

The Effect of Transcutaneous Auricular Vagus Nerve Stimulation on Novel Language Learning

Aubrey E. Tonsager*, Vishal J. Thakkar, Annie Dang, & Tracy M. Centanni

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

* SERC grant awardee and presenting author



Introduction

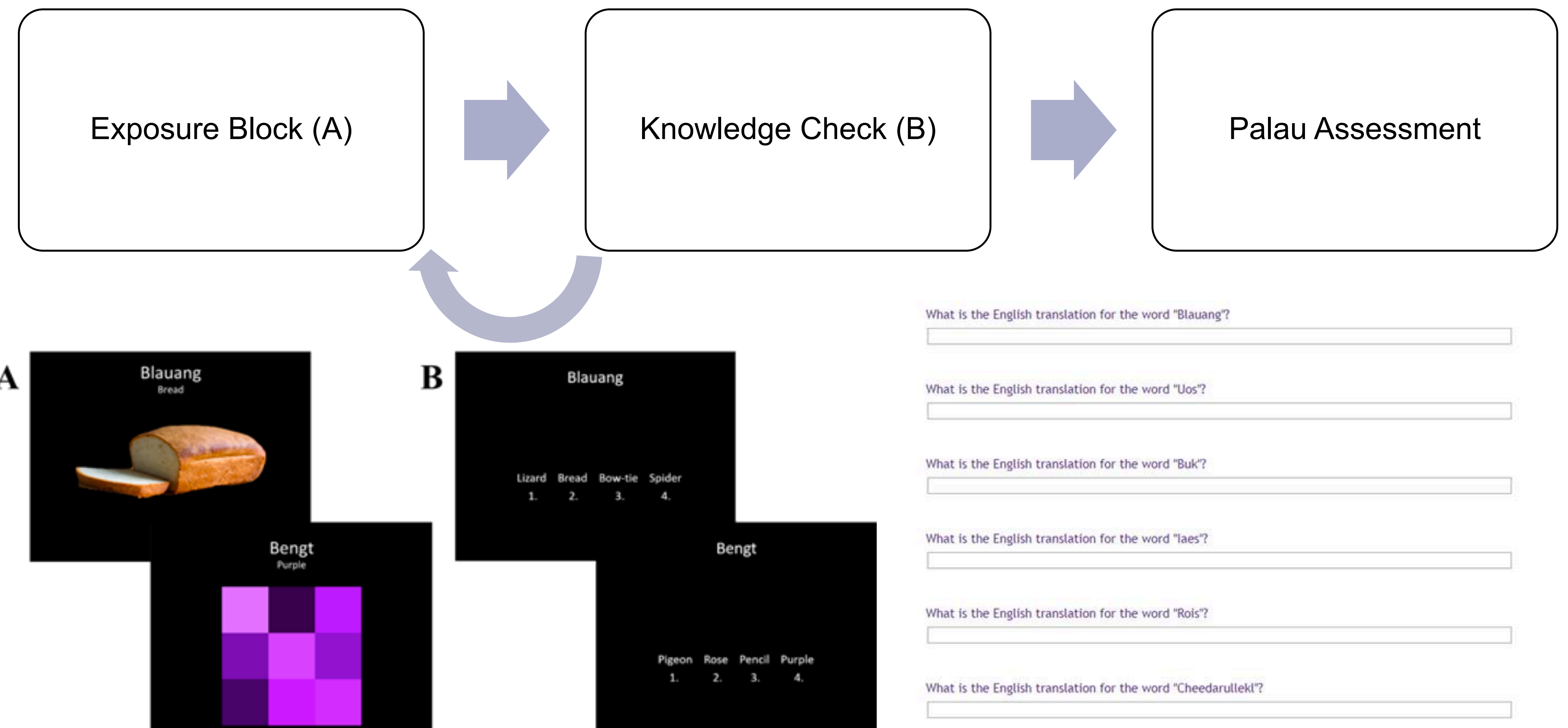
- Being able to speak and understand a second language is becoming increasingly important in the modern world.
- Learning novel language is possible with intense instruction and practice, but it becomes increasingly difficult with age (Hartshorne et al., 2018) .
- Cervical vagus nerve stimulation (cVNS) has been proven to be safe and effective for various conditions and is FDA approved treatment for depression and epilepsy (DeGiorgio et al. 2000; Ogbonnaya and Kaliaperumal 2013).
- cVNS is expensive and invasive (Yu, Zhao, Guo, Rong 2016). Thus, cVNS is not a practical alternative for second language learning.
- Transcutaneous auricular Vagus Nerve Stimulation (taVNS) is a noninvasive intervention that stimulates the auricular vagus branch of the vagus nerve, and is both safe (Kreuzer et al., 2012) and as effective at driving plasticity as cVNS (Redgrave et al., 2018; Stefan et al., 2012).
- Recent work in our lab provides evidence that taVNS drives improvement in novel sound-letter learning (Thakkar et al., in review).
- The goal of the current study is to evaluate a novel intervention approach that improves novel language learning in adults.



