Brain responses in language production following disruption of the left MTG

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INTRODUCTION

- Language function often impaired following left-hemispheric lesions
- Lexical and word retrieval processes are characterised by alpha-beta (8-30 Hz) power decrease in frontotemporal areas[1,2]
- Network shifts to the right hemisphere in patients with damage in left middle temporal gyrus (MTG)[3]
- **Aim of this study:** Examine immediate effects of perturbation of the left hemisphere at the behavioural and neuronal level
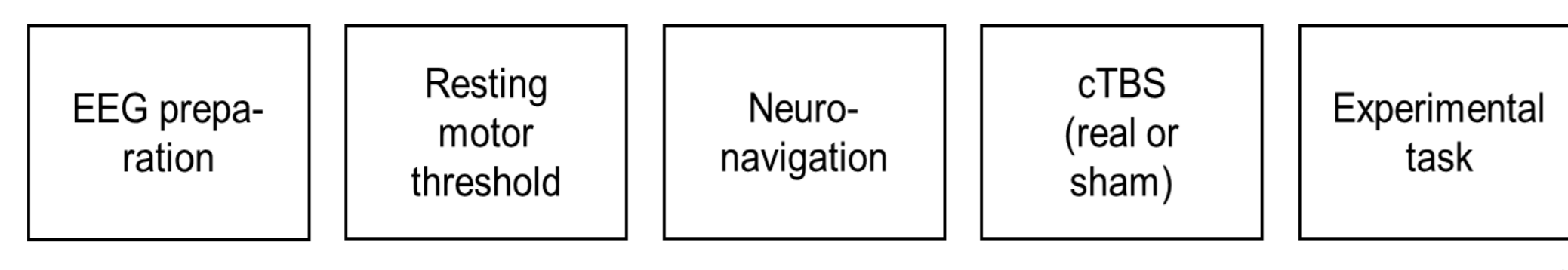
DESIGN

PARTICIPANTS

- 16 right-handed, native Dutch speakers (2 male, mean age = 23.0 years, SD = 3.7)
- Screened for TMS compatibility

PARADIGM

Constrained (C)

Unconstrained (U)

The | farmer | milks | the | | 🐄 | ...
The | farmer | buys | the | | 🐄 | ...

0.3 s 0.2 s 0.3 s 0.2 s 0.3 s 0.2 s 0.3 s 0.8 s 1.0 s 2.0 s

EEG | Vocal response

- Two sessions per participant
- 100 pictures (total: 200) each appearing in constraining and unconstrained condition

PROCEDURE

EEG preparation → Resting motor threshold → Neuro-navigation → cTBS (real or sham) → Experimental task

- Neuronavigated cTBS: 3 bursts of pulses given at 50 Hz and repeated every 200 ms at 80% resting motor threshold (600 pulses in total)[4] over left temporal cortex (MNI: −63 −26 −2)
- EEG with 32 Ag/AgCl preamplified scalp electrodes

