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Investigating bimanual fine motor training and interhemispheric communication

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Coordinating the movement of both hands is of major importance in everyday life. While the mechanisms underlying unimanual movements are well documented, less is known about mechanisms modulating bimanual coordination. It is generally agreed that the initiation and execution of movement are associated with activation of the contralateral motor cortex (Dassonville, Zhu, Ugurbil, Kim, & Ashe, 1997). However, previous studies have shown that, in addition to the contralateral representation, a co-activation ipsilaterally to the movement is present (Chiou, Wang, Liao, Wu, Lu & Yang, 2013). A structure that is especially important for the execution and coordination of bimanual movement is the corpus callosum, a white matter structure connecting regions of the cortex of both hemispheres, which mediates transcallosal information transfer (Van der Knaap & Van der Ham, 2011). Interhemispheric transfer can have inhibitory and excitatory effects and while interhemispheric inhibition has been investigated in various studies (Morishita, Kubota, Hirano & Funase, 2014; Hinder, Fujiyama & Summers, 2012), less is known about the mediating mechanisms of interhemispheric facilitation.

The present study was designed to investigate interhemispheric facilitation in a simple reaction time task under unimanual and bimanual conditions. EMG data from left and right First Dorsal Interosseous (FDI) will be collected to determine facilitatory effects of homologous preactivation at different Interstimulus-intervals (ISI's). Subjects will be asked to react as quickly as possible to an auditory signal by moving their index finger. In the two bimanual conditions, two auditory signals will be presented at randomized ISI's of 400, 500, 600 and 700ms. Participants will be instructed to move their left index finger as fast as possible to the first and their right index finger to the second signal in one of the two sets of trials, reversing this pattern in the other set. The unimanual conditions, each consisting of 20 single trials, performed with either the left or right index finger, will serve as baseline EMG measurement. Of special interest are the differences in reaction time between first and second responses in the two bimanual conditions.

We hypothesize that, in the unimanual (baseline) conditions, reaction times are shorter for movements made with the dominant hand than those made with the non-dominant hand. However, we expect a facilitatory effect on the second response in the two bimanual conditions, due to co-activation of homologous muscles.

References

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