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

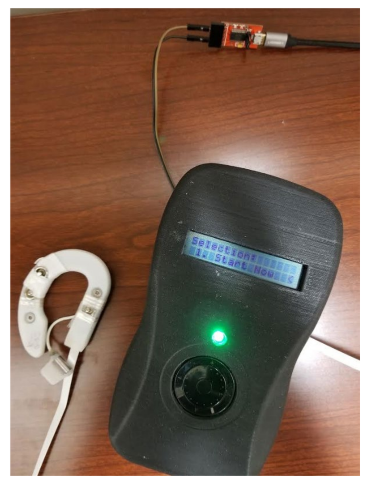

Madeline Pitcock*, Vishal J. Thakkar, Abby S. Engelhart, Grace Pecoraro, Zoe Richardson, & Tracy M. Centanni

Department of Psychology, Texas Christian University, Fort Worth, TX

* SERC grant awardee and presenting author


## 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.

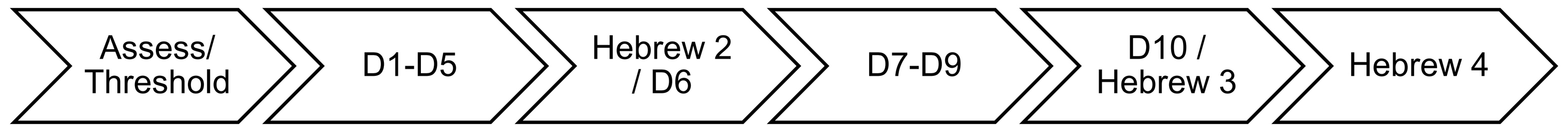


## Participants and Design

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