ANALYSIS

- Within-participant design: cTBS (real vs. sham) × Context (constrained vs. unconstrained),
- Behavioural: linear mixed-effects models
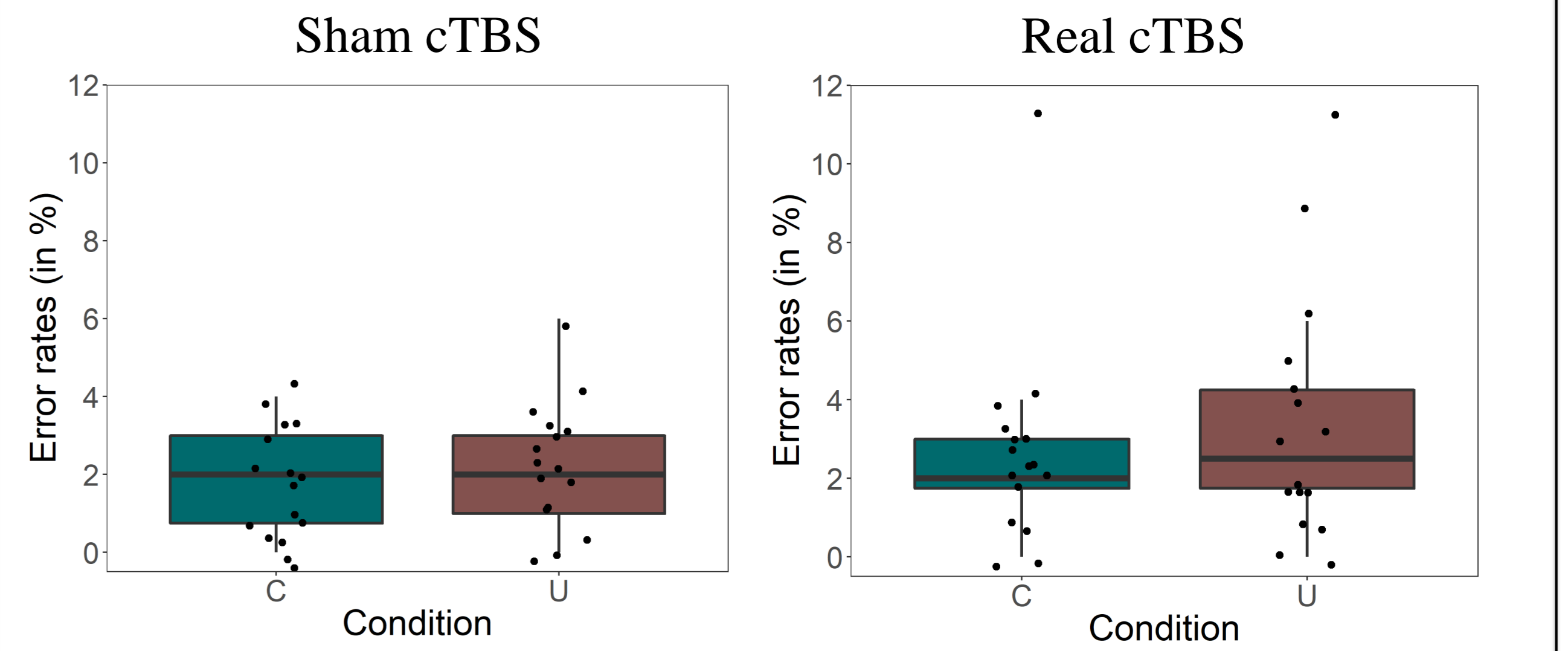- EEG: cluster-based permutation tests on entire frequency range and pre-picture time window (-0.8 to 0 s)

