, when facing dangers or encountering new situations in the environment, they are now inclined to refer to the facial expressions of others that are paying attention to the same events (Campos & Sternberg, 1981; Striano & Rochat, 2000). The meaning of a perceived event (e.g., whether something is dangerous or threatening) is now referred to others' emotional responses, to some extent evaluated in relation to others, but it ends there. The process does not yet entail any kind of negotiation regarding the value of what is experienced. The world is essentially divided into either good (approach) or bad (avoidance) things and events. Such basic social referencing emerges at around 9 months, in parallel to the propensity of infants to share attention with others

and to communicate with them intentionally (Tomasello, 1999; Rochat & Striano, 1999).

3.4 Tertiary Intersubjectivity: From joint attention to negotiation

Next, we focus on this latter level that we introduce as a major extension of the first two, both well accounted for in the literature (Bruner, 1983; Trevarthen & Hubley, 1978; Trevarthen, 1979; Tomasello, 1995; see table 1 above). At the tertiary level of inter-subjectivity, objects and situations in the environment are not just jointly attended to (secondary inter-subjectivity), they become also *jointly evaluated* via negotiation, until eventually some kind of a mutual agreement is reached.

By the middle of the second year, triadic exchanges develop beyond basic social referencing and the sense of co-experience with others that is the trademark of secondary inter-subjectivity. The child now begins to engage in active negotiation regarding the values of things co-experienced with others. They manifest *tertiary inter-subjectivity*; a sense of shared experience that rests on complex on-going exchanges unfolding over time: things that happened in the past, are manifest in the present and are projected by the child into the future. The prototypical expression of this new level of inter-subjectivity is the expression of secondary emotions such as embarrassment or guilt.

In relation to the self, by 20 months, children begin to represent what others perceive of themselves and gauge this representation in relation to values that are negotiated. If they see themselves in a mirror and notice a mark surreptitiously put on their face, they will be quick to remove it and often display coy behaviors or acting out (Amsterdam, 1972; Rochat, 2003). They begin to pretend and mask their emotions (Lewis, 1992). In general, they become self-conscious, negotiating and actively manipulating what others might perceive and evaluate of themselves (Lewis, 1992; Rochat, 2009). From this point on (18-20 months), children project and manipulate a public self-image, the image they now identify and recognize in the mirror. It is an image that is objectified and shared with others, a represented "public" self-image that from now on will be constantly updated and negotiated in relation to others. Interestingly, by 20 months, children's linguistic expressions begin also to include the systematic use of possessives, children starting to claim ownership over things with imperative expressions such as "mine!" (Bates, 1990; Tomasello, 1998). Such expressions

demarcate the value of things that are jointly attended in terms of what belongs to the self and what belongs to others. This value begins to be negotiated in the context of potential exchanges, bartering, or donations. With the explicit claim and demarcation of property, the child develops a new sense of reciprocity in the context of negotiated exchanges of property, whether objects, feelings or ideas. At around the same age, children also begin to demonstrate pro-social behaviors, engaging in acts of giving and apparent benevolence by providing help or spontaneously consoling distressed others (Zahn-Waxler, 1992). Self-concept, ownership claim, and a new concern for others bring the child to the threshold of moral development and the progressive construction of an explicit sense of justice (Damon, 1994). What follows in development is a new level of social reciprocity that is increasingly organized around an ethical stance taken by the child. But this ethical level of reciprocity develops between 3 and 5 years of age, and beyond.

4.CONCLUSIONS:NEGOTIATION AND MUTUAL RECOGNITION TRADEMARK OF HUMAN SOCIALITY

Our intention was to revise the development of intersubjectivity, stressing that it originates from reciprocal social exchanges that include imitation, empathy, but also negotiation from which meanings, values and norms are eventually constructed with others. This process starts from birth via imitation and mirror processes that are important foundations for sociality providing a basic sense of social connectedness and mutual acknowledgement with others. Nevertheless, these basic mirroring processes are necessary, but not sufficient, to account for the early development of reciprocal exchanges that takes place from the second month on. Imitation and emotional contagion, taken literally as close-loop automatic mirror systems, are soon transformed into dynamic, ultimately creative exchanges that take the form of open-ended proto-conversations ruled by principles of *reciprocation*, and develops as *negotiation* and *mutual recognition*. As we intended to show, from the second month, mirroring, imitative and other contagious responses are by-passed. Neonatal imitation gives way to first signs of reciprocation (primary intersubjectivity), and joint attention in reference to objects (secondary intersubjectivity). From 20 months, we proposed a third level of intersubjectivity, that is the emergence of values that are jointly represented and negotiated with others, as well as the development of an ethical stance accompanying emerging theories of mind from about 4 ye-

ars of age. The tertiary intersubjectivity is an ontogenetically new process of value negotiation and mutual recognition that are the cardinal trademarks of human sociality. In conclusion, we tried to show that the way infants and young children connect to the social world develops dramatically with the emergence of active, creative, and increasingly complex reciprocal exchanges. The emergence of reciprocal exchanges allow for the social construction of meanings that drive human transactions, e.g., shared ideas or values such as trust, guilt, the sense of what's right and what's wrong, who is to be admired and emulated, who is commendable and has prestige, who is to be avoided and despised.

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DYADIC EMOTIONAL REGULATION IN MOTHER AND INFANT INTERACTION AND MATERNAL ATTACHMENT AT NINE MONTHS

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ABSTRACT

36 mother/infant dyads at nine months, 20 of which had mothers with secure attachment models and 16 with insecure attachment models, examined using the Adult Attachment Interview, were video-recorded and coded with the *Infant and Caregiver Engagement Phase (ICEP)* coding system (Weinberg, & Tronick, 1999) to which some changes were made, to evaluate their emotional regulation. The 36 mothers (mean age = 34,05 sd = 3,41), were Italian, and their socio-economic level was medium. The infants, 12 girls and 24 boys, (mean age = 9,31 sd = 0.82) were full term and did not present any pathologies at birth. The aim of the study was to evaluate the relationship between the security of maternal attachment and the styles of mutual regulation engaged in by the dyads when the infant is nine months old. Matching is defined as the extent to which mothers and infants share joint negative, neutral, or positive states at the same moment in time; mismatching is defined as any non-shared dyadic state in which the two partners are not in the same state of engagement (Tronick et al, 2005). Significant differences emerged between the two groups in relation to coordinated and miscoordinated affective states. The secure mother dyads had a greater overall duration of affective matches with more positive matches than insecure mother dyads. The insecure mothers dyads had a greater overall duration of affective mismatches than secure mother dyads; furthermore they spent more time in negative matches than the former, who almost never engaged negatively in their interaction. In this perspective the secure mother dyads appeared more able to share emotions, particularly positive emotions than insecure mother dyads. The latter appeared less able to regulate the negative emotions of their infants (more negative matches). In relation to the different types of mismatches the insecure mothers displayed proportionally more positive states when the infant displayed negative states and more negative states when the infant was neutral. In brief, this study highlights the existence of significant differences in the infant/mother dyads regulation modalities in relation to the different quality of the attachment model of the mothers, showing itself in the insecure mother dyads' greater difficulty in mutual regulation and in the regulation of negative emotions.

1. INTRODUCTION [1]

It is well-known that styles of emotional regulation employed in mother and infant interaction in the first year both characterize the interaction and constitute it (Tronick, 1989, 1998; Beebe, 1998; Beebe & Lachman, 2002). These styles appear to be fundamental not only in determining the development of an infant's emotional regulation skills in the following years (Sroufe, 1995) but also guiding his subsequent social-emotional and relational development (Sroufe, Egeland, Carlson, & Collins, 2005).

Experiments based on the Still Face paradigm (Tronick, 1989; Cohn & Tronick, 1983; Adamson & Frick, 2003) have demonstrated that an infant at a very early age displays self-regulatory behavior – including self-comforting and looking away from a stressful stimulus. This behavior must interact with the regulation function of the caregiver in order to fully develop (Sroufe, 1995; Hofer, 1994), beginning with the infant's requests for regulation which he starts to communicate to the caregiver through specific forms of expression (hetero-regulatory behavior) (Tronick, 1989; Bridges & Gronlick, 1995). Thus, a system of mutual regulation is created whose characteristics depend both on the infant's regulatory skills and the caregiver's regulatory scaffolding function (Tronick, 2007; Weinberg, Tronick, Cohn, & Olson 1999). This system appears to be distinguished by mutual interactive regulatory processes involving coordinated emotional states alternating with miscoordinated emotional states (Tronick & Weinberg, 1997). During normal interaction, mother/infant communication appears to be characterized by processes of matching/mismatching/ disruption/repair in which the mother and the infant, after failing to coordinate their actions and intentions, effect successful repair, leading to the emergence of new coordinated emotional states (Tronick & Gianino, 1986). The sensitivity of the adequate mother in this perspective appears to be an "intermediate" sensitivity. She

seems able to attune to the emotional states of her infant and, at the same time, repair the interactive errors she commits through not understanding or misunderstanding the infant's messages. At the same time, the infant too shows his intent to repair the breakdown in communication with his mother, as illustrated by the experiments conducted with the Still Face paradigm (Cohn & Tronick, 1983).

The experience of successful repair is a social-interactive process which is fundamental to personality development. It allows the infant to develop a representation of himself as effective, of his interactions as positive and reparable and, finally, of the caregiver as reliable and available, and worthy of basic trust. In this way, thanks to the experience of successful repair and of negative emotions being repeatedly transformed into positive emotions, the infant constructs a positive emotional core in relation to himself (Tronick & Weinberg, 1997; Emde, 1991, 2005). In contrast, repeated disruption in communication and unsuccessful repair on the part of the mother can cause the infant to construct a negative emotional core of himself and a representation of himself as ineffective and of the mother as unavailable.

The importance of the caregiver's emotional availability in the development of an infant's emotional regulation has led attachment theorists to hypothesize that attachment patterns can be considered as styles of dyadic regulation of the emotions which the infant develops in interacting with caregivers (Sroufe, 1995; Cassidy, 1994). Secure attachment seems to be correlated to the possibility experienced by the infant of communicating positive and negative emotions to the caregiver, perceiving the caregiver as emotionally available and effective in emotional regulation. Other types of insecure attachment, however, seem to involve a restriction of this skill in the face of a difficulty in regulation on the part of the caregiver. In this regard, a number of studies have highlighted the relationship between the sensitivity demonstrated by the mother towards the infant's regulation in the first months and his subsequent form of attachment (Cohn, Campbell, & Ross, 1992; Kogan & Carter, 1996; Fuertes, Lopez Dos Santos, Beeghly, & Tronick, 2006).

Few studies, however, have examined the factors which render the mother/infant regulation system adequate. Haft and Slade (1989), in considering responsiveness as a mother's skill in sharing syntonically the positive and negative emotions of the infant, revealed an association between maternal internal working models as regards

attachment and her ability to attune to her infant. According to this study, mothers classed as secure using AAI demonstrate an ability to respond syntonically to the infant's positive and negative emotional states during play sessions at 14 months, while dismissing mothers attune less to the negative emotions of their infants, not accepting their requests for comfort and consolation and attuning selectively to the infant's positive experiences of autonomy and control. The mothers classified as preoccupied appear to find it difficult to attune to their infant's entire range of emotions, in particular to his expressions of exuberance linked to the accomplishment of control and autonomy. A recent study by DeOliveira, Moran and Pederson (2005) confirmed the Slade results, highlighting how maternal working models of attachment, measured using AAI, together with the styles mothers adopt with regard to their own emotions, measured by means of an interview, appear to be associated with their methods of handling the emotions of their infants at 24 months. Secure mothers display an open and flexible approach to their own emotions and those of their infant, dismissing mothers tend to minimize their own negative emotions of fear and sadness and also those of the infant while mothers with unresolved attachment patterns display great difficulty in attuning to both.

A few studies, however, have examined the relationship between parental attachment models and styles of regulating emotions. In this regard Feldman (2003) compared the co-regulation of positive affect during mother-infant and father-infant interaction. She found that security in paternal attachment is associated with greater synchrony between the father and the infant, an association which is not shown in mothers.

Some studies have, however, examined the conditions which may make maternal communicative and emotional regulation less adequate. Of these studies, those of Field (Field, Healy, Goldstein, & Guthertz, 1990) involving depressed mothers show that in depressed mother dyads, infants of 3 months spend less time with their mothers in coordinated affective states, the greater proportion of these being coordinated negative affective states, than infants in non-depressed mother dyads. A longitudinal study by Tronick (Bell, Weinberg, Yergeau, & Tronick, 2004) revealed that in their first year the infants of depressed mothers displayed fewer positive emotions in interaction with their mothers and a smaller proportion of coordinated positive affective states with their mothers. Therefore, since there are no exhaustive studies into the relationship

between the security of maternal attachment and the individual and dyadic styles of regulation adopted by the mother and infant in the first year, the examination of this subject is of particular interest. In fact, as was highlighted above, creating an adequate system of regulation between mother and infant in the first year is a factor which promotes the establishment of secure attachment patterns, favoring the subsequent social-emotional development of the infant (Cohn, Campbell, & Ross, 1992; Kogan & Carter, 1996; Riva Crugnola, 2007). The aim of our study, therefore, was to examine the possible differences in maternal and infant regulation and their mutual regulation in infant/secure mother dyads and infant/insecure mother dyads at 9 months. To this end, we observed the interaction of mother/infant dyads composed of secure and insecure mothers and their infants, video recording their interaction in a laboratory setting. On the basis of the above considerations and research studies as to the social-emotional functioning of the mother-infant dyad we expected that: (a) the infants of secure mothers would differ from those of insecure mothers as regards positive and negative engagement, displaying a higher level of positive engagement and a lower level of negative engagement; (b) secure mothers would display a higher level of positive engagement with their infants compared to insecure mothers and a lower level of negative engagement; (e) the dyadic quality of secure mother/infant interaction would be different to that of insecure mother/infant interaction, with more time being spent in coordinated emotional states (matches) and less time in miscoordinated emotional states (mismatches).

2. METHOD

2.1 Participants

36 mother-infant dyads participated in our study. The couples were recruited at the beginning of a program organized by a service of a Milan hospital to follow infants during their first year. The service is intended for mothers of infants and is aimed at monitoring the infant's growth in early infancy. The 36 mothers were Italian, aged between 25 and 40 (mean age = 34,04 sd = 3,41) and primipara in the majority of cases (75%). All were cohabiting and in stable relationships. The mothers were middle and upper class and their mean educational level was 15 years, with a range of 8 to 18 years (47,2% were graduates, 47,2% had a high school diploma, 5,5% had a middle school diploma). 94,4% of the mothers were in

employment. The infants (12 girls, 24 boys) were full term and did not present any pathologies at birth.

2.2 Procedure

The security variable of the internal working model of the mothers was evaluated when the children were 3 months old using the Adult Attachment Interview and relative coding system (Main & Goldwin, 1994-1998). For what concerns mother-infant interaction, the mother-infant couples were video-recorded in the laboratory at nine months of age (infant mean age = 9,31 sd = 0.86). The laboratory was a suitably furnished play room containing a small mattress on which the mother and infant could sit or lie and a number of toys appropriate for the age of the infant. The mothers were instructed to play and interact with the infant as they would normally do at home. The video-recordings lasted at least 5 minutes and during this time the mother-infant pair was left alone in the laboratory room.

