Comparing Biofeedback Types for Children with Residual Speech Production Errors on /ɹ/

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Abstract

Errors on speech sounds persist past 8 years of age for approximately 1-2% of individuals (Flipsen, 2015), and some of these errors may be resistant to traditional treatment approaches (e.g., McAllister Byun & Hitchcock, 2012). Parameters influencing the *acquisition* (performance during practice) and *generalization* (performance on untrained tasks) of speech sounds have been identified and applied to speech therapy (e.g., Maas et al., 2008; Preston, Leece, & Storto, 2019). Disordered motor schema are thought to be remediated most effectively through the systematic manipulation of prepractice, practice and feedback parameters: the *principles of motor learning* (Maas et al., 2008).

Knowledge of performance (KP) – detailed feedback about the target movement – is one feedback parameter that may enhance *acquisition* for novice learners with speech sound disorders (Maas et al., 2008). Specifically, biofeedback interventions provide real-time KP about how a speech sound was produced: tongue shape is shown visually during ultrasound biofeedback while the spectral envelope is shown visually during visual-acoustic biofeedback.

The primary aim herein is to determine if one or more children with residual rhotic distortions responded to a course of biofeedback treatment, structured according to the principles of motor learning, and if any responders demonstrated an increased treatment response to either biofeedback modality. Arising from the work of Guenther (2016), ultrasound biofeedback is hypothesized to provide novel information to learners with poorly specified somatosensory targets for a given speech sound, while visual-acoustic biofeedback is hypothesized to provide novel information to learners with poorly specified auditory targets for a given speech sound. As such, one exploratory aim is to highlight patterns between the measured somatosensory ability of participants and their response to each biofeedback modality.

This pilot small-n, single-case experimental study used a within-subject alternating-treatment randomized block design such that, during each visit, children were treated with both

ultrasound biofeedback and visual acoustic feedback (in random order). Data collection for the seven children and adolescents, aged 9;0-15;11, has been completed at two different sites with acoustic analysis (F3-F2 distance; see: Campbell & McAllister Byun, 2018) of speech outcomes in progress. The overall treatment package consisted of twenty sessions focused on speech motor *acquisition* of /ɹ/, distributed across two weekly 110-minute blocks. Treatment was standardized across sites using the Challenge Point Program (McAllister Byun, Hitchcock & Ortiz, in revision), an empirically-validated open-source software program that delivers adaptive, yet standardized, stimulus presentation.

After the ongoing extraction of acoustic data is complete, randomization tests (e.g., Rvachew & Matthews, 2017) will be completed to determine if there is a significant difference in normalized F3-F2 distance across biofeedback conditions at a within-subject level. This same acoustic measure will be utilized to calculate effect size from pre-treatment to post-treatment as a measure of treatment response for each participant. Qualitative and non-parametric comparisons will be made between individuals with high and low somatosensory skills and patterns of response to treatment targeting the auditory pathway and the somatosensory pathway. Insights from this pilot study that can inform a large-n randomized clinical trial will be discussed.

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