The Effect of Transcutaneous Auricular Vagus Nerve Stimulation on Reading Comprehension

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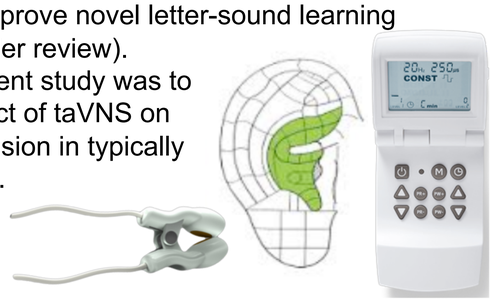
Introduction

- Reading comprehension is an important skill.
- Deficits in this skill negatively impact a person's quality of life, especially in school and work environments (Pederson et al., 2016).
- Previous research has shown that cervical vagus nerve stimulation (cVNS) is a safe and effective treatment for treating various conditions (Sackeim et al., 2001; Dawson et al., 2016).
- However, an invasive and expensive procedure is not practical for a reading intervention.
- The auricular branch of the vagus nerve can be accessed in a non-invasive way through stimulation of the outer ear (taVNS) and activate similar deep brain structures as cVNS (Frangos, Ellrich, & Komisaruk, 2015).
- Recent work in our lab provides evidence that taVNS paired with training can improve novel letter-sound learning (Thakkar et al., under review).
- The aim of the current study was to investigate the effect of taVNS on reading comprehension in typically developing readers.



Participants and Design

Assessment	Sham	Active	T-Statistic
Sample (# Females)	11 (8)	11 (8)	
Age	20.59 ± 2.58	19.11 ± 0.90	1.80
Kaufman Brief Intelligence Test II: Matrices	99.82 ± 9.46	102.91 ± 10.30	0.73
Sight Word Efficiency	106.55 ± 12.72	104.64 ± 13.50	0.34
Phonemic Word Efficiency	108.55 ± 7.06	112.27 ± 7.23	1.22
Word Identification	104.27 ± 6.51	109.27 ± 9.84	1.41
Word Attack	96.55 ± 29.48	102.55 ± 6.76	0.66
Number Letter	9.73 ± 2.20	13.00 ± 2.32	3.40*

* = $p < 0.05$
Standardized scores reported as M ± SD. Control group is sham.

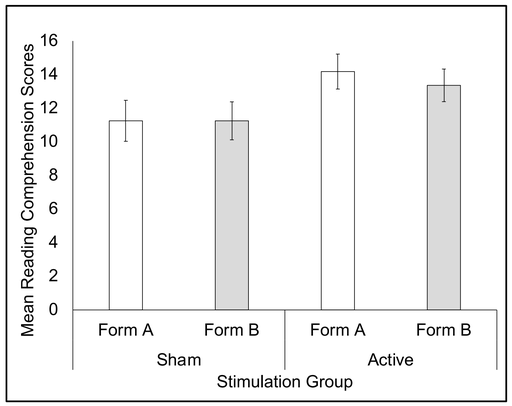
Reading Task

Thresholding → Sample Passage → Passages 11-16 → Sample Passage (2nd Form) → Passages 11-16 (2nd Form)

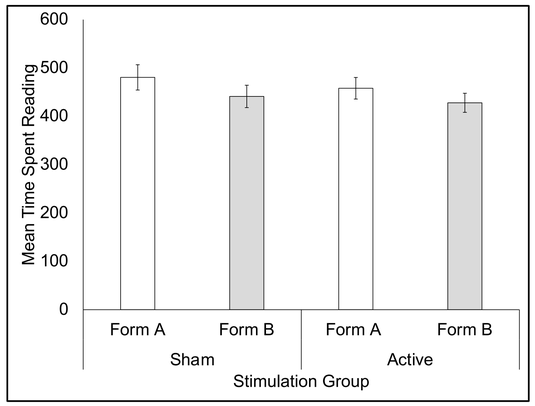
There are sundry definitions of jazz, all of them vague. Their vagueness seems imperative, however, if they are to accommodate the custom of jazz to appropriate everything in sight. This receptivity to sources derives from a dominant feature of jazz: improvisation. The emphasis on improvising entails an openness to the entire legacy of diverse musical elements. Although formulating the content of jazz is not feasible, there is little difficulty in pinpointing the group that spawns the music. Jazz musicians have always constituted a subculture of music, a cultish but scarcely organized body of instrumentalists who rarely manage to eke out a livelihood from their music. Until recently they have been unschooled in their chosen music, except as they have imitated recordings of other musicians. Never accepted by academics, only partially accepted by the public, jazz musicians comprise a closed community in which innovation and experimentation are more valued than tradition.

#	Score	Question	Correct Response
1		What does the story state as to why jazz is difficult to define?	Tends to absorb other types of music; composed of different elements; jazz appropriates everything in sight
2		Why are jazz musicians probably less organized than other musicians?	Jazz is individualistic; no set rules; music is improvised
3		According to the last sentence of this story, what two elements do jazz musicians value more than tradition?	Innovation and experimentation
4		In the story, what one word described a dominant feature of jazz?	Improvisation
5		According to this story, what group has never accepted jazz?	Academics

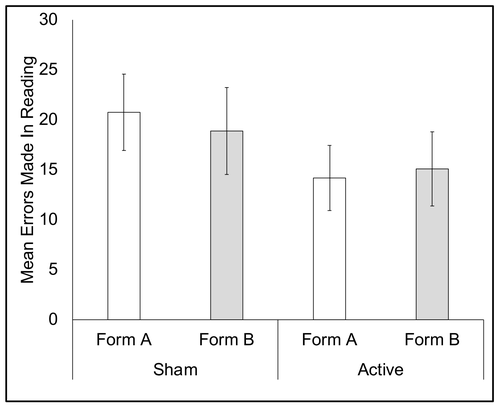
Results



Stim: $F(1,17) = 3.44$, $p = 0.08$
Form: $F(1,17) = 0.31$, $p = 0.58$



Stim: $F(1,17) = 0.31$, $p = 0.59$
Form: $F(1,17) = 70.64$, $p \leq 0.001$



Stim: $F(1,17) = 1.02$, $p = 0.33$
Form: $F(1,17) = 0.09$, $p = 0.77$

Conclusions

- Reading comprehension data suggests that TD individuals who received taVNS stimulation had marginally higher reading comprehension scores than TD sham individuals.
- Individuals spent more time reading Form A than Form B.
- 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 number letter subtest.

Future Directions

- Recruit more participants in order to increase the sample size.
- Perform the study with additional earlobe stimulation and computer control groups.
- Compare active stimulation to sham stimulation in a dyslexia subgroup.
- Create an in-house GORT-5 measure. This ensures that passages contain equal numbers of memory and inferential style comprehension questions.

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