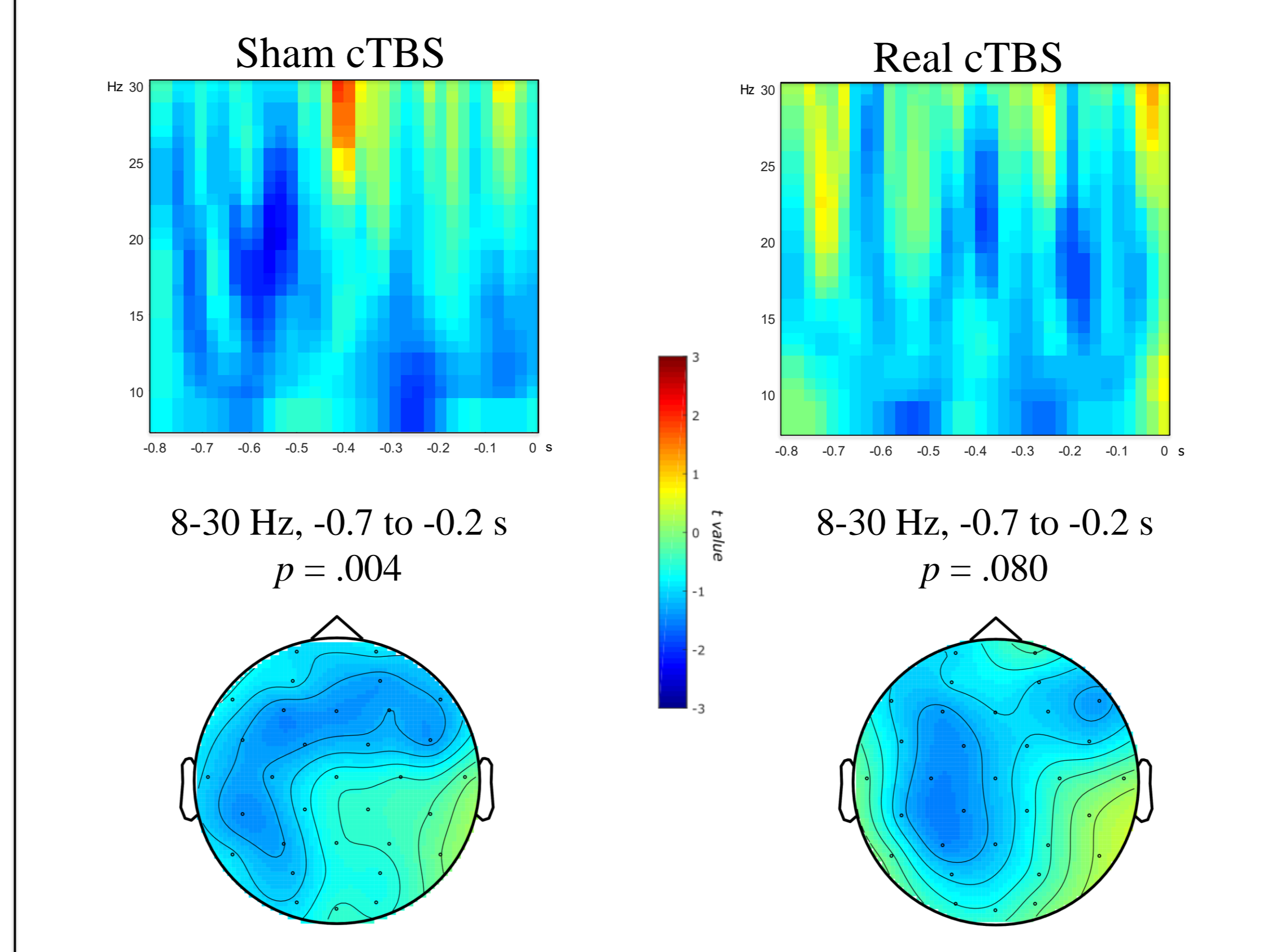## RESULTS

NAMING LATENCIES

Sham cTBS / Real cTBS
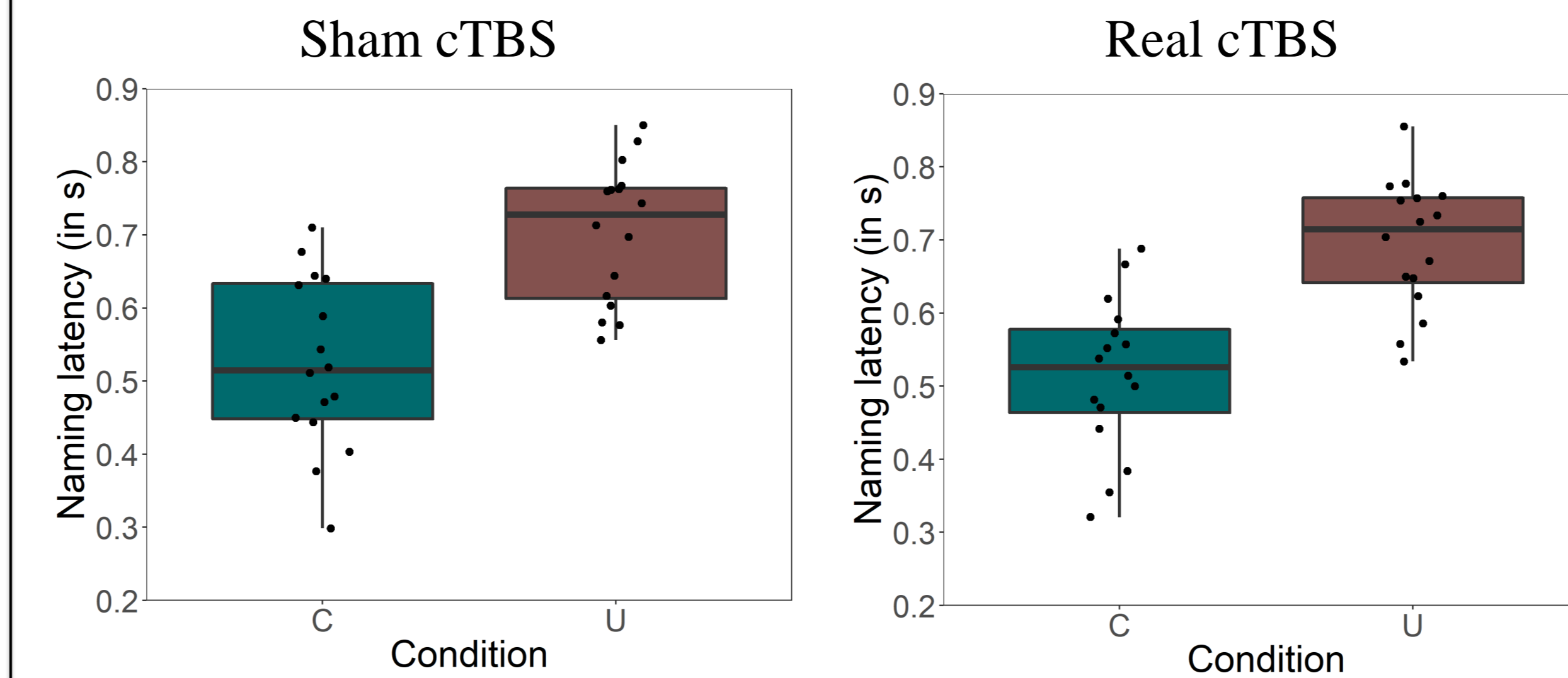
Faster naming latencies in constrained compared to unconstrained