

# Comparing 10Hz and theta-burst stimulation protocols for treatment-resistant depression using DLPFC TMS-fMRI

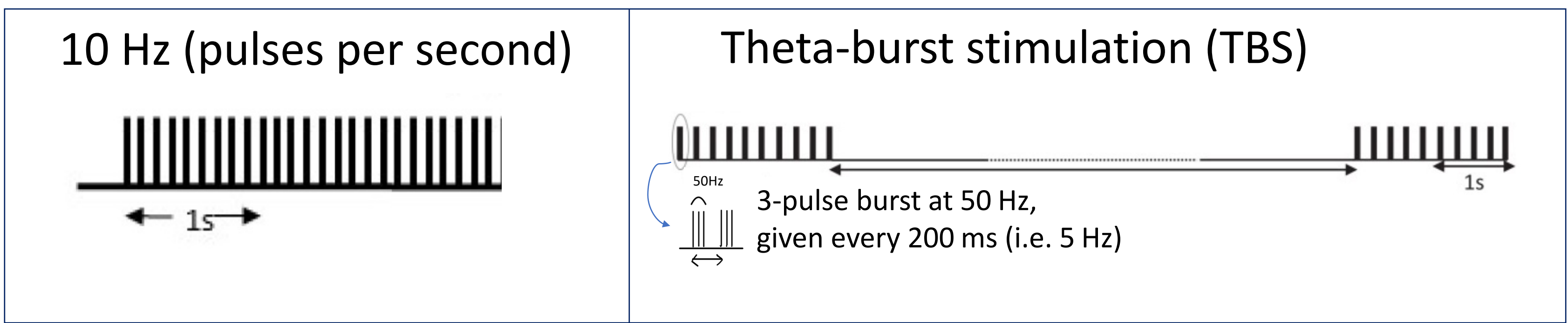
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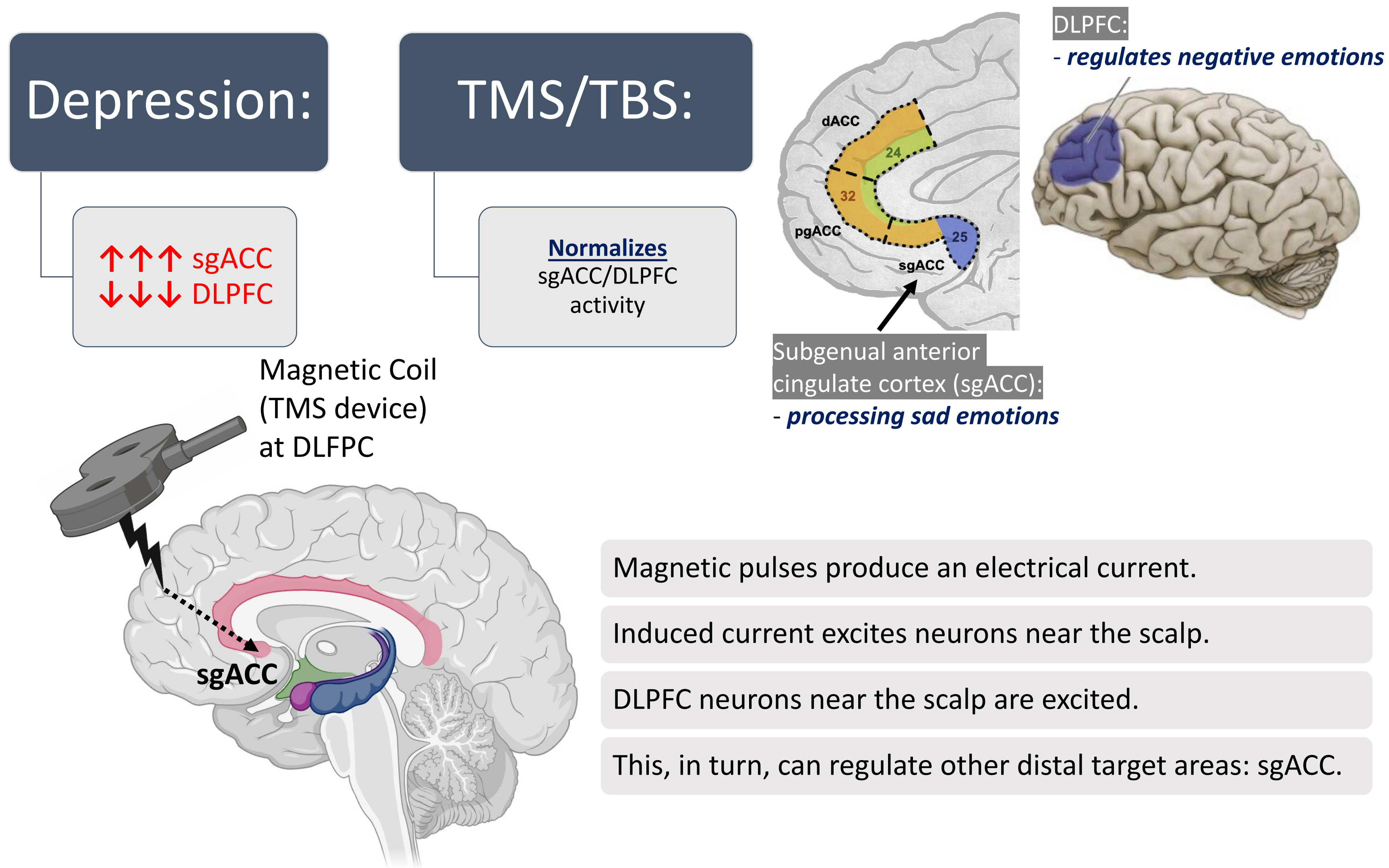


