False Memories: Investigating The Role Of Transcranial Magnetic Stimulation In Modulating Memory Encoding And Distortion Across Event Boundaries In Supernatural And Crime Narratives Using Naturalistic Stimuli

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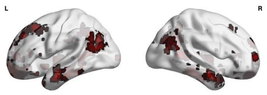
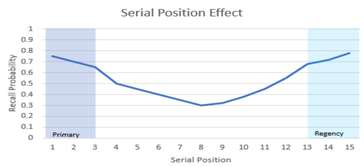
Introduction

- Memory recall is a reconstructive process that subtly alters details upon memory retrieval [3].
- The **Hippocampal-Cortical Network (HCN)** is critical in the formation of episodic memory.



- **False memories** (False Memory Syndrome) are defined as the recollection of an event that did not previously occur impacting PTSD patients, children, and older adults [4,5].
- Both the HCN and regions responsible for False Memory overlap in the prefrontal cortex and hippocampus [6].
- Previous research suggests event boundaries being a crucial element for memory formation and encoding [5].
- **Serial position effect** refers the tendency to remember events that occur in the beginning and ending of events, rather than the middle [14].



- **Transcranial Magnetic Stimulation (TMS)** is known to modulate encoding and retrieval by disrupting or strengthening neural activity in these regions[13] .
- Studies have shown that low-frequency repetitive TMS applied to L-ATL can reduce false memories without affecting true memories [1,6].
- Interaction between TMS, false memory, and event boundaries remains unclear, but research indicates that TMS can modulate memory processes via targeting specific brain regions [6].

RESEARCH QUESTION

How does Transcranial Magnetic Stimulation (TMS) affect false memory formation in the context of naturalistic event recollection and event boundaries.

HYPOTHESIS

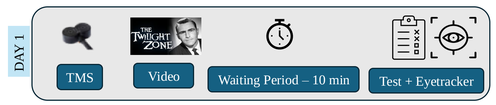
I. TMS applied to the hippocampus will enhance memory encoding, reducing false memories and strengthening recall accuracy.

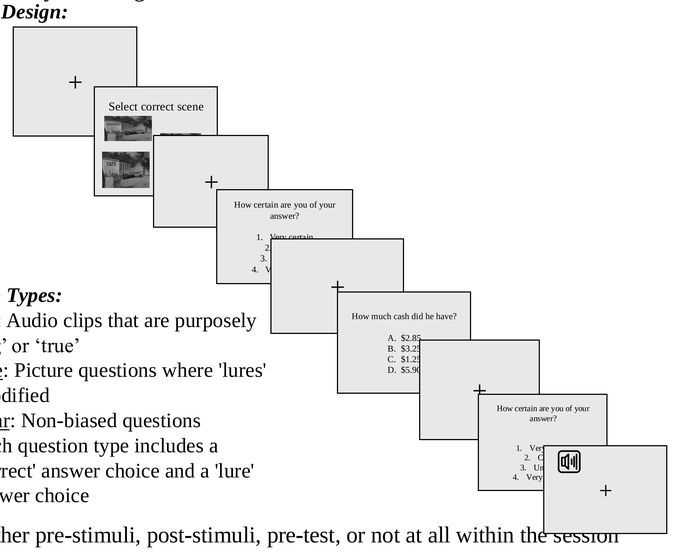
II. TMS will most significantly improve recall of details occurring in the middle of event boundaries, counteracting the serial position effect typically prioritizing memory retention at the beginning and end of sequences.

TASK DESIGN

- Participants (N=20) will complete a within-subjects design involving 4 sessions (nonconsecutive days) at FSU.
- During each session subjects will complete a task where they view stimuli consistent of one video (~25 minutes) and a memory test consisting of 60 questions (20 regular, 20 picture, 20 audio) with eye tracking.

Test Design:





Question Types:

- Audio: Audio clips that are purposely 'wrong' or 'true'
- Picture: Picture questions where 'lures' are modified
- Regular: Non-biased questions
  - Each question type includes a 'correct' answer choice and a 'lure' answer choice

- Continuous theta-burst (~45 sec) will be delivered at HCN either pre-stimuli, post-stimuli, pre-test, or not at all within the session (counterbalanced per session).
- Each session will be counterbalanced with video (4 videos) and TMS stimulation condition (pre-stimuli, post-stimuli, pre-test, none).
- Lures or wrong choices followed by high confidence levels (1 or 2) are considered "False Memories".

