Excitatory offline effects of 5Hz-rTUS (tbTUS) fail to replicate: a double-blind study

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INTRODUCTION

Plasticity inducing TUS protocols are particularly promising for **clinical interventions**. Zeng and colleagues (2022) demonstrated strong **offline excitatory effects of 5Hz-rTUS (tbTUS)** on the primary **motor cortex**. These results have been reproduced several times by the same research group[8,9,10,11,12]. This **preregistered** study is a **double-blind, neuronavigated, independent replication**.

We novelly assess **targeting accuracy** when positioning TUS based on **TMS motor hotspot**, as implemented in most TUS-TMS studies.

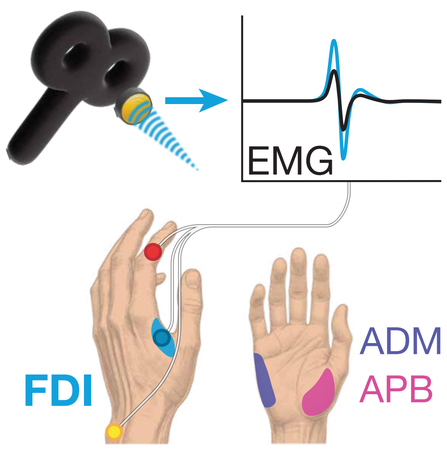
[8]Oghli et al., 2024, *BrainStim*; [9]Grippe et al., 2024, *Mov Disord*; [10]Zeng et al., 2024, *BrainStim*; [11]Xia et al., 2024, *J Physiol*; [12]Samuel et al., 2022, *BrainStim*

CONCLUSION

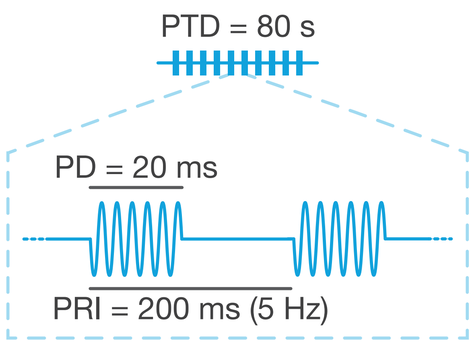
We find **no significant effects** of 5Hz-rTUS (tbTUS) on **corticospinal** or **intracortical excitability** over the target FDI, or the APB and ADM. We show that **the same TMS-based TUS targeting approach as prior work does not reliably engage M1**.
However, even with **accurate targeting**, there were **still no significant effects**.
In another independent study with **anatomical TUS targeting[12]**, there were also no excitatory effects (inhibitory instead). The two primary differences in the present replication - **TMS neuronavigation** and **double blinding** - should be used in addition to targeting to facilitate inter-lab replicability.

[12]Bao et al., 2024, *J Physiol*

TUS-TMS paradigm



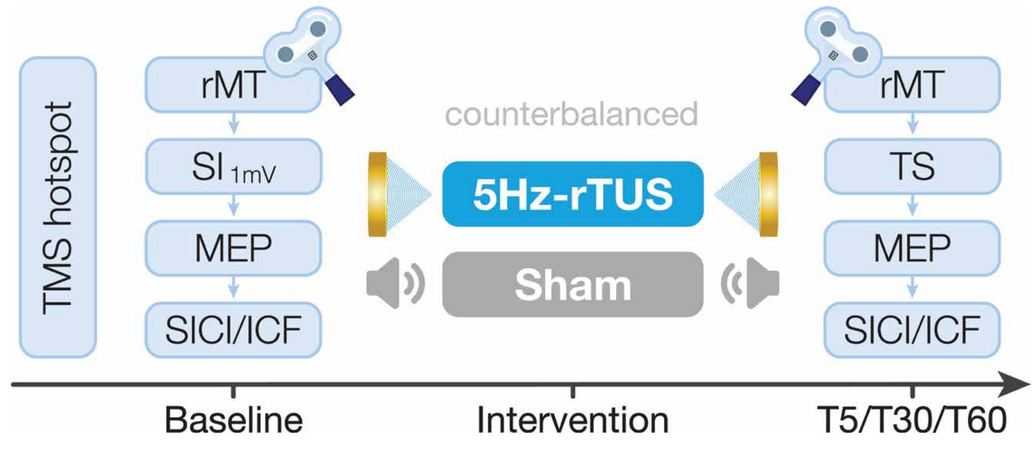
5Hz-rTUS (tbTUS)



