A Philosophical Approach to Embodied Cognition through Mirror Neuron System

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Abstract

In our day-to-day lives we are constantly exposed to the actions of other individuals who inhabit the social world. We not only experience their behavior, understand its contents and anticipate their consequences, but also we can do much more than that: we can attribute intentions to others and recognize immediately if their behavior is the result of an objective and a deliberative attitude or an unforeseen consequence of an accidental event beyond its control.

The discovery of Mirror Neurons by Rizzolati and Gallese seems to show how the same neural substrates are activated both when actions are being executed and observed. This neurological discovery is of an outstanding importance to the cognitive theories of intersubjectivity in Philosophy of Mind and Cognitive Sciences: for the first time, a neural mechanism allows a direct mapping between the verbal description of an action, and its motor execution.

New data provide newfangled empirical source for the intersubjectivity discussion. Under these conditions, I will first proceed with an analysis of Mirror Neuron System (MNS) implications to contemporary Philosophy of Mind; and I will access the hypothesis that Mirror Neuron System demonstrates that human minds learn by interaction. Finally I will, then, argue that mind and brain ascertain an interactive experience system with others, since the mind is not the brain; rather the mind is disseminated within brain, body and environment.

1. Mirror Neuron System: a Succinct Literature Review

Rizzolatti and Gallese, at the University of Parma, demonstrated during experiments on non-human primates, that the premotor cortex is not limited to the control of body movement itself. In fact, some of the neurons, located in this area, also represent the movements visually recorded of another animal's action. This observation causes neural activity similar to the movements of the body. The most peculiar feature of mirror neurons is that they become active only if the observer sees an action with a purpose or meaning. The visual understanding of the objective seems to be crucial for the activation of neural mirror system component.

The research in F5 area shows that the visibility of the action purpose is one of the most important factors in the activation of mirror neurons. These findings have led some neurologists to the assumption that there might be an expanded version of mirror neurons in the brain network, both of which are activated by the very performance of the action and

action observation made by others. The phenomenological question that needs to be adressed is how do other people and their experiences appear in my conscience and my experiences?

The discovery of mirror neuron and other mechanisms in the brain, show how the same neural substrates are activated in first person when expressive acts are performed by a third person. A common functional mechanism mediates our ability to share the meaning of the actions, intentions, feelings and emotions with others, allowing self-identification and connection with others. Social identification, empathy, and we-ness, seems to be the foundation of our development and self.

The novelty of these findings is the fact that, for the first time, a neural mechanism allows a direct mapping between the verbal description of a document and its motor execution. This mapping system provides a parsimonious solution to the problem of translating the results of a visual analysis of an observed movement — in principle meaningless to the observer — into something that the observer is able to understand.

Thus, the mirror system reflects an internal motor description of the meaning of a perceived action, which goes beyond a mere visual description of characteristics. In their first study, Umitta et al. [1] found a mirror subsystem that is also activated during the observation of partially hidden actions, i.e., when visual information is incomplete. This means that the mirror neurons respond to observed acts with non exclusive basis on their unique visual description, but as well based on the anticipation of a state of targets, i.e. simulated thought.

This information does not, obviously, preclude the co-existence of a system that visually analyses and describes other's actions. However, such visual analysis *per se* is probably not sufficient to provide an understanding of the observed action. With no reference to the internal "motor knowledge", this description is devoid of factual meaning for the individual who observes it [2].

A second study [3], showed that mirror neurons (F5 audio-visual neurons) also decode the meaning of actions based on their related sound, responding not only when it observes a particular action but also when someone hears the sound typically produced by the same action. These neurons respond to the sound of actions and discriminate between sounds of different actions.

Mirror neurons' activity of reveals the mechanism through which we perceive events, representations of goals / intentions of motor action. It has been proposed that mirror neurons, by the mapping they allow, involve 1) actions with objectives / intentions on the substrate of neural engine and 2) similar activities in the observer system which allows a comprehension directly through the action of a mechanism activities body simulation (embodied simulation) [4,5,6].

