

1 What Intersubjectivity Affords: Paving the Way for a Dialogue between Cognitive Science, Social Cognition and Neuroscience

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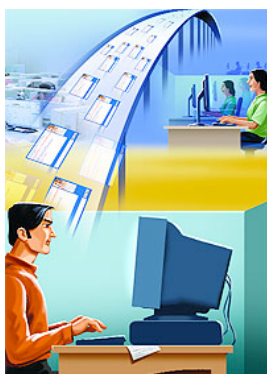
Abstract. The past decade has witnessed a growing interest in the study of the *self-other relation*; as a result, there has been a convergence of theoretical thought and research in the cognitive sciences, social cognition, and the neurosciences. At the moment, probably under the impact of recent mirror neurons findings, one notices a gradual but significant coming together of disciplines whose research tradition used to be grounded in areas often far apart from each other. In particular, it may legitimately be claimed that, albeit from different perspectives, the study of inter-subjectivity has laid the foundations for a constructive dialogue between these disciplines generating a common ground for the study of interpersonal relations. The present contribution aims to show that, if we take this stance, some concepts close to the situated cognitive sciences, such as embodied cognition and enaction, become neurobiologically plausible in research on mirror neurons, and manage to shed new light on what social cognition has known for some time on the relation between human beings.

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1.1 Introduction

Blossoming interest in the study of intersubjectivity has opened up new perspectives for cognitive and social research, by providing plausible and long-awaited biological foundations to the study of the human relationship.

The picture that unfolded before the eyes of a scholar of the cognitive and/or social sciences until only a few years ago looked rather different from today's. On the one hand, the study of the human mind had focused quite closely on the study of consciousness, i.e. the peculiar ability of human beings to live in this world, and their ability to act intentionally in the specific context that surrounds them [1]. On the other hand, equally authoritative disciplines stemming from the social sciences and psychology concerned with interpersonal relations [2] have highlighted the relationship dynamics that human beings are capable of when confronting their fellow beings, while disregarding the study of the cognitive functions that support these abilities.

At the same time, perhaps because of their kinship with medical-clinical fields rather than with the humanities, the neurosciences have continued to conduct research by themselves, on the neurobiological foundations of the cognitive nature of human beings. Indeed, their research on the functioning of neurons has sought principally to confirm or revisit the cognitive theories of mind functioning and, more marginally, the social theories [3].

It is only in the past ten years that new discoveries have been made substantially altering our perception: the emergence of social cognitive neurosciences as well as mirror neuron studies have laid sound foundations for a fruitful convergence of the cognitive sciences, social cognition, and the neurosciences. The celebrated discovery of mirror neurons, on the one hand, invested the self-other relation with a new wave of optimism by proposing a much longed-for biological plausibility to the studies on the simulation of action and identification with the other. On the other hand, it has taken advantage of these studies to gain a fuller understanding of the cognitive significance of their discoveries [4, 5]. At the same time, these findings shed new light on research projects that had long been focussing on the study of intersubjectivity [6-8].

Today, the study of inter-subjectivity acts as a test-bed for the convergence of research interests enhanced by the triangulation between cognitive sciences, social sciences, and the neurosciences. The contribution made by these disciplines is complementary to the study of the relation, carrying with them significant research findings that the same disciplines have so far been unable to explain in full, as they draw exclusively on resources available within their research areas. Intersubjectivity provides them with a primary forum for exchange, enabling them to extricate findings that have until now suffered from an excessively clear-cut modularity of research.

The following paragraphs will be devoted to showing how, these disciplines have been preparing the ground for convergence over the years, while now, in their latest research phases, have laid the foundations for a new form of dialogue. In paragraph 2, we will look at the way a computational cognitive science has given way to the situated perspective of cognition which contemplates its embodied and enactive nature. In paragraph 3 we will examine the shift from the merely representational study of a *self-other understanding* to an approach that is less related to mindreading in understanding the other's intentions. Finally, in

paragraph 4 we will try to illustrate two facts: on the one hand, how the neurosciences have become less behavioural and much more cognitive over the years; on the other how the rise of social cognitive neuroscience and of mirror neuron studies have sown the seeds for a cross-fertilisation of disciplines.

1.2 Towards an enactive cognitive science

It was only at the end of the last century that the scientific community began to greet with more warmth the study of human cognition as closely connected to action, and to the interaction with the context where agents are steeped. From a strictly computational paradigm, widespread among the cognitive sciences [9,10], we have more recently moved on to a conception of human cognition as associated with a potential for significant action and interaction with the world [11-16].

Classical cognitive sciences have long promoted a modular view of cognition upholding the dichotomy between perception and action. Then, new approaches were introduced that were more closely context-related, and at that point the dichotomy was (albeit in part) set aside to make space for a more accurate study of the mind-world interaction. By contrast with a classical view of the cognitive sciences, within a situated view of the mind, cognition is not the result of aggregation and organisation of noteworthy information from the outside world; it is the product of perception-action cycles where mind and world are constantly at play.

This shift has created a different vantage point for the study of cognition where interaction does more than just point to the single action in the world (or the sequence of more complex actions the user can perform through it); it points to the dynamic building up of meaning as human beings tend to do while acting in a surrounding context.

But what does it mean, indeed, to create a dynamic, meaningful relationship between mind and environment? As early as 1977 Gibson [13] stressed the need for an often disregarded theoretical shift: the objects of the world every time become affordances, but at the same time represent species-specific opportunities for the agent that happens to use them. The context in which human beings happen to act, therefore, is no longer something objective that they perceive and process creating firm images. Rather, the way that human beings represent an environment is every time a function of the activities that they are performing or are about to perform within it.

Starting from theoretical standpoints identifiable with a view of cognition as inseparable from its field of action, a view of experience and cognition gradually takes shape that is closely linked not only to physical action, but above all to corporeity as a cognitive medium. A good description of this perspective may be found in studies on embodied cognition.

Bateson [17] described the human mind as ecological, i.e. able to fit in with, and adapt well to, its surroundings through a continuous evolutionary process. The human mind, he claimed, is capable of creating a progressive integration between the physical features of human beings and artifacts essentially on the basis of a continuous process of cultural mediation. The human mind, indeed, is not disembodied, but closely tied with the body in which it dwells, from which it continues to acquire information on the world. In short, we may call it *embodied*.

This is why thought needs the body's mediation to arise, and it is precisely to the body that it adapts. As Lakoff and Johnson [18] pointed out, the body is, on the one hand, the frame of reference in which all our experiences take place; on the other, the body becomes, through our senses, the main link between the mind and the world.

Until the twentieth century, the definition of embodiment met with limited fields of application; it nonetheless opened up the field for extensive debate in philosophy as well as in the cognitive sciences. Among twentieth-century philosophers, Heidegger was the first to refer explicitly to the importance of the body for human thought [19]. It was Heidegger, in fact, who developed a phenomenology in which human activity may be understood not as the result of representations of the world disconnected from their context, but rather through the contextualised experience of a body-environment system. Merleau-Ponty [20] provides us with a further example of phenomenology of the mind in which the role of embodiment is granted considerable weight. Merleau-Ponty maintains that the way in which human beings see physical objects is entirely conditioned by opportunities for interaction which the object itself offers to our body. Let us observe, in this respect, that this philosophical belief has had a significant impact on the theory of perception later to be developed by Gibson [13]. There, in fact, the world is not perceived in an undifferentiated manner, but supplies living beings with opportunities for action, in other words, species-specific affordances. Merleau-Ponty himself, then, stretches his view of embodied cognition to the extreme, claiming that the body is the medium with which human beings can encompass the world in its totality. It is precisely and only through the activity that men do in the world that men are able to determine what experience of this same world means.