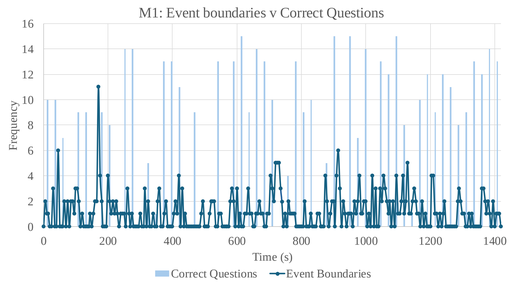
PILOTING RESULTS

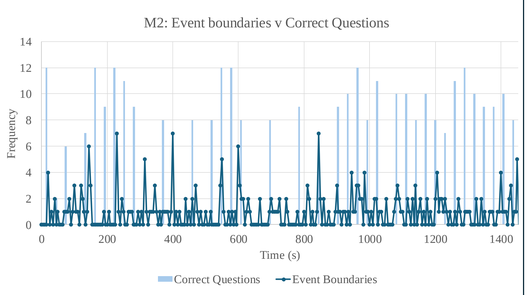
Piloting Task:

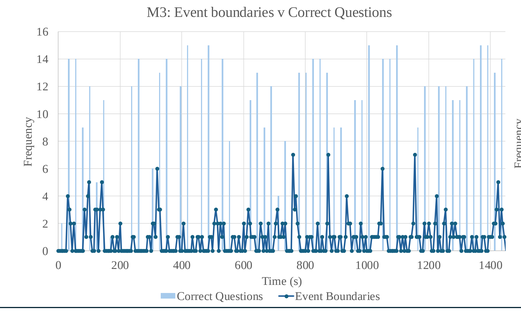
- Participants (N ~ 15) completed a two-part task consistent of a video-encoding phase (1-4 videos; counterbalanced) and a test-recall phase.
- During the encoding phase, participants watched videos and identified perceived event boundaries.
- During the test-recall phase, participants:
  1. Rated the difficulty of each question.
  2. Provided their answer to the question.

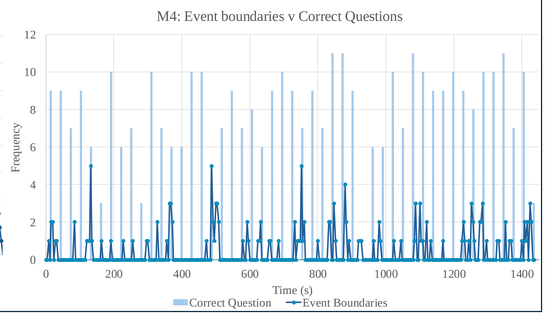
Event Boundaries:

- Visual inspection of the data does not reveal a clear relationship between peaks in event boundary responses and correct answers; however there does seem to be oscillations of correct frequency – further analysis is needed.
- Although some overlap is observed at certain time points, there is no strong pattern indicating that correct responses consistently increase around event boundaries. Further statistical analysis (e.g., correlation or regression) is needed to determine whether a meaningful relationship exists.



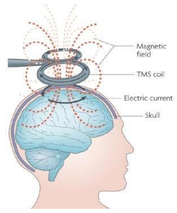




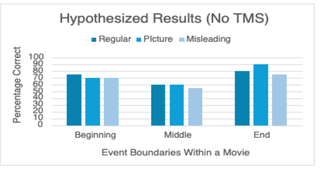


Future Directions

- Transcranial Magnetic Stimulation (TMS) is a noninvasive brain stimulation method that modulates targeted brain networks [6,10].
- We will deliver TMS to cortical nodes of the Hippocampal-Cortical Network (left parietal cortex) to affect network activity during memory formation [6].



We anticipate that the results would support the hypothesis that TMS will increase accuracy of memory recall for all event boundary regions. We expect to see the greatest increase in memory recall accuracy in the middle of events, which will override the typical serial position effect.



- Videos with no TMS will replicate the serial position effect.

- Videos with TMS will counteract the serial position effect and overall increase recall accuracy.

- For future experiments we will incorporate fMRI to explore the brain regions related to false memory and their activation when recalling false memories.
- Incorporating more crime-based stimuli including use of virtual reality to determine how false memory plays a role in the natural world.

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