How can these findings be phenomenologically neurological translated into our own sensory experiences, emotions and desires? How is it possible to have access to the sensations, emotions, thoughts and desires of others?

2. The "I", "you" and "s/he" Perspective

In Philosophy of Mind there is a duality between the first and third person perspective, but this seems insufficient since there is a gap between a person's mental states and another's perception of that person's body which is the only experienced from within and the other observable from without. To overcome the antagonism of first and third person perspective, it has recently been proposed to introduce the notion of the second person perspective ([7]; [8]; [9], [10]).

In spite of the remarkable progress made in the burgeoning field of neuroscience, the neural mechanisms that underlie social encounters are only beginning to be studied and could — paradoxically — be seen as "dark matter" [11]. The field of Neuroscience has begun to illuminate the complex biological bases of human social cognitive (SoCog) abilities ([12]; [13]). Two new neuroatomically distinct large-scale networks have gained center stage as the neural substrates of social cognition (SoCog): the mirror system (MNS) and the *mentalizing network* (MENT). The formed is believed to give us a "first-person grasp" of the motor goals and intentions of other individuals [14]. The later has been seen as providing evidence for a "Theory-Theory" account of SoCog. This is believed to give us an inferential, reflective and what might be called a *third-person* grasp of the others' mental states ([15], [12]). However it is remained unclear whether, and how, activity in the large-scale neural networks described above is modulated by the degree to which a person does or does not feel actively involved in an ongoing interaction.

The experiential perspective of a subject and the observational perspective (i.e. neuroscientist) cannot be brought to a final congruence because even the sum of any possible knowledge about objective process occurring in the subject's brain, body and surrounding world would not include what it is like for the subject to have the experience in question [17].

It has recently been proposed to introduce the notion of the second person or intersubjective perspective (2PP) in order to overcome the antagonism of first and third person or subjective and objective perspective ([7]; [8]; [9]; [16]). From this context results a triad of perspectives that has gained importance in contemporary Philosophy of Mind and SoCog. Each theory defining the access we use in understanding other persons:

1. Theory of Mind or Theory-Theory, claims traditionally, that other minds are known by reference to the best suitable hypotesis on the resins and motives for their behavior, this is, on the basis of observation, which means from a *third-person perspective.* This means that interacting with others does not add anything to this access in principle.

2. According to Simulation Theory, other minds are known by reference to a first person perspective. This means that understanding others requires to run an inner simulation of their behavior, thus creating an "as-if" mental state which then has to be somehow projected onto the other [18].

3. The Interaction Theory is the most recent approach to Philosophy of Mind and SoCog and it claims that it is though immediate perception of, and embodied interaction with others that we gain our primary experience of their feelings and intentions, without recourse to inner theories or simulations. This approach focuses on the expressive bodily behavior, inter-bodily resonance, intentions as visible in action and the shared situational context in order to explain social understanding ([19]; [20]).

The second-person approach has already begun to be productive within SoCog, pointing out the importance of experiencing and interacting with others as our primarily ways of knowing them. Preliminary evidence from neuroimaging demonstrates profound differences in neural processing related to the reciprocity of social interaction [11], and that the second-person perspective can make an important contribution to the neuroscientific study of social encounters and could, in fact, lead to the development of second person

neuroscience. The role of social interaction for cognitive and social development has begun to gain center in several scientific discourses: the role of interaction as a vehicle for the acquisition of knowledge has, for instance, been demonstrated in language development. In contrast with the Chomskian idea of a "language acquisition device" [21], the perception of structure in social engagement has been shown to guide vocal development and language learning ([22]; [23]), both in terms of speech perception or turn taking.

In other areas of research interaction has been investigated by focusing on processes such as involuntary mimicry ([24]; [26]), which leads to enhanced rapport and linking, but is also influenced by differences in affiliate motives and independent self-construal [27]. Social interaction, however, involves more complex forms of coordination present from early on life [28]. In this respect, Knoblish & Sebanz [29] distinguish between "action simulation" [14], "joint attention" and "shared intentionality" [30]. The development of a shared perceptual and attentional space within early mutual attentional engagements is curtail, because it paves the way for triade interactions in which we share our mental states about a third object or person with others.

