Focality of the Excitatory and Inhibitory ppTMS phenomena

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Introduction

Paired pulse transcranial magnetic stimulation (ppTMS) is used for evaluating cortical excitatory and inhibitory processes.[1]

In this study we investigated: 1) whether a given ppTMS phenomenon evokes a similar modulation of the motor output in different upper limb muscles and 2) whether different ppTMS phenomena lead to a similar variability in a given muscle.

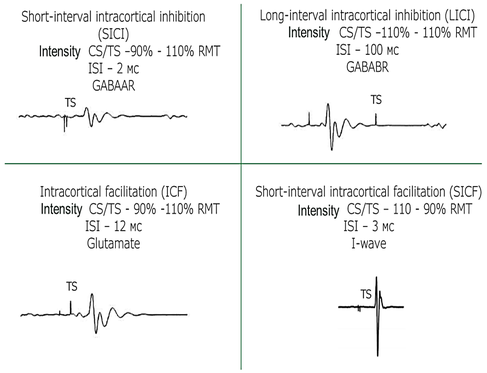


Figure 1. Studied ppTMS phenomena

Methods

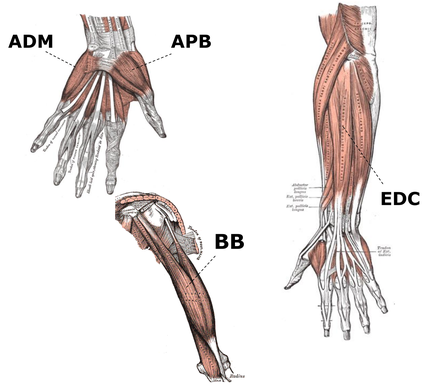
Participants: 24 healthy right-handed volunteers 19-34 y.o

12 males **12 females**

Procedure:

- MRI-navigated TMS applied to the **abductor pollicis brevis (APB)** hotspot in the left primary motor cortex
- Motor evoked potentials (MEPs) were recorded from the right upper limb muscles:
  - **Abductor pollicis brevis** (**APB)**
  - **Extensor digitorum communis (EDC)**
  - **Abductor digiti minimi (ADM)**
  - **Biceps brachii (BB)**

The following ppTMS protocols were applied in 15x3 trains in pseudo-random order and normalized to the results of a single pulse stimulation.



Results

Average ppTMS values are shown in the figure 2.

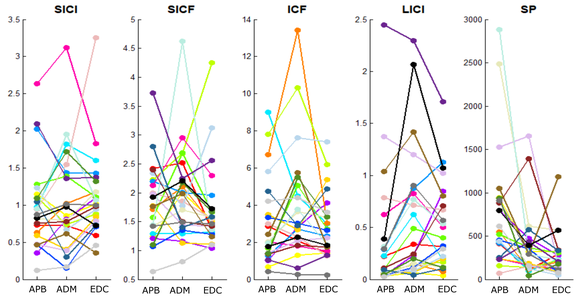


Figure 2. Individual participants values for each ppTMS phenomena and spTMS sessions

A common variability PCA factor was significantly different among all the ppTMS phenomena, showing that the largest explained variability among muscles was observed for LICI (88.0 %) and the smallest - for SICF (54.8 %). The differences among all ppTMS phenomena were significant.

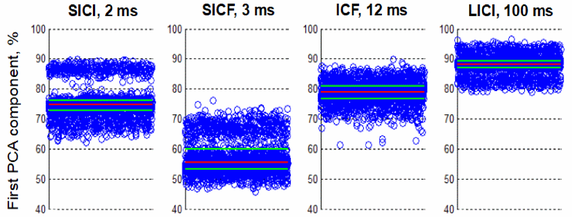


Figure 3. PCA first component size among muscles for different ppTMS phenomena. Arbitrary combinations (blue dots) of 19 from 24 subjects. Red line – median, green lines – 1st and 2nd quartiles.

Conclusion

We demonstrate that the strength of ppTMS phenomena correlates across different upper limb muscles, but the size of such shared variance is different for every ppTMS phenomenon. Interestingly, the length of the interstimulus interval (ISI) was not the main discriminative factor. Having ISI very similar to SICI`s, SICF has much smaller first PCA component, indicating that it is a more topographically specific phenomenon. It may be due to the fact that SICF is possibly mediated by I-wave facilitation on a pyramidal neuron [2]. SICF phenomenon should be further investigated for the development of more functionally focal TMS approaches.

References

1. U. Ziemann et al., "TMS and drugs revisited 2014," Clin. Neurophysiol, 2015.
2. M. A. J. Van den Bos, P. Menon, J. Howells, N. Geevasinga, M. C. Kiernan, and S. Vucic, "Physiological processes underlying short interval intracortical facilitation in the human motor cortex," Front. Neurosci., 2018.

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