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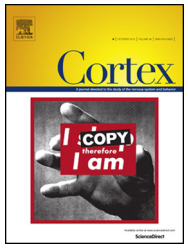


Discussion forum

# Mirror neurons, embodied simulation and a second-person approach to mindreading

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## 1. Mirror neurons (MNs) and embodied simulation (ES)

Intersubjectivity can be profitably understood if framed within a phylogenetic perspective. The discovery of MNs enabled establishing a relation between human intersubjectivity, the inter-individual relations of other animal species and their underpinning neural mechanisms.

MNs are motor neurons first discovered in macaques' premotor area F5 and, later on, also in a sector of the posterior parietal cortex reciprocally connected with area F5 (see Gallese, Gernsbacher, Heyes, Hickock, & Iacoboni, 2011), in the primary motor cortex (see Vigneswaran, Philipp, Lemon, & Kraskov, 2013) and in the anterior cingulate cortex (see de Araujo et al., 2012). MNs have been interpreted as the expression of direct form of action understanding, hence their potential relevance for social cognition (Rizzolatti, Fogassi, & Gallese, 2001).

The existence of a mirror mechanism (MM) is now firmly established also in the human brain (see Kilner, Neal, Weiskopf, Friston, & Frith, 2009; Mukamel, Ekstrom, Kaplan, Iacoboni, & Fried, 2010). Motor goal detection, action anticipation and the hierarchical representation of action can be viewed as the direct consequence of the functional architecture of the motor system, organized in terms of goal-directed motor acts. Such perspective was qualified as "motor cognition" (Gallese, Rochat, Cossu, & Sinigaglia, 2009).

The motor system, together with its connections to viscero-motor and somatosensory cortical areas, structures action execution and action perception, action imitation and imagination. When the action is executed or imitated, the cortico-spinal pathway is activated, leading to movement. When the action is observed or imagined, its actual execution is inhibited. The cortical motor network is activated, however, not in all of its components and not with the same intensity: action is not produced, it is only simulated.

ES aims at providing a unitary account of basic aspects of intersubjectivity showing that people reuse their own mental states or processes represented in bodily format to functionally attribute them to others (Gallese, 2003; Gallese & Sinigaglia, 2011). Mental states or processes are embodied primarily because of their bodily format. ES theory neither provides a general Theory of Mind (ToM) reading, nor of mental simulation covering all types of simulation-based mindreading. ES aims at explaining the MM and related phenomena. For sake of concision, I will not deal here with emotions and sensations.

It was proposed that MM-driven ES plays a constitutive role in forms of mindreading, not requiring propositional attitudes, mapped onto mental representations with a bodily format (Gallese, 2007; Gallese & Sinigaglia, 2011). I am not implying that we experience the specific contents of others' experiences, but only that we experience others as having experiences similar to ours.

ES posits that the capacity to understand others' intentional behavior *also* relies on a more basic functional mechanism, which exploits the intrinsic organization of the motor system of primates. More simply put, there are several ways of understanding others: ES is one of them.

## 2. The so-called "problem of other minds"

A mainstream view in philosophy of mind basically equates human social cognition with social meta-cognition, that is, with the possibility to explicitly reflect upon and theorize about one's mental life in relation to the mental life of others. The understanding of other minds is conceived as a predica-

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tive, inferential, theory-like process, called ToM. Most of brain imaging studies investigating ToM (for recent reviews, see Frith & Frith, 2012; Van Overwalle, 2009) have repeatedly claimed the ToM specificity of several brain areas, like the temporo-parietal junction (TPJ) area, and medial Pre-Frontal cortex (mPFC). However, bilateral damage of medial frontal areas, doesn't produce any sort of mind-reading deficit, as shown by the neuropsychological case described by Bird, Castelli, Malik, Frith, and Husain (2004). To make things worse, the mind-reading specificity of the activation of these brain areas is being seriously questioned (see Gallese et al., 2011). One could hypothesize that medial frontal areas and TPJ systematic involvement with mindreading tasks doesn't depend upon the fact that they contain ToM-specific neurons, but because self-other differentiation at a bodily level is a necessary ingredient of mentalizing activity.

## 3. The second-person approach

The fundamental relational character of human beings is at least two-folded. It can be a third-person relation, or a second-person relation, an *I-you*. What distinguishes these relations is not their object but the epistemic status adopted by the I. The second-person approach (also known as second-person perspective, see Schieber et al. 2013) differs from third-person approach because it defines a radically different and deflationary epistemic approach to the problem of other minds, by substantially reducing the mental gap supposedly separating them. The solution to the issue of intersubjectivity can't be a forced choice between a third-person and a second-person perspective since we constantly switch between these two modes of inter-personal relation.

We do not only mentally entertain an "objective" third-person account of what others are and do to us and with us. When encountering others, we can experience them as bodily selves, similarly to how we experience ourselves as the owners of our body and the authors of our actions. We can challenge the idea that a theoretical meta-representational approach to the other is the *sole/main* key to intersubjectivity. Mindreading, as conceived of in a broad sense, could designate our understanding of others allowed by the possibility to map the other onto the self, reciprocated by the mapping of the self on the other. Mindreading in a narrow sense should instead qualify intersubjectivity only when a more explicit need for explanations requires less-engaged, more third-person like types of relations. I posited that before and below both types of mindreading is the fundamental relational nature of action (see Gallese, 2003, 2007).

A new understanding of intersubjectivity could benefit from a bottom-up study of the non-propositional and non-meta-representational aspects of social cognition. This epistemological approach to intersubjectivity has the merit of generating predictions about the functional nature of our social cognitive operations, cutting across and not being subordinated to a specific mind ontology, like that purported by the classic cognitivist approach.

The limited space allowed prevents me to address the important related issue of simultaneous or sequential joint actions and the possible different functional mechanisms underpinning them. For the same reason I can't discuss the brain regions putatively involved in the overall hierarchical coding of actions of increasing complexity, likely including mesial premotor cortex and dorsal prefrontal cortex. I would only observe that the MM looks like an ideal underpinning candidate for the synchronization of joint actions. Sequential joint actions require the understanding and anticipation of the action partner's behavior, thus I would argue that in this particular case ES is a necessary but not sufficient condition.

## 4. Conclusion

The neuroscientific results triggered by the discovery of MNs highlight the role played by the motor system in providing the building blocks upon which more sophisticated social cognitive abilities can be built. The relational character of behavior as it is mapped by the cortical motor system enables a direct appreciation of purpose without relying on explicit propositional inference. Is this behavior reading, mindreading, or neither? I leave it to the reader to decide.

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