2.3 Data coding

Maternal internal working models were evaluated using the Adult Attachment Interview and relative coding system (Main & Goldwyn, 1994-1998) when the infants were 3 months old. According to the Main coding, autonomous secure attachment involves a consistent and objective narration of attachment experiences together with their valorization; dismissing attachment involves an inconsistent narration of attachment experiences with idealization of attachment figures, characterized by generally positive descriptions of the latter which are not supported or contradicted by specific episodes, difficulty in remembering and underestimation of these experiences; preoccupied attachment involves an inconsistent narration characterized by vagueness and prolixity together with persistence of feelings of anxiety and anger towards the attachment figure; unresolved/disorganized attachment is characterized by failure to elaborate traumatic episodes (mistreatment, abuse, etc.) and mourning; finally non-classifiable attachment involves the co-presence of contradictory mental states regarding attachment. The interviews were analyzed by the first author, who is proficient in the AAI coding system, having attended a specific training session with Mary Main. The video-recordings were coded using the Infant and Caregiver Engagement Phase coding system of Weinberg and Tronick (1999) to which some changes were

made with respect to a number of categories relating to playing with objects and attending to the infant. Tables 1 and 2 show the categories used for the coding of infant and maternal behavior, highlighting the modifications made with respect to the Weinberg and Tronick system.

Table 1. - Categories used to code infant behavior

INFANT CODES	DEFINITION
General Negative Engagement	Infant is negative, protesting or withdrawn. GNE has two specific sub-codes: protest and withdrawn. When it is not possible to make a distinction code GNE.
Protest	Infant is protesting with facial expressions of anger, annoyance, often with crying.
Withdrawn	Infant is passive and minimally engaged with the mother and the environment.
Orientation to Objects Offered by the Mother*	Infant is looking, touching, playing with objects offered by the mother.
Orientation to Objects Not Offered by the Mother*	Infant is looking, touching, playing with objects not offered by the mother.
Orientation to Environment	Infant is visually exploring the setting without focalizing attention on any specific object.
Shifting Attention*	Infant is shifting attention towards a new object or from an object to another.
Social Monitor	Infant's attention is directed towards the mother. He/she is looking at her.
Social Positive Engagement	Infant is displaying facial expressions of joy, astonishment and smiles. SPE is considered play with or without with objects, but with social play.
Comforted *	Infant lets the mother comfort him/her while crying or annoyed.
Sleep	Infant is asleep.
Unscorable	Infant's face is obscured (e.g. his/her face is covered by the mother's body or is outside the view of the camera).

Note. Categories with an asterisk were not provided in the original system, being introduced for the purposes of this study.

Table 2. - Categories used to code maternal behavior

MOTHER CODES	DEFINITION
General Negative Engagement	Mother is negative, intrusive, hostile or withdrawn. GNE has three specific sub-codes: Hostile, intrusive or withdrawn. When it is not possible to make a distinction code GNE.
Hostile	Mother is hostile or annoyed. She does not help the infant if in difficulty.
Intrusive	Mother is intrusive towards the infant's physical space, activities and the objects.
Withdrawn	Mother is minimally engaged with the infant's activities.
Non-infant Focused	Mother is not attending to the infant.
Social Monitor	Mother's attention is focused on the infant and his/her activities. She is looking at him her.
Social Positive Engagement	Mother is interacting with the infant through facial expressions of joy and interest, with positive vocalizations, motherese and social play.
Exaggerated Positive Engagement	Mother is showing exaggeratedly positive engagement, continuous and intense.
Offer of Object *	Mother is offering a new object to the infant
Involvement in the Play *	The mother joins in the game with the object chosen by the infant
Call for Infant's Attention*	Mother is trying to draw the infant's attention to her or to an object.
Comfort and Care*	Mother is responding to the infant's uneasiness by nursing or comforting him her, or caressing or kissing him with a neutral tone.
Unscorable	Mother's face is obscured (e.g. her face is covered).

Note. Categories with an asterisk were not provided in the original system, being introduced for the purposes of this study.

Weinberg and Tronick's system uses mutually exclusive codes. Coding was done through continuous surveying per phases, recording the beginning and the end of the behavior. The end of each behavior corresponded to the beginning of the following behavior. Infant and maternal behavior were coded separately and at different times. Two observers operating independently of

each other observed the behavior of the 36 mother-infant dyads. The rate of agreement between the observers was determined by the Cohen's Kappa coefficient (1960), particularly suitable for comparing data gathered through multi-item code schemes. The result was 0.72 for the observation of maternal behavior and 0.71 for infant behavior.

2.4 Data analysis

A specific program for sequential analysis, GSEQ (Gnisci & Bakeman, 2000; Bakeman & Quera, 1995), was chosen to process data resulting from behavior coding. This program calculates a number of simple statistics such as frequency and the duration of both maternal and infant behavior. Inferential tests were also used to compare the different groups and, for this purpose, the statistic packet SPSS/PC version 12.0 was employed. In order to examine infant and maternal behavior individually and in interaction with each other, two sets of data analysis were carried out:

1. Using the GSEQ sequential analysis program, we re-coded the mother and infant codes, grouping them according to their positive, negative or neutral affective state and adding together the durations of the previous codes. The first analysis concerned the proportional duration of the infant and maternal affective states. Since the video-recordings lasted at least 5 minutes but were of different durations, in order to compare the data between dyads, we calculated the "proportional duration" of each observed behavior out of the total time of the play-session using the formula: "time spent on the selected behavior / total video-recording duration". Possible differences in the duration of behavior in relation to group placement, i.e. between secure and insecure mothers and between the respective infants, were examined.

2. The second analysis examined coordination/miscoordination of the emotional states of the dyad. We calculated the relative duration of the co-occurrence of various combinations of affective states in mother and infant, comparing the secure and insecure dyads in this perspective. Matching is defined as the extent to which mothers and infants share joint negative, neutral, or positive states at the same moment in time. Mismatching is defined as any non-shared dyadic state in which the mother and the infant are not in the same state of engagement (e.g. infant negative, mother positive) (Tronick, Messinger, Weinberg, Lester, LaGasse, Seifer, Bauer, Shankaran, Bada, Wright, Poole,

& Liu, 2005). It was also possible to calculate the total relative duration of matches and mismatches in the various dyads.

3. RESULTS

3.1 Mother's models of attachment

According to the coding of the interviews, 20 mothers displayed secure attachment models (55%) and 16 displayed insecure attachment models of which 6 were preoccupied (16,6%), 6 dismissing (16,6%), 4 disorganized (11%). Due to the limited number of subjects in relation to the different attachment models, we dichotomized the data into secure/insecure.

3.2 Dyadic and individual characteristics of maternal and infant behavior

Analysis aimed at evaluating the relative duration of the different affective states of the infant and the mother and the coordination and miscoordination of affective states within the dyads was then carried out. For this purpose, we created new codes, combining the codes, using the GSEQ program, of the coding scheme previously used according to the affective state they represented within three categories: neutral affective states, positive affective states, negative affective states (see above and table 3).

Table 3. - Individual and coordinated affective states definitions

COORDINATED AFFECTIVE STATES	INDIVIDUAL CODES
Positive match: infant and mother positive	*Infant positive:* Positive Engagement, Orientation to Objects Not Offered by the Mother, Orientation to Objects Offered by the Mother *Mother positive:* Positive Engagement, Offer Object, Involvement in Play
Negative match: infant and mother neuter	*Infant negative:* General Negative Engagement, Protest, Withdrawal *Mother negative:* General Negative Engagement, Intrusive, Withdrawal, Extra Positive Engagement
Neutral match: infant and mother neutral	*Infant neutral:* Social Monitoring, Orientation to the Environment, Shifting Attention, Orientation to Another Person, Comforted, Unscorable *Mother neutral:* Social Monitoring, Comfort and Care, Call for Infant's Attention, Non-infant Focused, Unscorable

We then calculated the relative duration of each affective state of the infant and of the mother (see table 4). Secure mothers differed from insecure mothers in their interaction with the infants while spending more time involved in positive affective states; on the other hand insecure mothers spent more time involved in negative affective states than the former. Infants with insecure mothers spent more time than infants with secure mothers involved in negative affective behavior for what concerns interaction with the mother.

Table 4. - Relative duration of affective states of infants and mothers of secure mother and insecure mother dyads

	Secure mother dyads (n=20)		Insecure mother dyads (n=16)				
	M	Sd	M	Sd	T	df	p
Infant positive	.685	.120	.669	.169	-.342	34	.735
Infant neutral	.305	.123	.257	.144	-1.054	34	.300
Infant negative	.008	.026	.075	.105	2.478	16.482	.024*
Mother positive	.394	.155	.242	.166	-2.821	34	.008**
Mother neutral	.605	.156	.617	.155	.218	34	.829
Mother negative	.000	.002	.137	.176	3.104	15.004	.007**

*Note. * p<.05, ** p<.01 *** p<.001.*

We then distinguished positive, negative and neutral coordinated states (match) (mother positive/infant positive, mother negative/infant negative, mother neutral/infant neutral) and miscoordinated affective states (mismatch) (infant positive/mother negative, infant positive/mother neutral, infant negative/mother positive, infant negative/mother neutral, infant neutral/mother positive and infant neutral/mother negative) (see table 3). We calculated the relative duration of the coordinated affective states, in which mother and infant presented the same affective states concomitantly. In the same way we calculated the duration of the miscoordinated affective states, in which mother and infant presented different affective states concomitantly. We also calculated the overall relative duration of the states of match and mismatch. Analysis revealed significant differences between the dyads, composed of secure and insecure mothers and their infants, both in relation to individual matches and mismatches and in relation to the overall duration of matches and mismatches (see table 5 and 6).

Table 5. - Relative duration of coordinated and miscoordinated affective states of secure mother and insecure mother dyads

	Secure mother (n=20)		Insecure mother (n=16)				
	M	Sd	M	Sd	T	df	p
Infant positive – Mother positive	.321	.138	.184	.128	-3.049	34	.004**
Infant positive – Mother neutral	.364	.137	.405	.153	.851	34	.401
Infant positive – Mother negative	.000	.001	.010	.028	1.407	15.075	.162
Infant negative – Mother negative	.000	.000	.033	.052	2.512	15.004	.024*
Infant negative – Mother neutral	.007	.024	.027	.060	1.337	34	.190
Infant negative – Mother positive	.000	.001	.079	.107	2.935	15.005	.010**
Infant neutral – Mother neutral	.232	.114	.182	.133	-1.212	34	.234
Infant neutral – Mother positive	.072	.037	.046	.043	-1.897	34	.066
Infant neutral – Mother negative	.000	.000	.025	.031	3.205	15.011	.006**

*Note. *p<.05, ** p<.01 *** p<.001*

Table 6. - Relative duration of match and mismatch.

	Secure mother (n=20)		Insecure mother (n=16)				
	M	Sd	M	Sd	T	df	p
Match	.554	.106	.400	.146	-3.667	34	.001***
Mismatch	.445	.107	.595	.147	3.535	34	.001***

*Note. *p<.05, ** p<.01 *** p<.001.*

Secure mother dyads had a greater overall relative duration of coordinated affective states than insecure mother dyads. At the same time, significant differences also emerged for what concerns individual matches. Secure mother dyads spent more time in coordinated affective states in which both partners had positive

engagement unlike insecure mother dyads which showed a shorter duration of positive affective states. On the contrary, insecure mother dyads spent more time in coordinated negative affective states, a type of match almost completely absent in secure mother dyads. For what concerns overall duration of miscoordinated emotional states (mismatches) the insecure mother dyads spent on the whole more time in mismatches compared to secure mother dyads (see Table 6). Furthermore, significant differences emerged in relation to the individual types of mismatch. In mismatch situations, when the infant displayed neutral emotional states the insecure mother expressed negative affective states unlike the secure mother. Furthermore, when the infant expressed negative emotions, insecure mothers expressed positive emotions, a type of mismatch almost completely absent in secure mother dyads.

On the whole, secure mother dyads spent 55% of the total time in conditions of match and 45% in conditions of mismatch; insecure mother dyads, on the other hand, spent 40% in conditions of match and 60% in conditions of mismatch. For what concerns matches, all the dyads spent most of the time in positive match states: 32% secure dyads and 18,4% insecure dyads. In secure dyads neutral matches took up 23% of the total time and in insecure dyads 18% of the total time. The negative match was rarer: close to 0% for secure dyads and 3% for insecure dyads.

4. DISCUSSION

Thus, on the basis of maternal security/insecurity it is possible to construct a different profile of the individual and dyadic styles of the two groups of mother/infant pairs.

For what concerns analysis of the relative durations in infants of insecure mothers, negative interaction with mothers was more present than in infants of secure mothers, who very rarely had this behavior. A greater occurrence of negative engagement behavior was also to be found in insecure mothers, as it was in their infants. However, compared to insecure mothers, secure mothers – like their infants – spent more time involved in positive engagement behavior.

Significant differences emerged between the two groups in relation to coordinated and miscoordinated affective states. Firstly, the duration of coordinated affective states was on the whole longer in secure mother dyads than in insecure mother dyads, with a greater ability to share emotions being seen as characteristic of secure mother/infant pairs. This confirms our hypotheses and

also the Slade study (Haft & Slade, 1989) which revealed how secure mothers were more able than insecure mothers to match the emotions expressed by an infant of between 9 and 13 months. The DeOliveria study (DeOliveria, Moran, & Pederson, 2005) also revealed how secure mothers were more open and more able to understand the emotions of their infants at the age of 2 than insecure mothers.

Furthermore, secure mother/infant pairs appeared more able to coordinate positive affective states than insecure mothers dyads which displayed a lower number of coordinated positive states. Insecure mother/infant pairs were distinguished with respect to secure mother dyads by greater matching of negative emotions, something which was almost completely absent in secure dyads.

In the light of these findings it may be hypothesized that infants with insecure mothers are less able to regulate their own negative emotions as is demonstrated by the greater length of time spent on negative engagement compared to infants with secure mothers and also by the sharing of negative states with their mothers. At the same time, insecure mothers seem less able to transform the negative emotions of their infant, remaining in a negative affective state when the infant is in a negative state unlike secure mothers who almost never engage negatively in their interaction. On the other hand the infants of secure mothers, like their mothers, compared to the infants of insecure mothers appear more able to maintain positive emotional states as is demonstrated by the greater length of time spent on positive engagement and by sharing them with their mothers.

For what concerns the overall duration of miscoordinated emotional states, there were overall significant differences between the two groups, also in relation to the different mismatches. What is interesting is the difference between the two groups in relation to infant neutral emotional state. In this situation, insecure mothers adopted more negative behavior compared to secure mothers. This has also been demonstrated by Tronick (Tronick, Messinger, Weinberg, Lester, La Gasse, Seifer, Bauer, Shankaran, Bada, Wright, Poole, & Liu, 2005) in relation to pairs composed of mothers who had used cocaine during pregnancy and their infants. These pairs showed a higher percentage of mismatches of the infant neutral/mother negative type than the control group in which mothers had not used cocaine. The second difference between the two groups of dyads for what concerns mismatches relates to when the infant expresses negative emotions. In fact, in concomitance with that

state, insecure mothers expressed positive emotions, a type of mismatch not present in secure mother dyads.

