

# Effects of Brain Stimulation on Cortical Excitability in Healthy Adults: A Validation Study



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## INTRODUCTION

Older adults usually demonstrate larger motor variability than younger adults, which can affect their ability to perform everyday tasks and learn new skills [1]. We have proposed a non-invasive transcranial direct current stimulation (tDCS) technique to reduce motor variability in older adults. We will measure the effects of tDCS on the brain using transcranial magnetic stimulation (TMS).

Here, we present findings pertaining to the validation of the effects of tDCS and TMS techniques on cortical excitability in healthy adults.

First, we validated whether TMS delivered with varying inter-stimulus intervals can be used to assess changes in intracortical inhibition and facilitation (Experiment 1).

Second, we validated the effects of different stimulation electrode distances and different stimulus parameters for tDCS on cortical excitability assessed using TMS (Experimental 2).

## METHODS

For validation experiments, we have recruited 8 healthy young adults with no history of neurological and musculoskeletal disorders.

**Experiment 1:** Five healthy young adults received TMS pulses over the brain with varying inter-stimulus interval (ISI).

To assess intracortical inhibition:

ISI = 1, 2, and 5 ms.

To assess intracortical facilitation:

ISI = 8, 10, 12, and 15 ms.

**Experiment 2,** Three healthy young adult participated in one to three sessions.

Interelectrode distance (IED):

3.5 cm and 7 cm.

Stimulus parameters:

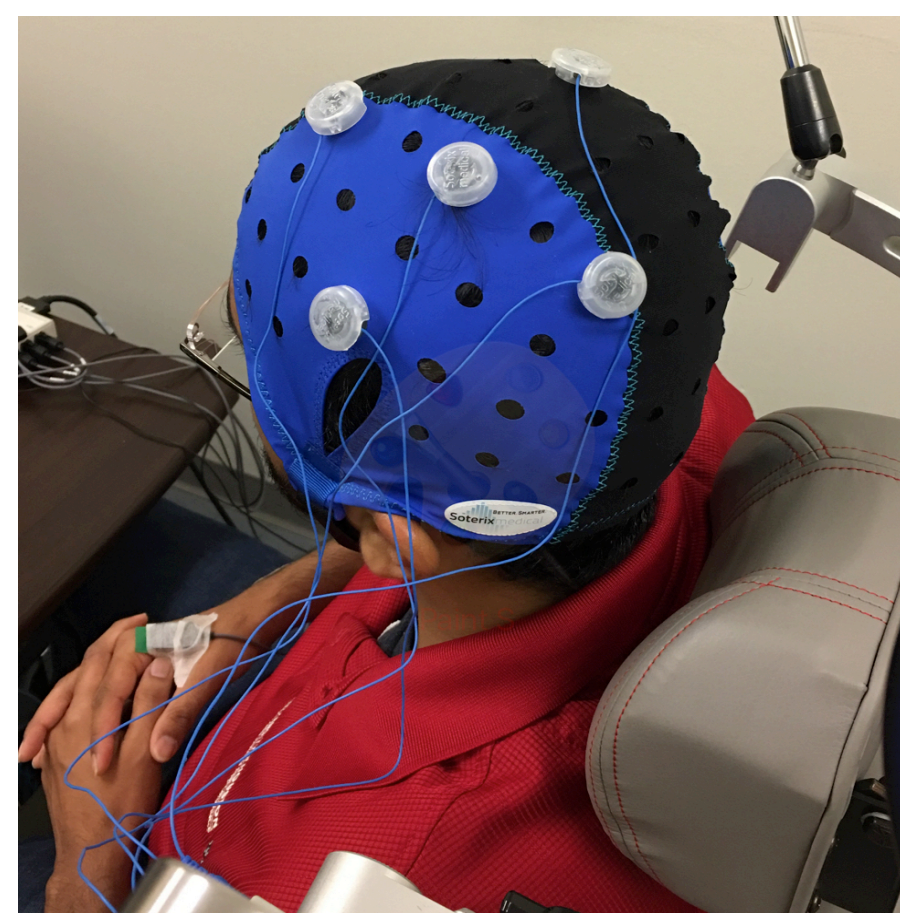
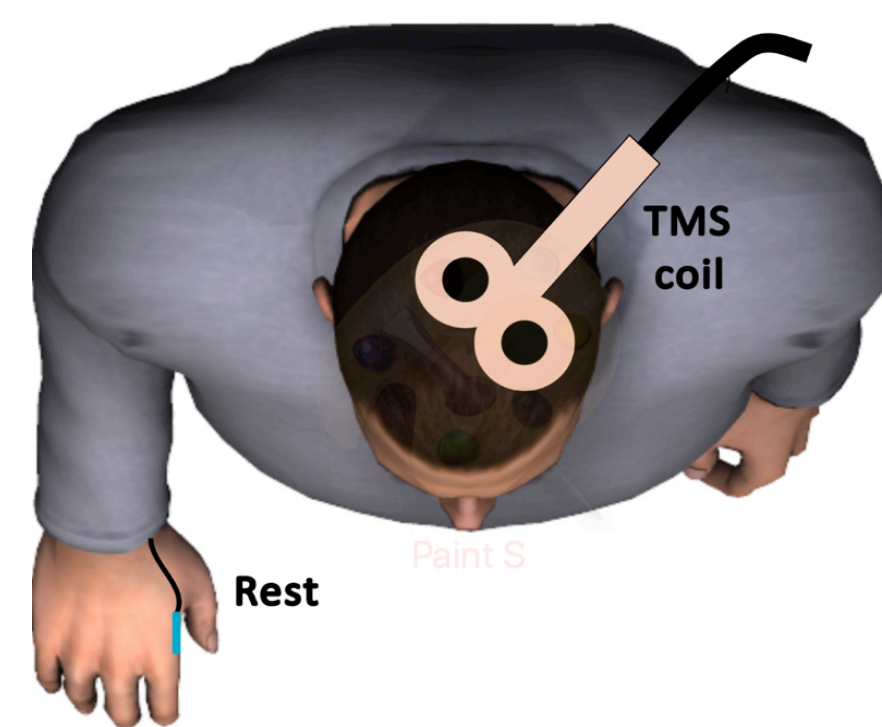
2 mA for 20 min and

