Resenha

Book Review

Perception and Action after the Discovery of Mirror Neurons

Percepção e Ação após a Descoberta dos Neurônios-espelho

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RIZZOLATTI, G.; SINIGAGLIA C. *So quel che fai.* Il cervello che agisce e i neuroni a specchio. Milano: Raffaello Cortina, 2006. 216 p.

In everyday life experience we usually attribute beliefs, intentions and desires to other individuals. At the same time, the most of our social behaviours implies the ability of understanding other people's actions. But what does *understanding other people's actions* mean? Which kind of *understanding* do we need in order to "read" into the other minds or to "grasp" others' gestures? For several decades cognitive scientists and philosophers of mind used to keep separated perception and action in their theories. In this way, they ended up reducing them to peripheral processes of a "disembodied" brain without any kind of biological roots. Actually, the main trend has been to maintain the conception of a brain whose main skills were computing mental representations and executing cognitive tasks. This is the perspective that Susan Hurley some years ago compared to a "sandwich" just to underline that perception and action, considered as two different "slices of bread" and depending, for their taste, on the rich filling (i.e. intentions, desires, beliefs), imply a rigid distinction of levels in cognitive functions. Hurley's metaphor focuses the attention exactly on the topic which Giacomo Rizzolatti (director of the Department of Neuroscience, University of Parma, Italy) and Corrado Sinigaglia (philosopher of science, University of Milan, Italy) deeply challenge in *So quell che fai.* Il cervello che agisce e i neuroni a specchio: the processing of sensorial information in a linear and unidirectional way, i. e. *perception-cognition-action.*

Everything begins at the University of Parma in the early 1990's, when Giacomo Rizzolatti and his colleagues, while they were recording the activity of single neurons in the premotor cortex of monkeys, realized that some neurons of that area (today known as *mirror neurons*) respond not only when the monkey performed a given action, but also when the animal observed the researcher (or another monkey) performing the same action. This discovery has been the very beginning of a paradigmatic change in neurosciences. As Vilayanur S. Ramachandran properly predicted: "Mirror neurons will do for psychology what DNA did for biology". Several monkey experiments, actually, specified the mechanism of mirror neurons and their possible functions, as well brain-imaging and other non-invasive techniques showed that mirror neuron system belongs also to human beings. Rizzolatti and Sinigaglia's book provides, for the first time, a systematic overview of experimental settings and theoretical issues concerning this discovery which let the researchers understand that certain brain areas – usually labelled

as "motor" ones – have to be considered, as the authors think, an "acting brain" that plays a fundamental role in perceiving and understanding objects and people around us.

After a detailed description of the neurophysiological basis (chapter 1) that made the researchers aware of the effective role played by motor system in cognitive functions (i. e. data concerning anatomical organization of the frontal and parietal lobe, the connectivity of the motor areas with parietal and frontal lobe areas and the single neuron properties of the motor areas), Rizzolatti and Sinigaglia show how neurons belonging to a specific motor area (area F5) do not code simple *movements* but specific *actions*, that is movements with a *goal*. But this area – conceptualized as a sort of "vocabulary" of actions – includes both a variety of actions (grasping, holding, breaking, and so on) and also more specific ones (such as grasping with a pinch, with the whole hand or just with fingers). It is also well worth pointing out that just the mere observation of a given object may activate motor neurons – even if these neurons discharge only when the observed object has physical properties congruent with the action they code. As the authors maintain, such a mechanism explains how brain transforms visual information into motor commands, and the fact that these neurons respond in the presence of objects (even if the tested animal is still and does not interact with them) shows that the motor system has perceptive and cognitive functions enabling to *recognize* and "*categorize*" objects.

But there is something more: on the basis of the scientific acquaintances this book is about, the conception of space itself has to be radically qualified. Actually, if ordinary experience persuades us to perceive objects in a unitary space, recent experiments have shown that our brain is endowed with several spatial maps, each one with its own system of coordinates. This evidence confirms not only how deeply the motor cortex makes individuals conceptualize objects as, for example, *objects to grasp*, but also that motor cortex allows us to localize objects in space. There is, actually, a completely different way of coding the so called *peripersonal space* (the space immediately around us) and the *extrapersonal space* (the space far away from us). The second one appears to be essentially visual, the first one is both visual and tactile, and the receptive fields of neurons coding it are linked to various body parts (head, torso, arms, legs, etc.) and to actions that these parts are able to execute.