With regard to this data it is interesting to note how the characteristics of insecure mother dyads have some points in common with the depressed mother dyads studied by Tronick (Bell, Weinberg, Yergeau, & Tronick, 2004) and Field (Field, Healy, Goldstein, & Guthertz, 1990) both for what concerns the predominance of negative emotions in the infants and mothers at an individual level and the greater proportion of affectively negative coordinated states and the smaller proportion of positive emotional states. Early aspects of dysregulation also emerge in the dyads with mothers who had used cocaine studied by Tronick (Tronick, Messinger, Weinberg, Lester, La Gasse, Seifer, Bauer, Shankaran, Bada, Wright, Poole, & Liu, 2005), in which mother and infant engage in more negative matches and a greater number of mismatches, with infant negative/mother positive, compared to the control group. In the light of what has been observed thus far, the emotional regulation which distinguishes insecure mother/infant pairs from secure pairs, characterized by a lower proportion of coordinated emotional states with the presence of negative affective coordinated states and a greater proportion of miscoordinated affective states, could have a significant effect on the subsequent social-emotional development of the infant at the level of both emotional expression and regulation and the security of attachment patterns and the formation of the first cores of the self. In fact, it is well-known that an infant being able to share positive emotional states with the caregiver (Emde, 1991, 2005; Stern, 1985) and to see them validated by the latter, such as experiencing repair of affective mismatches (Tronick, 1989, 2004), is crucial in the first stages of development. This experience provides an essential contribution to the formation of the first cores of the infant self. At the same time, the predominance of negative emotional states in the infant and failure on the part of the caregiver to regulate them, by exposing the infant to experiences of non-reparation and the ineffectiveness of his own ability to communicate, may affect the formation of relational and attachment models (Tronick, 1989, 2004) and have a disorganizing function in their formation (Lyons-Ruth, 2003). The fact that the insecure mother is less able to match the infant's emotions than the secure mother, demonstrated by the lower proportion of coordinated emotional states and, in particular, of positive coordinated states in the former dyad as compared to the latter, could also influence the ability of the infant to read and

recognize emotions. It is well-known that this ability appears to develop in concomitance with the ability of the mother to respond both contingently to the emotions of the infant (Gergely & Watson, 1996) and syntonically, i.e. with the same rhythm and intensity (Nicely, Tamis-LeMonda, & Grolnick, 1999).

Our study has therefore been of use in highlighting the existence of significant differences in the infant/mother dyads regulation modalities in relation to the different quality of the attachment model of the mothers, showing itself in the insecure mother dyads' greater difficulty in mutual regulation and in the regulation of negative emotions. It is also important to note that the different quality and duration of affective matches and mismatches seen in the mother-infant dyads observed, correlated with the different maternal attachment models, may be considered not only the expression of the system of attachment which connects mother and infant, characterizing its styles of regulation. Hypothesizing the existence of different motivational systems at the basis of mother-infant interaction, that of attachment for the purposes of protection and that of intersubjectivity based on the sharing of experience (Stern, 2004), the greater/lesser presence of matches and mismatches in the dyads, understood as different ways of sharing affective experiences (Trevarthen, 1998) and not only as methods of emotional regulation, could in fact be considered as the expression of the different quality of the intersubjective relationship between mother and infant.

In a follow up to this study it would be interesting to examine at longitudinal level the effects of the observed difficulties in regulation in insecure mother dyads on the formation of attachment patterns in the infant and on his subsequent social-emotional development. This aspect may have significant clinical implications for what concerns the realization of preventive projects aimed at promoting adequate social-emotional development in the infant, by using the quality of maternal attachment and the styles of regulation between mother and infant which emerge during the first year as early risk indicators.

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MOTOR INTERFERENCE IN ACTION SIMULATION

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ABSTRACT

Taking into account mirror neuron research with evidence from single-cell recording in macaque monkeys and imaging studies in humans, there are shared representations of action perception and action execution (see for Common Coding Principle: Hommel et al., 2001). Perceiving other person's actions seems to activate corresponding motor programs in the observer. This mechanism is ascribed to the mental simulation of observed actions. There is evidence that this mental simulation runs in real-time and works even when the action is temporally occluded (Graf et al., 2007). The present study focus on the question whether this mental simulation relies on motor representations. To investigate this, participants watched transiently occluded every-day actions and had to predict the action course after occlusion. Participants were assigned to three groups: performing the simulation task only (No-Action Group) versus receiving a secondary task involving either high-motor activation (Action Group) or low-motor-activation (Passive Group). Results show that all groups show real-time simulation (replication of Graf et al., 2007), indicating that all groups fulfilled the simulation task adequately. Moreover, there is evidence that motor interference in action simulation occurs more strongly in the Action-Group relative to the other Groups. This effect is enhanced when real-time simulation of occluded actions is more demanding due to longer occlusion. The presented results will be discussed in the context of motor simulation theory and ideas for future studies will be presented.

Keywords: action execution, action perception, action simulation, motor interference, shared representations

1. WHY WE ARE GOOD IN PREDICTING BEHAVIOUR

Imaging you are going on your bike in a pedestrian area of a big city. Hundreds of people cross your way and you have to predict the direction in which they will go as well as to consider the speed in which they walk. These predictions help to adapt your own behaviour (e.g. to avoid hitting a pedestrian) and to increase effectiveness to find your way. Living in a social environment human beings are constantly making thousands of such action predictions and mostly they are not aware of it. More theoretically, it has recently been proposed that these predictions arise from an internal simulation of the observed action, as derived by using the obser-

ver's own motor representations. This internal simulation allows predicting the process of the action based on the observer's own motor experience. For instance, experts in performing a particular type of movement (e.g. classical ballet movements) were shown to have greater premotor, parietal and cerebellar brain activity when viewing moves of their own motor repertoire compared to those which are not in their repertoire (Calvo-Merino, Grezes, Glaser, Passingham, & Haggard, 2006).

Mirror neuron research with evidence from single-cell recording in macaque monkeys (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996) and imaging studies in humans (Fadiga, Fogassi, Pavesi, & Rizzolatti, 1995; Grezes, Armony, Rowe, & Passingham, 2003; Rizzolatti & Craighero, 2004) have provided significant insights on the neuronal correlates of the link between action execution and action observation.

Specifically, they support that humans use common mechanisms for executing and observing motor actions (Prinz, 1997; see for Common Coding Principle: Hommel, Musseler, Aschersleben, & Prinz, 2001), which may enable predicting others' ongoing behaviour (Blakemore & Frith, 2005; Prinz, 2006; Wilson & Knoblich, 2005; Wolpert & Flanagan, 2001).

Evidence that action execution and action observation can interfere with each other comes from Kilner and colleagues (Kilner, Paulignan, & Blakemore, 2003). The authors demonstrated that participants show an increased variance in arm movement execution when they observe a human model executing a qualitatively different arm movement, rather than the same arm movement. This interference effect breaks down when participants watch a robot executing the same and different arm movements, respectively.

1.1 How Action Simulation Works

One central function of internal simulation is assumed to be the prediction of the sensory consequences of a certain movement. Self-produced actions result in a highly correct correspondence of the predicted and actual sensory consequences (Blakemore, Wolpert, & Frith, 2000). The mechanisms of the internal simulation of other person's actions are less clear. While observing an action of another person, the brain seems to simulate the observed action by mapping it onto our own motor representation of the same action (Schutz-Bosbach & Prinz, 2007).

Recently it has been proposed that the internal simulation of observed actions runs in real-time and works even when the observed

action is temporally occluded (Graf et al., 2007). Graf and colleagues used a paradigm, in which the participants perceived brief sequences of point-light actions. These sequences were covered by a short occluder followed by a static test posture. There were two independent variables, which were manipulated within-subject: the occluder time (100, 400 or 700 ms) and test posture time (the time which would go on by behind the occluder (100, 400 or 700 ms)). The task of the participants was to decide whether the test posture was a continuation in the same visual angle, or whether it was rotated in depth. According to the real-time simulation hypothesis, best performance in the unrotated trials (i.e., showing a test posture in the same visual angle) should occur when occluder and test posture time correspond. The internal representation of the action is updated in real-time and in turn, it corresponds to the upcoming test posture. Furthermore performance decreases as the time distance between occluder and test posture time increases, because of an increasing dissimilarity of the internal representation and the test posture.

2. AIM AND HYPOTHESES OF THE PRESENT STUDY

Based on the results by Graf and colleaques indicating a mechanism of real-time simulation, the present paper focusses on the kind of representations which may be involved in this real time simulation mechanism.

According to the mirror-neuron research cited above (Fadiga et al., 1995; Grezes et al., 2003; Rizzolatti & Craighero, 2004), we propose that motor representations are a good candidate to be involved in processing observed actions.

To investigate whether and to what extent action simulation draws on motor representations in the observer, we applied Graf et al.'s real-time simulation paradigm (as outlined above) in connection with an interference approach. More specifically, simulation performance was measured within three groups: No-Action-Group, Action-Group and Passive-Group. The No-Action Group performed the action simulation task (i.e., a slightly modified replication[1] of the study of Graf et al. (2007). Participants in the Action

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[1] The modification of the real-time simulation paradigm of Graf et al. includes foot pedal responses and feedback for the given response (in contrast to finger responses and no feedback in the original paradigm, respectively).

Group performed the action simulation task and an active motor task simultaneously.

The active motor task involved executing circular movements on two separate cranks bimanually. In order to keep participants attended to the active motor task, the movements were either symmetrical or parallel ones (Swinnen, Jardin, Meulenbroek, Dounskaia, & HofkensVanDenBrandt, 1997).

The Passive Group performed the action simulation task and a passive motor task simultaneously. The passive motor task corresponded to the active motor task of the Action Group except of the fact that the cranks were motor-powered and moved by themselves. By using an active and a passive secondary motor task in the presented study, it was possible to disentangle two aspects of movement execution: motor command and sensory feedback (proprioception).

In the Action Group the participants are required to send a motor command to their arms and they got back the sensory feedback, which fits to their sensory prediction made up in the forward model. In contrast the Passive Group received sensory feedback from their moving arms without giving a motor command.

The present study addressed to the following hypotheses:

1 Real-time simulation hypothesis: A replication of the real-time pattern of Graf et al. was expected, i.e. best simulation performance when occluder and test posture time corresponds. Furthermore simulation performance should decrease with increasing time distance between occluder and test posture time (distance effect).

2 Motor interference hypothesis:

  2.1 A decreased simulation performance was expected when movement execution during action simulation is required (Action-Group) compared to conditions where no motor execution is involved (No-Action Group and Passive-Group).

  2.2 This motor interference should take place especially when simulation is demanding. This is the case when long occlusion occurs (due to the fact that the internal model stays a long time without input). Differences between the groups are hypothesized due to motor interference.

3. METHODS

Participants: A total of 60 healthy participants (mean 24 years+/-3 years; 31 female, all right-handed) took part in two single sessions

of about 90 and 60 minutes, respectively with a break of 1-2 hours in between[2]. All participants reported normal or corrected-to-normal vision and were naive with respect to the purpose of the study. They were paid for their participation.

Material: We used 9 movie sequences showing of a point-light walker performing familiar every-day actions that involve the whole body (e.g., bowling or lifting something from floor). The stimulus-material has been provided by Graf et al. (2007) by use of a motion capture system (for further details see Graf et al., 2007). In line with Graf et al., we used point-light stimuli (instead of real motion pictures) in order to emphasize pure motion information. The duration of the sequences prior to occlusion lasted from 70 to 275 ms.

Design and Data Analysis: The experiment followed a mixed design, with the two within-subject variables and one between-subject variable. As within-subject variables the occluder length (100, 400, 700) and test posture time (100, 400, 700) was manipulated.

The factor occluder length was blocked and the order of blocks was balanced across participants with the restriction that two identical occluder lengths do not follow each other.

Each block of occluder length was presented eight times; so that each participant performed 24 blocks in total (and 648 trials, respectively). As in the original simulation paradigm of Graf et al. (see above) participants had to decide whether the test posture was a continuation in the same visual angle, or whether it was rotated in depth.[3]

As a between-subjects factor the group was varied (No Action versus Action group versus Passive Group). As mentioned above the active motor task contained a continuous circular movement on two cranks in a self-chosen speed, whereas the passive motor task contained a motor-powered circular movement in the same manner.

Data analysis focussed on error rates. Reaction times were only

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[2] The break was included after half of the trials in order to give participants a resting period.

[3] Each participant received a familiarization of all point-light actions and a practise phase of the simulation task prior to the experiment.

analyzed for correct responses. Due to the fact that spatial and temporal aspects are mixed in the rotated trials the analysis included only same (i.e., unrotated) trials.

4. RESULTS

4.1 Error Rates

As hypothesized in the **real-time simulation hypothesis** error rates[4] were lowest when occluder and test posture time correspond, indicated by a significant occluder x test posture time interaction ($F=(4,531)=11.634$; $p<0.001$) over all three groups (see Figure 1). There was a significant main effect of occluder time ($F=(2,118)=3.822$; $p<0.05$) with best performance in medium versus short and long occluder times. Furthermore there was a significant main effect of test posture time ($F=(2,118)=67.425$; $p<0.001$) with increasing error rates with increasing test posture time.
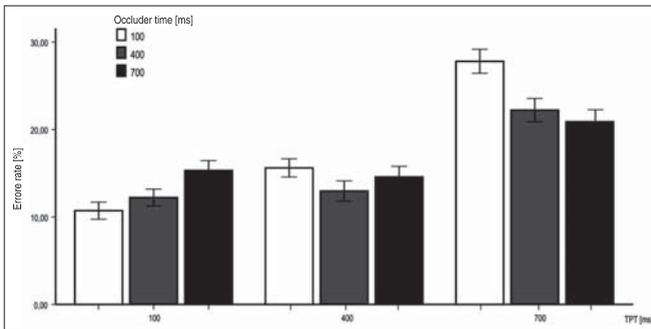

Figure 1 - Mean and standard error of the error rates are plotted for different occluder times (100, 400, 700 ms) and different test posture times (TPT; 100, 400, 700) over all three groups. Error rates are lowest when occluder and test posture time correspond (real-time hypothesis).

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[4] The relative error rates were arcussinus transformed prior to data analysis. This transformation is necessary, because relative error rates lack the prerequisite of variance homogeneity. Arcussinus transformation homogenises the variances of relative error rates (Steel, Torrie & Dickey, 1997).

After averaging over cells with the same time distance level (0 and 300 and 600 ms, respectively) there was a significant main effect of time distance, with increasing error rates with increasing time distance between occluder length and test posture time in all three groups ($F=(2,38)>8.550$; $p<0.01$) (see Figure 2). The time distance x group interaction did not reach significance ($F<1,3$), indicating that all groups fulfilled the simulation task adequately.
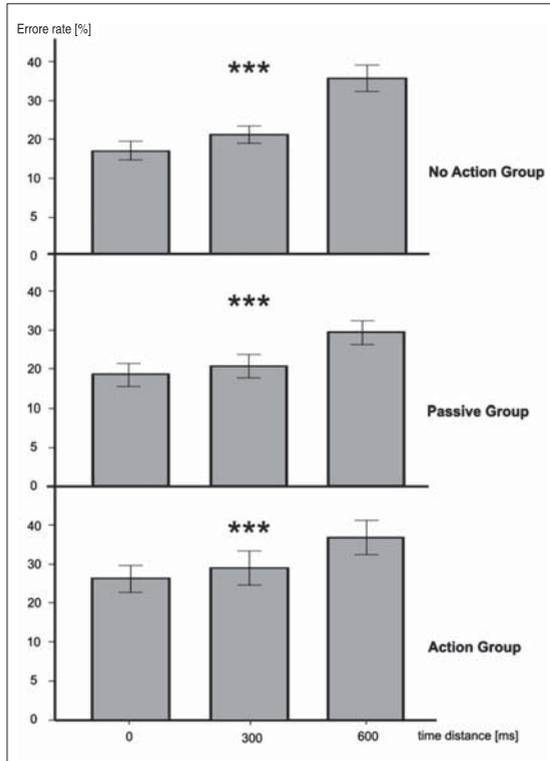

Figure 2 - Mean and standard error of the error rates are plotted for different time distances (0, 300, 600 ms) and different groups (No-Action, Passive and Action Group). In all three groups error rates are lowest when occluder and test posture time correspond (0 ms) and increase linear with increasing time distance. Furthermore the Action Group shows a significant higher error rate when time distance was 0 ms (time congruency) in comparison to the No Action Group.