3. Implications of Mirror Neuron System to Social Cognition

Mirror neurons appear to support a direct form of action understanding. However, human social cognition is rather sophisticated. Not only we understand what others are doing, but also why, in fact, we can attribute intentions to others.

The dominant theories concerning intentionality and action, advocate roughly, that humans (understanding others) do it from an observation of an opaque intentionality that has to be interpreted and explained in mental terms — in a process called "Mind Reading". The attribution of internal mental states to others constitutes a mapping from the observer's mind , of internal representations in the propositional format of third person. These representations supposedly, play a causative role in determining the understanding of the observed behavior.

Gallese challenges the notion "Mind Reading", proposing that the basis of our ability to understand the intentional behavior of others — both from a phylogenetic and ontogenetic point of view — is a more basic functional mechanism that exploits the intrinsic functional organization of the parieto-premotor circuits, similar to the mirror neurons circuits. This proposal is inspired by emerging studies about the striking similarities between neural mechanisms.

Findings on the mirror neuron system (MNS) level, raises several questions for Philosophy of Mind and Cognitive Science. It suggests that activity in SNE is not related to the perspective that human adopts, but with a tracking observed behavior, regardless of whether it's "my" or "your" action.

This view seems consistent with the dominant interpretations of the MNS literature, which suggests that the MNS may have evolved to represent actions in the same way between subjects and that MNS explains the ability to understand the others' minds by allowing a perspective of "first person" with respect to the objectives and intentions of others [14]. This approach has been, however, criticized by the fact that over-emphasize similarities in the process self-other [31] and not answering the important question of "where" really, mirror neurons arise [32]. In this context, an important consideration has been that MNS play an important role in situations in which action and his context are highly familiar.

Data from Schilbach's studies [31] shows that brain regions that seem to correspond to MNS, respond more actively to arbitrary facial movements compared to those socially

relevant. This seems to contradict the idea that the MNS play a role in familiar situations. Indeed, arbitrary facial movements also cause the activation of MNS. This finding can be understood in terms of a prediction error signal [33] and may be relevant to the associative learning process recently discussed as an alternative to the development and MNS modulation [32]. Indeed, according to the "associative hypothesis", mirror neurons can be reconfigured into adulthood through sensorimotor learning. Recent data demonstrate that sensorimotor experience can enhance, abolish [34] or even reverse [35], the activation of the neuron. This medium seems consistent claim that sensorimotor experience may have an impact on MNS. According to Heyes [32], much of this experience is obtained through interaction with others.

These studies seem to confirm the hypothesis that learning enables the interaction, that is, from the perspective of the second person. In this context, there seems to be a role for MNS beyond resonance: the simulation of a routine that allows the other to gain a "first person" perspective. Such affordances may, thus, be understood as opportunities for interaction (provided by the other) in terms of an activation of programmed engines that allow an interpersonal coordination of behavior. Under these conditions, social interactions have a profound impact on the activity of MNS and it can be understood that the actions performed jointly between subjects involve complement actions and not imitations ([21]; [37]). Studies conducted by Newman-Norlund et al. [38] demonstrated that MNS is more active when preparing complementary actions, while other studies [39]; [40]) show that activity in human MNS can be modulated by social interaction.

I wrote somewhere [41], that the ability to “read” others is primarily a form of body reading rather than mind reading, and that the basic bodily capacities that make humans naturally attuned to the expressions of others are largely pre-reflective, emotional, sensory-motor, perceptual and not intellectual governed. All face-to-face interactions are based in embodied intersubjectivity. Social understanding should be, thus, understood as a product of the embodied social interactions of primary intersubjectivity, which are both enactive and essentially emotive.

There are good reasons to believe that our appreciation of others as a person involves a disposition to affect them, and to be affected by them. It is during this process of mutual affection that joint meanings are generated and individuals’ distinct perspectives are intersubjectively merged and modified. Interpersonal engagement is enactive in the sense that individuals do not passively receive information from their environments, which they are translate into internal representations whose significant value is to be added later, but instead actively participate in the generation of meaning.

