MOTOR IMAGERY OF SPEECH: THE INVOLVEMENT OF PRIMARY MOTOR CORTEX IN MANUAL AND ARTICULATORY MOTOR IMAGERY

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Background: The grant aimed to elucidate the neural network supporting motor imagery in speech production. We will specifically focus on the roles of primary motor cortex and supplementary motor area in motor imagery of articulation of syllable sequences. Motor imagery is thought to involve motor cortex activation without effecting muscle movement. Research in this area focuses primarily on hand actions in the context of rehabilitation. However, people also regularly engage in other types of imagery, such as speech imagery, yet this orofacial imagery has not received as much attention, though it may play a critical role in speech development, disorders, and rehabilitation.

Aims: In this study, we investigated the activation of lip and hand motor cortex by testing whether motor-evoked potentials (MEPs) of lip motor cortex are facilitated during motor imagery of simple tasks and sub-phonemic speech. This finding would implicate the involvement of motor cortex in the process of not only motor execution, but also motor imagery of speech.

Method: Twenty participants were asked to execute or imagine performing a simple squeezing task involving a pair of tweezers, which was comparable across both effectors. MEPs were elicited at six time points (50, 150, 250, 350, 450, 550 ms post-stimulus) to track the time course of M1 involvement in both tasks. Electromyography was conducted throughout the experiment and participants underwent 18 blocks of 25 trials, accounting for 30 trials per timepoint, per prompt. The experiment lasted 2 hours.

Results The results showed increased MEP amplitudes for action execution compared to baseline for both effectors at time points 350, 450 and 550ms. However, we found no evidence of increased cortical facilitation during motor imagery of the same task compared to baseline for the hand or lip results.

Conclusions: The results indicate that motor imagery does not involve M1 for simple tasks for manual or articulatory muscles, contrary to previous literature and our expectations. The results have implications for models of motor imagery of simple gestures, articulatory or otherwise, in that no evidence is found for somatotopic activation of lip and hand muscles in sub-phonemic contexts during motor imagery of such tasks, suggesting that motor simulation of relatively simple actions does not involve M1. We are now examining the role of M1 in more complex speech actions, such as complex consonant clusters.

Keywords: Motor imagery, TMS, MEP, Speech imagery

Publications:

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