Single-pulse TMS over rIFC evokes an electromyographic response

Fisher M.¹, Wadsley C.G.¹,², Bakken K.¹, Byblow W. D.², and Greenhouse I.¹

¹Action Control Laboratory Dept. of Human Physiology, University of Oregon, Eugene OR
²Movement Neuroscience Laboratory, Dept. of Exercise Sciences, The University of Auckland, Auckland, New Zealand

Background

Hyperdirect projections from right inferior frontal cortex (rIFC) to subthalamic nucleus (STN) are implicated in response inhibition.

Invasive direct electrical stimulation of rIFC can elicit negative motor responses (NMR) characterized by inhibition of movement without loss of muscle tone or consciousness (Luders 1988).

Single-pulse transcranial magnetic stimulation (TMS) can non-invasively activate cortical regions (e.g., positive motor responses over M1).

We examined whether single-pulse TMS over rIFC:

1) Elicits NMRs in the electromyogram of tonically active muscles
2) Exhibits different effects for different TMS coil orientations.

Methods

Sample

• 15 healthy young right-handed adults (7 female, 25 ± 5 years).

TMS

• Targets: rIFC & Occipital cortex (control) using Montreal Neuroscience Institute (MNI) brain.
• Orientations: Anterior-posterior (AP) & Posterior-anterior (PA).
• Intensities: % resting motor threshold (%RMT) determined for FDI hotspot (M1)

Task

• EMG recorded from four effectors tonically contracted at ~10% MVC
• First dorsal interosseus (FDI) & abductor pollicis brevis (APB) co-contracted pinch grip
• Extensor carpi radialis (ECR) engaged by extending the wrist
• Anterior deltoid (Delt) engaged by forward flexion of the arm

Stimulation site

<table>
<thead>
<tr>
<th>Stimulation site</th>
<th>Intensity (% RMT)</th>
<th>Coil Orientation</th>
<th>MNI Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: M1 (FDI Hotspot)</td>
<td>80</td>
<td>PA</td>
<td>N/A</td>
</tr>
<tr>
<td>rIFC</td>
<td>130</td>
<td>PA</td>
<td>X = 42, Y = 18, Z = -6</td>
</tr>
<tr>
<td>Control (Occipital)</td>
<td>130</td>
<td>PA</td>
<td>X = 6, Y = 84, Z = -1</td>
</tr>
</tbody>
</table>

Results

![Graphs showing EMG responses over rIFC and Occipital stimulation](image)

Conclusions

• Positive EMG responses can be elicited with TMS over rIFC.
• Observed between 50 and 150 ms post stimulation.
• Evoked responses may contain oscillatory or hysteresis-like effects (e.g., deltoid).
• Future directions:
  - Neuro-navigated TMS targeting for individualized approach.
  - Linking TMS-evoked responses with response inhibition parameters (e.g., SSRT).

References: