Does treatment influence speech variability in stuttering?

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Background

- Stuttering: a developmental disorder characterized by involuntary disfluencies[1].
- Adults who stutter (AWS) are at a higher risk for lower quality of life, social anxiety disorder and difficulties with academic and occupational functioning[1,2].
- Disfluencies are noisy and unpredictable[3] but the fluent speech of AWS may provide insight into the nature of disfluencies.
  - AWS have higher variability of speech movements during their fluent speech than typically fluent speakers[3,4,5].
  - Heightened variability is viewed as a link between fluent and disfluent speech that may constitute a biomarker of vulnerability in the speech motor system of AWS.
- Given that stuttering treatment reduces stuttering symptoms[6,7] we predict the variability of fluent speech will decrease post-treatment.
- Speech rate is typically slower in AWS regardless of treatment history. We predict that successful intervention will lead to faster rates of speech[6], that may be associated with a decrease in speech movement variability[8].

Research Questions

- Will the variability of articulatory movements and duration of fluent speech decrease following treatment for stuttering in AWS?
- Will the decrease in variability and duration occur for preferred speech patterns and with therapy techniques?

Significance

Investigating the link between fluency and articulatory variability will bring us closer to identifying the cause of vulnerability.

Methods

Participants:
- Three male AWS were tested before and after intensive stuttering therapy - Age: 20-40 years, right handed, English speakers
  - Treatment involved 3 weeks of daily instruction and practice following the Comprehensive Stuttering Program at the Inst. for Stuttering Treatment and Research (ISTAR).

Procedure:
- Two stimuli with multiple bilabial sounds were produced using preferred speech style:
  - 1) a sentence with real words, "Buy Bobby a puppy"
  - 2) a multi-syllabic nonword, "boblifripawap".
- Speech movements of upper/lower lips were recorded with motion capture system (Optotrak).
  - Measurements were taken at onset of therapy and after 3 weeks
  - Variability of speech using therapy techniques was also recorded in post-therapy session.
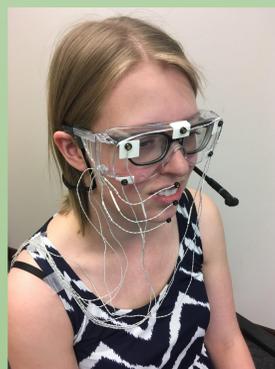
Analysis

- Dependent variables: 1) Spatiotemporal index (STI) is an index of kinematic variability across utterances. The standard deviation of 10 utterances is measured at 50 points and summed. Higher STI values indicate higher variability. 2) The duration of the kinematic traces in seconds.
- Descriptive comparisons of variability and duration are shown for pre-treatment, post-treatment (no techniques) and post-treatment with techniques.
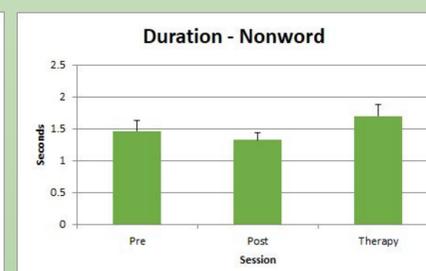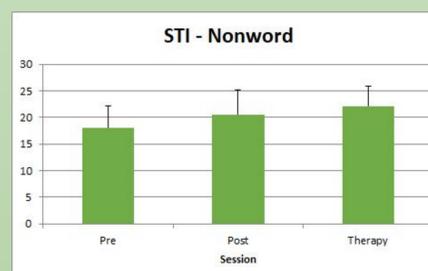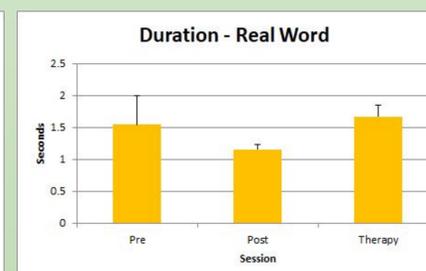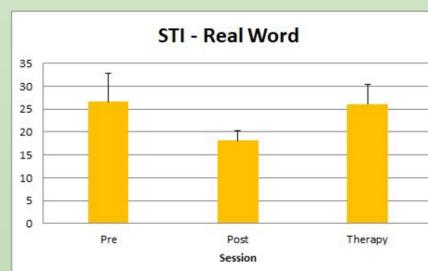
Results

- Each participant successfully completed the treatment program. Disfluency rate decreased to less than 3 per 100 words.
- Variability of the real word utterance decreased after therapy for preferred speech styles
  - No change for therapy techniques.
- The average duration of the real word utterance followed the same pattern
- No changes observed in nonword utterance.

  Overall, AWS fluent and faster in post-session

Discussion

- Speech variability and duration of real words decreased following intervention for stuttering.
- A reduction in variability and increase in rate may indicate preferred speech styles have become more stable.
- The novelty of when therapy techniques were used or for nonwords may involve intrinsically higher variability and require more time. Additional practice may lead to changes that follow the trend for real words.
- AWS fluent, less variable and faster → real world system is adaptable to changes after treatment.

Limitations: 1) Small number of participants; 2) Low generalizability; 3) Lab speaking environment

Future Directions: 1) Continue recruitment; 2) Expand analysis to other stimuli (real words and nonwords); 3) Compare with control group

References

[1]Blumgart, E., Tran, Y., & Craig, A. (2010). Social anxiety disorder in adults who stutter. *Depression and Anxiety, 27(7)*, 687-692.
[2]Iverach, L., & Rapee, R. M. (2014). Social anxiety disorder and stuttering: Current status and future directions. *Journal of Fluency Disorder, 40(Anxiety and Stuttering)*, 69-82.
[3]Usler, E., Smith, A., & Weber, C. (2017). Lag in speech motor coordination during sentence production is associating with stuttering persistence in young children. *Journal of Speech, Language & Hearing Research, 60(1)*, 51-61.
[4]Kleinow, J., & Smith, A. (2000). Influences of length and syntactic complexity on the speech motor stability of the fluent speech of adults who stutter. *Journal of Speech, Language & Hearing Research, 43(2)*,548-559.
[5]Smith, A., Sadagopan, N., Walsh, B., & Weber-Fox, C. (2010). Increasing phonological awareness reveals heightened instability in inter-articulatory coordination in adults who stutter. *Journal of Fluency Disorders, (35)*, 1-18.
[6]Langevin, M., Kully, D., Teshima, S., Hagler, P., & Narasimha Prasad, N. (2010). Five-year longitudinal treatment outcomes on the ISTAR Comprehensive Stuttering program. *Journal of Fluency Disorders, 35*. 123-140.
[7]Tasko, S. M., McClean, M. D., & Runyan, C. M. (2007). Speech motor correlates of treatment-related changes in stuttering severity and speech naturalness. *Journal of Communication Disorders, (40)*, 42-65.
[8]Smith, A., & Kleinow, J. (2000). Kinematic correlates of speaking rate changes in stuttering and normally fluent adults. *Journal of Speech, Language & Hearing Research, 43(2)*, 521-536.