There are, however, some sceptical perspectives on Mirror Neurons on recent literature. Hickok [44], is not convinced of Mirror Neurons evidence. His research seems to suggest that mirror neurons have a vital role to play within a broader class of sensorimotor cells, which may lead to a new understanding of the brain within a computational theory of the mind. As a matter of fact, Hickok proposes that the initial theory of mirror neurons may have had a false start, but it inspired an even more complex and interesting story that is just beginning to unfold. He is equally confident that mirror neurons have not provided clues to the evolution of language, empathy, or theory of mind.

According with Kilner and Lemon [45], The functional role(s) of mirror neurons and whether mirror neurons arise as a result of a functional adaptation and/or of associative learning during development are important questions that still remain to be solved. In answering these questions we will need to know more about the connectivity of mirror neurons and their comparative biology across different species.

Conclusions

Cognition is not something that occurs “inside” of an agent, but is a product of that interaction, much like a handshake is the product of an interaction. There are five key "pillars" to the enactive approach: a dynamical systems perspective and emergence, embodiment, biological autonomy, "sense-making" (the creation of meaning), and experience. Some key implications result from these principles for how we think about and how we investigate cognition.

In the domain of artificial cognitive systems, it means taking the autonomy of the system seriously, and trying our best to develop a science with such autonomy at its center. Brooks behavior-based robotics [42] make the task to be performed fundamental to the operation of the agent themselves, and as such share some common ground with the enactive way of thinking. Evolutionary robotics approaches (see Harvey, Di Paolo, Wood, Quinn, & Tuci, 2005), particularly those that emphasize the evolution of the agent's own value system will allow us to examine cognition as emerging in a dynamic and skillful interaction between the agent and the world, rather than something which must be pre-built into the agent in some way. It is the existence of some kind of value that "belongs" in some sense to the agent, instead of our values as researchers trying to understand cognition that means we are studying enaction rather than computation.

The findings on the MNS level, raises several questions for Philosophy of Mind and Cognitive Science. It suggests that activity in MNS is not related to the perspective that a human adopts, but with a monitoring of one's own behavior observed, regardless of whether it's "my" or "your" action.

According with recent data on MNS stated on this article, contemporary Philosophy of Mind, Social Cognition and Neuroscience need to address mind and brain as a system of experience and interaction with others. The brain is an organ of modulation and transformation that mediates the cycles of interaction between organism and environment. The mind is not the brain [43], but rather is distributed throughout the brain, body and environment, i.e., the brain is an organ of the mind, taking into account that is linked to a human head and a body not only and this body connected to their environment and to other human beings.

Traditional cognitive science considers the mind as being somehow located in or caused by the brain, not accessing the relational feature of bodily, relational and biographical dimension of the human mind, this is, the living body and the world in which mind and brain are inserted, taking into account that it still relies on the Cartesian split between "mental" and "physical" or between subjective mind and objective body.

Moreover, traditional Philosophy of Mind argues, in general, the profound difference between conscious and biological life, in other words, internal and external and purely mental and functional characteristic of physical systems. The so-called problem of consciousness cannot be precisely resolved while mind and life are considered two exclusive concepts. Humans should not be thought of as purely subjective experience from within or as a complex physiological system observed from outside, but as living beings who interact with others from the second-person perspective, viz. the "you" perspective.

One possible way to overcome the problem of self-other awareness is the notion of "embodiment" as a process of insertion of the mental in the living organism and therefore, puts it in a dynamic relationship with the environment through which the sensorimotor experience occurs. To this extent, the brain must be considered primarily as an organ of a

living being, and only for this reason, becomes an organ of mind. In such conditions, consciousness is not an object or condition which might be situated, but rather a relational process with something [43]. It is possible to overcome the problem of consciousness if mind, consciousness and life relate in coexistence from the second person perspective.

The "lived body" on the one hand and the physical body (which includes the brain) on the other, are two dimensions of a living organism in relation to others — the first of which corresponding to the first and second perspective and the latter to the third.

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