

The value of corticospinal excitability and intracortical inhibition in predicting motor skill improvement driven by action observation

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OBJECTIVES

The observation of other's actions represents an essential element for the acquisition of motor skills [1,2]. While action observation is known to induce changes in the excitability of the motor cortices [3], whether such modulations may explain the amount of motor improvement driven by action observation training (AOT) remains to be addressed.

METHODS

By using transcranial magnetic stimulation (TMS), we first assessed in 41 healthy volunteers the effect of action observation on corticospinal excitability, intracortical inhibition, and transcallosal inhibition. Subsequently, half of the participants (AOT group) were asked to observe and then execute as quickly as possible a right-hand dexterity task, while the control group had to observe a no-action video before practicing the same task.

RESULTS

AOT participants showed greater performance improvement relative to controls (27.67% \pm 6.4 vs. 19.01% \pm 3.1; $t[39] = 5.362$; $p < 0.001$; Cohen's $d = 1.718$). More importantly, the amount of improvement in the AOT group was predicted by the amplitude of corticospinal modulation during action observation ($R^2 = 0.304$, $p < 0.001$) and, even more, by the amount of intracortical inhibition induced by action observation ($R^2 = 0.604$, $p < 0.001$). These relations were specific for the AOT group, while the same patterns were not found in controls.

DISCUSSION AND CONCLUSION

Taken together, our findings demonstrate that the efficacy of AOT in promoting motor learning is rooted in the capacity of action observation to modulate the trainee's motor system excitability, and even more its intracortical inhibition. Our study not only enriches the picture of the neurophysiological effects induced by action observation onto the observer's motor excitability, but linking them to the efficacy of AOT, it also paves the way for the development of models predicting the outcome of training procedures based on the observation of other's actions.

References:

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