Effect of Auricular Vagus Nerve Stimulation on Novel Letter Learning in Dyslexia

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Introduction

- Most individuals learn to read as children.
- Learning to read becomes difficult after passing the critical window (i.e., after the age of 18 or 19).
- Correcting reading problems also becomes increasingly difficult (Royer et al., 2017).
- About 10% of people have dyslexia (Pennington & Bishop, 2009).
- In those who struggle acquire reading, matching letters to sounds is often difficult.
- In spite of many therapy options, not all individuals benefit from intervention (e.g., Torgesen et al., 1999).
- Vagus nerve stimulation has been shown to drive plasticity in the brain, so we tested a non-invasive approach (aVNS) as an intervention on those with dyslexia.

Participants and Design

<table>
<thead>
<tr>
<th>Group</th>
<th>TD, Sham</th>
<th>TD, Active</th>
<th>DYS, Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>9</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Age</td>
<td>20.90 (2.25)</td>
<td>21.53 (3.53)</td>
<td>19.44 (1.04)</td>
</tr>
<tr>
<td>KBIT IQ</td>
<td>107.22 (14.08)</td>
<td>106.63 (8.52)</td>
<td>99.29 (10.00)</td>
</tr>
<tr>
<td>TOWRE SWE</td>
<td>107.67 (10.91)c</td>
<td>101.75 (6.99)</td>
<td>92.43 (12.39)a</td>
</tr>
<tr>
<td>TOWRE PDE</td>
<td>103.67 (4.90)c</td>
<td>104.63 (6.37)c</td>
<td>88.00 (7.92)p</td>
</tr>
<tr>
<td>WRMT Word ID</td>
<td>104.89 (9.44)c</td>
<td>107.88 (9.19)c</td>
<td>94.29 (7.57)p</td>
</tr>
<tr>
<td>WRMT Word Attack</td>
<td>97.89 (9.65)c</td>
<td>104.25 (10.10)c</td>
<td>84.71 (9.84)b</td>
</tr>
</tbody>
</table>

Standardized scores reported as M (SD). Superscripts show group differences: a = different vs. TD sham, b = vs. TD active, and c = vs. DYS active.

Training Procedure

- Assess/Threshold
- D1-D5
- Hebrew 2 / D6
- D7-D9
- D10 / Hebrew 3
- Hebrew 4

- Introduce Letter
- Series Practice
- Word-Like Items

Results

- Participants are learning letter-to-sound combinations in Hebrew after five training lessons, as seen through the letter identification task.
- Rapid automatized naming data suggest that TD individuals receiving stimulation perform better than those with dyslexia.
- The TD active group performed better than the DYS active group on the rapid naming measure.

Future Directions

- Evaluate genetic analyses (i.e., BDNF) in those with dyslexia to test efficacy of aVNS.
- Investigate efficacy of aVNS of those on Adderall, as there can be comorbidity with dyslexia and ADHD.
- See what participants remember after a period of no stimulation (i.e., retention).
- Compare active stimulation to sham stimulation in the dyslexia group.
- Test a higher frequency of stimulation, in line with other aVNS studies in the literature (5 vs. 25 Hz).
- Investigate neural correlates of an aVNS intervention.

Conclusions

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- The TD active group performed better than the DYS active group on the rapid naming measure.