According to the *motor interference hypothesis* a t-test showed a significant higher error rate when occluder and test posture

time correspond in the Action Group compared to the No Action Group (p=0.056) (compare Figure 2). There was no main effect of group (F<2,5), indicating that the Action group did not show higher error rates per se.

A more detailed analysis of these corresponding cases (time congruency) showed a significant time congruency x group interaction (F=(4,102)=2.876; p<0.05). Post-hoc t-Tests showed that this interaction is driven by the fact, that there was no significant difference in short occluder time conditions between the groups (p>0.12), but an increased error rate in medium and long occluder time in the Action Group compared to the No-Action Group (p<0.05) (Figure 3). However, there was a significant main effect of time congruency (F=(2,102)=29.391; p<0.001) with a linear increasing in error rates with increasing time congruency (100/100 < 400/400 < 700/700) and no significant main effect of group (F<2.5).
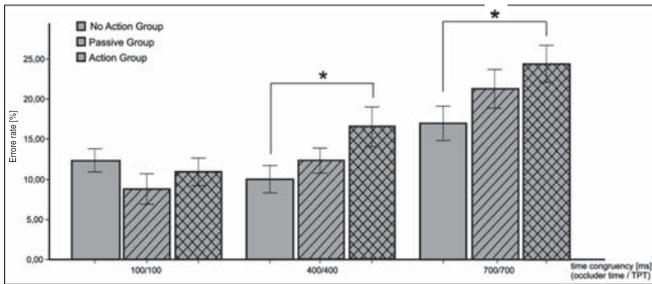

Figure 3 - Mean and standard error of the error rates are plotted for cases where occluder and test posture time correspond (i.e., time congruency) for all three groups. There was a significant time congruency x group interaction. No difference in error rates between Groups were found in the short time congruency condition (100/100 ms), rather there was a parametric increase of error rates in medium (400/400 ms) and long (700/700 ms) time congruency conditions with increasing motor involvement of the Groups (No Action < Passive < Action Group).

4.2 Reaction times

As hypothesized in the **real-time simulation hypothesis** there was a significant occluder x test posture time interaction over all groups (F=(4,531)=12.802; p<0.001) with lowest error rates when occluder and test posture time correspond. Furthermore there were a significant main effect occluder time (F=(2,108)=24.066;

p<0.001) with best performance in medium occluder times and a significant main effect test posture time $(F=(2,108)=91.155; p<0.001)$ with increasing error rates with increasing test posture time. Analyzing time distance (0 ms, 300 ms, 600 ms) showed a significant main effect of time distance, with increasing RT with increasing time distance between occluder time and test posture time in all three groups $(F=(2,38)>10; p<0.01)$. No other interactions with the factor group reached significance $(F<0.65)$. RT showed a similar pattern than error rates.

5. DISCUSSION

The present study provided evidence that persons use real-time simulation for prediction other person's actions. Supporting the real-time simulation hypothesis, all three experimental groups (No Action, Passive and Action Group, respectively) show the real-time simulation pattern as suggested by Graf et al. (2007). This reflects that the used paradigm worked in all three conditions properly, although there were dual-task options. Participants appeared to be able to simulate and predict actions both when they move and when they do not move.

Furthermore, the results show that this real-time simulation pattern differs in dependence of the participants' degree of motor activity. This supports the motor interference hypothesis stating that motor representations are involved in action simulation. More specific, it supports the prediction that the execution of movements interferes with the simulation of observed movements. This motor interference effect is characterized by a decreased benefit from a time congruency between occluder and test posture time while performing a motor task simultaneously. However, this effect applies to more demanding (i.e., longer) simulation conditions. Interestingly there seem to be a parametric increase in error rates in the medium and long time congruency condition (400/400 and 700/700, respectively) with an increasing amount to which the motor system of the observer is involved. While the No Action Group show the smallest involvement of the motor execution system (due to the fact that they only respond with their feet), the Passive Group involves a slightly higher amount of motor command (e.g., holding the knobs) and motor control (e.g., updating the position where the hands are moved to). In contrast the Action Group involves the highest amount of motor involvement with a high level of action planning (due to the direction and kind of the circular movement), action execution (giving a motor command and tense

of the appropriate muscles) and motor control (correcting errors in action execution). While Kilner and colleagues demonstrated interference effects of a congruent biological movement observation on the acuity of action execution, this study showed interference effects of action execution on the prediction of action outcomes (i.e., action simulation of occluded actions).

As mentioned above, the present study indicates that motor interference in the Action Group is specific to cases where long periods of occlusion have to be bridged, i.e. when long real-time simulation is required. The fact that the interference effect appeared only in medium and long occlusion times and the fact that the error rates showed a parametric increase with increasing motor involvement of the groups (No-Action < Passive < Action Group) for medium and long occlusion conditions argues against pure dual-task costs due to working memory or attention effects. Therefore we propose (at least partly) overlapping mechanisms to be involved in the simulation and execution of motor actions.

Long simulation goes along with the fact that the internal model of the observed action is not being updated by visual input for a long time. This makes real-time simulation and prediction of the action output more demanding. The higher demanding character of longer simulation could cause motor interference in the Action Group only in medium and long occlusion cases. On the other hand, it is possible that the simulation process gets less accurate the longer it needs to be maintained. This could be due to adaption to the increasing number of possible outcomes of the occluded action. This increase of inaccuracy could be speeded up when humans do move due to the fact, that moving person's change their own positions in every-day life and therefore need to have more flexible simulation outputs.

We have to keep in mind that the present study used stimuli showing full-body movements. More specifically, we found a motor interference effect in the simulation of full-body movements although the motor interference task involved a different kind of movement as the observed one, namely simple circular movements drawing with both hands. Accordingly, on the basis of the present study it is hard to specify which particular representations are shared when simulating and executing action (Prinz, 1997). Thus it seems promising to investigate how the interference effect may relate to effector mappings between executed actions and observed actions in future experiments. For instance, interference effects may be increased by an increased overlap between the observed

and the actively used action effectors. In fact, evidence for effector specificity in action execution and action observation has been reported (Reed & Farah, 1995; Reed & McGoldrick, 2007). For example, Reed and McGoldrick (2007) used a dual-task paradigm where participants are ask to move a certain body part (arm versus leg) and to memorize posture of the congruent body part of another (virtual) person. When the participants moved and memorized the same body part (congruent effector condition) interference took place only when a short processing time is available. In contrast the authors showed facilitation when long processing times are offered. Taking into account that the participants in the presented study execute the secondary motor task and the simulation task simultaneously, it is likely that motor interference effects on action simulation are stronger when the observed and the executed action involve the same kind of effector. Such evidence would speak for shared representations in action execution and action simulation on the specific level of action effectors.

Apart from this motor interference effects can be assumed to get stronger when the kind of executed and observed actions correspond. For example, Jacobs and Shiffrar (2005) showed that walking observers have a decreased performance in evaluation the walking speed of point-light walkers compared to standing or cycling observers. With respect to the current results, it would be an interesting extension to disentangle two factors: the congruency of moved and simulated effector and the congruency of the kind of executed and simulated action. Therefore, we are currently planning further studies that will contrast (a) congruent/incongruent actions with regard to the *type of action* observed in the movies and (b) congruent/incongruent actions with regard to the *effector* involved in the observed action (e.g., observing an arm-related action while performing a leg-related action). If these manipulations are to be effective, the argument for common motor representations would be substantially strengthened.

As mentioned above the use of an active versus a passive secondary motor task allowed it to disentangle the motor command and the sensory feedback, which arises from the movement of the arms. The finding that motor interference is strongest in the Action Group can reflect the fact that giving the motor command seems to be the critical issue. These assumption would fit to the theoretical framework of de Vignemont and Haggard (2008), in which they wonder 'what is shared?' in shared representations in action observation and action execution. The authors claim

that the "best candidate for shared representations of action is intention in action" (de Vignemont & Haggard, 2008, p. 1). The intention to move the crank is only given in the Action group of the present study.

Future studies will investigate whether "motor interference" addresses to higher levels of the motor hierarchy like motor intentions as proposed by de Vignemont and Haggard. For instance, when contrasting a secondary motor planning task with a motor execution task in action simulation (like used in the Action Group of the presented study), one could hypothesize an increased "motor interference" in motor planning in contrast to motor execution.

Another in interesting future question refers to the specificity of the interference effect of action simulation. Firstly, whether it is a more general effect operating on the level of task difficulty. To test this, it is planned to contrast a motor and a purely cognitive type of secondary task, with the hypothesis that interference will take place only in the group which executes the secondary motor task. Last not least, thinking of human's everyday actions leads to the question what motor interference means in respect to social situations. For instance, considering performance in team sports when persons have to move simultaneously to others, they would suffer from impairment in action simulation. Sportsmen would collide with each other or had trouble to predict trajectory of balls thrown by the opponent. Therefore one can think of "motor interference" also in terms of increased flexibility in every-day life involving the simulation of our conspecific's actions. For example, imaging you on your bike in the pedestrian area of the big city, you cannot benefit from a mental simulation of the absolute direction and speed of each pedestrian, rather you need a flexible adaptation taking into account your own movement and position changing. This idea fits well to a study done by Themanson and colleagues (Themanson, Pontifex, & Hillman, 2008). They could show that higher body fitness (operationalized as walking movements on a treadmill) leads to an increased cognitive flexibility, which was shown by a greater post-error accuracy and a higher error-related negativity in EEG in an Eriksen flanker paradigm. The authors suggest that higher fitness is related to an effective modulation of cognitive control in order to adapt the actual behaviour to the current situational demands. According to the authors this is enhanced in situations were accuracy (rather than speed) is important. Interestingly, in the presented study the participants were instructed to perform the simulation task (deciding whether

the test posture was rotated or not) as fast and as accurate as possible. Nevertheless the participants received response feedback (correct versus incorrect), which may have forced a focus on task accuracy and in turn, could have led to an increased cognitive flexibility. Because this idea is highly speculative for interpretation of the presented results, future experimental accounts of how to address the hypothesis of enhanced flexibility in action simulation in moving participants will be another interesting aspect to be discussed on the workshop.

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INTERACTIVE SENSE-MAKING IN THE BRAIN

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ABSTRACT

One of the great challenges for the advancing field of 'social cognitive neuroscience' is to address issues concerning the neural underpinnings of human social interaction. Though some attempts have been made in this direction the conceptual frameworks underlying most existing paradigms are often unelaborated and ambiguous to the structure of human interaction. This presentation has two overall aims: first, to discuss which kinds of predictions logically follow from existing approaches to social cognition such as 'simulation theory' (ST) and 'theory of mind' (ToM), and why these might prove unproductive for the study of true social interaction. Following from this, we propose an alternative framework for neurocognitive studies of social interaction, rooted in enaction theory. A central distinction in our approach is the differentiation between observing and participating in social situations. This distinction has not been appreciated by ST and ToM advocates whom tend to treat interaction as continuous with the mentalistic act of 'figuring out the mind of the other'. We argue that contrary to observational social situations the nature of participatory interactions is not fully captured by reference to the autonomous, individual minds of the participants, but rather in their dynamic reciprocal couplings. These critically depend on material mediation. When engaging in interaction, participants enter into a shared referential space where bodies, acts and objects are perceived in a new functional perspective as mediators of social coordination and meaning. They become social symbols affording mutual responsiveness and co-action. A social enactive conceptual framing of participatory interaction thus calls for new types of experimental questions, hypotheses and paradigms geared to capture these cognitive and neurocognitive properties. We suggest three such testable predictions and bring these to a meta-analysis of a series of existing functional brain imaging studies of social cognition, joint action and non-verbal communication. When comparing brain activation patterns in studies of what we term observational social situations with studies featuring an element of enactive interaction these do not fully overlap. Interestingly, a consistent pattern of activations in studies of interaction cluster in an area of the inferior frontal gyrus (roughly comprising BA 44, 45, and 47) not normally considered part of the so-called 'social brain'. We suspect that this anatomical site might play a general role as an interface for socially interactive sense-making across expressive modalities of mediation (from bodies and objects to verbal language). Furthermore, the analysis supports our intuition that social

observation and interaction should not be treated in direct continuation (as suggested by ST and ToM) but as differentially organized cognitive phenomena – not as one, but two social brains.

Keywords: participatory interaction, brain imaging, social enactment theory, material mediation, simulation theory, theory of mind

1. SOCIAL COGNITION - BRIDGING THE DIVIDE?

Two influential approaches pervade the majority of existing cognitive brain imaging studies on social cognition - theory of mind (ToM) and simulation theory (ST). No doubt, these are successful in their account of a diverse range of social phenomena, from the feeling of empathy to the detection of deceit. But there are aspects of our social life that seem to work neither by theory-making nor simulation. We will argue that to capture the true cognitive profile of full-blown, cooperative social interaction other approaches are needed.

Common to theory of mind and simulation theory is that they take as their point of departure the autonomy of the individual mind. From this perspective a social situation has one person trying to figure out the fundamentally inaccessible mind of another by metarepresentation or simulation of internal cognitive states. This might be what is going on in some situations as when we 'passively' observe social phenomena from a distal third-person perspective (De Jaegher & Di Paolo, 2007; Gallagher & Hutto, 2008). As such ToM and ST can possibly account for some of the cognitive processes involved in the detection of false-beliefs or the comprehension of someone's intentional grasping. But these approaches seem unsuited to grasp the basic nature of participatory social interactions. Taking a ToM perspective on social interaction would entail something like two individual agents constantly working to 'bridge the gap' by figuring out the mind of the other. And in the simulation version the two interactants would understand each others' actions by something like an immediate pre-conceptual simulation, which is then attributed to the discrete other. In both cases the experience is taken primarily to be about the other person and his/her special mental dispositions toward the one self. From this perspective it is far from obvious how we manage in relatively effortless and efficient manners to achieve fine action coordination and joint sense-making. The emphasis on such 'person-centered' approaches as the grounds for participatory social interaction seems counterintuitive and unproductive. Rather than conceiving minds as individual representations that meta-represent one ano-

ther, we suggest the human mind to be profoundly intersubjective in nature (Zahavi, 2008; Russel, 1998). Following the ideas of e.g. De Jaegher and Di Paolo (2007) and Zlatev et al. (2008), we will sketch out an enactive approach to the study of interaction structured along two related lines: 1) participatory interaction as an instance of dynamic, reciprocal coupling and coordination, and 2) attention to the special mediating role of the shared material environment in this process. Besides, we attempt to show how this conceptual approach can explain some of the recent findings in functional brain imaging studies of social cognition, revealed by a meta-analysis of a series of studies on non-verbal communication and joint action.

