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Editorial

Mirror Neurons−Some of Their Physiological and Clinical Implications

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Mirror neurons were first discovered serendipitously, in the ventral premotor area of monkey's brain by an Italian group of neurophysiologists led by **Giacomo Rizzolatti** in 1996 [1,2]. These neurons fire not only when the monkey is in action, but also when it observes others carrying out the same actions (action recognition and action imitation). Therefore they are also called "monkey- see- monkey- do neurons. In addition, the mirror neurons that discharge not just to the execution (for instance, pea nut breaking by monkey itself) or observation of specific action (for instance, monkey seeing pea nut breaking by other monkey or investigator)) but also when this action can only be heard (if only monkey hears pea nut breaking). Since they respond to both visual as well as auditory stimuli, they are also known as "audio-visual mirror neurons" [3]. These neurons are part of a network that allows you to see the world "from the other person's point of view," hence the name "mirror neuron."

Interestingly, humans too have mirror neurons that are far smarter, more flexible and highly evolved than those found in monkeys. Human brain has mirror neurons in many regions of the brain and according to Rizzolatti, they may play a crucial role in understanding the meaning and intentions of observed actions, learning by imitation (action imitation), feeling empathy (emotions of others) and also allow us to grasp the minds of others (mind reading) not through conceptual reasoning but through direct simulation (by feeling not by thinking). Other interesting aspect about the mirror neurons is that they are observed in an area that appears to be the homolog of human Broca's area (speech producing area in humans). This finding might help us to understand how the language was evolved [4, 5].

This discovery can shed light on how children learn, how people respond to certain types of sports, music, art, culture and dance and why watching media violence may be harmful, why do we cry while watching emotive scenes in television, why men like pornography, why do we yawn while seeing others and about many other aspects of social cognition [6].

Clinical Implications:

Ramachandran et al investigated the role of mirror neurons in patients with left side paralysis due to a right hemisphere stroke. About 5% of the patients vehemently denied their paralysis even though they are mentally otherwise lucid and intelligent. This is the so called "denial" syndrome or anosognosia. His team also found that some of these patients not only denied their own paralysis, but also denied the paralysis of another patient whose inability to move his arm was clearly visible to them and to others. He reasons that this

bizarre observation may be due to damage to Rizzolatti's mirror neurons [7].

Since mirror neurons get activated when we read and understand others intentions, Ramachandran and others suggest that a loss of these neurons could explain **"Autism"** that afflicts children. Without these neurons the child can no longer understand or empathize with other people emotionally and therefore completely withdraws from the world socially. Evidence comes from the studies that involved on the observation that the firing of neurons in the premotor cortex suppresses the "mu" wave, a component of the electroencephalogram (EEG) measurement of the brain's activity. (Mu waves range from 8-13 hertz). The scientists monitored the mu waves of children with autism and control subjects as they made opening and closing of hand and then watched the same action on video.

The EEG of normal control subjects showed the suppression of the "mu" wave when they made opening and closing of hand as well as they watched the same action on video. However, the EEG of autistic children showed the "mu" wave suppression only when they performed opening and closing of the hand but not when they watched someone else perform the same action on video. Ramachandran et al concluded that the child's motor command system was intact but that his mirror neuron system was deficient (8).

Many other studies too have confirmed these findings using different techniques (5) such as magnetoencephalography (MEG), transcrainial magnetic stimulator, functional magnetic resonance (fMRI) and positron emission tomography (PET). The discovery of mirror neurons certainly, will unfold the physiological basis of many diseases affecting the brain, in the days to come.

"I am a brain, my dear Watson, and the rest of me is a mere appendage."— Sherlock Holmes.

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