

## Editorial

### Mirror neurons: some critical remarks

The research that has been conducted following the discovery of mirror neurons has extended the implications of the initial empirical data in two ways. Firstly, it has led investigators to formulate the hypothesis that mirror neurons are a complex that involves the entire brain - the so-called "Mirror Neuron System" (MNS). Secondly, it suggests that this MNS is involved in a wide variety of psychological processes and functions. These hypotheses pose important conceptual questions, which have been thoroughly examined, as the papers included in this special issue show.

One apparent indication emerging from the research into the MNS is that the comprehension of otherness<sup>(1)</sup> is based on the activation of neural circuitry that is either involved in the execution of an action by the executor herself, or by their first-person experience of another's feelings or thoughts leading up to action. Thus, the MNS can be conceived of as the neurobiological basis of the circumstance in which "I understand you". However, the meaning of this sentence is rather ambiguous, while the precise role of the MNS seems to depend upon the meaning of each of the three terms occurring in it.

Looking first at the term 'you', which aspect of the understanding of 'you' is allegedly supported by the MNS? My comprehension of what 'you' are doing can be based on different kinds of knowledge. On the one hand I may simply grasp your behavioural attitude, whereas on the other hand I can know your mental states. This distinction is important as, whereas in the first case a representation is not needed - the purpose of your action is detectable within the action itself as

a sort of perceptual feature - in the second case, to arrive at understanding I have to conceptualise your intention. A further relevant distinction could be that between the goal of others' actions and their dynamic. I may be able to identify the intention of another's actions without knowing the steps (and associated mental processes) through which he or she is attempting to reach their goal. For instance, in a card game I might understand that a fellow player is intending to cheat by observing her facial expressions and hand movements, but these behaviours in no way tell me how he or she will succeed in cheating.

As far as the term "understanding" is concerned, as in the previous case we can think of it as a continuum with two opposing poles. One of these poles is constituted by the proper motor patterns through which I react to another's action. For instance, if you suddenly grabbed a saucepan, and you consecutively flexed your limbs, moving it backwards and then forwards with an angry expression on your face, I would rapidly jerk my head aside to avoid being hit by the missile you were about to throw at me. I thereby demonstrate that I have "understood" what you were intending to do, since I have anticipated the consequences of your action, even though I had no time to conceptualise it. At the other extremity of the

<sup>(1)</sup> Otherness can have different forms, such as understanding the meaning of another's actions, even if only from a static representation, like a painting or a statue; grasping the intention underlying another's body movements; or comprehending how another is feeling, from facial and bodily expressions of pain, for instance; and so on.

continuum, in order to understand your actions I have to construct a representation of what is occurring in your mind as the cause of your behaviour. Another aspect that differentiates between the kinds of understanding at the basis of otherness comprehension is the level of personal involvement that understanding implies. My understanding of your behaviour can be accompanied by visceral sensations or strong feelings: I am “immersed” in what you are doing or experiencing, and I re-enact the nuances of your “*Erlebnis*” in my own mind and body. It may be, however, that my understanding is emotionally neutral, with no empathetic participation or concrete image accompanying it, as if it were a sort of abstract sharing of your action.

Finally, the term “I”; what characteristics are possessed by the “I” who understands your behaviour? On the one hand, my understanding could be founded merely on establishing some stimulus-response associations. Alternatively, my understanding could be the result of a series of inferences I draw from perceptual data, perhaps owing to the integration of previous beliefs about your temper and concurrent contextual cues. Harking back to the previous example, if I see you rummaging around in the kitchen cupboard with furrowed brows when I suspect I have done something to make you mad, I may remember the time you got angry with someone else and threw a frying pan at the object of your ire, and imagine that you are making ready to throw one at me.

To summarise, there are several paths to understanding other people’s actions, and the MNS only needs to be invoked as the neurobiological basis in certain forms of otherness comprehension. As stressed in the papers collected in this special issue, there are ways of understanding others which seem to involve mechanisms that are rather different from the embodied, non-conceptual, immediate, direct, emotionally charged grasping of other minds, which is usually considered the form of understanding associated with MNS.

The theoretical problems associated with the implications of the MNS, however, are not restricted to the kind of understanding that the MNS underpins. As is implicitly suggested in some articles in this special issue, two further conceptual problems can be identified.

First, proponents of the MNS claim that I understand what you are doing because when I watch you, this activates the same areas in my brain that are activated

when I perform that action myself. But the identity of the brain processes alone does not explain why I succeed in understanding your actions. In fact, I should understand the meaning of the patterns activated in my brain concurrently to my action in order to understand the meaning of those patterns when they are activated by your action. In other words, I understand what you are doing because the concomitant cerebral activity is the same as that of the corresponding action performed by me; I understand what you are doing on the basis of what I do. But how I understand what I do?

Second, how can I understand the meaning of others’ actions if I have never performed them myself? One possible explanation might be that new actions are usually constructed from segments of known actions. Thus, the meaning of the whole new action can be discerned by integrating the meaning of each action segment that has been assembled. Such an interpretation, however, conflicts with one of the main claims, supported by findings, concerning the mirror neurons, namely that the brain system encodes not the spatial features of our movements, but the global aim to which they are addressed. As a consequence, new movements should be encoded in a similar holistic and teleological way, and their meaning could hardly emerge as merely the summation or composition of the aims of each act they are made up of. Another problem with this scenario is that the partial acts comprising the new global act were also once new for the subject. It is clear that, in addition to the repertoire of innate responses and those automatically elicited by the situation at hand, a large set of actions have at some time been learned. Thus, there has been a time in which we did not perform such actions. How would we be able to understand their meaning if the corresponding activation pattern were not present in our brain, since we had never executed them? Studies into imitation have shown that babies imitate adults’ behaviour if they understand its goal; imitation is never copying others’ actions without being aware of the meaning of those actions (unless children are compelled to imitate meaningless movements).

Research into the MNS is a striking example of a field in which experimental investigation and theoretical analysis can fruitfully collaborate, as the relationships between experimental and theoretical exploration seem to be bidirectional. In one direction, empirical findings can make apparent the need to revise existing views of certain phenomena (such as

the relationships between perception and action or space representation) and suggest intriguing new perspectives<sup>(2)</sup>. In the other, conceptual clarification may contribute to providing greater precision regarding the alleged implications of the experimental data, and may enable refinement of the theoretical models that are proposed on the basis of those findings.

Therefore, critical examination of some issues involved in MNS research, such as that undertaken by the Authors featured in this special issue, is of fundamental importance.

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<sup>(2)</sup> Or, as in the case of mirror neurons, renewed perspectives, since neurological, psychological and philosophical motor theories of cognition have been already proposed in the past.