1.1 Interactive sense-making and material mediation

As indicated above, there might be good reasons for differentiating two distinct types of social encounters: 1) one in which we passively observe a social interaction from a third-person perspective, and 2) one in which we are first/second-person active participants in the social interaction (Tylén, 2007; De Jaegher & Di Paolo, 2007; Gallagher & Hutto, 2008). So far this important distinction has not been appreciated in ToM and ST approaches to social neu-rocognition that have almost exclusively favored the first type. As a consequence, findings related to the observational type of social experience have been suggested as general models for social cognition (cf. e.g. Gallese et al., 2004). However, we will suggest that in social interactive encounters the structural dynamics of the whole situation is altered in fundamental ways, challenging these traditional models on several grounds.

In the enactive account, when two people engage in reciprocal so-cial interactive activities they become part of an emergent coupled system making up the interaction. The interaction itself is thus the minimal object of study while the individual minds entering the interaction can only be considered constituent "subparts" as their complementary roles are defined and constrained in relation to the interactional whole (De Jaegher & Di Paolo, 2007). The object of mutual attention is thus not the participants' individual mental states, but the shared perceptual space of bodies, objects and action that scaffold joint sense-making. Interactive social meaning is thus a mutual creation between brains, minds, and the material media-tions that form the interaction. From this approach it follows that the persons involved are neither preoccupied with theory-making

nor simulation, but are continuously adjusting their actions in complementary ways by orientation of the dynamic matter of the interaction and mutual commitment to regulating social normative practices (Tylén et al, in review; Sinha & Rodríguez, 2008; Roepstorff & Frith, 2004). Such coordination dynamics include not only procedural practices of turn-taking and gaze-following and fine temporal motor coordination, but are likewise involved in scaffolding symbolic meaning construction. In both cases the driving force is found in aspects of our shared materiality.

The mediating impact of the material environment on human social cognition has been somewhat neglected in most approaches to human cognition that often pursue a more mentalistic or metarepresentational account. But several recent advances in intersubjectivity find our joint engagement with the *material* world to pave the way for new styles of symbolic thinking (Clark, 2006; Sinha & Rodríguez, 2008; Gallagher & Hutto, 2008; Roepstorff, 2008; Tylén et al, in review). Rather than being empty vehicles for encoded denotational meanings travelling *between* minds, social symbols primarily do their work in concrete local, contextualized settings by joint manipulation of their signifying materiality (Clark, 2006; Cowley, 2004; Kravchenko, 2007). Symbolic communication (e.g. in verbal languages, bodily gestures or material objects) is thus also a type of joint action (Clark, 1996) in which socially shared meanings are negotiated and grounded in specific social contexts by virtue of the social affordances of their materiality (Sinha & Rodríguez, 2008). Interaction is thus not about the participants involved, but about the subject matter. It is a collective 'making sense of the shared material space' between the participants.

1.2 Shared attention, social meaning and responsiveness

From the dynamic structural architecture of participatory interaction sketched out above it could be argued that participatory interaction is not even a cognitive enterprise and thus does not lend itself to traditional experimental cognitive studies of single subjects. This is not necessarily so. In the following we will consider three contrastive predictions characterizing the difference in cognitive profile between the observational and interactive social encounters: 1) differences in attention distribution of the interacting agents, 2) different semiotic profiles of the social meaning attributed to these situations, and 3) differences in the agents inclination to respond

or co-act. Though the empirical evidence is still sparse some of these predictions already find support in recent behavioral studies. Though the experimenters might not fully subscribe to our conceptual prospects the main ideas are supported in a series of recent studies of infant cognition (e.g. Gergely et al., 2007; Senju & Csibra, 2008; Senju et al., 2008). The experimental finding is that when an infant observes an experimenter's behaviors from a third-person perspective, the infant seems to interpret the behaviors as expressing the preferences of this specific experimenter. In contrast, when the infant is directly addressed by the experimenter's ostensive cues (such as making eye-contact, nodding and vocalizing in 'motherese') the infant tends to interpret accompanying object-oriented behaviors as generalizable socially relevant information about the object world. In other words; in the first (observational) situation the infant learns about the specific preferences and dispositions of the other person (the experience is about *the person*) and in the interactive situation the infant learns something about the shared object world (the experience is about *the intersubjectively shared world of meaning*) (Gergely et al, 2007).

In support of our first predictions outlined above, the studies seem to suggest quite different attentional strategies for the two types of social encounters leading to different kinds of 'social meaning'. We speculate that this is due to differences in semiotic attitude to the scenes. Though quite compatible bodily actions or objects might be involved they become perceived in fundamental different ways. When we investigate another person in an observational fashion we might infer, explain or predict his/her behavior in terms of particular contents of mind and intentions towards the world. This style of 'private sense-making' is primarily dependent on indexical (causally explanatory) strategies (De Jaegher & Di Paolo, 2007; Tylén, 2007). In contrast, when we engage in interactive encounters aspects of the material world gain another semiotic status; bodily movements, facial expressions and material object manipulations are suddenly perceived and employed as intentional mediators of the ongoing dynamic coordination: they become shared social symbols (Tylén, 2007; Tylén et al, *in review*; Clark, 2005).

The last prediction that seems to follow from the proposed enactive approach to social cognition is related to the social normative practices of interaction. In most cases when we are addressed ostensively by someone to take part in a joint action we will feel an almost automatic inclination to respond. Such addressing gestures are part of a distributed normative structure that is only realized

by the complementary turn-taking effort of both parties. One act calls for the other in a dialogical structure across participants. If a participant fails to respond, i.e. fulfill her role in this shared normative structure, the interaction is likely to break down (cf. e.g. Garfinkel's breaching experiments, Garfinkel, 2002).

The motivated predictions concerning differences in attention, semiotic attitude and responsiveness in relation to observational and interactive styles of social encounters are likely to be reflected in functional brain activity of social agents engaged in these situations. Though so far this has not been systematically investigated, a series of existing functional brain imaging studies might throw some light on the biological underpinnings of participatory interaction.

2. THE SOCIAL BRAIN

In recent years, a still growing number of brain imaging studies address the neural underpinnings of social cognition. As mentioned above two well-established and influential approaches, ToM and ST (closely allied to the mirror neuron literature) have dominated this field. The findings are summarized under appealing titles like 'The meeting of minds' (Amodio & Frith, 2006), 'Understanding intentions in social interactions' (Walter et al., 2004), and 'A unifying view of the basis of social cognition' (Gallese et al., 2004). A common trait in these studies is – again - an 'observational approach' to social phenomena. While a full review of this large literature is beyond the scope of this presentation, we will attempt a brief overview of the basic functional anatomical findings. These will be compared with a number of studies on joint action and non-verbal communication that can be argued to conceptually imply an element of interaction. Interestingly, the findings do not fully overlap. Rather, the two clusters of studies involve a number of dissociate functional activations which could suggest (contrary to the expectancies of ST and ToM) that observational and interactive social situations are in fact subserved by partly dissociate systems due to their fundamental structural cognitive differences.

2.1 Theory of Mind in the brain

One of the well-established paradigms in cognitive neuroscience is sometimes treated under the somewhat presumptuous headline "the social brain" (cf. e.g. Gobbini et al., 2007). It more or less implicitly defines 'social' in term of our abilities to 'mentalize', that is, to make inferences about the mental states of others. In

an extensive series of studies of 'theory of mind' and 'mentalizing' (cf. e.g. Castelli et al., 2000; Walter et al., 2004; Gallagher et al., 2000, 2002; Gallagher & Frith, 2003, 2004; Amodio & Frith, 2006; Fletcher et al., 1995; Kampe et al., 2003; Saxe, 2006; Schilbach et al., 2006, etc.) it has been suggested that a distinct pattern of brain areas including (among others) the temporal poles bilaterally, the right temporo-parietal junction (TPJ), the right superior temporal sulcus (STS) and the medial prefrontal cortex (MPFC) are involved in explaining and predicting the behavior of other people regardless of the sensory modality or task involved. A couple of these studies could potentially be of great relevance for the present conceptual purposes as they seem to entail an element of cooperative interaction. In Kampe et al. (2003) and Schilbach et al. (2007) the experimenters investigated functional brain activations related to subject-directed ostensive cues (Sperber & Wilson, 1986). Like in the behavioral studies of Gergely, Senju, Csibra and colleagues such cues could arguably be said to facilitate the initiation of social interaction. Still, when the activation patterns in MPFC largely replicate the findings from other ToM studies it is likely due to the fact that no real interaction follows from these cues. They are thus merely expressing the intention to initiate a not yet realized interaction and in that sense they are still perceived as being about the particular mental dispositions of the depicted person.

2.2 Simulation in the brain

Another cluster of studies on social neurocognition are founded on simulation theory (ST). Though we acknowledge that ST has a long history preceding Gallese and colleagues' groundbreaking finding of mirror neurons in the F5 motor cortex of monkeys (Gallese et al., 1996), we will in the following brief overview primarily focus on the human mirror-neuron literature (e.g. Gallese et al., 1996, 1998, 2004; Gallese, 2007; Buccino et al., 2001, 2004; Decety & Grèzes, 2006; Rizzolatti & Craighero, 2004; Newman-Norlund et al., 2008, etc.). The central idea is that the basic mechanism for understanding other people is not conceptual reflection but a very direct and immediate mental simulation (mirroring) of the other's emotions and actions. When we thus for instance recognize someone's motor actions as intentional and meaningful it is because special populations of mirror neurons related to our own motor system simulate the action and thereby impose on us a similar imagined first-person experience of intentional action.

Since single cell recordings in the human brain are not possible the existence of mirror neurons in humans cannot be directly validated as in the case of monkeys. Still, when investigating action perception using functional brain imaging 'mirror activation patterns' are consistently found in compatible sites of the human brain including the rostal part of the inferior parietal lobule (IPL) and in the pars opercularis of the inferior frontal gyrus (IFG) and adjacent areas of the premotor cortex homologue to the F5 areas of the monkey brain (Rizzolatti & Craighero, 2004). Furthermore, some brain areas involved in emotional affect (e.g. the insula) show the same mirroring behaviors (Gallese et al., 2004). Although it is likely that the mirror neuron system is involved in direct access to the emotions and actions of others it is not entirely clear how these simulations are 'fed into our own decision making system' to explain the actions of others and navigate social terrain (Gallagher, 2007).

Since the whole idea of a simulative understanding of other people is about 'bridging first-person and third-person experiences' no elaborate predictions concerning the first-person/second-person social encounter have yet come from this approach. However it has been suggested that the mirror-system might facilitate communication. The proposed anatomical sites' partial overlap with Broca's area (BA 44 and 45) of the left inferior frontal gyrus (IFG), a structure consistently found in studies of verbal language production and comprehension (cf. e.g. Price, 2000; Wallentin et al., 2005, 2006, among many others) has motivated some speculations concerning simulation being the basic underlying mechanism of human language (see Rizzolatti & Craighero, 2004 or Gallese, 2007 for reviews). However, this is still the subject of ongoing debate (cf. e.g. Toni et al., 2008). A couple of recent investigations however do attempt (at least indirectly) to suggest how the mirror system might relate to first/second-person participatory interaction. In two studies on the neural underpinnings of cooperative joint action Newman-Norlund and colleagues found activations of the human mirror system when two subjects had to continuously coordinate their actions in a complementary fashion to solve cooperative tasks (Newman-Norlund et al. 2007, 2008). Interestingly, a general finding across these studies is that activation in some regions of the mirror system (e.g. the right IFG) is more enhanced in conditions of non-imitative, complementary actions than in imitative conditions. This could seem counterintuitive since the mirror system has mostly been thought to involve imitative simulations, but

Newman-Norlund and colleagues hypothesize certain populations of mirror-neurons to be 'broadly congruent', context sensitive neurons rather than strictly imitative, context independent neurons. The first ones are thus supposedly involved in the planning of non-imitative, complementary actions (Newman-Norlund et al., 2007a). Though these findings are highly relevant and promising for our stated objective concerning the neural underpinnings for participatory interaction there are a couple of central issues that are not considered in these studies. These are related to joint sense-making and its proposed material mediation, possibly related to other structures of the IFG.

2.3 Non-verbal communication in the brain

While ToM and ST pose ambitions towards a general theory of social cognition ironically this is not where we find the most studies on participatory interaction. Rather these are often reported as instances of (non-verbal) communication. A series of studies on various kinds of non-verbal communicative mediation thus allow for meta-interpretations with regard to the proposed enactive framework of participatory interaction. These are studies that in their experimental design contrast communicative and non-communicative conditions (cf. e.g. Lotze et al., 2006; Dietrich et al., 2007; Lawrence et al., 2006; Tylén et al., in press). Like in the studies on ostensive cues treated above they feature the experimental subject as the intended addressee of the communicative activity. Though it can be argued that this form of interaction is less strong than the case of joint motor action, conceptually they do involve an element of interaction in their framing of the subject as aa addressee and cooperative interpreter of social communicative meaning (Tylén, 2007; Tylén et al., in review). Interestingly, the brain areas involved in the studies of non-verbal communication do not consistently overlap with the areas found in studies of ST and ToM as might have been expected if these cognitive strategies had been subserving social interaction. Rather, activations gather in a cluster of areas of the IFG traditionally associated with verbal language and semantics.

In an fMRI experiment, Lotze et al. (2006) contrasted the neural responses to three different kinds of right hand movements: isolated hand movements (e.g. twisting a lid), body-referred movements (brushing teeth) and expressive gestures (e.g. holding up the index finger to threat someone). While the first two are not intended as communicative signals the third mediates social communicative

meaning. In the body-referred and the expressive movement conditions the experimenters found activity in the STS of the social brain network. This area has previously been associated with the perception of another person's action (Gallagher & Frith, 2004). But, when the expressive gesture condition was contrasted with the body-referred movement condition only the left ventro-lateral prefrontal cortex (VLPRC)/Brodmann Area (BA) 47, was active. Interestingly, this area has previously been associated with semantic processing in verbal language (cf. e.g. Dapretto & Bookheimer, 1999; Fiez, 1997).

In another imaging study of brain regions associated with the perception of non-verbal vocalizations Dietrich et al. (2007) found a similar pattern. They were interested in the fact that in addition to words in a natural language people make use of other types of vocalizations to express social meaning. For instance, affective bursts like laughter or cries have an intrinsic (indexical) social communicative function in signaling other individuals' affective states, but in addition vegetative sounds such as belches and yawns are sometimes produced deliberately to signal arbitrary (symbolic) communicative meanings. This fact was manipulated in Dietrich et al.'s experiment. While being scanned subjects were instructed to classify different types of vocalizations including affective bursts (e.g. laughter) and vegetative sounds (e.g. snoring or belching) in terms of their presumed function: communicative signals vs. non-signals. As in the previous study, we could have expected the task in this study to involve mentalizing or simulation as it targets the recognition of communicative intentions. But when the experimenters contrasted vocal signals with non-signals an interesting additional pattern of areas normally not considered part of mentalizing or simulation were elicited. The hemodynamic responses resided in areas of the left hemisphere temporo-parietal junction, proposed to be an verbal 'auditory-to-meaning interface' in previous studies (cf. e.g. Hickok & Poeppel, 2000), together with some structures of the inferior frontal gyrus (left BA 47 and right BA 44 and 45). Again these are all areas consistently found in studies of verbal language and semantics. Besides, note that one of the prefrontal components (left BA 47) overlaps with the findings of Lotze et al. (2006).

