

# Effect of Hand and Lip Contraction on Motor-Evoked Potentials of the First Dorsal Interosseous Muscle

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## Research Question

Does contraction of the lip muscle influence the peak-to-peak amplitude of motor-evoked potentials (MEPs) generated through external stimulation of the first dorsal interosseous (FDI) muscle?

## Introduction

### Lip and Hand Movement Connection

Previous studies have suggested that evolutionarily, there is a connection between brain regions that control lip and tongue movements and those that manipulate hand movements [1]. In this study, we used transcranial magnetic stimulation (TMS), a form of non-invasive brain stimulation, to examine the relationship between the lip and hand motor regions in the brain.

### Active vs. Resting MEPs

Studies have shown that cortical excitability increases during active muscle contraction [2]. This is evident from increases in MEPs during muscle contraction (active MEPs) compared to MEPs of a relaxed muscle (resting MEPs). We hypothesized that the contraction of both the lip and hand muscles will impact the amplitude of the MEPs generated in the hand.

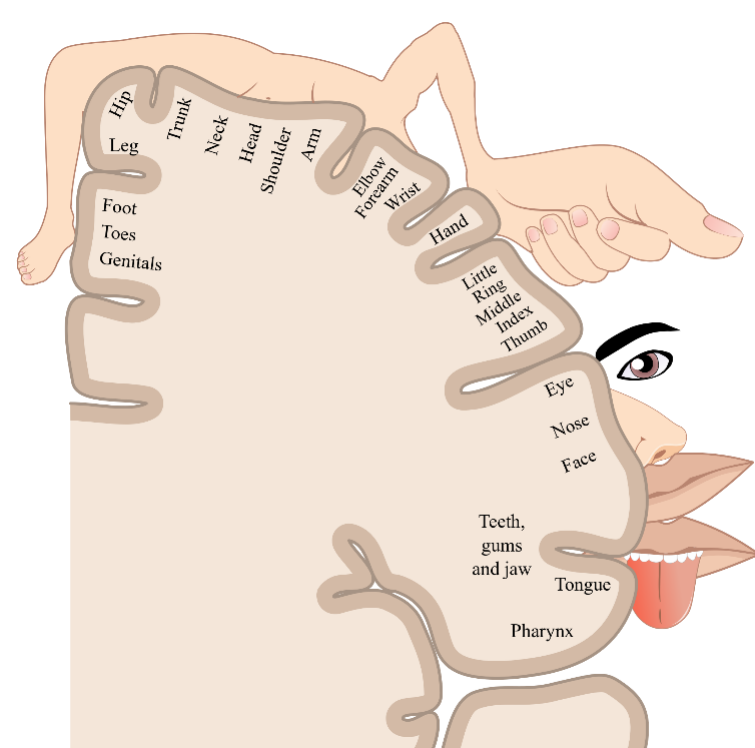


Fig. 1. Cerebral Cortex

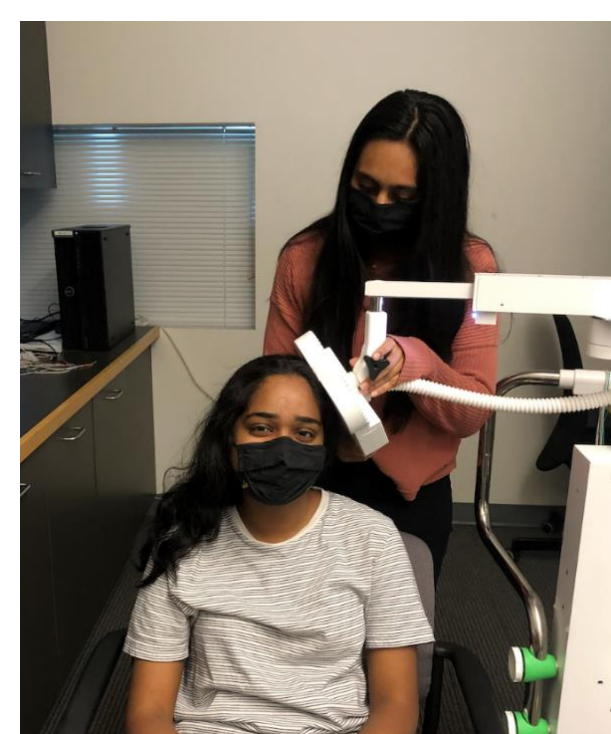


Fig. 2. TMS Machine

Targeting the first dorsal interosseous muscle



Fig. 3. EMG electrode placement for FDI muscle

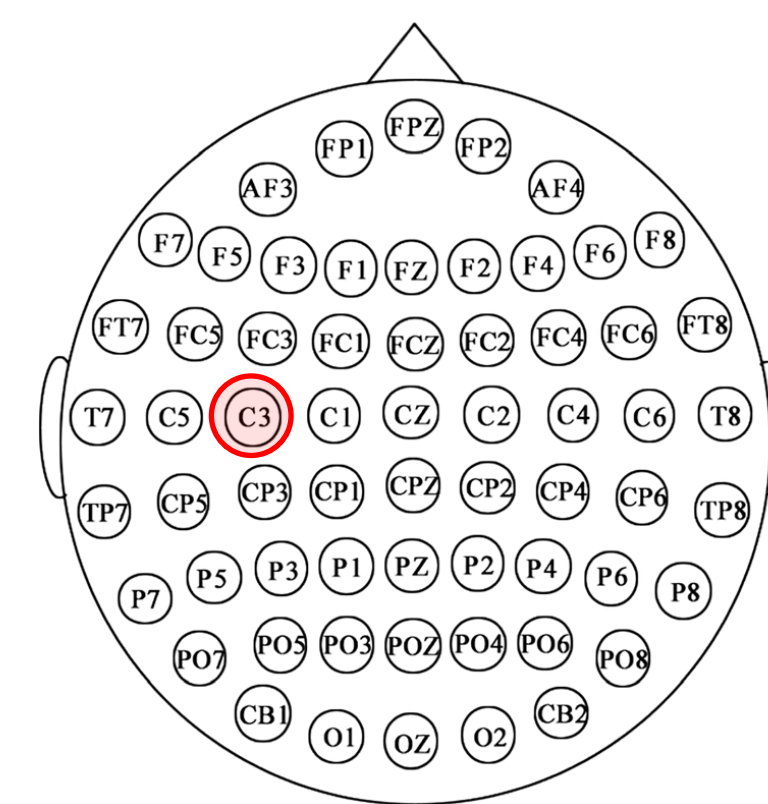


Fig. 4. Electrode cap locations highlighting C3 electrode

## Methodology

- For this study, we had a total of 4 healthy adults.
- Electrodes placed on the subject's first dorsal interosseous muscle
- TMS coil placed at C3 electrode and location and intensity were adjusted until the "hot spot" was found
- The following tasks performed in randomized order:

### Tasks

- 1 Finger and Lip Relaxation (FRLR)
- 2 Finger Relaxation and Lip Contraction (FRLC)
- 3 Finger Contraction and Lip Relaxation (FCLR)
- 4 Finger and Lip Contraction (FCLC)

- For each task, pulses were applied in intensities from 50%-90% and then 90%-50%, both in increments of 10% with 5 repetitions at each intensity
- The MEP peak to peak amplitude was compared between tasks, subjects, and intensity variations

