Stimulability as a Predictor of Treatment Response in an Ultrasound Biofeedback Study of Rhotic Misarticulation

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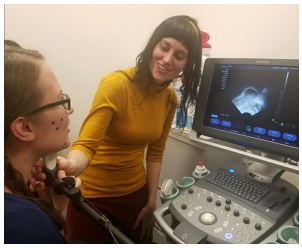
Ultrasound Biofeedback



- Ultrasound biofeedback uses ultrasound technology to provide participants with a visualization of their tongue during speech production.

- Volin (1998) found that visual biofeedback training for breathing was more effective for participants with poor or moderate stimulability and suggested that biofeedback may be disruptive for highly stimulable participants.
- For children with residual /ɹ/ misarticulation, we expect ultrasound biofeedback to increase stimulability. However, it is possible that higher rates of stimulability could be a negative prognostic indicator. Therefore, we explored the relationship between stimulability and response to ultrasound biofeedback treatment.

Research Questions

1. Does stimulability increase over the course of ultrasound biofeedback treatment?
2. Does a participant's performance on a stimulability probe at pre-treatment predict their magnitude of change over the course of treatment?
3. Is stimulability related to the participant's phonological awareness or auditory acuity (Powell & Miccio, 1996)?

Methods

- Participants: 34 American English speakers aged 9-15 with residual /ɹ/ misarticulation
- Participants completed a 10-week treatment study:
  - 1 week intensive traditional (three 60-min sessions)
  - 1 week intensive ultrasound biofeedback (three 60-min sessions)
  - 8 weeks low-intensity ultrasound biofeedback (two 40-min sessions)
- Stimulability Probe (adapted from Miccio 2002):
  - Included in a battery of tasks administered before and after treatment
  - A visual and auditory model was provided, and participants were asked to produce their "best /ɹ/ sound."
  - Stimuli differed from all other study targets
  - 15 syllables/disyllables: ree, ray, rai, roo, row, ra, ear, air, ire, or, ar, our, mer, der, erg
- In the present study, stimulability is measured in terms of normalized mean F3-F2.

References

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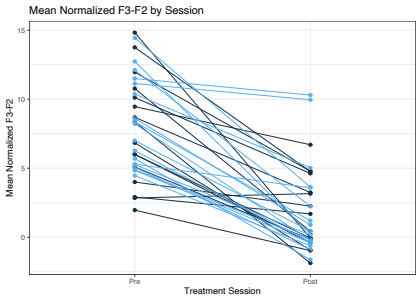
Stimulability

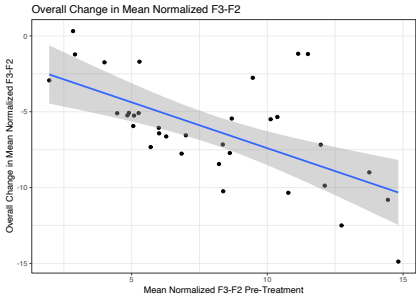
- Stimulability is an assessment of a participant's phonetic knowledge based on their ability to correctly imitate a sound when given a visual and auditory cue (Miccio 2002). The same probe was administered before and after treatment to assess the magnitude of participants' speech-motor learning.

Main Findings

1. Yes: Normalized mean F3-F2 on the stimulability probe significantly decreased over the course of treatment (β=-4.35, SE = 0.56, r^2= .47, $p < 0.0001$). A lower F3-F2 indicates greater acoustic accuracy. Figure 1 shows that most participants become acoustically more accurate from pre to post treatment.



2. Yes: Participants who were less acoustically accurate at baseline made significantly greater gains, i.e. larger reduction in F3-F2 distance (β= -0.6, SE = 0.14, r^2 = .38, p=0.0001). Consistent with Volin (1998), participants who were more stimulable at pre-treatment showed a smaller magnitude of improvement.



- Is this just a ceiling effect?
  - One participant who was an outlier (> 3 SD from other participants in acoustically measured accuracy at pre-treatment) was excluded to avoid ceiling effects.
  - All participants included in the present analysis were well below ceiling-level accuracy (i.e., less than 60% of productions rated perceptually correct).

3. No: Neither participants' phonological awareness nor auditory acuity were significantly correlated with normalized mean F3-F2.

Looking forward: In this study, high stimulability was associated with less progress, but previous non-biofeedback treatment literature has found conflicting results (Powell et al., 1991; Sommers et al., 1967). We plan to analyze whether stimulability behaves differently as a predictor of response to ultrasound biofeedback versus traditional treatment.