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

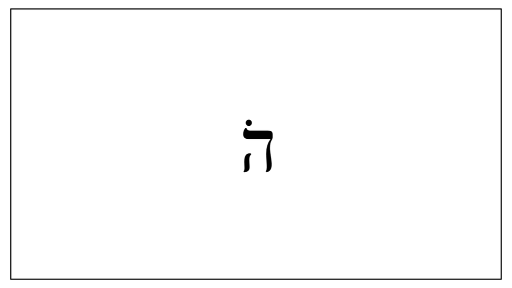
## Training Procedure



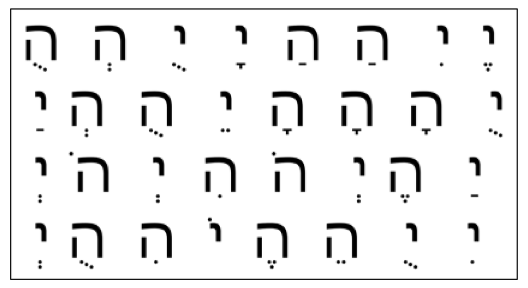

Introduce Letter

Series Practice

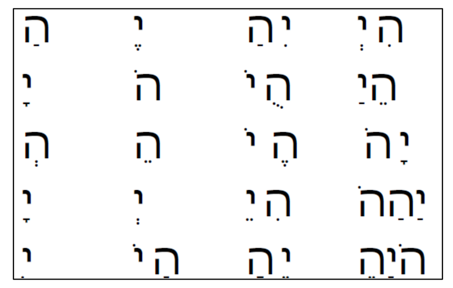
Word-Like Items



Letter ID



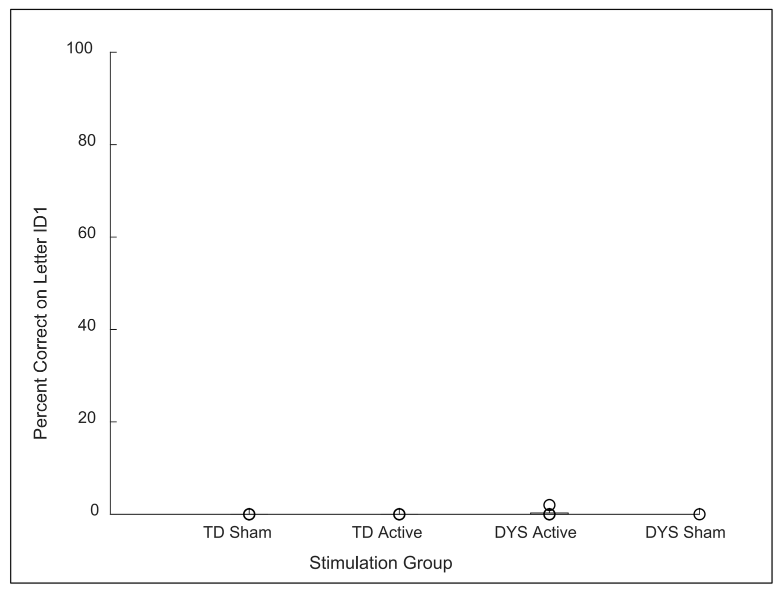
RAN



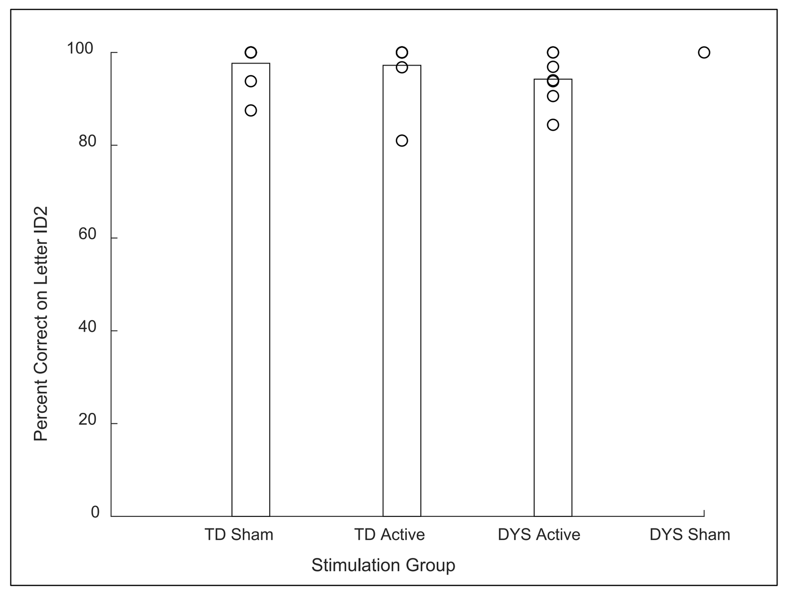
TOWRE

## Results

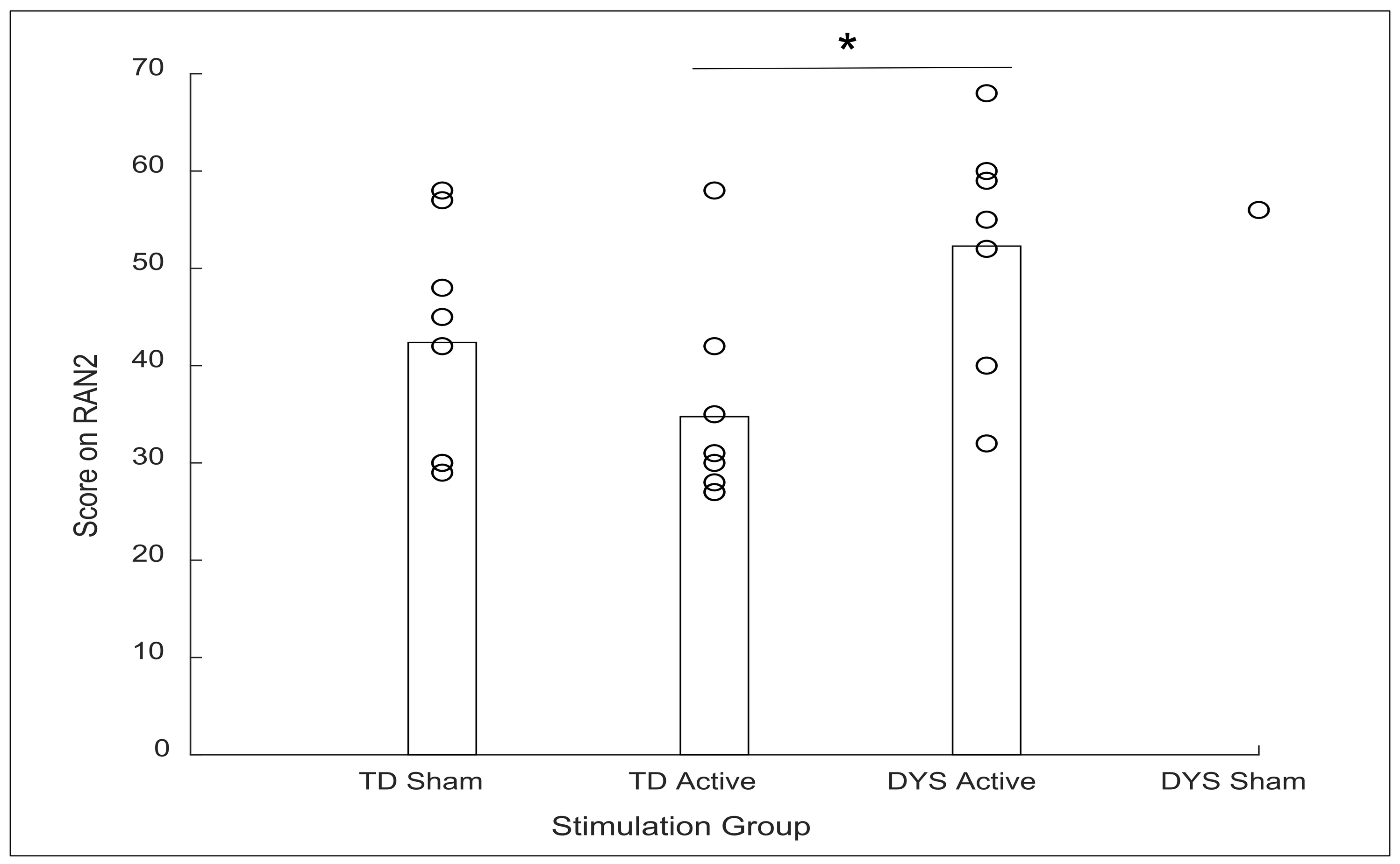
Figures show between-groups ANOVAs with multiple participants



