Understanding the mechanisms of lateral parietal memory modulation in Mild Cognitive Impairment

Mnemology Lab

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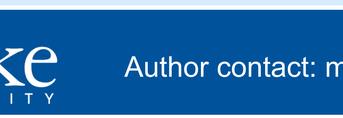
BACKGROUND

What is known

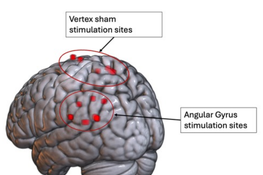
- TMS can improve general cognitive function and memory in many psychiatric conditions and is increasingly explored for neurological conditions
- Most promising target to improve memory is in **parietal cortex**
- Healthy older adults and MCI find a benefit to episodic memory when given greater **semantic context**
- Parietal TMS has been shown to affect hippocampal activity, which is responsible for memory encoding
- TMS shows episodic memory benefits in the same regions coding for semantic properties, **but it's not known why**

HYPOTHESIS

Parietal TMS increases the representation and encoding of semantic information which support episodic memory in hippocampus

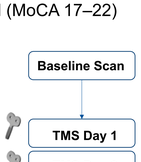


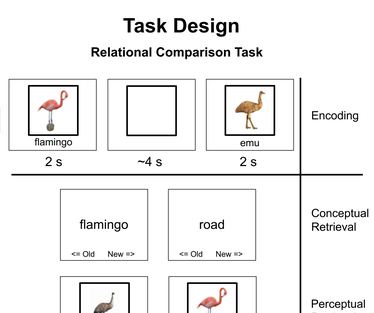
PROTOCOL AND TASK DESIGN



Intermittent Theta-Burst Stimulation (iTBS)
80% RMT, 1800 pulses, ~6min

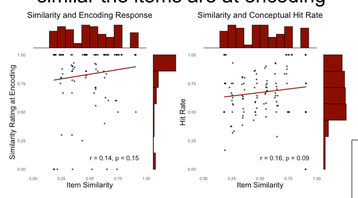
n = 13 active (9 MCI, 4 hOA), 7 sham all MCI (MoCA 17–22)



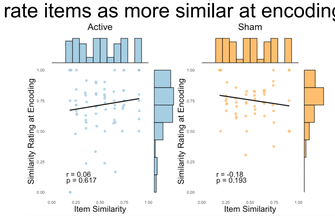


TREATMENT-RELATED CHANGES IN BEHAVIOR

At baseline, performance higher the more similar the items are at encoding

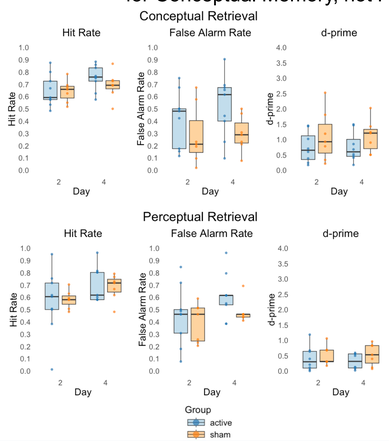


On TMS days, active group tends to rate items as more similar at encoding



Item similarity may provide a cueing effect that supports successful memory, and TMS enhances this effect

Active group show greater Hit Rate and False Alarm Rate for Conceptual Memory, not Perceptual Memory



`Memory ~ Day * TMS Condition`

Average by subject:
t = 1.34, p = 0.19

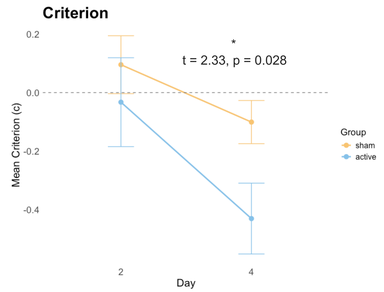
Trial-wise:
t = 2.82, p = .0048

Average by subject:
t = 0.46, p = 0.65

Trial-wise:
t = 1.18, p = 0.24

- After three TMS treatments, active group performance marginally significantly higher
- Active TMS group gets more **hits** but also more **false alarms**

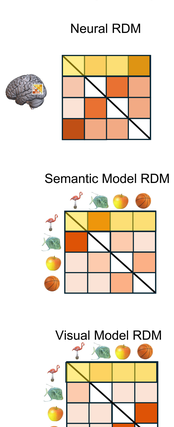
Criterion significantly lower for active group by day 4 for conceptual memory



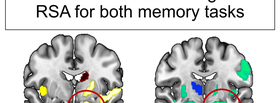
Active group shows significantly lower **criterion**, so they respond "old" more often

TREATMENT-RELATED CHANGES IN NEURAL REPRESENTATION

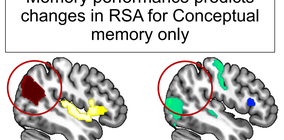
Representational Similarity Analysis



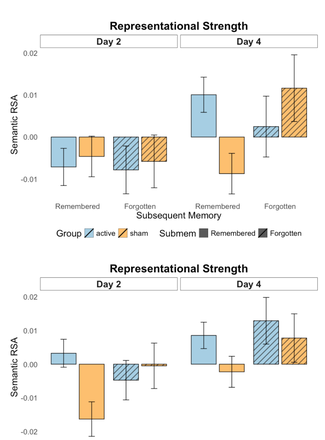
Left Parahippocampal Gyrus: Memory performance predicts treatment-induced changes in RSA for both memory tasks



Left Inferior Parietal Lobule: Memory performance predicts changes in RSA for Conceptual memory only



Memory performance, group, and day predict RSA in stimulation and downstream target regions



`Representational Strength ~ Memory * Day * TMS Group`

Conceptual Mem PhG
t = 2.15, adj p = 0.046

Perceptual Mem PhG
t = 3.52, adj p = 0.001

Conceptual Mem IPL
t = 2.28, adj p = 0.049

Perceptual Mem IPL
t = 3.52, adj p = 0.001

- TMS increases semantic representations at **parahippocampal gyrus** for both memory tasks and at **stimulation site** for conceptual memory *only*
- At **stim site,** representations stronger for subsequently remembered *and* forgotten trials.

CONCLUSIONS

- Active TMS group performs better than sham, but they also have more false alarms that off-set the gains in hit rate. Why?
- It may be that both true memory and false memory increase because there is **increased representation of stimulus semantics**. How do we know?
- We see **enhanced semantic representations** for both subsequently remembered and forgotten trials, especially at stimulation site
- Theta-burst TMS improves memory performance in MCI, though enhanced semantic information can lead to lower criterion, interfering with successful memory

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