I_{sppa_fw} = 10 W/cm^2

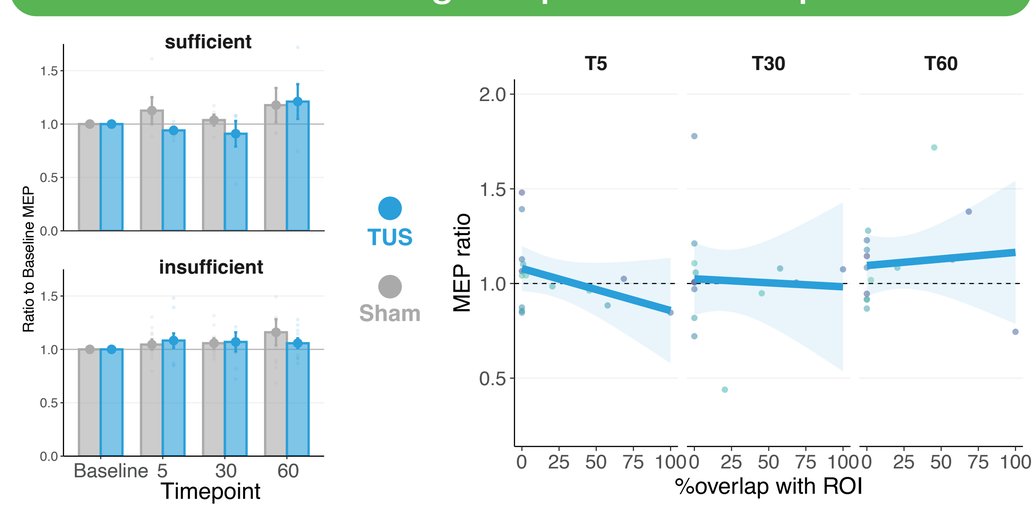
I_{spta_fw} = I_{sppa_fw}*DC (10%) = 1 W/cm^2