2 mA for 10 min.

Dependent variables [2]:

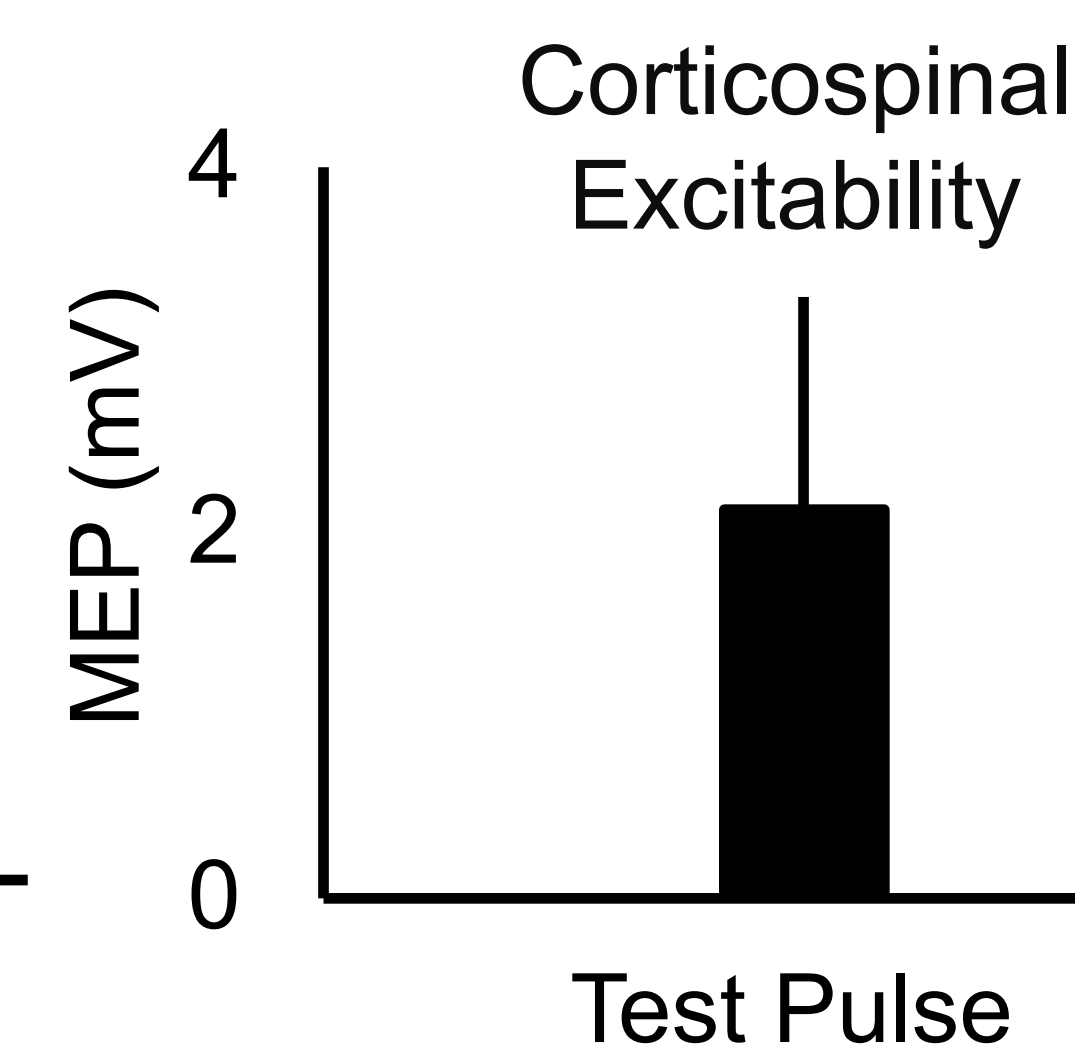
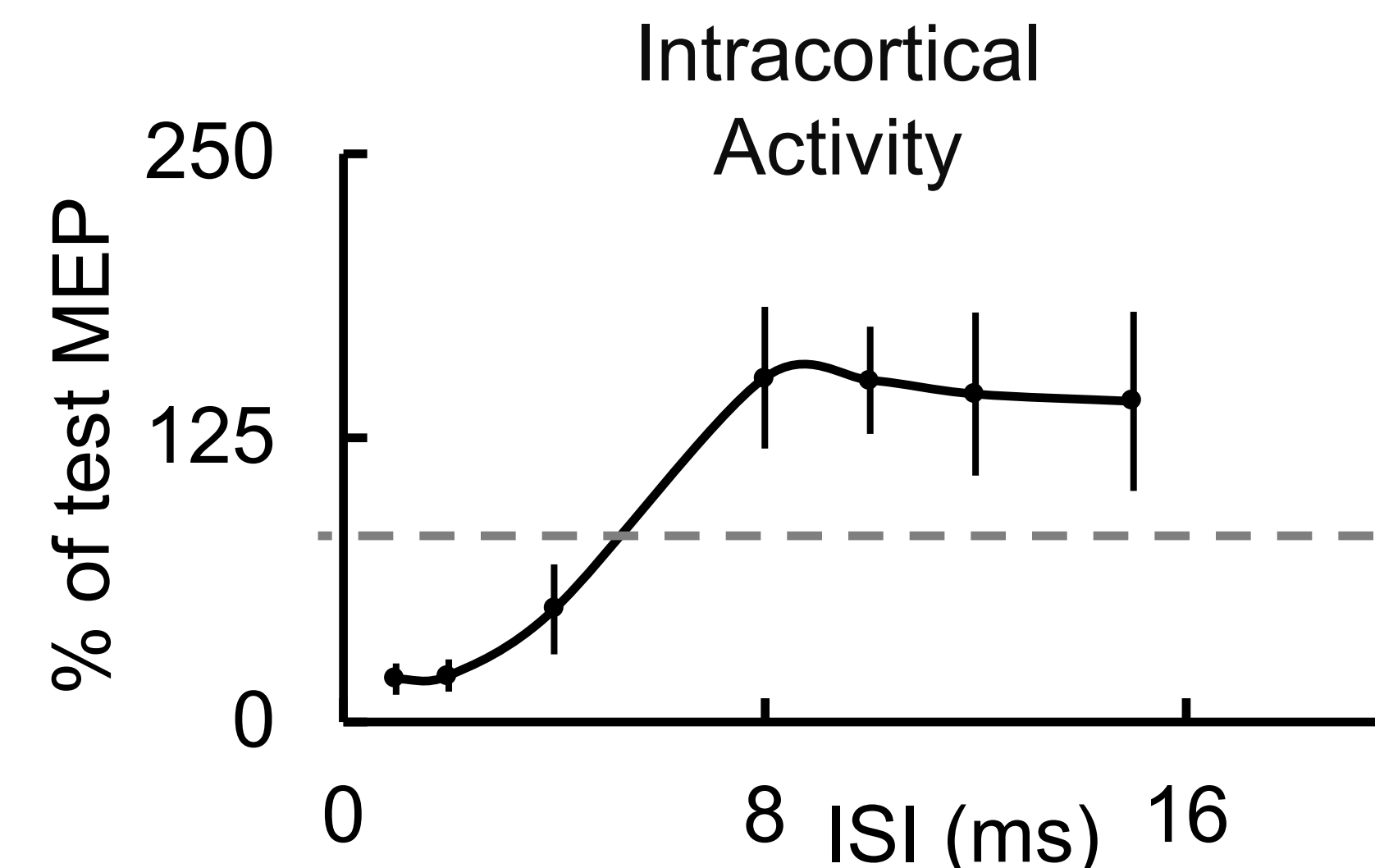
*Corticospinal excitability* = Motor evoked potential (MEP) size (single pulse TMS).