## Treatment-resistant depression

- Antidepressant drugs and psychotherapy do **NOT** work for more than **1/3<sup>rd</sup>** of depressed patients.
- Alternatives are to **stimulate the left dorsolateral prefrontal cortex (DLPFC)** using **magnetic pulses** in two ways:
  - **10 Hz repetitive transcranial stimulation (rTMS)**
  - **intermittent theta-burst stimulation (iTBS)**

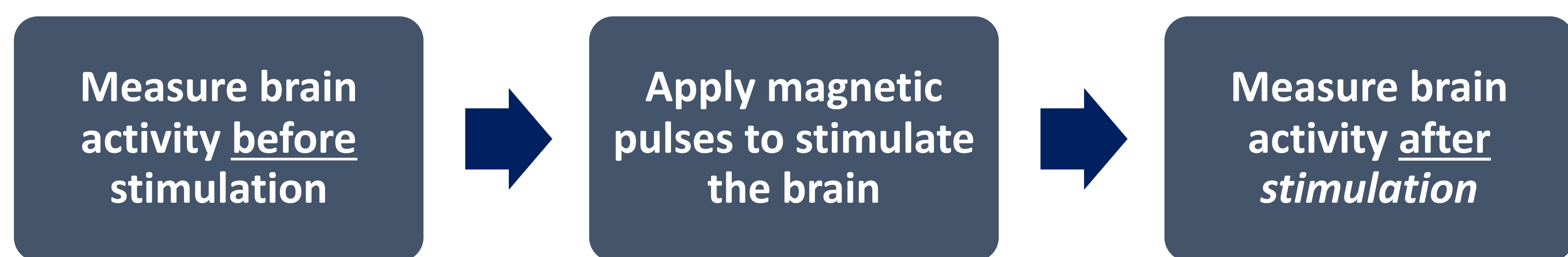


## Hypothesized mechanisms of how rTMS/iTBS help depression



## Research gap: Finding causal proof of target engagement

### Previous research methodology



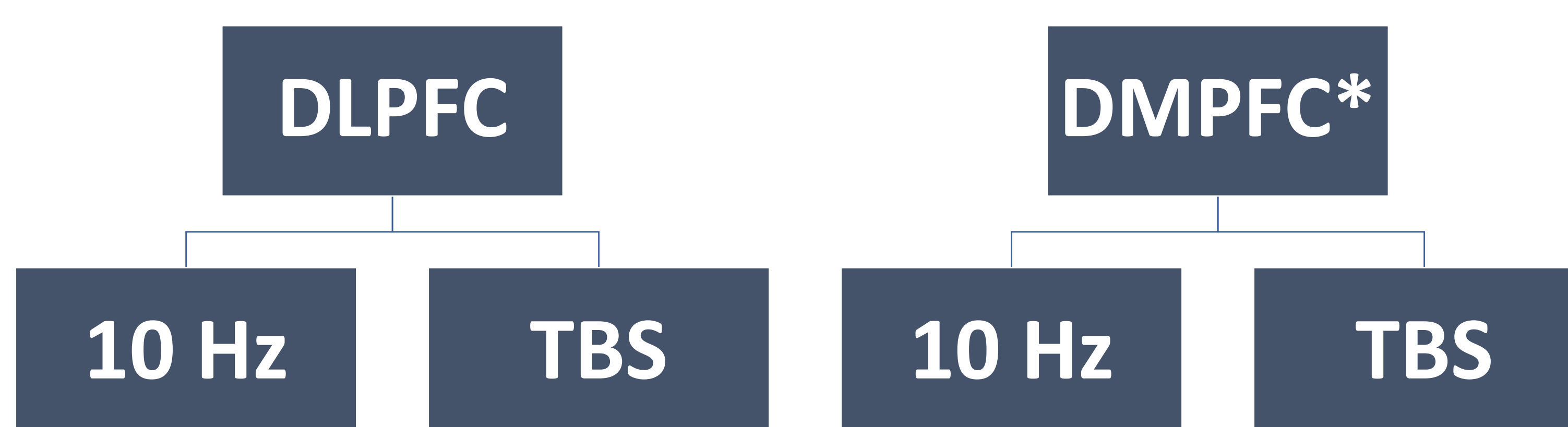
The above method is NOT direct and immediate.

How do we know that left DLPFC stimulation **causally** induces activity in the sgACC?

We need to measure brain activation WHILE stimulating the brain.

Limited research used "interleaved TMS-fMRI" to establish causal proof.