Study Procedure

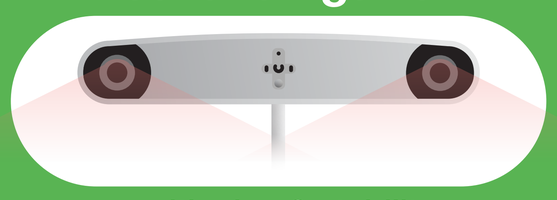


Offline motor excitatory effects do not replicate

Also not when target exposure is acceptable

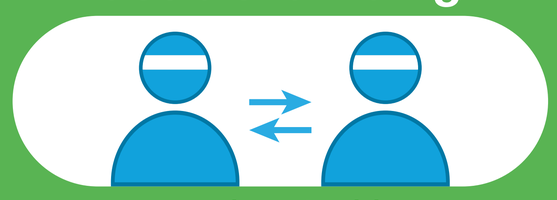


neuronavigation



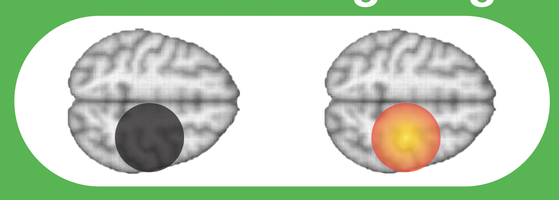
positioning & stability

double-blinding



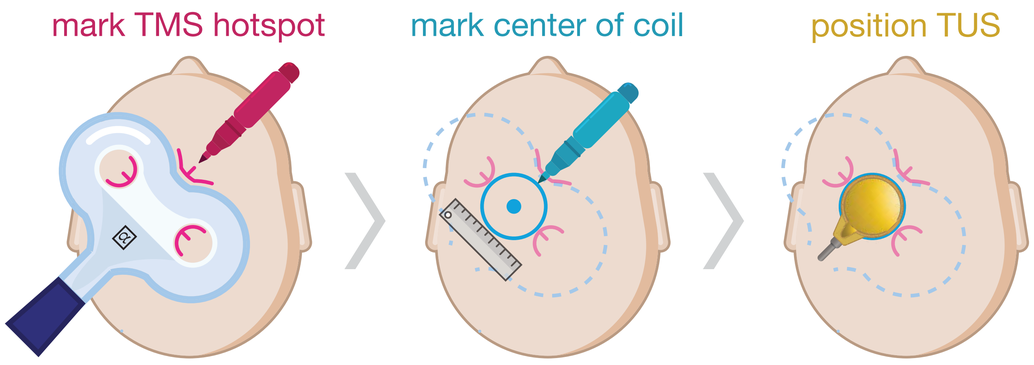
experimenter bias

informed targeting

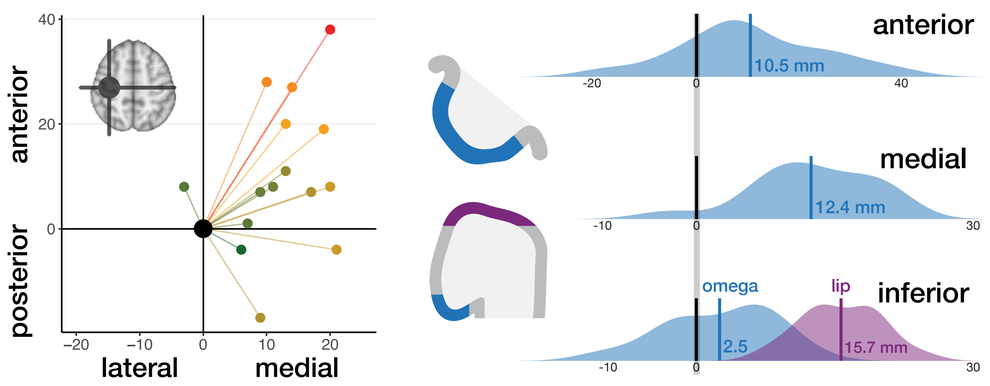


target exposure

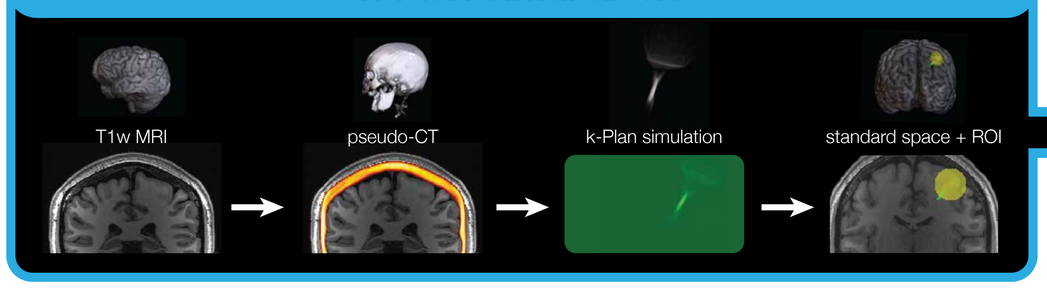
Replicated TMS motor hotspot based targeting



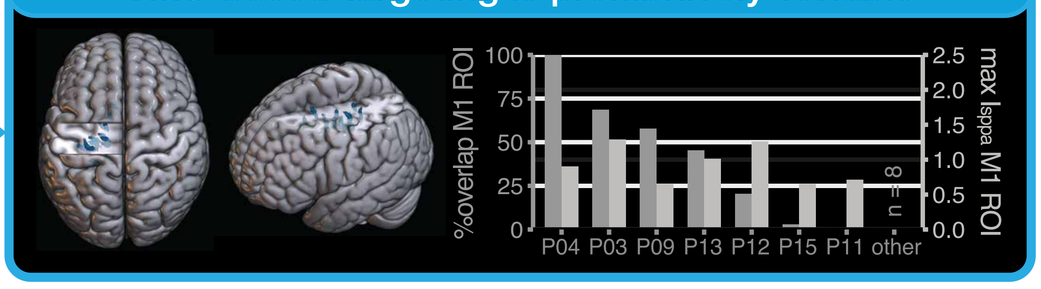
TMS motor hotspot targeting ➔ anteromedial shift



k-Plan simulations



TMS-based targeting is prohibitively variable



preregistration

poster pdf

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