

The essential role of the dorsolateral prefrontal cortex in motor imagery: A TMS interference study

ABSTRACT:

Background

A currently popular theory, the Functional Equivalence Model, holds that motor imagery and overt action use similar brain regions and have similar outputs, such as timing. This model is being contested by the Motor Cognitive Model, which posits that significant differences exist between the two behaviours, specifically that motor imagery relies heavily on executive resources involving the dorsolateral prefrontal cortex, whereas overt actions do not.

Aims

To test the two aforementioned models of motor imagery by disrupting the activity of the dorsolateral prefrontal cortex while participants performed either motor imagery or overt actions (Experiment 1). To further test the models also using a task which interferes with executive functions (Experiment 2).

Method

In Experiment 1, participants had transcranial magnetic stimulation applied over their dorsolateral prefrontal cortex, disrupting its function, while carrying out tasks involving motor imagery or overt action. Behavioural tasks tested the efficacy of the disruption on various executive functions. Experiment 2 was similar, except that a behavioural interference task (backwards calculation) was added to further impact executive functions.

Results

Disruption of the dorsolateral prefrontal cortex in both experiments affected the timing of motor imagery but not overt actions. Similarly, interfering with executive functions using the backwards calculation task had much greater effects on the timing of motor imagery than on overt actions.

Conclusions

The two experiments conducted here provided strong support for the Motor Cognitive Model over the Functional Equivalence Model, by showing the critical importance of executive functions, subserved by the dorsolateral prefrontal cortex, in motor imagery but not overt actions. Future studies will employ other neuroscientific and behavioural methods to test these theories further.

Keywords

Motor imagery, Executive functions, TMS, Reaching and grasping, Task interference

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