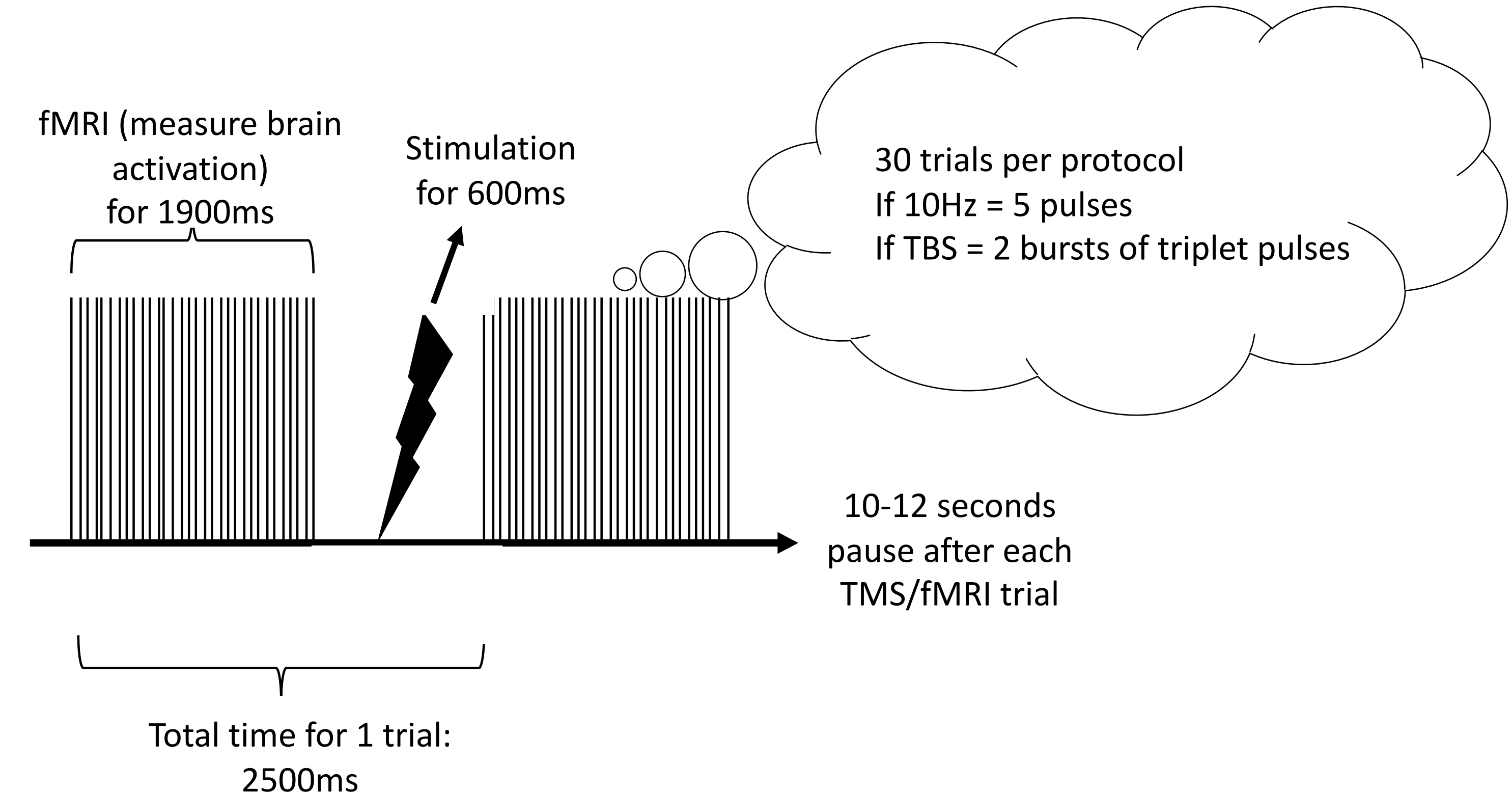
## Study design and research questions



**Note: Each participant completed 4 protocols**  
\* **DMPFC (dorsomedial prefrontal cortex) stimulation is an active control**

- RQ 1:** Are there any differences in whole-brain TMS-evoked activity between DLPFC and DMPFC (active control) stimulation?
- RQ 2:** Are there any differences in whole-brain TMS-evoked activity between DLPFC 10Hz and TBS?
- Hypothesis:** Greater sgACC deactivation in DLPFC > DMPFC protocols