Thus the body becomes an interface between the mind and the world, not so much as a collector of stimuli, but rather providing as it does a stage for the enactment of a drama, an interface allowing a merger between thought and the specific surrounding space. Human beings, indeed, constantly interact with the context in which they live, preserving in such situation an uninterrupted thread of activities which they carry out entirely by themselves. The continuity of their actions helps us establish a match between individuals (or better their intentions, planning of complex actions, and executions of movements) with the context in which they happen to be each time. Actors and world thus end up being inseparably connected and reciprocally adaptable.

This embodied and situated view of cognition, which is, as we shall see, fundamental to the study of intersubjectivity may be associated to the definition of the concept of *enaction*. The concept of enaction was introduced into cognitive science in 1991 by Varela, Thompson & Rosch [21], to explain how mental life relates to bodily activity in the form of embodied action. In their book, *The Embodied Mind*, in fact, these authors suggested a *sensorimotor coupling between organisms and the environment* in which they live that determines recurrent patterns of perception and action leading to the acquisition of knowledge. Enactive cognition unfolds through action and is constructed on motor skills, such as manipulating objects or practising a specific activity. It is not simply multisensory mediated knowledge, but knowledge stored in the form of motor responses and acquired by the act of doing. According to the enactive approach, the human mind is embodied in our organism, is not reducible to structures inside the head, but is

embedded in the world with which we interact [22]. In rejecting the Cartesian mind-body dichotomy (in which there is a mental and a physical way to acquire knowledge, namely theoretical and procedural learning) the world become inseparable from the subject, and humans' primary way of relating to things is neither purely cognitive nor sensory, but rather bodily and skillful. Maturana and Varela define the living being as an *autopoietic machine*, that is a system whose primary function is the creation and preservation of a unity of its own which singles him out from the environment which it inhabits [23]. Enactive knowledge is more natural than other forms of knowledge acquisition, because it is gained through perception-action interaction in the environment. Moreover, enactive knowledge is inherently multimodal because it requires the coordination of the various senses. The development of such approach requires a common vision between situated and embodied cognition.

Recently this situated and enactive perspective has been extended to the social sciences, inasmuch as significant interaction, far from taking place merely with the world, does so with a physically and culturally more complex context, namely that of social relations.

1.3 Towards a cognitive perspective on the study of social interactions

One of the most exciting attempts to move the cognitive sciences towards the study of social relation is undoubtedly represented by social cognition [24-26]. By definition social cognition aims to build a bridge between the cognitive and social sciences. To do so, the 'social cognition' approach needs the contribution not only of social psychology but also of evolutionary studies [27, 28], and animal cognition research [29]. In particular, social cognition research helps us understand both individual cognition and collective activity integrating the cognitive modelling approach (according to which beliefs are formed by and drive behaviour) with social studies (according to which behaviour is determined by relationships and informal practices). Within this area it will be possible to extend the study of consciousness and human activity in interaction with other minds, trying to understand how the construction of an intersubjective space of activities may prove possible.

Starting from a more cognitive approach several studies of how one person understands, and interrelates with, others have been conducted under the *Theory of Mind* heading. Among them, Frith and Happé [30] suggest that mind-reading 'appears to be a prerequisite for normal social interaction: in everyday life we make sense of each other's behaviour by appeal to a belief-desire psychology'. Discussions of theory of mind are dominated by two main approaches: *theory theory* and *simulation theory*. The major tenets of theory theory claim that the understanding of other people's minds is based on an innately specified, domain-specific mechanism designed for reading other minds [31-33]. Common to different versions of theory theory is the idea that humans attain their understanding of other minds by implicitly postulating the existence of mental states in others and using such postulations to explain and predict another person's behaviour [34].

Simulation theory, argues that one does not theorize about the other person but uses one's own mental experience as an internal model for the other's mind [35, 37]. To understand the other person, one simulates the thoughts or feelings that one would experience if she were in the situation of the other. Some theorists [31, 36] claim that mind theory is our primary and pervasive means of understanding other persons. Both theory theory and simulation theory conceive of communicative interaction between two people as a process that takes place in a set of internal mental operations that end up being expressed (externalized) in speech, gesture, or action. Addressing this feature, it has recently been suggested that social interaction may influence the development of children's mentalistic understanding, finding that competence on false belief understanding is correlated with aspects of children's socialization history [38].