context (t = 12.56, p < .0001), but no difference between real and sham cTBS overall (t = -0.92, p = .372); no interaction (t = 0.08, p = .950)
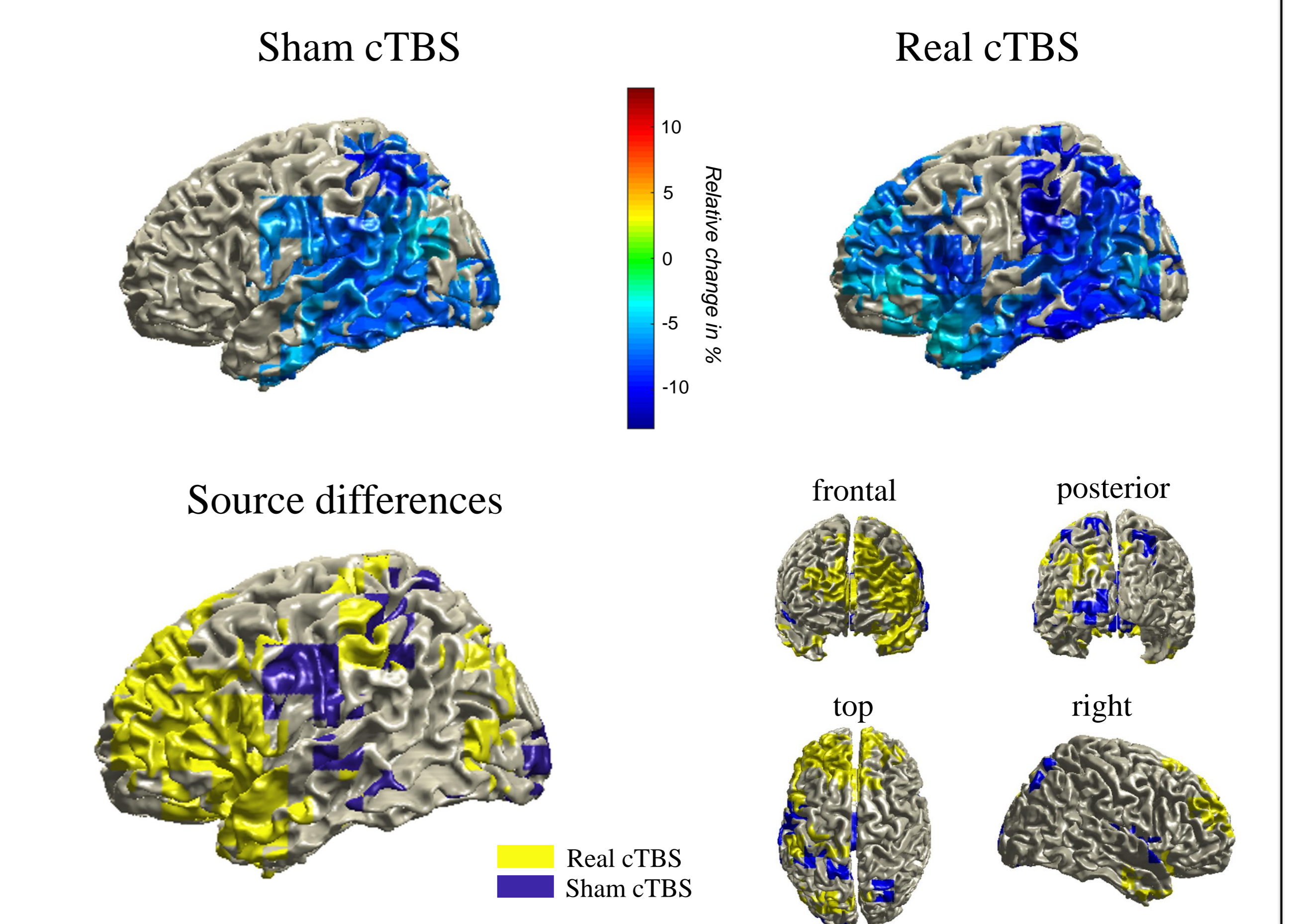
ERROR RATES