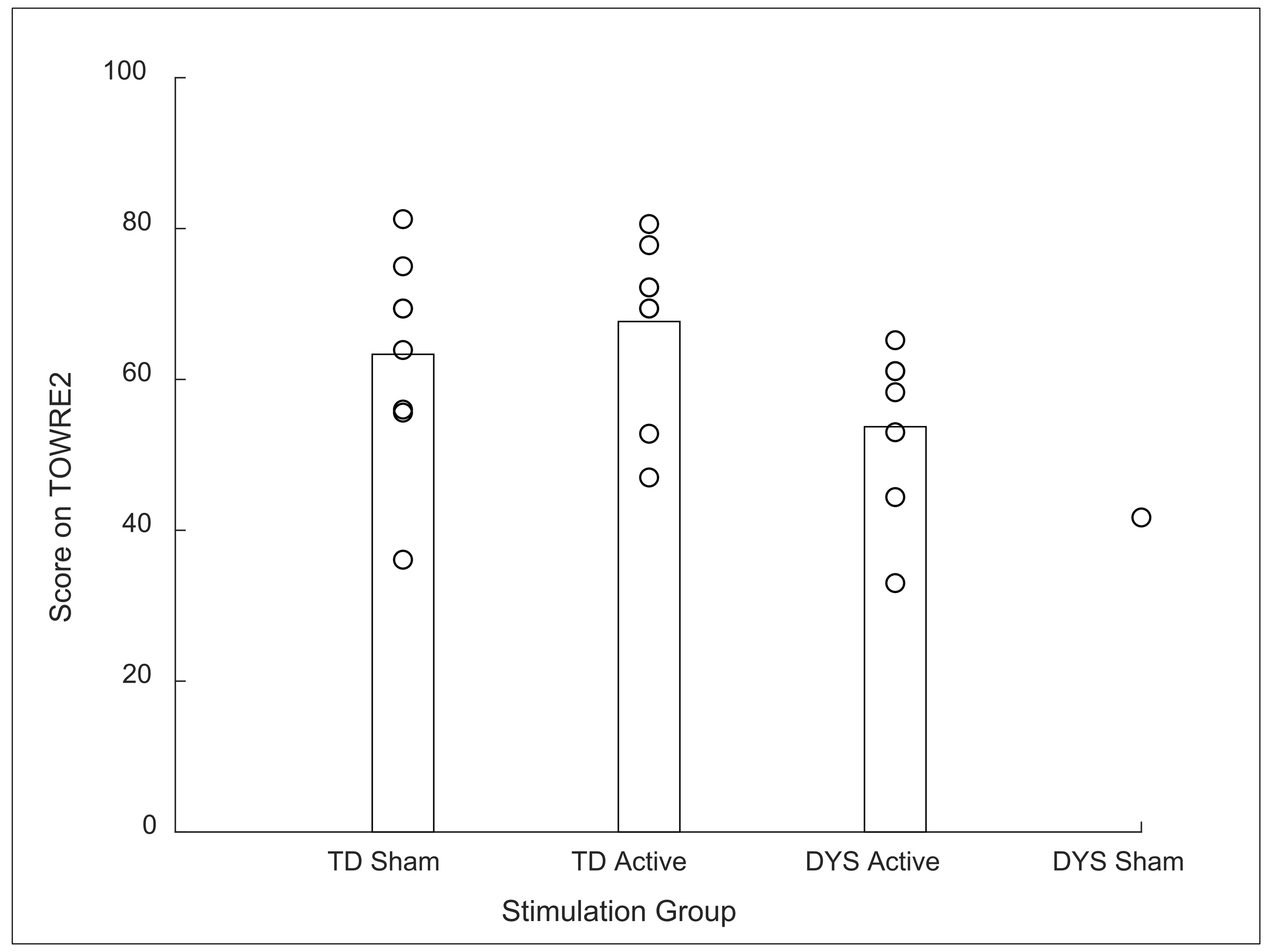

Letter ID1: $F(2, 21) = 1.24$, $p = .31$




Letter ID2: $F(2, 20) = .79$, $p = .47$




RAN2: $F(2, 20) = 4.26$, $p = .03$




TOWRE2: $F(2, 20) = 2.40$, $p = .12$

## Conclusions

- 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.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