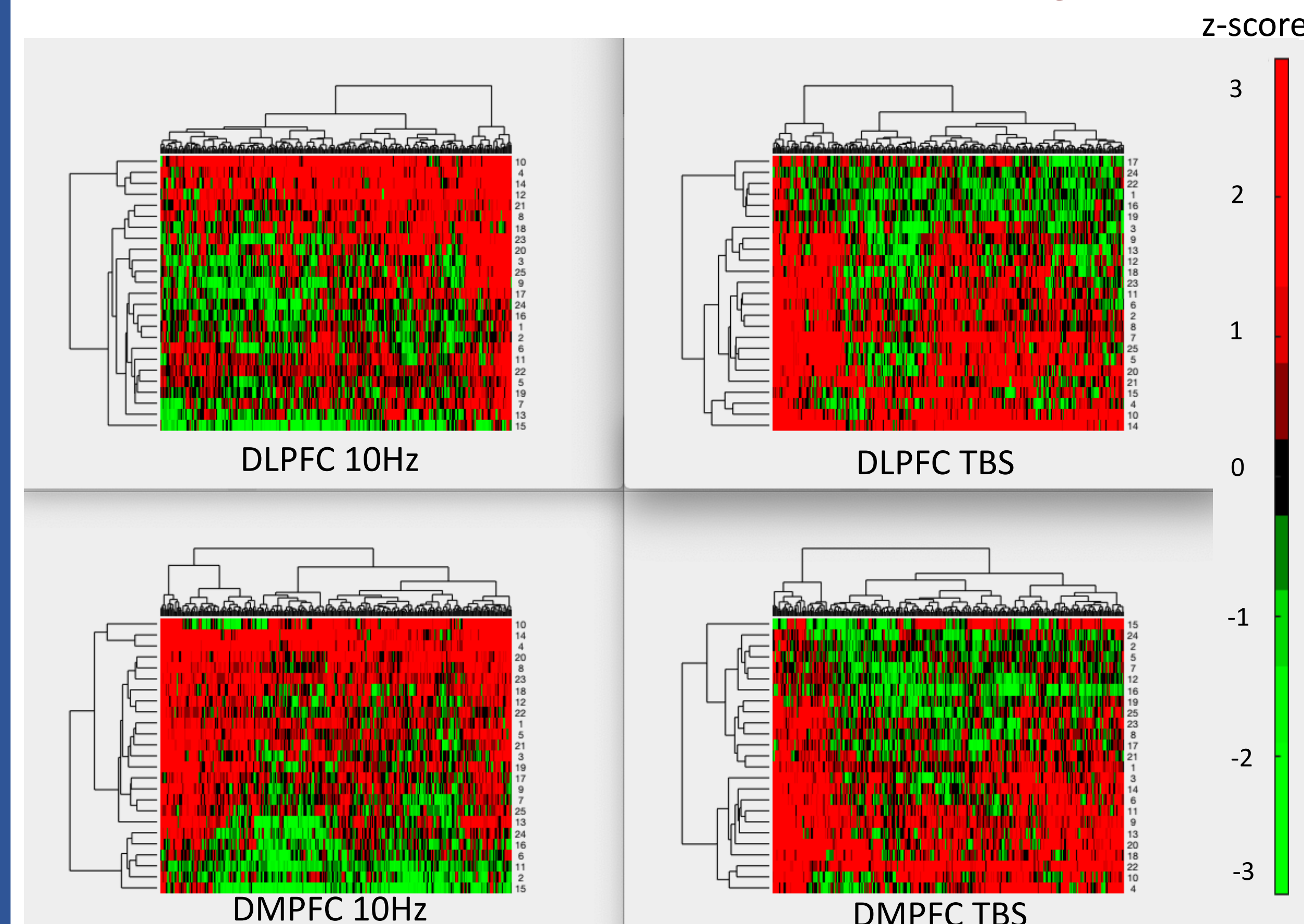
## Interleaved TMS-fMRI



## Statistical analysis

- 2 Independent variables: site of stimulation & stimulation protocol
- Dependent variable: brain activity from fMRI
