Effects of inhibitory stimulation of visual area V5/MT on visual speech recognition

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Introduction

How does the brain recognize visual speech?

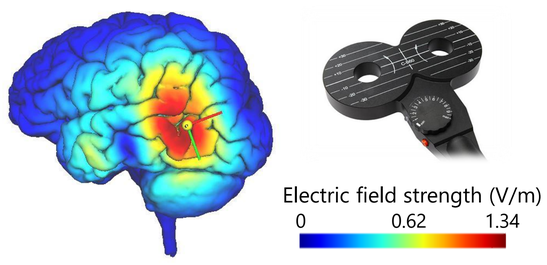
- Neural pathways for auditory speech processing are well-defined, but pathways for visual speech remain unclear[1]
- Visual speech recognition relies on the perception of visible articulator movements,[2] suggesting a role of visual motion areas of the cortex such as the middle temporal visual area (V5/MT)[3]
- ***Hypothesis:***
  If area V5/MT is critical for visual speech recognition, then transcranial magnetic stimulation (TMS) applied over V5/MT should disrupt visual speech recognition response times and accuracy

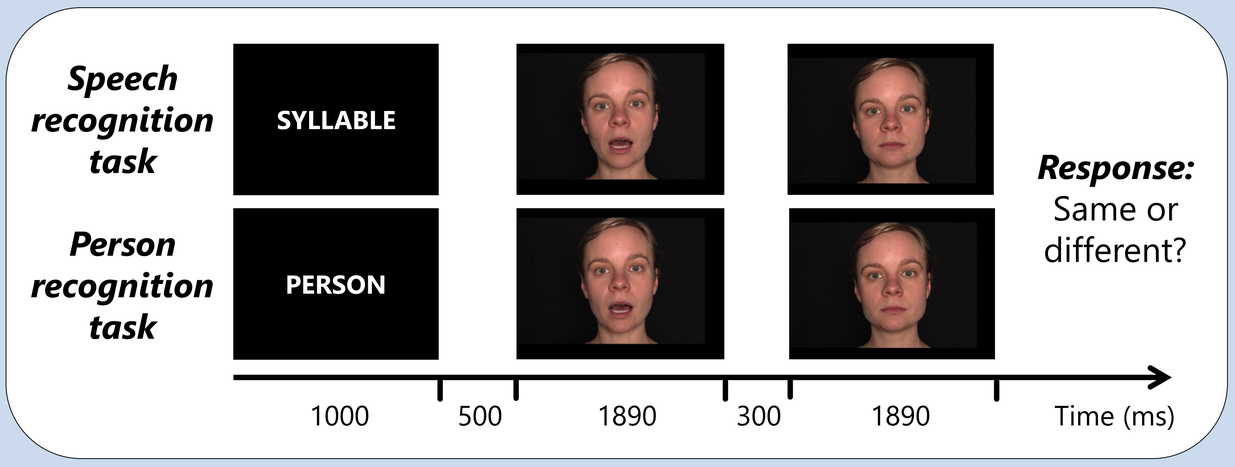
Methods

Experiment 1: Comparison of effective and placebo TMS of V5/MT

• 28 right-handed native German speakers (*M* age = 23.2 years, *SD* = 4.4)

Effective* or *placebo TMS applied to V5/MT in separate sessions prior to recognition tasks



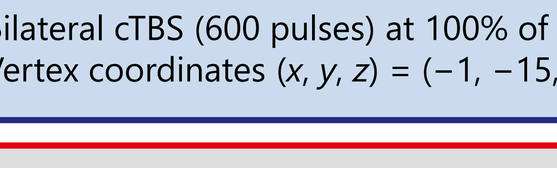


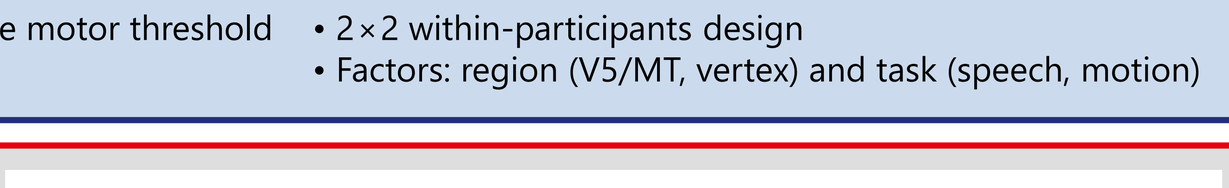
- Bilateral cTBS (600 pulses) at 90% of active motor threshold
- fMRI-localized *M* V5/MT coordinates (*x*, *y*, *z*) = (−46, −74, 5)
- 2 × 2 within-participants design
- Factors: TMS (effective, placebo) and task (speech, person)

Experiment 2: V5/MT versus vertex stimulation

• 24 right-handed native German speakers (*M* age = 25.2 years, *SD* = 5.5)

