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Action Observation and Mirror Neuron Network: a tool for motor stroke rehabilitation

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Mirror neurons are a specific class of neurons that are activated and discharge both during observation of the same or similar motor act performed by another individual and during the execution of a motor act. Different studies based on non-invasive neuroelectrophysiological assessment or functional brain imaging techniques have demonstrated the presence of the mirror neuron and their mechanism in humans. Various authors have demonstrated that in the human these networks are activated when individuals learn motor actions *via* execution (as in traditional motor learning), imitation, observation (as in observational learning) and motor imagery. Activation of these brain areas (inferior parietal lobe and the ventral premotor cortex, as well as the caudal part of the inferior frontal gyrus, IFG) following observation or motor imagery may thereby facilitate subsequent movement execution by directly matching the observed or imagined action to the internal simulation of that action. It is therefore believed that this multisensory action-observation system enables individuals to (re)learn impaired motor functions through the activation of these internal action-related representations. In humans, the mirror mechanism is also located in various brain segment: in Broca's area, which is involved in language processing and speech production and not only in centers that mediate voluntary movement, but also in cortical areas that mediate visceromotor emotion-related behaviors. According to this finding, during the last 10 years various studies have been carried out regarding the clinical use of action observation for motor rehabilitation of sub-acute and chronic stroke patients.
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1. **Mirror neurons and their mechanism**
   A. are activated only during observation of the same act performed by another individual
   B. are activated only during the execution of a motor act
   C. are activated both during observation of the same motor act performed by another individual and during the execution of a motor act
   D. are located only in centers that mediate voluntary movement
   E. are not important in language processing and speech production

2. **In regard to action observation in motor stroke rehabilitation**
   A. it activates the motor system similarly to execution
   B. combined with physical therapy it has the same effect as standard physical therapy

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C. action observation training has no effect in chronic stroke patients
D. mental rehearsal ("motor imagery") does not recruit cortical motor areas
E. it has minimal effects on brain plasticity and cortical reorganization

3. **The parietal and frontal mirror areas in humans code mostly**
A. for fine motor skills
B. for strength of motor acts
C. for imitation of motor acts
D. for goals of motor acts
E. for pain processing

Cortical plasticity and brain computer interface

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There is increasing evidence to support the concept that adult brain has the remarkable ability to plastically reorganize itself. Brain plasticity involves distinct functional and structural components and plays a crucial role in reorganizing central nervous system's networks after any lesion in order to partly or totally restore lost and/or compromised functions. The idea that a computer can decode brain electromagnetic signals to infer the intentions of a human and then enact those intentions directly through a machine is becoming a reasonable technical possibility. In neurological patients unable to move and to communicate with the external environment, technologies implementing brain-machine interfaces (BMIs) can be of valuable aid and support. The emerging possibility, through neuro-imaging advanced techniques, to clarify some crucial issues underlying brain plasticity will give the possibility to modulate these mechanisms in a BCI-oriented way. This approach may have a tremendous impact in a variety of neuropsychiatric disorders and the clinical advent of this technology will usher in a new era of restorative medicine.
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4. **Plastic brain changes can be measured by**
A. PET
B. CT
C. EMG
D. Blood exams
E. Transcranial Doppler

5. **Brain computer interfaces (BCI)**
A. can be detected by fMRI
B. acquire brain signals and convert into the machine commands
C. are already used in the majority of clinical settings
D. may be used in sensory as well as in motor stimulation
E. use computers to "order" the brain to execute motor tasks

6. **TMS-evoked activity spreads from the stimulation site**
   A. ipsilaterally via association fibers
   B. contralaterally via association fibers
   C. ipsilaterally via transcallosal fibers
   D. to cortical structures via projection fibers
   E. to cortical structures *via* transcallosal fibers

See answers on page 343.