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Multiple components of action simulation

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ABSTRACT OF THE TALK

An accumulating body of evidence suggests that interpreting and understanding others' behavior involves simulative "mirror-matching" mechanisms. Strong evidence for action simulation in Humans comes from transcranial magnetic stimulation (TMS) studies showing specific corticospinal facilitation during action observation. These studies converge to indicate that action perception selectively increases the amplitude of motor-evoked potentials (MEPs) recorded from the muscle groups that would be recruited during the execution of the observed action. Little is known about the causative role played by motor, somatic and visual areas in the corticospinal mapping of others' actions. To address this issue we developed a paradigm combining repetitive TMS (to create transient 'virtual lesions') and single-pulse TMS (to probe corticospinal excitability) during action perception. In different experiments we found that disrupting neural activity in key nodes of the action simulation system affected the vicarious response to others' actions in the corticospinal system. Virtual lesions to ventral (vPMc) or dorsal (dPMc) premotor regions disrupted corticospinal 'mirror' mapping of finger (e.g. grasping) and arm motor acts (e.g. reaching) respectively; this indicates that vPMc and dPMc play a crucial role in the internal simulation action performed with distal and proximal effectors. Virtual lesions to the superior temporal

sulcus (STS) increased the facilitatory response to the observation of actions, suggesting that interference with activity of the visual nodes of the action simulation system triggers a compensatory activity in the motor system. Finally virtual lesions to somatosensory cortex (S1) selectively disrupted mapping of biomechanically impossible body movements with high somatic components (pain, joint stretch), suggesting that S1 is involved in simulating the somatosensory components of the observed action. These findings indicate that during action perception visual, somatic and motor components exert distinct influences on the observer's corticospinal system, and suggest that 'perturb and measure' paradigms may disclose causative involvement and functional connectivity of action simulation system.