- Repeated-measures ANOVA: Site x Protocol
- Do stimulation sites and/or protocols affect brain activity, and how?

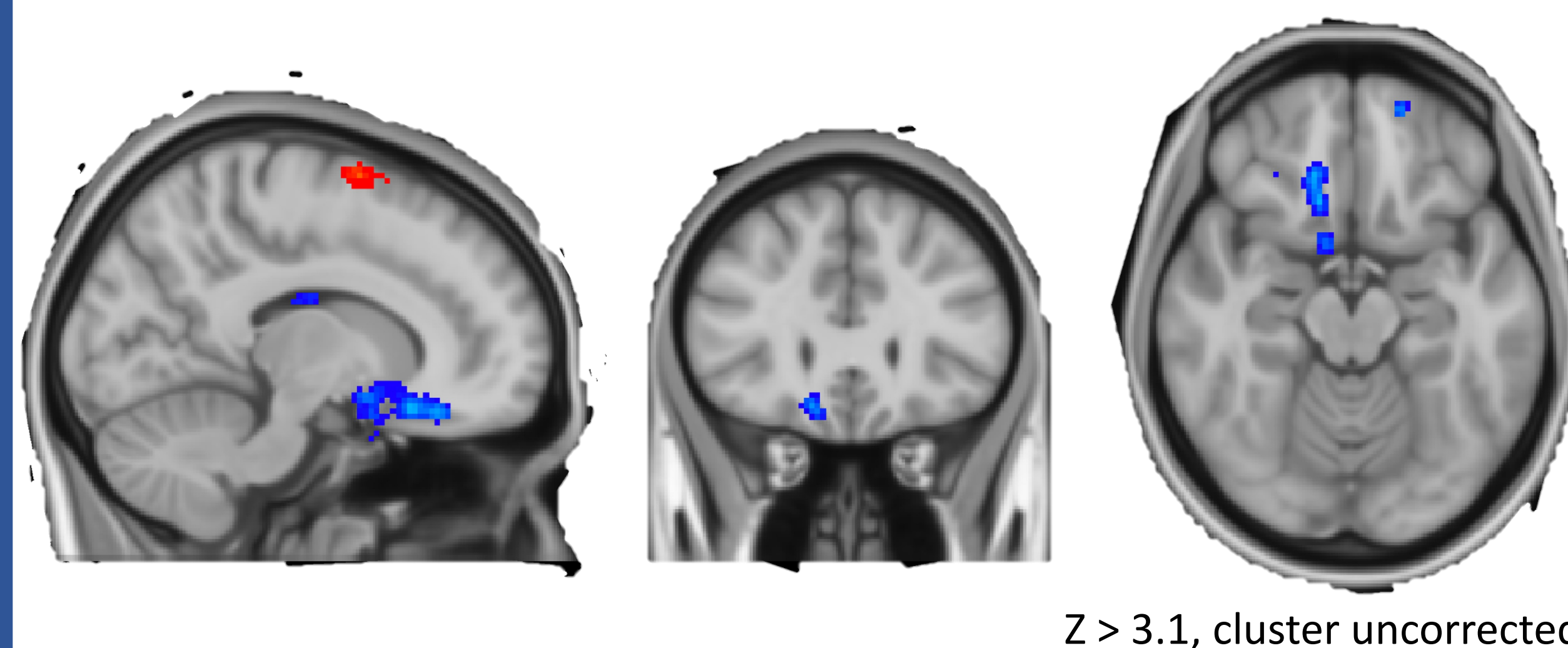
## Results: Lots of individual variability