*Intracortical inhibition (SICI) and intracortical facilitation (ICF)* = % change in MEP due to a conditioning TMS pulse (paired-pulse TMS).



### Exp. 1

## RESULTS

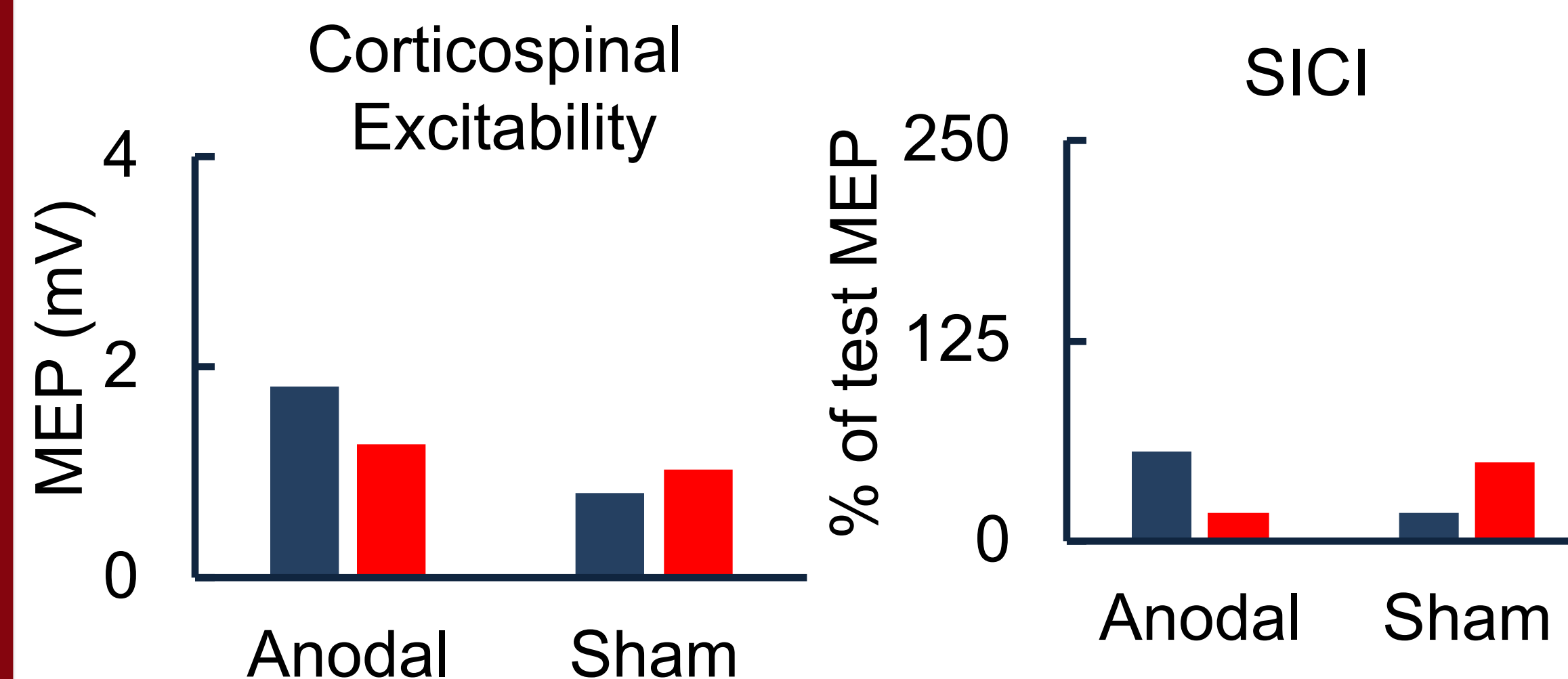