A third study of interest in this connection addressed aspects of 'body language'; ways we direct motor acts at other people as signals recruiting "shared representations" (Lawrence et al., 2006). The experimenters used an adapted version of the Profile

of Non-Verbal Sensitivity or PONS test (Rosenthal et al., 1979) in a fMRI experiment assessing subjects' understanding of non-verbal communication. In the scanner subjects saw a series of short video clips showing an actor conveying various types of facial and bodily expressions and gestures, and were asked to rate them on either a non-social (face or body?) or a social (angry or happy?) decision task. The experimenters interpreted subjects' behavioral responses (button presses) to the social condition in terms of their ability to empathize. Empathy is also normally considered part of our 'theory of mind' (Lawrence et al., 2006), yet in the main contrast between social perception and *non-social perception*, none of the regions supposed to be part of the 'social brain' were activated. Rather, similar to the previous examples the primary main effects are found in the dorso-lateral prefrontal cortex (DLPFC/BA 46) and inferior frontal gyrus (BA 44) including Broca's area bilaterally (among a couple of other sites). The authors interpreted these patterns of activation in terms of an orientation to 'shared representations'. The same areas are however part of a common network involved in various aspects of language processing (cf. e.g. Hagoort, 2005).

Finally, in an event-related fMRI study on object mediated communication Tylén and colleagues presented two contrastive types of images to subjects (Tylén et al., in press). In the test condition images depicted static scenes with configurations of everyday material objects that were manipulated in striking ways that seemed to call for a symbolic interpretation (e.g. chairs put out in the street to reserve a parking place or a bunch of flowers left on the doorstep of a private home to express a declaration of love, etc.). The control condition had the same objects in their canonical instrumental (or accidental) non-communicative contexts. Again, the main conditions thus contrasted communication and non-communication though in an externalized material mediation. The experimenters found that when subjects made communicative interpretations and explored the object configurations as sources of intentional social meaning they had enhanced activity in part of the fusiform gyrus and the pars triangularis of the IFG (BA 45). The studies on non-verbal communication introduced above (Lotze et al., 2006; Dietrich et al., 2007; Lawrence et al., 2006; Tylén et al., in press) are all concerned with a special type of social encounter; situations where bodily movements, facial expressions, vocal sounds, hand gestures and material objects are recognized as intentional signals addressing the subject to mediate social

meaning. And as such they call for a cooperative, interpretative attitude in the addressee. While from the point of view of the well-established approaches in social cognition, we could have expected 'conceptual reflection' or 'immediate simulation' to be central components in such interactions related to for instance the recognition of communicative intent (Walter et al., 2004; Kampe et al., 2003; Schilbach et al., 2006; Gallese, 2007; Buccino et al., 2004), areas of these brain networks seem to play a somewhat marginal role in the studies. Instead, we consistently find activation in closely adjacent regions of the IFG.

It might be noted that some of the findings in these studies (e.g. in Dietrich et al. 2007; Lawrence et al., 2006) tap into areas of BA 44 of the IFG that are also considered part of the mirror system and thus potentially could be interpreted in terms of mental simulation. Still, since the contrastive control conditions feature very similar vocalizations and gestures it is not obvious why the mirror system should be activated in the test and not the control conditions. Rather, the activations found in various neighboring sites of the IFG (BA 44, 45 and 47) could be seen as expressing a common trend; the same areas have thus been proposed as comprising the "unification area" by Paul Hagoort (cf. e.g. Hagoort, 2005; see also Müller & Basho, 2004, for an interesting discussion). Rather than assigning very subtle differentiated functions to each of these Brodmann areas, Hagoort finds them to be closely functionally related as an interface for the integration of various aspects of semantic and pragmatic meaning in verbal language.

Since the same cluster of areas consistently show up in studies on the diverse range of expressive mediations from gesture to objects (e.g. also including 'musical semantics', Vuust et al., 2005, 2006) we suggest to ascribe this 'unification site' a more general function across expressive modalities as responsible for human interactive sense-making and meaning construction. This idea is consistent with the often posed proposition that verbal language both ontogenetically and phylogenetically evolves from non-verbal modes of interactive communication (Arbib, 2005; Donald, 2001; Tomasello, 1999; Zlatev, 2008).

3. THE TALE OF TWO SOCIAL BRAINS

Based on the socially enactive framework outlined in the initial parts of this paper we might hypothesize not one common mechanism and brain network for social understanding but several depending on the type of social task at hand. For the matter of

the current argument we will propose a rude and simplistic model comprising two such 'social brains', that is, two dissociate neural networks underpinning various types of social understanding. One system is thus concerned with an observational style person-oriented approach and another - a interactive style object-oriented approach. The first system is thus concerned with various strategies for extracting social information from the perceived behavior of the other. It may work by mentalizing or simulation (or both) but essentially serves the same goal; to 'privately' understand the other. The reviewed empirical literature suggests that the system anatomically comprises a distributed set of regions such as the MPFC, TPJ, STS and the temporal poles bilaterally plus the IPL, the pars opercularis of IFG and possibly the insula.

The second system facilitates our engagement with other people in dynamic participatory interactions for purposes of joint sense-making. In these situations, participants' alignment of pragmatic implicatures, fine attentional attunement and complementary coordination entail mutual commitment to highly schematic social norms and practices in which roles are assigned and enacted. This socio-normative process is a triadic endeavor heavily scaffolded by material mediation in the form of mimetic and symbolic acts, objects and places affording mutual responsiveness.

Far too few brain imaging studies have explicitly addressed the issue of participatory interaction in proper contrastive experimental manipulations. However, the few existing studies that can be argued to feature an element of interaction point to the 'unification area' of IFG (BA 44, 45, 47) as one of the possible anatomical candidates for this interactive style of social cognition.

3.1 Toward an Enactive Framework for the Study of Social Neurocognition

By first sight, a social enactive framework for interactive sense-making would seem somewhat unfeasible to operationalize into concrete testable neurocognitive hypotheses. The idea that the cognitive profile of participatory interaction is not fully represented and thus cannot be captured in the individual minds and brains of the participants but only in their complex dynamical couplings seems to call for something like hyper-scanning paradigms where two persons are scanned simultaneously while interacting. Such paradigms are not beyond reach but until they are up and running other testable hypotheses more suited for state-of-the-art functional brain imaging seem to follow from the conceptual ela-

borations posed above. In the preceding, we have suggested three such hypotheses. One of these is that participatory interactions involve a special kind of joint attention to the mediating role of bodies, actions and objects. Another is that these interactions are structured by mutual orientation to socio-normative implicatures that assign complementary roles to the interactants. And a third hypothesis is that these normative structures and their material mediations afford for social engagement and thus evoke mutual responsiveness. Until further investigations are carried out along the lines proposed in this paper we suspect that at least some of the aspects of participatory interaction are subserved by brain regions of the IFG which consistently shows up in existing studies involving elements of interaction.

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THE INTERGENERATIONAL TRANSMISSION OF ATTACHMENT DISORGANIZATION: THE ROLE OF FRIGHTENING/ANOMALOUS BEHAVIOR IN MOTHER-TODDLER INTERACTIONS

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The present research examined the intergenerational transmission of attachment disorganization. Previous studies have shown associations among mothers' unresolved state of mind with respect to loss and trauma, mothers' display of frightening/frightened behaviour with their infants, and infants' display of disorganized behaviour during the strange situation. This study examined the continuity of frightening/frightened maternal behaviour over a 16 month period to further understand how the fear underlying a mothers' unresolved trauma will be transmitted to her child. A new method was developed to assess the quality of mother-toddler interactions during free play, toy clean-up and problem solving tasks.

Method: The sample consisted of 110 lower to middle class U.S. mothers and children. During their third trimester of pregnancy, 125 women were recruited from birthing classes and public service announcements on T.V. During this visit, mothers completed the adult attachment interview. When their infants were 8 months old, frightening maternal behaviour was assessed using a 9-point observational rating scale. At 12 to 15 months, infant attachment quality was assessed using Ainsworth (1978) Strange Situation. Finally, at two years, mother-toddler interactions were videotaped in a laboratory setting. Within each session, dyadic interactions were rated on four 7-point scales -- secure base, hostility, disconnected, blurred boundary, and controlling behavior -- as well as a 9-point frightening/anomalous behavior scale.

Results: Preliminary data demonstrate continuity in frightening caregiving from 8 to 24 months. Moreover, prenatal assessment of mothers' unresolved trauma and the 12/15 month assessment of infant attachment disorganization forecast higher scores on the frightening/anomalous behaviour scale at 24 months. Security of attachment in both the mothers and children forecast higher scores on the secure base scales and lower scores on the other scales.

1. INTRODUCTION

According to attachment theory, the most important factor guiding the formation of the attachment relationship is the reciprocal pattern of influence between the behaviors of the caregiver *and* infant: in particular, the child's experience and confidence on caregivers availability and social interactions with her (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969/1982; van Ijzendoorn & De Wolfe, 1997). The investigation of these themes is directly linked to the more recent theories on intersubjectivity (for a review see Morganti et al., 2008), that is considered, in fact, as a basic aspect of social cognition that allows to share experiences and to be attuned other's mental states in an immediate way. In fact, the fundamental thesis of the intersubjectivity is the impossibility to examine the subjective experience without the continuous sharing of it with the experience of the other persons (Liotti, 2001).

It has been widely acknowledged that the quality of dyadic interactions with parents and/or caregivers, and in particular attachment, is crucial for children's cognitive, social and emotional development. So marked aberrations in attachment organization are associated with developmental and mental health risks in children and adults (Solomon & George, 1999). However, only recently researchers begun to focus and documented the processes that mediate relations between adult state of mind regarding attachment (as manifested in language during discourse of childhood experiences in the Adult Attachment Interview, AAI, George, Kaplan, & Main, 1984, 1996), parenting behaviour (in particular, sensitive responsiveness) and children later socio-emotional development (Cohn, Cowan, Cowan & Pearson, 1992; van IJzendoorn, 1995). This study examined the intergenerational transmission of attachment disorganization. The attachment transmission is not a simple and mechanical repetition of the experience lived in the past, but it is the result of elaborative processes that can be taken part in successive periods of the life and that have carried to the construction of a complex and stratified representational world: the Internal Working Models, that it is assumed submitted mechanisms of the intergenerational transmission of attachment.

Since before the birth of the child, the parents have working models about them like parents and of the child not still been born (Ammaniti, 1991; Brazelton & Cramer, 1990). When the child has been born these models must be correct and syntonized in order to be adapt to the child's temperament and needs. This task will be relatively easy if the internal working models of the

parents are coherent and well organized. Instead it will be more difficult, if the internal working models of the parents are disorganized or insecure. If a high proportion of child's attachment or autonomy signals is not considered or is amiss interpreted, the open communication inside of the attachment relationships will be prevented, since the material excluded defensively cannot be used for a correction of the errors. Therefore, this type of communication will carry the child to develop some internal working models of inadequate himself, determining the inter-generational transmission of it. Various studies noticed a stability over the time of the disorganized behavior (van Ijzendoorn et al., 1999), both that this has been find out in the infancy, through the procedure of the Clown, both that has been noticed with the Strange Situation. Despite this, until now, the empirical studies that investigate the stability of the disorganized attachment models during the first two years of life (Barnett, Ganiban & Cicchetti, 1999; Vondra et al. 1999), have underlined remarkable differences in the result and skids in the manifestation of the disorganized behaviors, evidencing therefore the necessity of further investigation on the topic, in order to being able to formulate more reliable hypotheses. Less is known about how mothers' unresolved trauma and infants' attachment disorganization contribute to the quality of mother-child relationships during toddlerhood. Although the higher prevalence of disorganized attachment in high-risk samples (up to 77%) (Lyons-Ruth et al., 1993), suggests that it arises in chaotic environments where caregiving is inadequate, such as maltreatment (Crittenden, 1985; Lyons-Ruth et al., 1992), its occurrence in low-risk community samples (15 – 20%) indicates a more complex origin (van Ijzendoorn et al., 1999). As regard, an hypothesis has been drawn by the investigation on the difference of the attitudes between the mothers of the children classified like "disorganized" (D) and the mothers of children with others pattern of attachment; thus a result of great relief is emerged: the mothers of the children classified as D suffered, much more often of the other mothers, for the lacked elaboration of a mourning or of a serious traumatic events (incests, violences), in the relationship with own figures of attachment, and they had therefore an "unsolved" (U) state of mind regarding these traumas (Main & Hesse, 1990, 1992; Leon et al., 2004). Main and Hesse (1990) propose that the caregiver's frightening fragments of memories and emotions associated with experiences of unresolved trauma lead to a parental expressions of fear. The authors contend that

when the potentially protective parent is also a source of fear, a disorganized attachment relationship may ensue, and have coined the phrase "fright without solution" to describe this phenomenon. Under these circumstances, (i.e., fright without solution) the child is faced with an insoluble dilemma that prevents the development of an organized strategy for the use of the attachment figure when distressed or prompts a breakdown of an existing strategy. In the absence or breakdown of an organized strategy for dealing with distress, odd, conflicted, contradictory, or inexplicable behaviors associated with disorganized attachment are displayed (e.g., stilling, freezing, repeated incomplete approaches to the parent, failing to approach the parent when distressed; Main & Hesse, 1990; Main & Solomon, 1990). These disorganized behaviors appear to reflect fear, apprehension, and confusion toward the caregiver rather than an organized response for making use of the attachment figure when distressed. Repeated experiences of this type can create in the child a predisposition to the development of conscience disorders that if joined to traumatic experiences during the life can lead to serious alterations, like the dissociative disorders (Liotti, 1992). This study investigated how different aspects such as maternal state of mind, reflective functioning, maternal responsiveness to the child and sensitivity are carried out in the intersubjective experience (Zlatev, Brinck, & Andrén, 2008) of mother-child relationship and contribute to shape the child development. In particular, this study examined mother-toddler interactions during 2nd year of life through the development of a new method of evaluating the quality of relationship during a play session. The aims of the present study are: a) to examine the link between infant attachment patterns, mother state of mind with respect to relationship with her parents during childhood, and the quality of the relationship between mothers and toddlers; b) to examine mother-toddler interactions among children previously classified as having a disorganized attachment.

Particularly, the present study examined three issues:

1) Whether mothers who behave in ways that frighten their children during the first year of life continue to do so at age two;
2) Whether infants classified as disorganized at 12 and 15 months continue to display odd, disorganized and disoriented behaviors at during the toddler years;
3) The extent to which a mothers' display of disorganized and disoriented speech during the adult attachment interview forecasts her behavior with her child at age two.

2. METHOD

2.1 Sample

The sample is part of ongoing longitudinal study following 125 lower-middle class U.S. families over time (Jacobvitz, Hazen, Curran, & Hitchens, 2004; Curran, Hazen, Jacobvitz, & Feldman, 2004; Riggs & Jacobvitz, 2002).

The sample consisted of 110 lower to middle class U.S. mothers and children. During their third trimester of pregnancy, 125 women were recruited from birthing classes, public service announcements on T.V. and flyers distributed at maternity stores in the Austin area. The mean age of the parents was 30.5 years. A high percentage of them reported high educational with 60% beyond high school. 85% of them were Caucasian, 8% African American, 3% Hispanic and 4% biracial or other identifications.