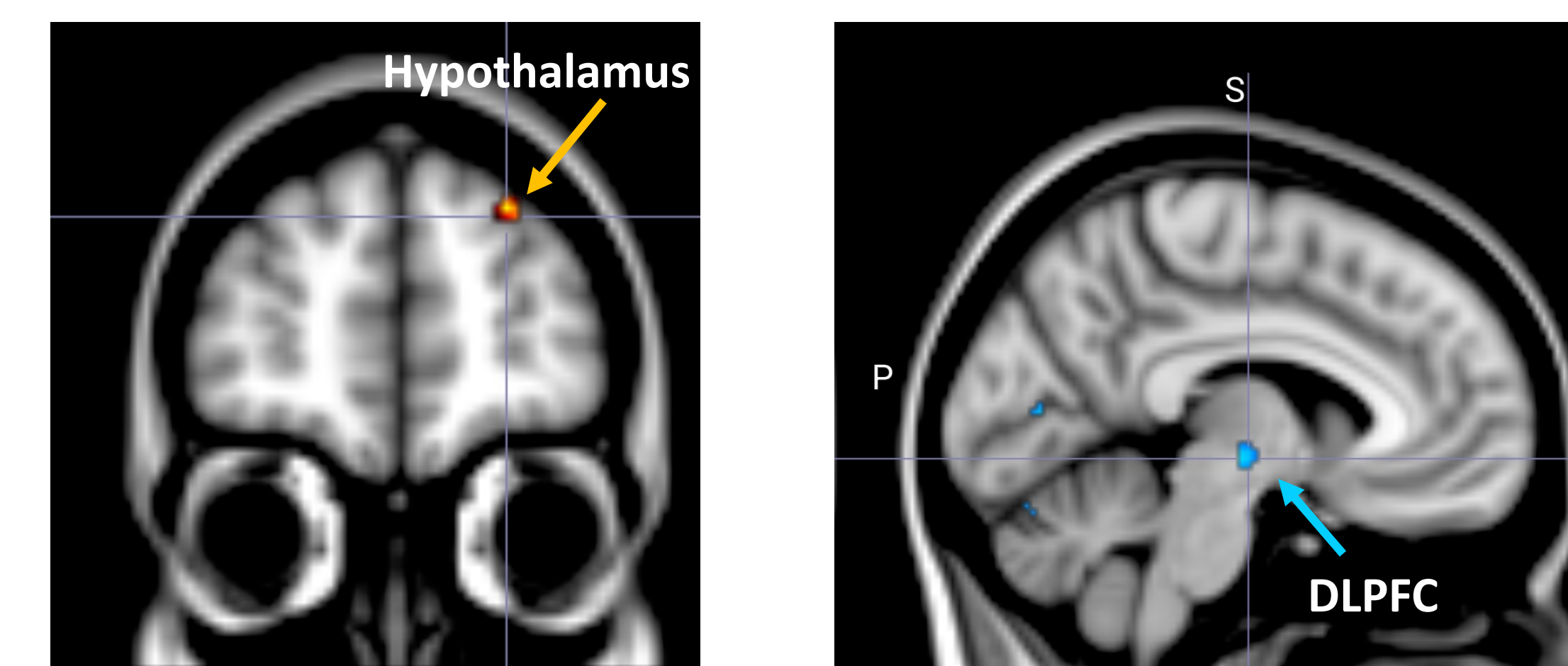
The above picture is a dendrogram heatmap cluster. Participants **cluster differently** to each TMS/fMRI condition. Each row = participant. Each column = brain activity for each brain area.

## Results: Group-level differences

**1. Greater sgACC deactivation in DLPFC > DMPFC, regardless of stimulation protocol**



**2. Significant difference in the DLPFC and hypothalamus activation for DLPFC 10 Hz > DLPFC TBS**



## Summary

1. DLPFC and DMPFC stimulation might differentially engage sgACC.
2. 10Hz and TBS might differentially engage DLPFC and hypothalamus.
3. Scalp navigation → heterogeneity in TMS-evoked brain activity.