At the same time, a different approach to social interactions has been developed showing that the primary and usual attitude of human beings in the world is grounded in interaction, rather than in mentalistic or conceptual prediction. Specifically, the interactive nature of the human mind is characterized by meaningful involvement (e.g. environmental and contextual factors) and movement possibilities (e.g. action planning) that allow humans to understand and share social situations. From this perspective, human encounters with others are not normally occasions for explaining or predicting the behaviour of others on the basis of postulated mental states; instead, in most intersubjective situations, agents have a direct understanding of another person's intentions because their intentions are explicitly expressed in their embodied actions, and mirrored in their own capabilities for action [39]. Incidentally, in defining primary intersubjectivity Threvarthen [40], had already gathered revolutionary scientific evidence supporting the claims that the basis for child interaction has already been laid by certain embodied practices that allows them to perceive gestures and sound cues allowing a not necessarily conceptual perception of the other person's intentional act. In adults, embodied practices constitute the primary access for understanding others, and continue to do so to a large extent, even after humans have achieved theory of mind abilities, supporting the creation of social relationships and knowledge sharing.

Consistent with this vision, with the publication of "The Cultural Origin of Human Cognition" [41], Tomasello suggests that social cognition in humans emerged to specialized cultural and biological adaptations. Specifically, he states that in addition to an ontogenetic development (which provides human children with the acquisition of perspective-based cognitive representations in the form of linguistic symbols) there was also a phylogenetic evolution in humans (which provides them with the ability to identify with co-specifics) and, finally, an historical socio-genesis (which encourages new forms of cultural learning in humans). According to all three approaches listed above, social interactions are the result of a cooperative process in which all agents involved actively play with, and coordinate, each other, sharing a common background (including an amount of knowledge about each agent's mental states, reciprocal expectations, and other types of social and cultural cognition) in order to perform and understand social actions.

This is where neuroscience research joins in, demonstrating how embodied interaction contributes to the self-organising development of the neuronal structure responsible not only for motor action, but for the way we become aware of

ourselves, communicate with others, and intersubjectively live in a meaningful world.

1.4 Towards a neuroscientific endorsement

The concern of the neurosciences for social behaviour goes back a long way. Essentially, it may be traced back to studies on the role played by frontal functions in the modulation of emotions, in the famous clinical case of Phineas Gage (for more on this case, see [16]). In their attempt to understand how frontal lobe lesions may cause substantial alterations of emotional and social behaviour, neurosciences find fresh stimulus in the study of the anatomical locations of these expressions of behaviour.

Despite constant keen interest and notable research achievements, true and proper cross-fertilization never took place between neurosciences and social cognition until the birth of Social Cognitive Neuroscience (SCN) [42- 45]. SCN, in fact, investigates social processes by means of the methodologies and instruments proper to research in cognitive neurosciences. According to Liebermann [43], SCN is the study of brain functions that allow people to experience the social world effectively by understanding themselves and others. Within the SCN, the social approach includes the study of experiences and behaviour of a person as she perceives and interacts with a social target, while the cognitive one includes the understanding of the psychological processes that give rise to the experience or behavior of interest. These approaches are closely linked with a neural level of analysis that includes a description of the neural systems involved in the psychological processes on which a broader social behavior is based [42]. The tools used to study these topics, in fact, generally include functional neuro-imaging tools, such as fMRI and PET, which provide a lot of information from the functioning brain of live humans.

A question arises here: does SNC represent a truly new approach to the study of relation? Before the emergence of SNC, research on the biological correlates of the social processes was already afoot. Indeed, some authors believe that 'the brain does not exist in isolation but rather is a fundamental component of developing and aging individuals who themselves are mere actors in the larger theater of life' [46, p.1019]. This standpoint was reinforced by the introduction of the techniques of functional neuroimaging, which led to the discovery of the crucial role the amygdala plays in social cognition [47, 48]. It is a largely shared opinion that this part of the limbic system is involved in emotional and motivational stimulus evaluation; it is also related to the human possibility of a social interpretation of behaviour, so much so that any damage it suffers may lessen the subject's ability to understand his relation to others and of using such understanding to modulate his social behaviour [47].