2.2 Procedure

During the first visit (third trimester of pregnancy), women completed the Adult Attachment Interview. When their infants were 8 months old, frightening maternal behaviour was assessed using a 9-point observational rating scale. At 12 to 15 months, infant attachment quality was assessed using Ainsworth (1978) Strange Situation. All the AAI interviews and SSP videotapes were double coded by two trained Researchers. Significant agreement was found in the three and four way classification on both AAI and SSP coding. Finally, at two years, 100 mother-toddler interactions were videotaped in a laboratory setting. Within each session, dyadic interactions were rated developing a new method to assess the quality of mother-toddler interactions. All the videotapes were double coded by two trained Researchers.

2.3 Assesment Instruments

Mother

• *Adult Attachment Interview*
(Main, Kaplan, & Cassidy, 1985)

Parents' mental representations of their childhood experiences with attachment relationships are organizing in working model of attachment, and it has been hypothesized that this set of rules determines parents' sensitivity to their infants' attachment behaviour and, in turn, shapes the infants' own internal working models of attachment (Main & Goldwyn, 1992). To assess adults'

internal working models or current "state of mind" with respect to childhood attachment relationships, George, Kaplan, and Main (1985) developed the Adult Attachment Interview (AAI): a semi-structured interview that probes alternately for general descriptions of relationships, specific supportive or contradicting memories, and descriptions of current relationships with parents. Adults are asked to retrieve attachment-related autobiographical memories from early childhood and to evaluate these memories from their current perspective. The coding of the transcripts is not based primarily on reported events in childhood, but rather on the thoughtfulness and the coherency with which the adult is able to describe and evaluate these discussion of their attachment biographies (Main & Goldwyn, 1991; Main & Hesse, 1990). The interview, therefore, does not assess the actual security of childhood attachments, and theoretically, a secure state of mind is not incompatible with an insecure attachment history throughout childhood. The AAI does not even measure adults' perception of their parents' current support in times of stress, because the interview may be classified as secure even when the parents have died or when they still treat their adult children inadequately. The coding system of the AAI leads to adult attachment classifications in three main categories, that parallel the Strange Situation attachment classifications for infants (Ainsworth, Blehar, Waters, & Wall, 1978): Autonomous or secure adults (F), Dismissing adults (Ds), Preoccupied adults (E). Some autonomous, dismissing, or preoccupied adults indicate through their incoherent discussion of experiences of trauma (usually involving the loss of an attachment figure) that they have not yet completed the process of mourning. Evidence for the continuing presence of unresolved responses to loss are lapses in the monitoring both of reasoning and discourse and reports of extreme behavioural reactions. These adults receive the additional classification *Unresolved (U)*, which is superimposed on their main classification (Main & Goldwyn, 1991).

Child

• *Strange Situation Procedure (Ainsworth et al. 1978)*

This is a standardized procedure developed by Mary Ainsworth and coll. (Ainsworth et al., 1978), to assess the quality of attachment between infant and caregiver. This 20-minute assessment is valid with children aged 12 to 21 months and includes two brief separations from, and reunions with, the parent. The mild stress

of these separations is intended to arouse the child's attachment needs so that the usual pattern of attachment behaviour is elicited. A four-group classification is used to describe individual differences in the organization of infant attachment behavior (Ainsworth et al., 1978; Main, Kaplan, & Cassidy, 1985): *Secure* (Group B), *Anxious-avoidant* (Group A), *Anxious-resistant* (Group C), *Anxious-disorganized or disoriented* (Group D).

Mother and Child:

• *24 Months Mother-Child Interaction Scales*
(Jacobvitz et al., 2004; Zaccagnino et al., 2004)

Mother and children are videotaped in a laboratory setting during three different sessions: 20 minutes of free play, 5 minutes of toy clean-up and problem solving tasks. Within each session, dyadic interactions were rated on four 7-point scales -- secure base, hostility, disconnected, and controlling behavior -- as well as a 9-point frightening/anomalous behavior scale.

The secure base scale measured the extent to witch the interaction promote autonomy in the child; it's important to consider both the parent and child's behavior when assigning scores on this scale. A sensitive parent generally is attuned, flexible, warm, encourages autonomy, shows an interest in toddlers' play and may help the toddler to stay engaged in play or shift attention from one play theme to the next (scaffolding), appropriately and promptly responsive to child's initiations, especially when the child indicates a need for the parent, and engages in relationship-appropriate interactions. During the play session, the parent displays a genuine sense of enjoyment in the being with the child, taking pleasure in the toddler's discoveries. During the play and problem-solving tasks, the mother responds with empathy or help when child is distressed, communicating to the child that she genuinely cares for him or her.

Autonomy in this setting, is shown by a child who is able to fully explore the toys (looks busy), initiates interactions on occasion (to share a discovery, ask for help) and is open on occasion to his mother's play ideas. Specifically, the child should look busy exploring since this is the job of a toddler in a room full of new toys. At the same time, the child will initiate interactions and is comfortable sharing discoveries. The child will try out some of the mothers' ideas for new play themes but a sensitive mother will not persist with a particular play theme if the child is clearly not

interested. The child is able to ask for help when frustrated and the parent will respond immediately and appropriately.

The controlling/interfering scale measured the extent to which parent is controlling toward child and may operate in a rigid manner. The parent may take on a dictator-like role toward the child. Parents' own agenda dominates the interaction. The parent may engage in mind reading rather than letting child voice their wants or needs. Parent controls child's problem solving rather than encouraging child's autonomy. The parent doesn't respect the child's personal space as shown through hovering, physically restraining the child or moving the child's hand during the play (not in the context of discipline). Further, the parent displays an intrusive lack of regard for the child's wishes, autonomy, and development.

The disconnected scale measured the extent in which the parent and / or the child are in separate spheres or arenas of activity or thought. This definition doesn't depend on the amount of interaction. A parent disconnects and moves into his own sphere when she breaks off her awareness of her child and lacks a supportive presence. She is on her own agenda. A child disconnects and moves into his own sphere when he no longer makes emotional bids or "checks in" with his parent. Disconnection involves a lack of shared pleasure from the dyad. The parent is unresponsive to or does not notice the child's pleasure or discoveries. The child brightens at a discovery yet does not make an effort to share his discovery with his parent. For example in one dyad the parent plays and explores the toys by herself for all the time and doesn't respond to child's requests or needs.

The hostility scale for the mother measured the extent in which the parent acts voluntarily in a way that results in distance in the relationship. The parent is critical or hurtful toward the child or may exhibit veiled hostility through jerky movement, impatient, and leaking anger. The hostility operates to distance the parent and child from each other. For example, in one dyad, the mother makes two directly hostile comments to the child, "Knock yourself out" and "what do you do with it, you punk"; the mother also uses jerky movements when handling the child and a mocking tone when playing with the phone.

The hostility scale for the child measured the extent in which the chid acts in a way that results in distance in the relationship. The child engages in intentional non cooperativeness towards the parent. The child directs anger and actions toward the parent or

toward objects in the room. For example in some dyads the child repeatedly hits the mother with the toys in a angry way.

The frightening anomalous scale for the mother measured the extent in which the mother shows odd behavior during interaction. The parent appears frightened or frights the child; also she looks disoriented, absent and shows contradictory behavior in simultaneous sequence. For example, in one dyad, the child hits repeatedly the mother with hammer; first she laughs in a weird way and suddenly she becomes angry. The mother may also act in a sexualised way towards the child.

The frightening anomalous scale for the child measured the extent in which the child shows odd behavior during interaction. The child appears frightened or frightens the mom, shows disoriented and contradictory behavior. The child, when frightened, can also shows active care giving toward the parent aiming to assuage parent distress. For example, in one dyad, child is worried about mother even though there's no reason to worry and keeps on asking the mom if everything is ok. Also he takes care of the mother during the entire session; for example he gives toys to her and says what to do in a controlling way.

3. RESULTS

Subject's classifications on the AAI were no associated with any family demographic variables including age, family status, education or income.

Distribution of Adult Attachment Classifications in Sample

When considering the five-fold distinction, 45.2% of the mothers were Free, 18.2% were Dismissing, 8.7% were Entangled, 23% were Unresolved, and 1.6% were Cannot Classify.

Distribution of Strange Situation Classifications in Sample

As regard the infant attachment quality: 9% of child were Avoidant, 37.8% were Secure, 9% were Resistant, 42.3% were Disorganized, and 1.8% were Cannot Classify.

Further, agreement between three-way attachment categories on the SSP and AAI was 62.9% (Kappa=0.297, $p < 0.029$); agreement on the secure/insecure classification was 70% (Kappa=0.419, $p < 0.023$). There was a significant association between the AAI /U category and categorical D rating on the SSP : agreement = 77.8% (Kappa=0.500, $p < 0.009$). In addition, we found a significant

correlation between the U score on the AAI and the D score on the SSP (r = .45 p < 0.017).

Score on the frightening anomalous scale
The average rating scale scores for each of the groups are presented in Figure 1 and 2.
- Disorganized children significantly differ from the other three coding for the score average of the Frightening anomalous scale (children) (F= 12,984, p < 0,001. Subscales: disoriented F=6,448 p < 0,001; frightened F=3,052 p < 0,032) and Frightening anomalous scale (mother) (F= 8,506, p < 0,001. Subscales: disoriented F=7,803 p < 0,001). Total score for the frightening anomalous scale F= 16,997, p < 0,001.
Ratings on the frightening anomalous scale varied significantly with D / not D coding on the Strange Situation.
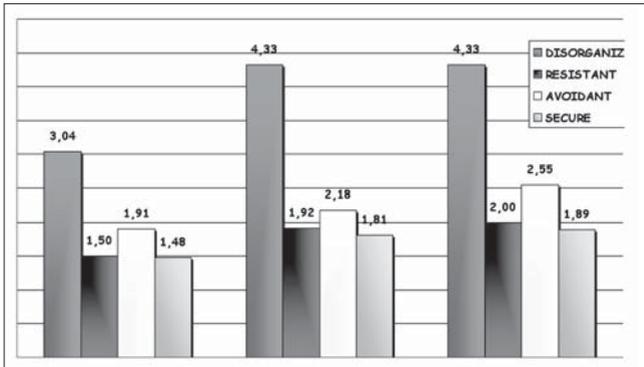
Figure 1. Score on the frightening anomalous scale for the children classified as secure, avoidant, resistant and disorganized

- Unresolved significantly differ from the other three coding for the score average of the Frightening anomalous scale (child) (F= 5,693, p < 0,001. Subscales: disoriented F=3,531 p < 0,009; odd movement F=2,505 p < 0,046; frightened F=3,338 p < 0,013) and frightening anomalous scale (mother) (F= 6,325, p < 0,001. Subscales: disoriented F=3,906 p < 0,005; frightened F= 3,783 p < 0,006; frightening F= 4,328 p < 0,003). Total score for the frightening anomalous scale F= 8,861, p < 0,001.
Ratings on the frightening anomalous scale varied significantly with U/not U coding on the AAI
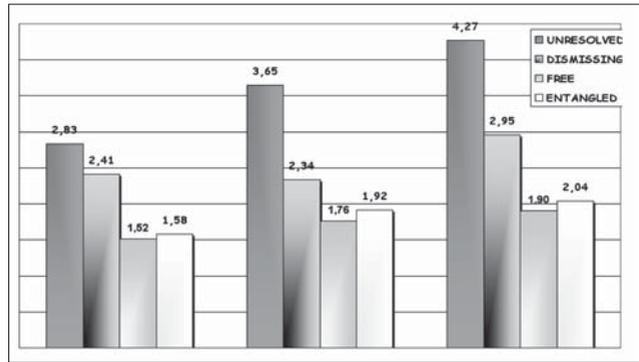
Figure 2. Score on the frightening anomalous scale for the mothers classified as free, dismissing, entangled and unresolved

There was a significant correlation between both total scoring on the Frightening Anomalous scale for the mother (r = .49 p < 0.013) and on the Frightening Anomalous scale for the child (r = .55 p < 0.01).

DISCUSSION
A central tenet of attachment theory is that parental behavior toward the infant (whose relationship is a constitutional aspect of intersubjectivity) is the primary determinant of individual differences in attachment relationships. Closely linked to this aspect, intersubjectivity appears (from neuroscience findings) to be a pre-reflexive functional mechanism that is not necessarily the result of an explicit and conscious cognitive effort (Braten, 2008). Given the theoretical and clinical importance of elucidating the etiology of disorganized attachment, attachment researchers have been devoted to understanding the role of parental interactive behavior in the development of disorganized attachment relationships. Moreover, mounting evidence suggests that a history of a disorganized attachment serves as a marker for later unfavorable outcomes in childhood and adolescence (Solomon, et al., 1995; Shaw et al., 1996; Carlson, 1998; Moss et al., 2004).
Our research is one of the first studies which aims to understand how mothers' unresolved state of mind and infants' attachment disorganization contribute to the quality of mother-child relationships during toddlerhood. We examined the associations between

the expression of mothers' unresolved states of mind, anomalous parental behaviour and disorganized attachment relationship. In particular, our study aimed to evaluate the stability and continuity of this associations, and so of the frightening caregiving, and of the disorganized attachment, from 8 to 24 months. Preliminary data demonstrate that security of attachment in both the mothers (assessed trough AAI) and children (assessed trough Strange Situation) forecast higher scores on the secure base scales of 24 Months Mother-Child Interaction Scales and lower scores on the other scales. Vice versa, prenatal assessment of mothers' unresolved trauma, displayed by disorganized and disoriented speech during the Adult Attachment Interview and the 12/15 month assessment of infant attachment disorganization, forecast higher scores on the frightening/anomalous behaviour scale at 24 months. So, mothers who behave in ways that frighten their children during the first year of life continue to do so at age two and their infants classified as disorganized at 12 and 15 months continue to display odd, disorganized and disoriented behaviors at during the toddler years. Such data has implications for understanding how the fear underlying a mothers' unresolved trauma or loss is transmitted to her child. In fact, our preliminary data can support the hypothesis that the qualities of the mother-child interaction beyond infancy is responsible for the intergenerational transmission of attachment disorganization, since the frightening/anomalous behavior assessed at 24 months is linked to mother's unresolved state of mind and child's attachment disorganization. Thus even at age two we can support the Main and Hesse's model (1998; 1990) consisting of three hypothetical associations: caregiver's unresolved state of mind cause parental expressions of frightening behaviour that elicits fear, confusion, disorientation and "fright without solution" (Solomon & George, 1999) in infant, and contributes to the development of a disorganized attachment relationship.

Moreover, our results are very encouraging about the validity of the frightening/anomalous scale for the 24 months, because it forecast mother's unresolved state of mind and child's attachment disorganization. Although the Strange Situation is an ideal paradigm for the observation of the activation and collapse of the attachment system, its suitability for assessing both infant and caregiver behavior can be questioned. It has been suggested that observing anomalous parental behavior during the Strange Situation procedure raises the possibility of common method variance that could lead to contamination with the observation of infant attachment

behavior during the same procedure, as the interaction that forms the basis for the assessment of anomalous parenting (Lyons-Ruth et al., 1999) includes the reunion episodes that are critical for assessing the attachment relationship. Such a situation is open to the suggestion that the assessment of maternal behavior could be unintentionally influenced by the fact that the coder unavoidably witnesses disorganized infant behavior throughout the procedure. Further exploration and more vigorous analyses of the categories and dimensions of anomalous behavior are particularly warranted then, to enhance our understanding of the patterns of anomalous behavior associated with disorganized attachment. Recent studies have underscored the importance of observing caregiver – infant dyads in conditions of stress (e.g., play without the use of toys) in order to increase the likelihood of observing collapses in the caregivers' behavioral strategies and idiosyncrasies during brief periods of time (Abrams et al., 2006; Madigan et al., 2006). In extensions of this line of research, recent studies have begun to demonstrate that coding systems measuring anomalous behavior serve as potent tools for assessing clinical efficacy in attachment-based interventions (Benoit et al., 2001; Madigan et al., in press). There is currently, however, a dearth of intervention-based research targeting the caregiver's propensity to engage in anomalous behavior (Bakermans-Kranenburg et al., 2005).