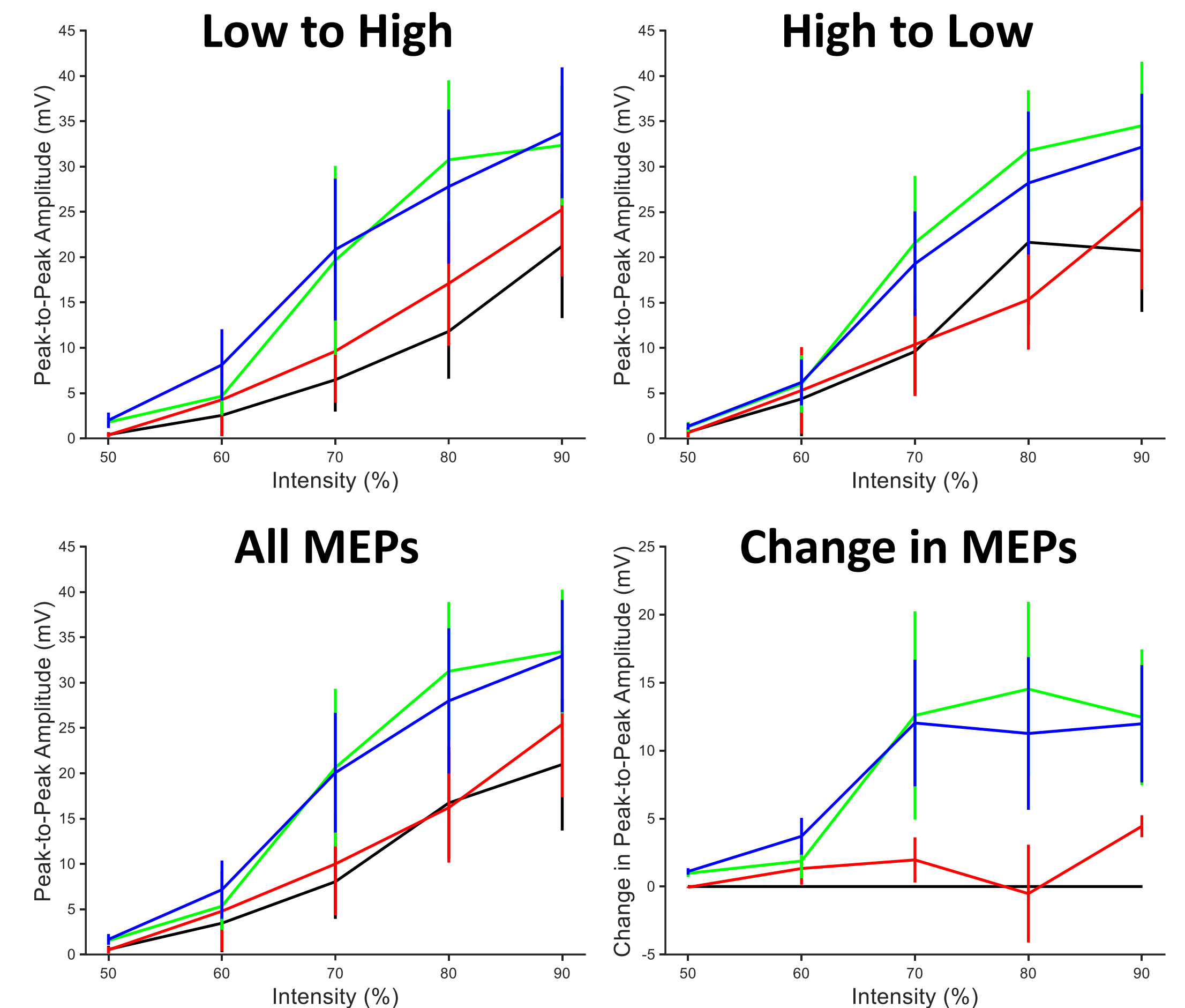
## Results

### Finger and Lip Relaxation (FRLR)

Finger Relaxation and Lip Contraction (FRLC)

Finger Contraction and Lip Relaxation (FCLR)

Finger and Lip Contraction (FCLC)



## Conclusion and Future Work

Currently, this study is ongoing. Our preliminary results indicate that lip contraction may increase resting MEPs of the hand muscle but does not influence the active MEPs of the hand muscle. Future work includes observing the effect of hand muscle activation on lip MEPs and observing the spread of hand and lip activation over the cortex at various intensities.



# Grand Challenges Scholars Program

### References:

- [1] Vainio, Lari. "Connection between Movements of Mouth and Hand: Perspectives on Development and Evolution of Speech." *Neuroscience & Biobehavioral Reviews*
- [2] Möttönen, Riikka, et al. "Stimulating the Lip Motor Cortex with Transcranial Magnetic Stimulation." *Journal of Visualized Experiments : JoVE*, MyJoVE Corporation, 14 June 2014

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