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#### Role of primary motor cortex in motor learning

I will describe a series of studies exploring the role of the human primary motor cortex (M1) in motor learning and motor learning by observing. In a first study we tested the idea that proactive interference in motor skill learning results from persisting neural representations of previously learned motor skills in M1. Subjects reached to targets while holding a robotic arm that applied force fields to the limb. Fifteen minutes of 1-Hz repetitive transcranial magnetic stimulation (rTMS) to M1 impaired the retention of a first force field, and importantly, reduced proactive interference when subjects learned a second one. In a second series of studies we explored the neural basis of motor learning by observing. We show that subjects can acquire information visually on the basis of observation that helps them later perform arm movements in novel force-fields. This process appears not to be dependent on the use of conscious strategies but instead is based on the implicit engagement of motor systems. A study using rTMS supports the idea that motor learning by observing is based on the activation of the motor system during observation, and provides direct evidence that neural representations of motor skills in M1, a cortical region whose role has been firmly established for active motor learning, are also involved in motor learning by observing. Data from a new fMRI study shows that part of the network that is engaged in processing self-generated reaching errors is also activated when observing reach errors committed by others.

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