Transcranial Magnetic Stimulation (TMS) of the Supramarginal Gyrus: A Window to Perception of Upright

- Name: Ganesh Arvapalli
- Mentors: VOR lab: Dr. Amir Kheradmand, Dr. David S. Zee, BIGSS lab: Farshid Alambeigi, Dr. Mehran Armand
Robot-Assisted Transcranial Magnetic Stimulation (RA-TMS)

**Topic:** Assess subjective visual vertical (SVV) perception via eye tracking and relationship between SVV and the SMGp.

**Solution:** Create a robotic tool that can perform transcranial magnetic stimulation (TMS) automatically to measure areas of activity around the brain.
Paper Selection

- Transcranial Magnetic Stimulation (TMS) of the Supramarginal Gyrus: A Window to Perception of Upright
  - Explanation of TMS
  - Outlines need for robotic tool
  - Specifies durations and site
Problem Summary

- Perception of upright
  - Vestibular feedback
  - Subjective Visual Vertical (SVV)
- Localization of activity
  - Supramarginal Gyrus (SMGp)
  - Pathway?
- Eye torsion and link to SMGp
Key Results and Significance

- Spatial reference frame integration
  - Vestibular pathway elements
- SMGp linked to SVV tilt post-TMS application ($p = 0.0039$)
  - $+2.7^\circ$ when head tilted left
  - $-3.6^\circ$ when head tilted right
Background

- Vestibular information
  - Spatial orientation
  - Navigation
- Supramarginal gyrus (SMGp)
  - Functional neuroimaging studies
  - Cortical lesions + behavior analysis
- Subjective Visual Vertical (SVV)
  - “Earth vertical”
- Transcranial Magnetic Stimulation (TMS)
  - Disruptive effect on cortex
Methodology

- Forced-choice paradigm
- 2 blocks pre and post-TMS
- Rotation of laser
  - Projected on screen far away
  - Rotated ±16° w/ 2° increments
- Rotation of dial
  - Subjects align with laser
  - Weights: Left = 0, middle = 0.5, right = 1
  - Logistic regression to fit data, then where 0.5 reached is overall angle
Experimental Setup

• 8 healthy (5 m, 3 f) volunteers
• Bite bar
• Training = 1 block
• TMS Application
  • Figure-eight coil held tangent to head
  • Continuous theta burst stimulation (cTBS)
    • 200 bursts every 200 ms
    • Each burst had 3 pulses at 50 Hz
  • Site of application monitored using external software (Brainsight)
• Previously mentioned block setup
Assessment

- **Importance**
  - Demonstrates significance of TMS
  - Highlights complexity of vestibular information processing

- **Relevance**
  - Tangency to head (safety)
  - Model of TMS coil being used
  - Duration of exposure
  - Length of time spent at each location
  - Visualization software
### Assessment (cont.)

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>• Clear methodology and setup</td>
<td>• Too few subjects</td>
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<tr>
<td>• Described application of TMS well</td>
<td>• Pre-TMS SVV not zeroed</td>
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<td>• Effects clearly demonstrated impact of SMGp inhibition</td>
<td>• Few important figures</td>
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<td>• Vestibular processing pathway was well researched</td>
<td>• Could always use more data analysis and graphs</td>
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Conclusions

- Solid foundation
- Linked SMGp to eye torsion successfully
- Demonstrated need for robotic tool to conduct experiment

Next steps:
- Functional mapping of SMGp (current project)
- Eye torsion tracking (current project)
- Repeat for left cerebral hemisphere

Questions?
References


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