The considerable innovation that the neurosciences have injected into the study of the self-other relation is mostly the result of research on sensory-motor coupling in understanding intentions [49] and of mirror neurons findings in humans [50,51].

Recently, in fact, there has been growing consensus on the fact that mirror neurons, and the related brain areas that are activated for self-movement and perception of another person's movements, play an important part in imitation and in the human being's ability to perceive intentions [52-54]. These findings support

the idea that to imitate a gesture, for example a facial gesture that she sees, an agent has no need to simulate the gesture internally. Rather, her body is already in communication with the other's body at pre-conscious and perceptual levels that are sufficient for subjective engagement in interaction [54].

The evolution of research on mirror neurons, one of the leading stars in the neuroscientific arena today, shows the existence of *mirroring neural clusters* which, besides contributing to the recognition and modulation of the action, represent a plausible neural basis for embodied intentional interaction. Along similar lines, Gallese's *shared manifold hypothesis* suggests that the mirrors system has a general role in enabling empathy [51, 56]. Accordingly, intersubjective identifications among humans are possible through intentional embodied attunement, while such primitive intersubjectivity remains an essential aspect of adult empathy and social behaviour.

A heated and broad debate is in progress on the role of mirror neurons and on the implications that these findings may have for the study of the understanding of oneself and the other. Something is already clear, and has met with widespread consensus: the mirror systems constitute the neural basis for a primitive intersubjective information space, which is both phylogenetically and ontogenetically prior to the explicit conceptualization of others' intention. Thus, by nature it doesn't necessarily require the intervention of the theory of mind in understanding others. From neuroscience findings, in fact, intersubjectivity appears to be a pre-reflexive functional mechanism that is not necessarily the result of an explicit and conscious cognitive effort. This statement could constitute a revolutionary, ground-breaking result for the study of interactions.

1.5 Conclusions

From our brief, and necessarily incomplete, outline of theoretical trends in cognitive science, social cognition and neuroscience, one may gather that these areas tend to converge towards a common ground of understanding for the study of intersubjectivity (Figure 1). The study of intersubjectivity calls for a fruitful triangulation of these disciplines, leading to mutual enrichment and enabling each discipline to help the others towards a better understanding of the relational skills of human beings.

At this stage, we are looking at a possible, though somehow difficult, communication between these areas, a communication which augurs well not only for mutual enhancement but also for a more *holistic* understanding of the human relation.

From this point of view, the enactive approach put forward by the cognitive sciences broadens the scope for an appreciation of the importance of action intentionality in our experience of the world. In turn, this has been one of the fundamental research topics on mirror neurons in neuroscience. Neurosciences, for their part, contribute to teaching enactive cognition that awareness of the world through biologically-determined action is definitely possible at the neural level.

At the same time, the motor-perceptive definition of mirror neurons has highlighted the fact that the other's action may be understood through embodied imitation, thus confirming biologically what social cognition had already largely speculated on by gradually putting aside mentalistic theories (e.g. mindreading and

Theory of Mind) and introducing an imitative meaning to one's awareness of the other's understanding.

The convergence between cognitive and social perspective has turned out to be equally fruitful, by establishing that making sense of cognitive architecture is not worth insisting on unless its social nature is duly taken into account. The human mind, in fact, relates not only to the world but also to other minds which it recognises as equivalent to itself in their intentional nature and with which it can set up a relation. Conversely, while researching intersubjectivity the social sciences may continue to address the relation alone without considering the way in which such relations occur not as a process of exchanges of actions and information, but as the result of an intentional mental activity between individuals.

