Investigating the link between prefrontal cortex plasticity, cortical thickness and memory: a multimodal approach

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Introduction

- Brain plasticity refers to the brain's ability to modify neural circuitry and can be estimated using non-invasive brain stimulation and electrophysiological procedures.
- One of the main mechanisms underlying brain plasticity is long term potentiation (LTP), a process that forms stronger and more efficient neural pathways.[1]
- In 2017, the first demonstration of intermittent theta burst stimulation (iTBS) induced LTP-like plasticity was measured by TMS evoked potentials (TEP; P30, N45, P60, N100 and P200) in the dorsolateral prefrontal cortex (DLPFC).[2]
- Human imaging studies show activation of the DLPFC during memory tasks[3-4], where LTP is a mechanism suggested to underlie memory processes.[1, 5-8]
- Cortical thickness in the prefrontal region has also been linked to memory performance [9] and may be considered a potential proxy measure of both memory performance and underlying brain plasticity mechanisms in the DLPFC.

Objective #1

Is there a relationship between left DLPFC plasticity and memory performance?

Objective #2

Is there a relationship between left DLPFC plasticity and cortical thickness of the left DLPFC?

Methods

Figure 1: Randomized double-blinded study design (n=5, mean age=36, all male)

- ✓ We delivered two blocks of TMS before and after the active iTBS and sham conditions to measure LTP-like plasticity in the left DLPFC (Figure 2)
  - Blocks: 5-7 second inter-pulse interval, 120% RMT intensity, 80 pulses
  - iTBS: Sham or active iTBS (3 pulses at 50 Hz, 80% AMT, intervals of 10 seconds, 600 pulses)
- ✓ One-tailed Pearson's correlations were used to assess the relationship between change in TEP component amplitudes in the left DLPFC pre and post iTBS to both memory performance and left DLPFC thickness
- ✓ Sham was not included in our preliminary analysis

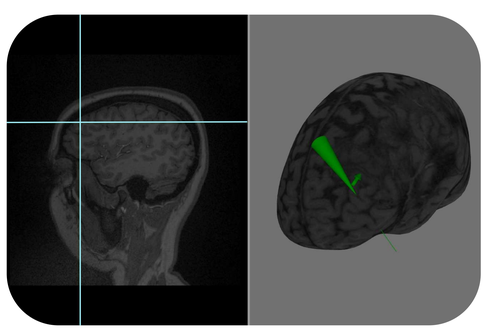

Figure 2: Left DLPFC region of interest

Preliminary Results

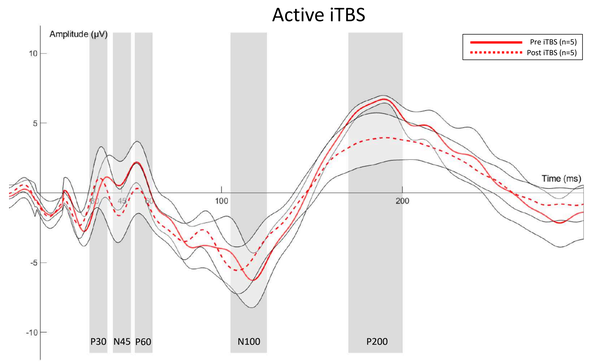

Figure 3: Change in TEP amplitude using grand average of active iTBS, n=5

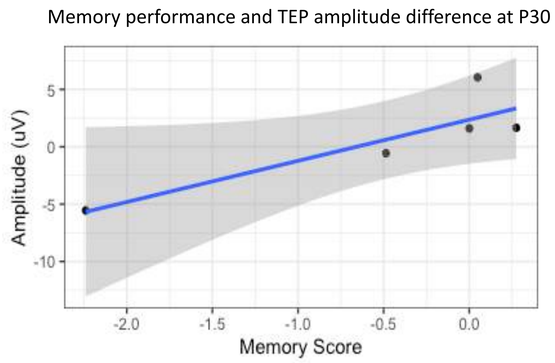

Figure 4: Overall memory composite score and P30 TEP amplitude difference, r=0.871

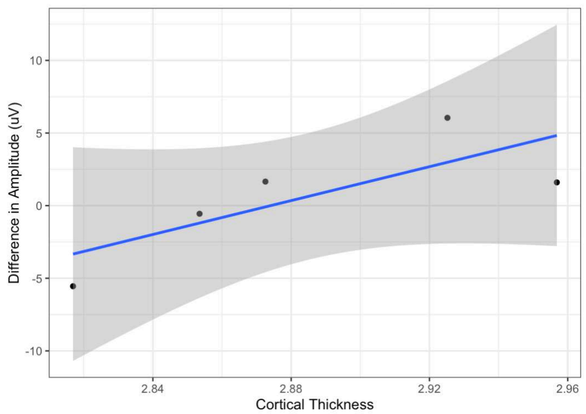

Figure 5: Left DLPFC cortical thickness and P30 TEP amplitude difference, r=0.776

Conclusion

- Objective #1: Preliminary evidence suggests a possible relationship between LTP-like plasticity in the left DLPFC and memory performance
- Objective #2: Preliminary evidence suggests a possible relationship between LTP-like plasticity in the left DLPFC and cortical thickness in the left DLPFC

Implication

- This project is one of the first to explore the relationship between left DLPFC plasticity to both memory performance and left DLPFC thickness.
- With 15 more participants, we plan to further evaluate the strength and direction of the relationships between both the structural and functional aspects of LTP-like brain plasticity in the left DLPFC.

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