Nevertheless, at the momentary state-of-art much of the variance in disorganized attachment still remains to be explained, because anomalous parental behavior mediates only a small part of the association between unresolved states of mind and disorganized attachment. So, there is a transmission gap between unresolved state of mind and infant disorganized attachment that is analogous to the transmission gap in organized attachment strategies (van IJzendoorn, 1995). Thus other factors yet to be uncovered must mediate the influence of unresolved states of mind on disorganization of attachment. Genetic factors may be relevant, although behavior genetic evidence does not point in that direction (Bokhorst et al., 2003). As an alternative, the interplay between genetic vulnerability and experiences with anomalous parenting may be important in explaining why some children are affected by anomalous parenting whereas others remain resilient. Investigation of interactions between infant factors (e.g., pre – perinatal stress, temperamental characteristics), family variables (e.g., marital discord), and parental factors (e.g., mental health such as depressive synthomps…), may also constitute valuable domains for

further exploration in order to more fully understand the mediating process between unresolved states of mind and disorganized attachment relationships. It is also possible that elaborations of existing assessments of maternal representations of attachment, such as hostile/helpless parental states of mind with respect to attachment (Lyons-Ruth et al., 2003; Lyons-Ruth et al., 2005), may augment our understanding and provide further insight into the transmission between states of mind and attachment relationships. Additional directions for the investigation of the role of related representational processes in the transmission of attachment are suggested by the work on reflective function (Fonagy & Target, 2005) and mind-mindedness (Meins et al., 2001). There is some suggestion, for example, that the probability of the emergence of disorganization can be reduced by sensitivity-focused interventions (Bakermans-Kranenburg et al., 2005). These authors have speculated that such interventions teach the parents to focus on their child's behavior more closely, thus leaving less room for absorption or dissociation into past traumatic experiences in the presence of the child.

Researchers have demonstrated that the mechanisms involved in the development of attachment relationships may differ for mothers and fathers. For example, it has been well documented that sensitivity is implicated in the development of secure mother – infant patterns of attachment, however, sensitivity is a weaker predictor of secure infant – father attachment (Easterbrooks & Goldberg, 1984; Volling & Belsky, 1992; van IJzendoorn & De Wolff, 1997). It is imperative that we enhance our understanding and conceptualization of father – infant attachment relationships, including how it relates to the display of anomalous behavior and the subsequent development of disorganized attachment. Clearly, involving both parents would provide a particularly welcome window on the broader complexities of the origins of disorganized attachment relationships.

Finally, it's important to underline how the present study could represents a connection between different research fields, like attachment theory and intersubjectivity, that share common interests like parents-child relationship, a crucial factor on the socio-cognitive development of the child. The state of consciousness varies at the same time in two individuals joined from a grip relationship, like parents-child relationship. A careful analysis of the mechanisms below the disorganized attachment will be able to lighting the intersubjective processes below the aforesaid alte-

ration of conscience (Liotti, 2005).The most intriguing area for future investigation, then, is the development and evaluation of an intervention program aimed specifically at reducing the caregivers' display of anomalous behavior to mitigate the risk of disorganized attachment. This will be of particular import in high-risk and clinically based populations, where infants are at a substantial risk of developing disorganized attachment relationships with their caregivers. Third, there is a notable dearth of knowledge and research regarding the role of the father's state of mind and behavior in the development of attachment relationships.

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POSTER SESSION

DECISION-MAKING AND INTERSUBJECTIVITY: AN OVERVIEW.

ILARIA CASTELLI, ANTONELLA MARCHETTI

Decision-making – the ability to process multiple alternatives and choose an optimal course of action to achieve the individuals' goals in a social interaction – has become a cross-current object of research among Economics, Psychology and Neuroscience (Sanfey, 2007). The decisional behaviour and its psychological components have been investigated through simple games requiring the division of a certain good into a social interaction, showing that decision-making can be conceived as a complex psychological process involving intersubjectivity.

The aim of this work is to provide an overview about the current knowledge of various components of decision-making in children and adults.

Such components have been investigated both on the behavioural and on the neural level through well-known games: the Ultimatum Game – the proposer makes an offer and the responder decides to accept (both players earn something) or to refuse (both players earn nothing) – and the Dictator Game – the responder can only accept the offer. Researches on adults showed that people's behaviour contradict classical economic theories of ideally maximizing decision-makers (Camerer, 2003): in the Ultimatum Game the proposer usually makes good or even equal splits, and the responder tends to reject offers around 20-30% of the amount half the times. In the Dictator Game the proposer still offers good splits – even though lower then those of the Ultimatum Game.

Given the intersubjective connotation of the games, it is important to note that various components different from rational ones have been discovered and will be analyzed here: the sensibility to fairness (Fehr & Schmidt, 1999), the attribution of intentionality (Blount, 1995; Rilling et al., 2004) and of mentalizing to the partner (Marchetti, Castelli, & Sanfey, 2008), the presence of emotions (Pillutla & Murnighan, 1996; Sanfey et al., 2003; Harlè & Sanfey, 2007), the impact of physical appearance (Solnick & Schweitzer, 1999), the cultural domain (Henrich et al., 2005).

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Specific attention will be devoted to the development of decision-making and intersubjectivity, since the studies on children and adolescents are quite recent and still show some contradictory findings about the development of fairness (Murnighan & Saxon, 1998; Harbaugh, Krause, & Liday, 2003; Sally & Hill, 2006; Marchetti et al., 2008; Sutter, 2007; Fehr et al., 2008) and of its links with other psychological abilities (such as moral development: Gummerum et al., 2008). Moreover, the role of structural variables such as gender and socio-economic status in the development of decision-making and intersubjectivity needs further studies.

Finally, in order to figure out a future path of research, some critical issues will be raised: the need for a direct assessment of fairness conception at various ages; the interest to deepen the role of intentionality understanding in decision-making; the plausibility to investigate interactions with various types of partners and into different contexts; the necessity to discover the possible changes in the neural basis of decision-making throughout development.

Keywords: decision-making, intersubjectivity, development, sharing games

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AN ANALYSIS OF TEACHER/ PUPILS CONVERSATION IN CLASSROOM DURING ERROR MANAGEMENT IN SOME ITALIAN PRIMARY SCHOOLS

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Theoretical background

Literature has for a long time demonstrated that the classroom conversation is important in educational process (Pontecorvo, 1999, 2004; Schegloff, 1992, 2000; Albanese, Fiorilli & Gnisci 2007; Santagata, 2004, 2005). An important step in this process is the errors' management and evaluation. The verbal interaction between teacher and pupils during the errors' treatment is an interesting topic that allows to analyse the most effective conversational strategies to guarantee pupils' participation and to promote errors' comprehension. Albanese, Fiorilli and Gnisci (2007) identified some specific teachers' conversational strategies influencing pupils' error comprehension. These conversational strategies are: co-construction with pupils of the right answer, reflection about the strategies adopted in a task, use of open questions, pupils' auto and etero- correction, involvement of the entire classroom in errors' treatment. We hypothesise that these strategies promote errors' comprehension in children and enhance their own management better than others. Mathematics errors are very important and their correction is very difficult at primary school level.

Aim of research

The aim is to compare teachers' conversational strategies used in the errors correction in mathematical problem solving activities and in Italian narrative text comprehension activities as in Fiorilli study (2007).

Participants

For mathematical problem-solving correction: six teachers and

their pupils, aged: 8-9 years (M= 8,6; d.s.= 3,73) of III class in Italian Primary Schools.

For Italian narrative text comprehension: thirteen teachers and their pupils, aged: 8-11 years (M= 10,56; d.s.=1,89) of III, IV, V class in Italian Primary Schools.

All the teachers belong to different schools in Italy: Monza, Cornate D'Adda, Muggio', Roma and Teramo.

Procedure

Video- recording of verbal interactions during mathematical problem- solving errors correction. Conversational data were transcripted according the criteria described in Pontecorvo and Fasulo (1999). Data were analysed using conversational analysis criteria (Albanese, Fiorilli & Gnisci, 2007). We calculated frequencies of categories occurrence.

Results

The results show that these teachers during the correction of mathematical problem solving errors use strategies which involve all the pupils (co-construction, pupils' auto and etero- correction). In the text comprehension task errors correction, the teachers use no co-construction strategies but they prefer to suggest the correct answer. They use few open questions. These results reveal differences in teachers' discourse practices related to the task. In our opinion it means that differences in conversational strategies depend on the situation in which communication occurs and on the task in which teacher and pupils are involved. According to educational perspective, the conversational strategies in mathematical task promotes pupils self-correction better than conversational strategies in comprehension task.

Keywords: conversational practices, teachers error treatment, error comprehension

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ENACTING INTERSUBJECTIVITY: EMPATHY AS A CLINICAL INSTRUMENT

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The limits of clinical strategies strongly embedded in verbal and interpretational approaches have been emphasized by a great number of scholars and clinicians. Many clinical situations and psychopathological experiences have proved to resist traditional settings and linguistic-based methodologies of interaction. A broader view of subjectivity — as situated, embodied and embedded —, and of therapeutic dialogue — as something deeply rooted in experiential features that are very frequently enacted, rather than discursively displayed — are needed. This research project explores the use of *empathy* as a crucially relevant tool in facing the challenges that come together with these assumptions.

In order to give support to this usage of the concept, one has to put together theoretical and clinical arguments from different fields that may contribute to an improved understanding of subjectivity as living embodiment in the world, and mind as arising from situated, embodied action: philosophy (Husserl, 1931; Merleau-Ponty, 1945, 1964; Todes, 2001), development and ecological psychology (Stern, 2000, 2004; Rochat, 2001; Reed, 1996; Gibson, 1977), psychoanalysis (Ferenczi, 1928; Kohut, 1959; Green, 1975; Winnicott, 1958; Widlocher, 2004), and enactive cognitive sciences (Cohen, 2000; Varela, 1991, 1999; Thompson, 1991, 2001).

The starting point is the undisputed fact that newborns are mindful and present the innate capacity of emotional attunement with other newborns and adults, responding in different ways to subtle changes in affective states that people around them experience. This capacity is in fact required as a foundational element of later full fledged linguistic intersubjectivity, and proves the existence of innate mechanisms of apprehension of inner experiences lived by fellow humans. It is also a crucial feature in meaning-generation, in the emergence of autonomous agency, and the constitution of various modes of coupling with the environment — hence its relevance for clinical theory and practice.

In the therapeutic scenario, taking empathy seriously entails a very

different kind of approach to the patient experiences, one in which the therapist is supposed to explore experiential awareness as a cognitive tool, enacting a different kind of presence, addressing the patient in a more active way, overcoming limits imposed by linguistically centered modes of operating in the relational domain. The first part of this two-fold project is a theoretical exploration of the concept of empathy. Three key notions will be explored: empathy as a way of *listening*, as way of *communicating*, and as a *therapeutic element*. A second part will follow, with clinical experiments based on this approach.

Keywords: empathy, intersubjectivity, psychoanalysis, enaction

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GOOD THINGS TO ME BUT NOT BAD ONES TO OTHERS

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Embodied theories of cognition propose that neural systems for perception, action and emotion are also engaged during language processing (Gallese & Goldman, 1998; Zwaan, 2004). Two different lines of research are relevant for our work. The first shows that understanding action sentences activates the motor system. Glenberg and Kaschak (2002) found a congruency effect between the movement implied by action sentences (toward or away) and the movement performed to respond (toward or away from the body). The second indicates that reading positive words evokes movements toward our body (attraction), whereas processing negative words activates avoidance movements (Chen & Barg, 1999; van Dantzig et al., 2008). These studies investigate the relationship of a given movement with a target-object without considering the social context in which the interaction with the object occurs. The present work aims at deepening the study of the influence of social aspects on compatibility effects during language comprehension, in light of the rising increase of interest in social cognitive neuroscience (Lindblom, 2007; Lindblom & Ziemke, 2007) motivated also by the recent discovery of neurophysiological underpinnings of social behaviour such as mirror neurons (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti & Fabbri-Destro, 2008).

The present work explores whether the interaction between self, others and objects modulates the motor system. Participants read sentences composed by an imperative verb implying a motion toward the self or another person and by an object described as positive or negative (e.g. The object is nice/ugly, bring it to you / give it to another person). They responded whether the sentences made sense or not by moving the mouse toward or away from their body. Two experiments were run, in which the congruency between the direction implied by the sentence and the one requested in the response movement was modulated. In Experiment 1 there was always congruence between these two directions, whereas in Experiment 2 half of the trials were incongruent, based on the

supposition that the effect would be due to the goal of the action required, linked to the specific relational frame, rather than to the kind of movement to perform.

Results revealed that the movements were modulated by the characteristics of the object and of the agent. Interestingly, participants tended to attract positive objects, but at the same time they refrained from offering negative objects to others. Implications of the results for embodied social neuroscience will be discussed.

Keywords: embodied language, social cognition, stimuli valence, language comprehension

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TRANSITIONAL OBJECTS AND SHARED ATTENTION: DEVELOPMENTAL PATHS TOWARDS INTERSUBJECTIVITY

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Referring to some of the remarkable socio-cognitive changes in infant development as the "nine month revolution", Tomasello (2000) describes a new set of communicative behaviors that arise at the end of the first year of life, that are characterized as goal-directed coordinated activities between infants and parents involving shared attention to objects or situations. At around nine to twelve months the frequency of the dyadic interactive behaviors between the mother and the child tend to decrease comparing to the triadic interactions that begin to emerge at this age. According to Tomasello (2000), young children start to engage in joint attentional interactions when they begin to understand other persons as intentional agents like the self. They "tune-in" to the attention and behavior of adults toward outside entities, taking them as a new source of knowledge of the world and creating a shared intersubjective space that opens a brand new arena for social-cognitive development, including word learning and language, and new possibilities for infants to express themselves through symbolic play and cooperative activities.

Among several psychiatrists and psychoanalysts that emphasized the emergence of object relations in the first months following birth (Eagle, 1983), the psychoanalyst Donald Winnicott (1999) confers a particular importance to what he called transitional objects. The transitional object – whether a blanket, a doll or any of other suck-able, hug-able, and transportable physical object –, is an affective invested object used by the child as a substitute for the mother-child bond. The young child uses such objects, in part, to cope with the anxieties that arise from temporary separation from primary caretakers. At the origins, transitional objects constitute affective means created by children that allow them to behave with growing independence and to explore the world outside the sphere of a secure base provided by the mother. The establishment of a

shared reality through the development of the transitional space coexists with important inflexions on the development, like the first signs of a new ability to play symbolically, to cooperate and to share in a context of emerging triadic exchanges.

The poster establishes some differences and similarities in the ways Tomasello and Winnicott describe the function of the object in infant development, focusing particularly some aspects of the intersubjective relations that characterize the end of the first year of life of the child and the way they promote the emergence of symbolic play and the first cooperative activities with their primary caretakers.

Keywords: object relation, shared attention, transitional object, intersubjectivity, symbolic play

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