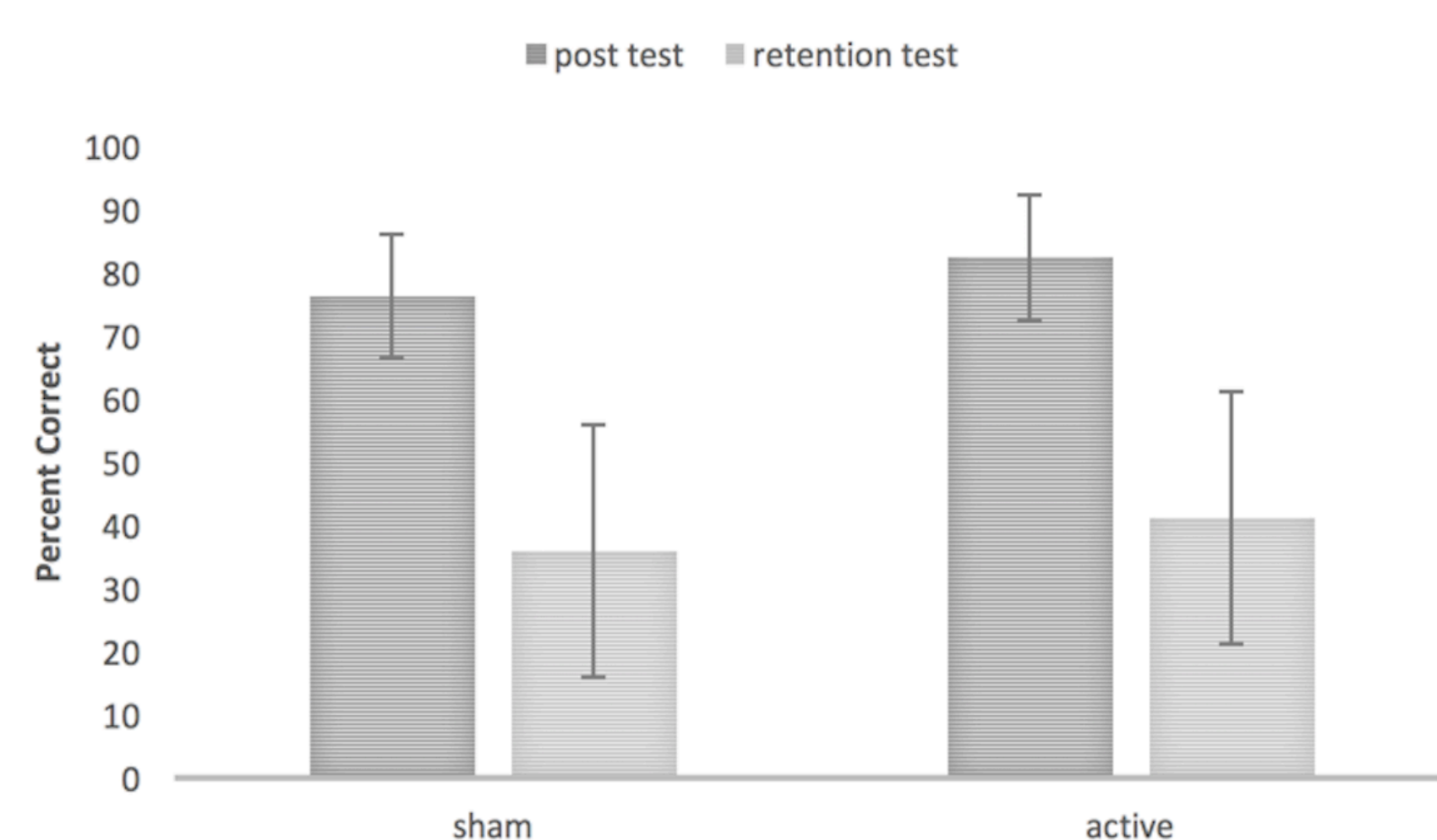
Participants and Design

Assessment	Sham	Active	T-Statistic
Sample (# Females)	8 (2)	8 (3)	
Age	19.75 ± 1.40	19.46 ± 1.07	
Kaufman Brief Intelligence Test II	107.25	100.6	1.17
Sight Word Efficiency	108.5	112.5	0.84
Phonemic Decoding Efficiency	112	109.8	0.78
Word Identification	111.67	105.2	2.62
Word Attack	105.67	110.1	1.27
Rapid Digit Naming	11.17	12.1	1.57
Rapid Letter Naming	10.67	11.2	0.72
Design Memory	9.08	8.3	0.87
Verbal Memory	11.17	11.2	0.03
Number Letter	12.42	12.6	0.23
Design Recognition	9.83	9.8	0.04
Verbal Recall	11.17	10.3	0.88

Palau Training and Assessment



Results



Percent correct of participants' posttest and retention test scores between the active and sham stimulation groups.

Conclusions

- Retention session results suggest that there is no benefit of 5 Hz taVNS on novel language learning.
- Active taVNS participants did not recall significantly more Palau words compared to the sham stimulation group as hypothesized.
- Both participant groups scored significantly lower during their retention session a week later compared to their post training test.
- The results seen cannot be attributed to age, IQ, or reading as there were no significant differences between active and sham stimulation groups with the exception of the Word ID task.

Future Directions

- Recruit more participants in order to increase the sample size.
- Perform the study with higher stimulation levels (25 Hz).
- Integrate different words types during training, such as abstract nouns instead of concrete nouns, would significantly increase recall at retention.
- Perform the study using a shorter retention interval between taVNS sessions to see if this can produce a significantly higher retention score.

Poster presented at the 2020 Michael and Sally McCracken Annual Student Research Symposium at Texas Christian University, Fort Worth, TX. This research was funded by a grant from the Science and Engineering Research Center.