### Paired-pulse TMS with varying ISI (n=5)

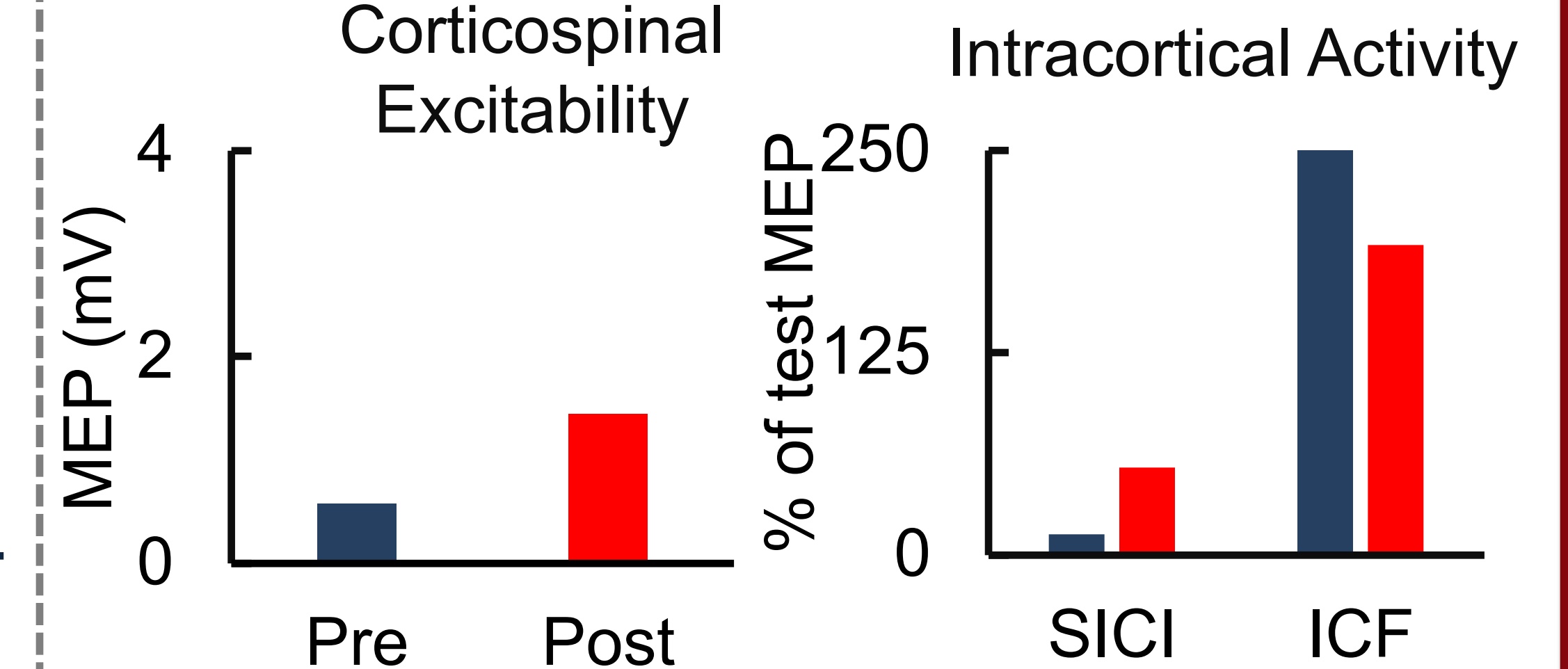
- ISIs of 1, 2, and 5 ms showed intracortical inhibition.
- ISIs of 8, 10, 12, and 15 ms showed intracortical facilitation.

