Introduction

- Research shows structural and functional neurological differences between people who stutter (PWS) and controls (Ingham, 2001).
- Psycholinguistic theories (e.g., Postma & Kolk, 1991; Vasic & Wijnen, 2005) account for stuttering as a deficit in the phonological-encoding stage of speech planning.
- Our research replicated findings by Saissekar et al. (2006) that PWS have increased reaction times during phoneme monitoring of the internal speech plan (Garnett & Den Ouden, submitted). In our study also made significantly more errors.
- Functional imaging studies show that LH posterior superior temporal gyrus (pSTG) supports phonological encoding (Indefrey, 2011) and is involved in monitoring internal speech (Den Ouden et al., 2013).
- Neuroimaging methods alone cannot conclude if specific brain regions are crucial for a task.
- High Definition Transcranial Direct Current Stimulation (HD-IDCS) is a non-invasive, focal method of brain stimulation which provides better information about neural involvement (Dmochowski et al., 2011).
- This study had two purposes:
  - First, can we disrupt or enhance task performance in healthy control participants on a covert phoneme detection task?
  - Second, can we ‘normalize’ the performance of PWS on the same task?

Method

Participants

- Presently 11 PWS (6 females, 5 males, mean age 25.5 years) and 5 controls (all females, mean age 22.8 years), all right-handed have participated.

Stimulation Location, Materials, and Task

- Target location was based on activation found in a cluster of 0.278 cl., with peak in left pSTG (Den Ouden et al., 2013; Figure 1).
- Electrode montages were configured using Soterix software (HD-Targets™ and HD-Explorers™; Figure 2).
- Two stimulation conditions (field orientations of left posterior and right anterior) were modeled for max focality using 4 active electrodes and a sham location was modeled separately to ensure adequate blinding (Figure 2).
- After 20 min of stimulation participants completed the monitoring task.
- Participants monitored for the presence of a target phoneme (e.g./pa/) during silent picture naming.
- 28 bisyllabic words were used, with the target phoneme occurring in one of four positions, /CVOCVC/ (e.g. ‘pilgrimage’).

Results

- Stimulation conditions were combined and compared to sham.
- No statistically significant results within either group, however results are preliminary at this time.
- Behavioral results in the sham (no stimulation) condition replicate previous findings: PWS are slower (M=1342ms) and less accurate (M=91.6%) than controls (RT~1204ms; ACC~97%) during phoneme monitoring.
- In controls, as a group, there is a trend for stimulation to slow RT (M=1272ms; Related-Samples Wilcoxon Signed Rank Test p = 0.08), irrespective of field orientation.
- A power analysis conducted using the means and standard deviations from sham vs. stimulation in controls yields an effect size of 0.8, and suggests that with an alpha of 0.05 and power of 0.8, this trend would reach statistical significance with a total sample size of 12.
- A similar power analysis using RT data from PWS suggests that although stimulation increases performance (decreasing RT by 52ms to 1290) this difference is unlikely to reach significance.

Discussion, Conclusions, and Future Analyses

- The present study is the first to investigate direct cortical stimulation effects on monitoring/phonological encoding in PWS.
- Results from the baseline (sham) condition support studies that suggest a phonological encoding/internal speech monitoring deficit in PWS (Postma & Kolk, 1993; Vasic & Wijnen, 2005; Saissekar et al., 2006) as PWS tend to be slower on a monitoring task designed to tap into this level of speech production.
- Tentative results suggest that stimulation of left pSTG affects RT in controls, which lends support to studies concluding this area is important for phonological encoding.
- However, stimulation of this area does not significantly improve performance in PWS.
- Data collection is ongoing with a goal of 20 participants in each group.
- Future analyses include covarying gender and stuttering severity, as well as individual structural scan use for modeling.
- Order effects will also need to be considered, as performance over time appears to be a factor.

References:


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