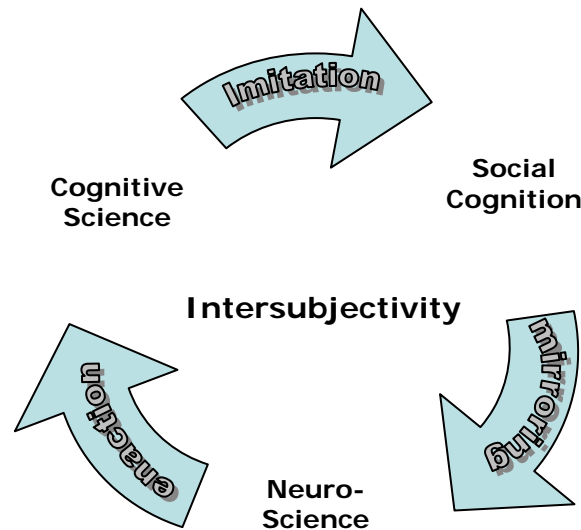


Figure 1. The convergence of cognitive science, social cognition and neuroscience towards a common ground of understanding for the study of intersubjectivity

For a thorough understanding of the intersubjective nature of human cognition we cannot ignore the convergence of these disciplines; indeed, the former is defined by the latter, though differently and complementarily, as the capacity to reach an attunement of biologically determined intentional actions enacted in an actor-tailored and meaningful situation.

Although we are satisfied that this is no longer uncharted territory, much more ground remains to be covered before subjectivity is fully understood and defined. Many research questions are still unanswered and point the way for potential approaches to applied research on this topic.

Not surprisingly, observing current research in progress, we notice at once that some of it focuses on:

- (i) How this capacity develops in human beings
- (ii) Whether or not this ability is typical of human beings or shared with other species
- (iii) What is the cognitive architecture underpinning this capacity

- (iv) How it allows us to see ourselves as belonging to the world and vis-à-vis our fellow beings
- (v) What this capacity is able to support in human cognition
- (vi) What happens when something fails in intersubjectivity

Each of these research lines helps us understand the *intersubjective nature of human beings* and confirms once more the need for cross-fertilization between the neurobiological, cognitive and social outlooks. Cross-fertilization calls for a lowering of the barriers separating disciplines; it prompts us to pay more and more attention to research conducted in other domains in order to discover in them an opportunity for understanding the non-understood or misunderstood and new suggestions for continuing research.

Even though, as we have observed, this convergence is based on excellent premises, we are not out of the woods yet. On the one hand, this is quite typical of multidisciplinary research, where all disciplines by nature co-evolve and build up step by step, on the basis of successive findings. On the other hand, we still have to clarify this need for multidisciplinary so that the results achieved by one discipline may be consistent with what is currently known to the other disciplines on the human relation. This does not necessarily mean that one has to be influenced by the sister disciplines in our interpretation of the results achieved; it does mean that one should try to find an interpretation that is congruent with the other disciplines when one's own results seem to be in line with theirs, and that one should apply a more rigorous critical spirit in expressing conclusions where a research result does not fit in well with what is already known to the other disciplines.

Finally, as is the case with any interdisciplinary approach, the study of intersubjectivity, too, must do its best to keep clear of errors and misunderstandings. First and foremost, there is a dangerous persistence of miscommunication among disciplines, which instinctively use a terminologies that are often too different from each other. This may give rise to unpleasant ambiguities and/or even more unpleasant overlapping of terms with different meanings (or denotations) from one discipline to another. Among other things, and not the least, one should avoid falling into the trap of assuming a predominant standpoint with regard to intersubjectivity, which is unfortunately often the case with the neurosciences. If in our research on intersubjectivity we manage to consider the poles of this ideal triangulation as equidistant from an understanding of our phenomenon, we will be able to view it with the appropriate degree of interdisciplinarity, and make sure that our conclusions will not be subject or subservient to evidence provided by the other disciplines. Only this way do we stand a chance to understand better what happens when we are intersubjectively related to each other, not merely from a neural, but also from a functional and qualitative point of view.

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