Corticospinal activation during observation, imagery and execution of a simple and complex hand-task: a TMS study

Roosink M, Zijdewind I
Department of Medical Physiology, University of Groningen, Groningen

It is known that during observation, imagery and execution (partially) the same brain areas are activated. However, subjects can observe actively (observe to imitate) or passively. We expect that during active observation subjects would activate more execution-related brain areas compared to passive observation. For imagery it is suggested that training effects on motor-tasks are more pronounced when subjects train from a first-person-perspective compared to the third-person-perspective. Therefore, transcranial magnetic stimulation was used to investigate changes in corticospinal activation during passive and active observation, external (third-person-perspective) and internal (first-person-perspective) imagery and execution of a simple and complex hand-task.
Fifteen healthy right-handed subjects participated in the experiment. The optimal stimulation site was located for inducing motor-evoked potentials (MEP) in a hand-muscle. The task consisted of a simple and complex finger sequence. This sequence was repeated ten times in all conditions (passive/active observation, external/internal imagery and execution), subjects were magnetically stimulated every sequence.
A repeated-measurements-analysis with condition (rest, passive/active observation, external/internal imagery and execution) as main factor showed a significant influence on the MEP-amplitude ($F_{(5, 70)}$=48.17; $p<0.001$). Post-hoc analysis revealed significantly lower MEP-amplitudes in the resting condition compared to all other conditions ($p<0.05$ or better). MEP-amplitudes were significantly higher during execution compared to all other conditions ($p<0.001$). Significant larger MEP-values were seen comparing active to passive observation ($p=0.013$). The MEP-amplitude during active observation was also larger than during external imagery ($p=0.045$). No significant difference was found between external and internal imagery or between internal imagery and passive or active observation. Also, no significant effect of task complexity or interaction between complexity or condition was found.
In conclusion, our data showed an increased corticospinal activity during observation, imagery and execution. However, no effect of task complexity could be observed. Interestingly, a larger increase in corticospinal activity was seen during active observation than during imagery conditions.

Meyke Roosink, Department of Medical Physiology, Anton Deusinglaan 1, 9713 AV Groningen, t 050 363 2681, e-mail m.roosink@med.rug.nl

Friday, June 4 2004, Session 47