Sham cTBS / Real cTBS

Higher error rates following cTBS compared to sham cTBS (z = 2.73, p = .006), but no difference between constrained and unconstrained context (z = 1.60, p = .110); no interaction (z = 0.01, p = .995)

EEG

Sham cTBS / Real cTBS

8-30 Hz, -0.7 to -0.2 s, p = .004

8-30 Hz, -0.7 to -0.2 s, p = .080

SOURCE ANALYSIS

Sham cTBS / Real cTBS

Source differences

frontal / posterior / top / right

Real cTBS
Sham cTBS

CONCLUSIONS

- cTBS over left MTG increases error rates, but does not impair lexical retrieval processes
- Power decrease in alpha-beta frequency range is substantially attenuated and shows a more condensed scalp topography
- Source localisation indicates that perturbation causes a shift of neuronal activity to additional frontal and parietal regions
- Language production system rapidly adapts to interference (potentially recruiting additional control mechanisms) but cannot alleviate function loss entirely

REFERENCES

1. Piai V, Roelofs A, Maris E (2014). *Neuropsychologia*, *53*, 146–156.
2. Piai V, Roelofs A, Rommers J, Maris E (2015). *Hum Brain Mapp*, *36*, 2767–2780.
3. Piai V, Meyer L, Dronkers NF, Knight RT (2017). *Hum Brain Mapp*, *38*, 3151–3162.
4. Huang YZ, Edwards MJ, Rounis E, Bhatia KP, Rothwell JC (2005). *Neuron*, *45*, 201–206.

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