MIRROR NEURONS: NEW FRONTIERS 20 YEARS AFTER THEIR DISCOVERY

DEVELOPMENT OF MIRROR NEURONS

One-day Symposium

9:00 a.m. - 9:45 a.m.  Claes von Hofsten - On the development of the MNS

9:45 a.m. - 10:15 a.m. Laila Craighero - Others’ action recognition in newborns: the role of goal-directedness

10:15 a.m. - 10:35 a.m. Ross Vanderwert - Mu rhythm desynchronization in the absence of visual information: Adults and infants

10:35 a.m. - 11:00 a.m. coffee break

11:00 a.m. - 11:20 a.m. Erin Cannon - An exploration of infant mu rhythm during the execution and observation of grasp actions

11:20 a.m. - 11:40 a.m. Graziella Fava-Vitiello - The mirror technique according to Paulina Kernberg. Mirror neurons in clinical practice

11:40 a.m. - 12:10 p.m. Elizabeth Simpson - Coupling action and perception in infancy. A review on the development of neonatal imitation in rhesus macaques

12:10 p.m. - 12:45 p.m. Jose L. Contreras-Vidal - Beyond mu rhythms: Decoding action observation from scalp EEG using a neural interface approach

12:45 p.m. - 2:30 p.m. lunch

2:30 p.m. - 3:15 p.m. Massimo Ammaniti - The role of the Mirror Neurons System in mother-infant affective resonance

3:15 p.m. - 3:45 p.m. Lynne Murray - Early interactive mirroring experiences in normal and clinical populations, and their possible implications for development

3:45 p.m. - 4:15 p.m. Harold Bekkering - Presentation of the Baby Research Centre Nijmegen

On the development of the MNS
Claes von Hofsten & Kerstin Rosander

It is suggested that the basic principle of the MNS is to project observed actions onto one’s own action system. It enables fast anticipation of others actions. A “library” of actions is needed for this task. One basic question in early human development is therefore how this library is formed? A number of studies indicate that it is gradually formed in accordance with the infant’s own action experience. Thus, motor development sets the constraints for the understanding of other people’s actions. We will review a number of examples showing that both goal anticipation and neural activity in infants follow this principle.

The role of the Mirror Neurons System in mother-infant affective resonance
Massimo Ammaniti - Sapienza University Rome, International Psychoanalytical Association

Observations of early mother-infant interactions have shown that intersubjectivity is a primary motivation and have underscored the importance of maternal attunement in this development. While psychoanalytical theory has fundamentally promoted the exploration of maternal and paternal intrapsychic constellation, the attachment framework has mostly considered real interactions between between parents and infants. Finally infant research has explored the complexity of communicative system between parents and infant. Recently these different perspectives have been broadened by neurobiological research which has began to explore maternal brain functioning and structure, emphasizing the role of the Mirror Neurons System in mother-infant affective resonance.
Others’ action recognition in newborns: the role of goal-directedness
Laila Craighero - University of Ferrara

Others’ action recognition is at the basis of social life and communication, and it has been proposed that it is grounded onto sensory-motor representations linking motor command and sensory consequences of action outcome. In the last twenty years much evidence has been collected demonstrating the fundamental role that the functional identity, either at a neuronal or at a representational level, between the motor command and the sensory consequences of motor execution, plays in cognitive functions. Several are the examples of sensory-motor neurons present in the primate’s brain. The most known is maybe represented by mirror neurons which possess the property to fire exactly in the same way when the monkey executes a hand/mouth goal-related action and when the animal merely observes or hears another individual executing that same action. Another example refers to canonical neurons, firing during execution of a grasping action towards a graspable object but also during the mere observation of that same object. However other examples can be found linking the motor and the related sensory information specific for other effectors, such as the eyes or the arm. What is particularly interesting in the sensory-motor association is that the common code is based not on the way the action is executed but on the pursued goal.

Recent findings using the preferential looking technique verified that 2-day-old newborns discriminate between a whole hand prehension and a reaching movement, but only when these observed actions are directed towards an object (goal-directed) and not when they are directed away from it (no goal-directed).

It is proposed that this ability is based on the establishment of a primitive cross-talking between motor and sensory systems present in foetuses, which determines the emergence of initial goal-directed behaviours. A possible interpretation is that in newborns attention is focused on the final part of the observed action, allowing them to recognize differences between stimuli only when these are present at the end of the movement. This attention unbalance would resemble the proactive gaze behaviour, present in 12-month-old infants, claimed to be an indication of action prediction ability during observation.

The alternative interpretation is that newborns are mainly attracted by observed actions rich in sensory feedback (such as the wrapping up of a ball with the entire hand), reflecting the research of sensory satisfaction driving the initial phases of motor behaviour development.

These results demonstrate that already at birth humans possess the bases for the fundamental social ability to recognize others’ actions, giving a new key for interpreting, and eventually testing, cognitive function development.

Mu rhythm desynchronization in the absence of visual information: Adults and infants
Ross Vanderwert

In their 1996 paper, Gallese and colleagues (1996) demonstrated a critical function of mirror neurons. These neurons fired in the absence of visual information thus demonstrating their isolated role in execution of a motor action without visual feedback. The mu rhythm (an EEG signal believed to represent activity in the putative human mirror neuron system) has been utilized extensively to examine responses to the observation and execution of actions; however, in the majority of these studies participants have had visual access to their own performance. No studies have examined mu suppression in human infants or adults in the absence of visual information. Using a modified procedure similar to that used by Gallese and colleagues, we measured EEG during the observation, execution, and execution in the dark of simple grasps in a sample of adults and 9-month-old infants. Results identify significantly greater mu desynchronization during the execution of grasps in the dark in both infants and adults.