From chapter 4 Rizzolatti and Sinigaglia focus on the very topic of the book: mirror neurons and their own functions. As seen before, premotor and inferior parietal lobe neurons code actions, but mirror neurons do something more. Let's start from the beginning. Mirror neurons are a set of neurons found in the ventral premotor cortex and in the rostral part of the inferior parietal lobe of monkeys. Their peculiarity is to discharge not only when the monkey performs a given action, but also when the monkey sees another individual (experimenter or another monkey) doing the same action. Such a discharge – Rizzolatti and Sinigaglia explain – reflects "a potential motor representation of the action the monkey observes". Mirror neuron mechanism is based upon the direct matching between perception and action, and its functional significance is to provide an understanding of the meaning of observed actions – and that without any kind of inference or reasoning on the part of the observer. Moreover, other experiments have recently shown that mirror mechanism let individuals understand not only actions done by others, but also the reasons *why* these actions has been executed. The sight of a researcher (or of another monkey) grasping food (or other objects) activates in the monkey's brain a series of motor chains that allows it to anticipate the outcome of actions. For example,

grasping food could also mean – if suggested by the context – lifting it to the mouth and eating it.

Referring particularly to human beings, electro-physiological experiments and brain-imaging studies has recently proved that also human brain is endowed with mirror neurons, but that is not all. Human mirror system, moreover, has a much greater range of skills than the monkey's one. For example, in addition to understanding actions (and intentions), the human mirror mechanism is also at the basis of the ability of learning complex behaviours by imitation – a lacking capacity in monkeys. Those acquaintances allow Rizzolatti and Sinigaglia not only to confirm once more their thesis about the close relationship between perception and action, but also to add (chapter 6) that "mirror neurons represent a non-intentional communication system that has a fundamental property inherent to it: what counts for the sender of the message counts also for its receiver". No conventional mediation is required. This property and the fact that human mirror system includes also Broca's area have also suggested to the authors that mirror system itself could be involved in the process of language evolution. From gestures to their development into "ritualize" mimicry, up to the appearance of verbal communication: this is the scenario prospected in *Io so quel che fai*.

In last chapter Rizzolatti and Sinigaglia propose a neurophysiological interpretation of empathy. There are empirical evidences of the fact that the observation of others' emotions – such as disgust or pain – activates the same areas activated when the observer himself experiences these emotions. Because of the fact that the cortical region involved in this function (*insula*) is also responsible for viscero-motor reactions characterizing emotions, the researchers end up supposing that, in addition to a "cold" mirror neurons system, there should be a second one for "hot" emotionally laden actions.

Mirror neuron systems offer, as seen, a sort of unifying framework for the investigation of a large number of behavioural patterns that underlie both individual conduct and social behaviour. Thus, according to Rizzolatti and Sinigaglia, *understanding other people's actions* (intentions and emotions as well) mean recognizing the significance of observed actions just on the basis of the our own motor repertoire – in other words, on the basis of that immediate combination between perception and action. This is not only an important step forward for neurosciences, but also an opportunity for a stimulating debate including some of the most significant philosophical perspectives: from Ernst Mach to Jules-Henri Poincaré about the motor character of perception; from Edmund Husserl to Maurice Merleau-Ponty about the acting body (*Leib*) skills in dynamics of perception, but overall the american pragmatism and in particular some of George Herbert Mead's intuitions. Actually, as Mead wrote in *The Philosophy of the Act* (1938), "a perception has in it […] all the elements of an act", but also each perceived objects (or other people's behaviour as well) "invite us to action with reference to it". According to Sinigaglia and Rizzolatti, this "invitation to act", just as belonging to the content of our perceptual experiences, allows observed objects and actions to acquire their own meaning for us. In this way *we know what other people are doing* just because the visual representation of a given action (or of a perceived object) arises from the *potential actions* evoked in the observer by the sight itself of *that* action and *that* object.