### Exp. 2

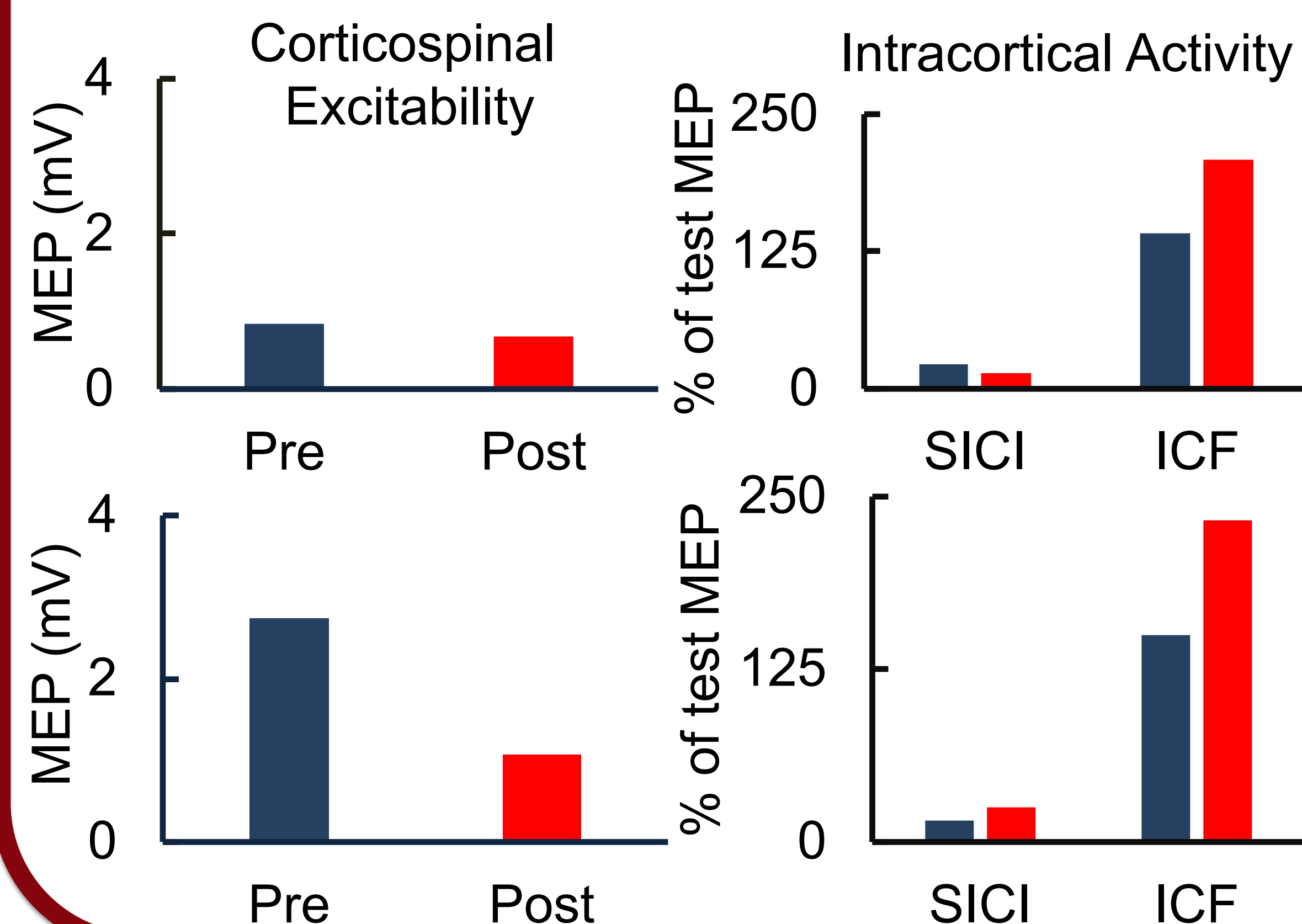
#### 7 cm IED, 2 mA tDCS for 20 minutes (n=1)



#### 3.5 cm IED, 2 mA tDCS for 10 minutes (n=1)



#### 3.5 cm IED, 2 mA tDCS for 20 minutes (n=2)



- **Earlier studies have shown that anodal tDCS increases cortical excitability [3].** That is an increase in corticospinal excitability (CSE), a reduction in intracortical inhibition (SICI) and an increase in intracortical facilitation.
- **3.5 cm IED, 2 mA for 10 min:** Anodal tDCS increased CSE and reduced SICI and ICF. We are currently recruiting more participants in this group.
- **7 cm IED, 2 mA for 20 min:** A decrease in CSE following anodal than sham tDCS. SICI showed an opposite trend.
- **3.5 cm IED, 2 mA for 20 min:** Subject 1 showed an increase in ICF but no change in CSE (MEP size) and SICI. Subject 2 showed an increase in ICF but a decrease in CSE (MEP size) and SICI.

## DISCUSSION

- TMS: Paired-pulse ISI of 2 and 10 ms are the most optimal ISIs for eliciting SICI and ICF, respectively.
- tDCS: 2 mA for 10 min with 3.5 IED is more effective in modulating the brain's excitability than the other tested protocols.
- After validating tDCS and TMS protocols on a few more subjects, we will conduct the main project.

## REFERENCES

- [1] Enoka et al. 2000. JEK.
- [2] Parikh et al. 2014. JNP
- [3] Nitsche et al. 2000. JP.

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