V5/MT* or *vertex brain regions stimulated in separate sessions prior to recognition tasks

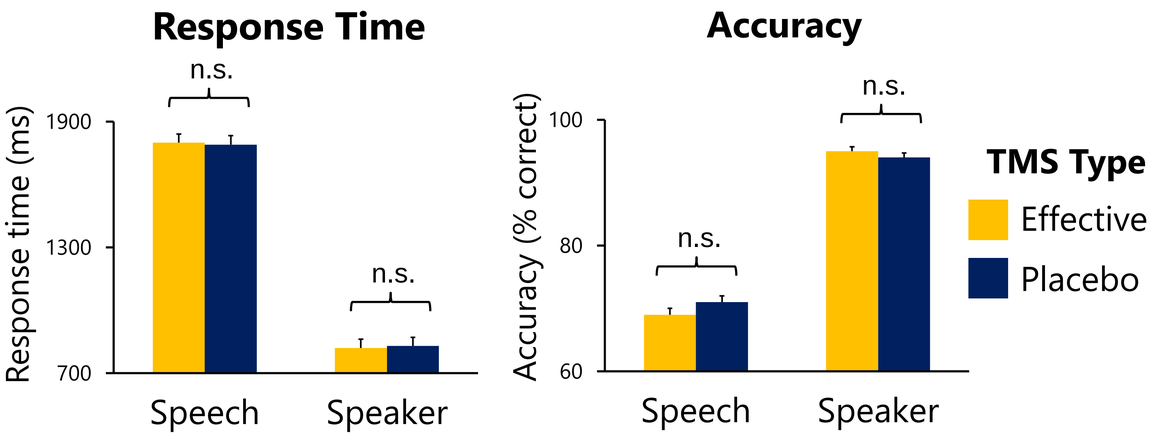




- Bilateral cTBS (600 pulses) at 100% of active motor threshold
- Vertex coordinates (*x*, *y*, *z*) = (−1, −15, 74)
- 2 × 2 within-participants design
- Factors: region (V5/MT, vertex) and task (speech, motion)

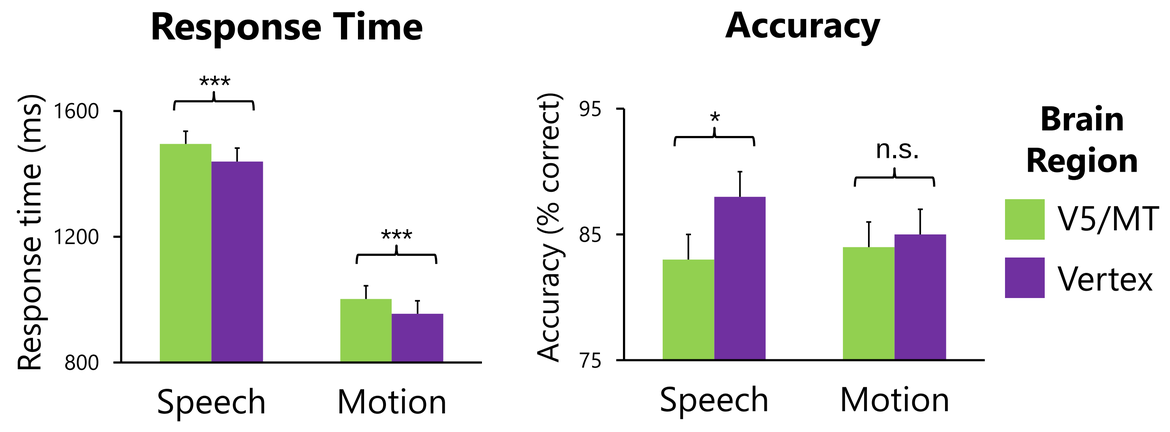
Results

Experiment 1: No effects of V5/MT stimulation relative to placebo stimulation



- No differences in response times and accuracies following effective versus placebo stimulation for either task

Experiment 2: TMS of V5/MT disrupted the recognition of visual speech and motion relative to vertex stimulation



- V5/MT > Vertex for both Speech and Motion recognition ($p < .001$)
- V5/MT < Vertex for speech recognition ($p < .05$)

Discussion

Experiment 2 findings suggest a *causal* role of V5/MT responses in the recognition of visual speech

- V5/MT integrity benefitted the speed and accuracy with which speech syllables were discriminated
- Facial motion information may transit through V5/MT[3,4]

Several possible reasons for lack of TMS effects on visual speech recognition in Experiment 1

- 40% of participants reported effective stimulation as more intense than placebo in Exp. 1; 10% in Exp. 2
- Lower stimulation intensity in Exp. 1
- Single speaker presented in Exp. 2

V5/MT may work together with form-based visual processing regions[5] and multimodal regions[6] to recognize visual speech

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