Poster C10, Wednesday, August 21, 2019, 10:45 am – 12:30 pm, Restaurant Hall

Fluency Effects of Novel Acoustic Vocal Transformations in People Who Stutter: An Exploratory Behavioral Study

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INTRODUCTION: Persistent developmental stuttering is a complex motor-speech disturbance characterized by dysfluent speech and other secondary behaviors. Stuttering phenotypes and severity vary across and within individuals over time and are affected by the speaking context. In people who stutter, speech fluency can be improved by altering the auditory feedback associated with overt self-generated speech. This is accomplished by modulating the vocal acoustic signal and playing it back to the speaker in real-time. Most research to date has focused on simple delays and pitch shifts. New embedded systems, technologies, and software enable a re-evaluation and augmentation of the shifted feedback ideas. The current study seeks to explore alternative, novel modulations to the acoustic signal with the goal of improving fluency. METHODS: Fourteen adults who stutter were evaluated. Throughout the study, subjects wore a microphone and earphones connected to a digital signal processing system. Subjects underwent a baseline fluency evaluation consisting of several speech tasks, including spontaneous speech and oral reading. No alterations in auditory feedback were provided during baseline testing. Following this, subjects heard their speech played through the headphones in real-time while they completed a series of shorter speech tasks that included spontaneous speech and oral reading. A series of acoustic manipulations ("modes") were applied to the speech signal in real-time, changing the vocal feedback the subjects received. This included modulations of the fundamental frequency, vocal timbre, and attack/decay characteristics. These modes produced changes in vocal self-perception, including whispering ("whisper"), choral effects with harmonies based on western scales ("harmony"), and changes in reverberation ("reverb"), among others. Stuttering rates (i.e., stutter-like dysfluencies per total spoken syllables) were calculated for each feedback mode and compared across modes. Several control modes were also tested: the pre-testing baseline, a "raw voice" mode (i.e., digital

auditory feedback without signal transformation), and a post-testing conversation. Statistical comparisons were made using Wilcoxon signed rank tests. RESULTS: Ten out of eleven experimental modes (including “raw voice”) yielded improvement in fluency compared with the pre-testing baseline, suggesting most types of headphone-based auditory feedback to be fluency-inducing. Compared with the “raw voice” mode, three feedback modes were associated with statistically significant fluency benefits (“whisper”, “harmony”, and “reverb”), suggesting a fluency benefit of these acoustic transformations beyond that of merely providing feedback. These modes were more fluency-evoking than simple pitch shifts or delays. Post-testing speech was associated with significant improvements in fluency compared to the pre-testing baseline, suggesting the procedure itself to yield persistent short-term fluency benefits even in the absence of ongoing acoustic feedback. This post-testing fluency benefit was robust but significantly less than the modes “harmony”, “reverb”, and “whisper”. CONCLUSION: The study re-demonstrates the well-described fluency benefits of altered acoustic feedback and extends this finding to novel acoustic transformations with stronger effect sizes. While the temporal persistence of fluency in these modes remains uncertain (and requires longitudinal study), the identification of multiple fluency-evoking feedback modes may offer the potential to overcome the habituation effects and intolerable listening experiences that limit the effectiveness of existing feedback technologies.

Themes: Disorders: Developmental, Speech Motor Control
Method: Behavioral

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