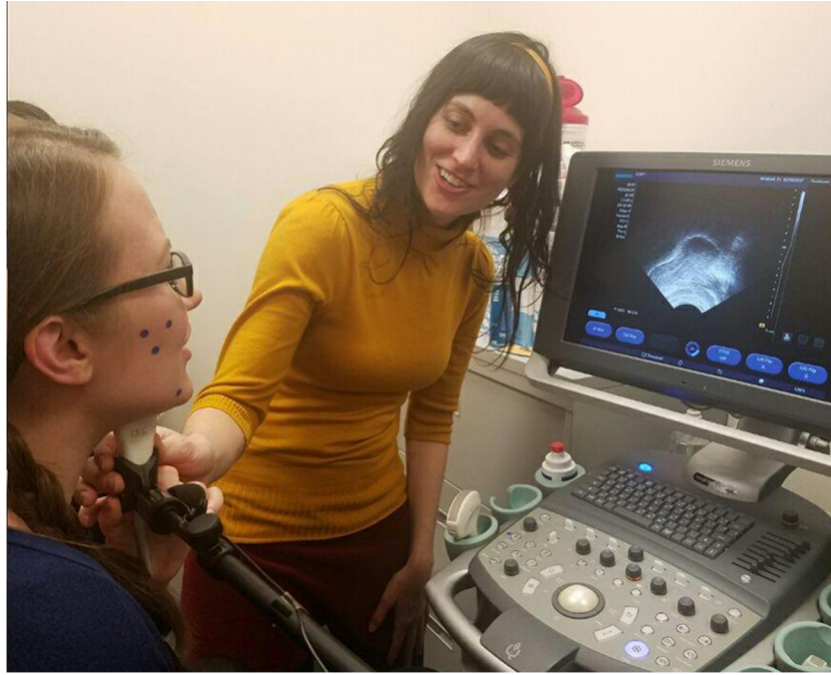


Stimulability as a Predictor of Response to Traditional and Ultrasound Biofeedback Treatment for Rhotic Misarticulation

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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 in a respiratory control task was more effective for participants with poor or moderate stimulability and suggested that biofeedback may be disruptive for highly stimuable participants.
- For children with residual /ɹ/ misarticulation, we expect ultrasound biofeedback to increase stimulability.
- However, it is possible that higher baseline stimulability could be a negative prognostic indicator for biofeedback.
- Therefore, we explored the relationship between stimulability and relative response to traditional versus ultrasound biofeedback treatment.

Research Questions

1. Does stimulability increase over the course of traditional and ultrasound biofeedback treatment?
2. Does a participant's performance on a stimulability probe at pre-treatment predict their relative magnitude of change over the course of traditional and biofeedback treatment?
3. Is stimulability related to the participant's phonological awareness or auditory acuity (Powell & Miccio, 1996, Preston et al., 2019)?

Methods

- Participants: 33 American English speakers aged 9–15 with residual /ɹ/ misarticulation
- Participants completed a 10-week treatment study:
 - 1 week intensive traditional (three 90-min sessions)
 - 1 week intensive ultrasound biofeedback (three 90-min sessions)
 - 8 weeks lower-intensity ultrasound biofeedback (two 60-min sessions)
- Stimulability probe (adapted from Miccio 2002):
 - Clinician provided visual and auditory model and asked participants 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*
- We measured phonological awareness using CTOPP-2 and auditory acuity using a categorical perceptual task described by McAllister Byun & Tiede (2017).
- In the present study, stimulability is measured in terms of normalized mean F3–F2 (Campbell et al. 2018).

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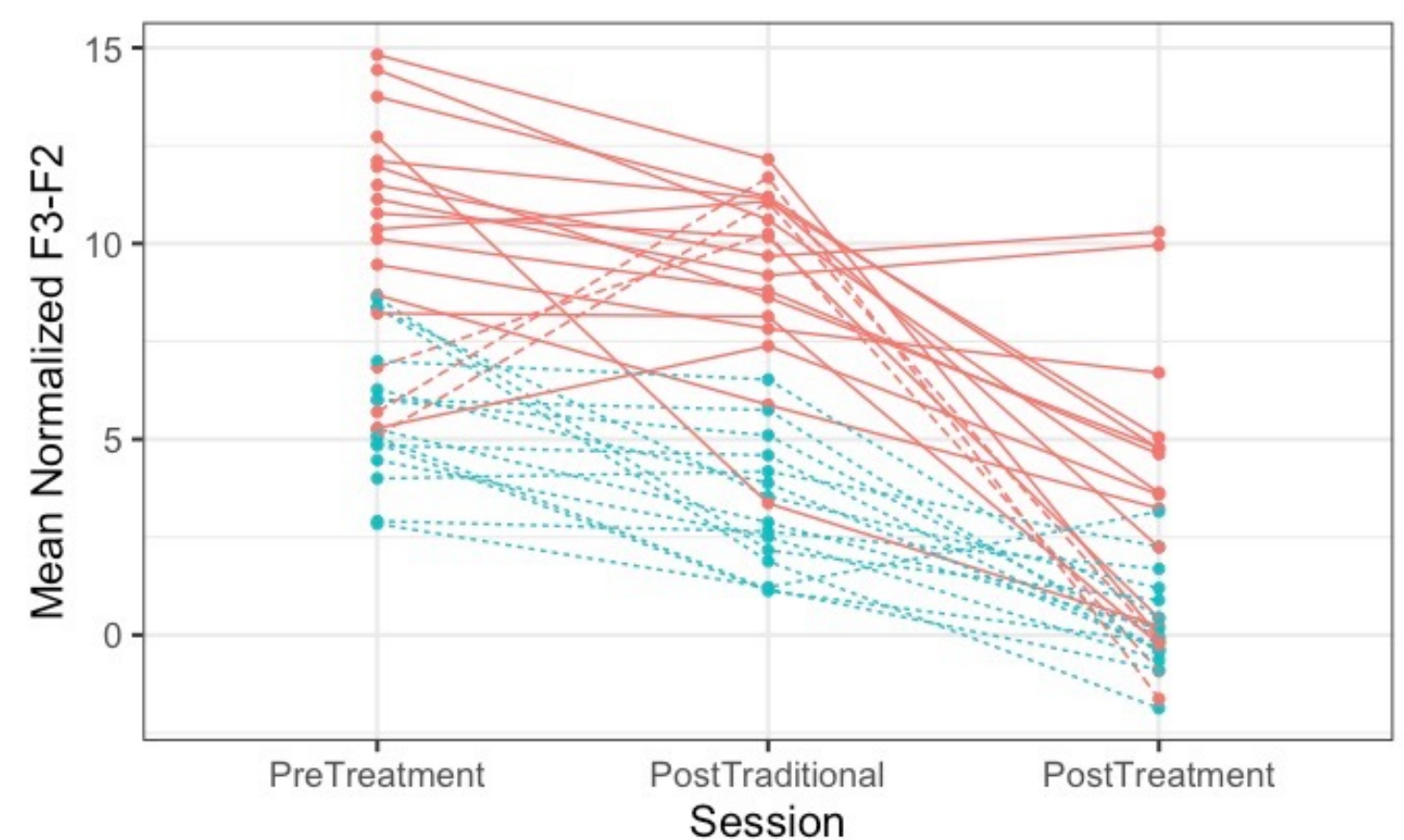
Stimulability

- 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 all treatment, after one week of intensive traditional treatment, and after ultrasound treatment to assess the magnitude of participants' speech-motor learning.

Main Findings

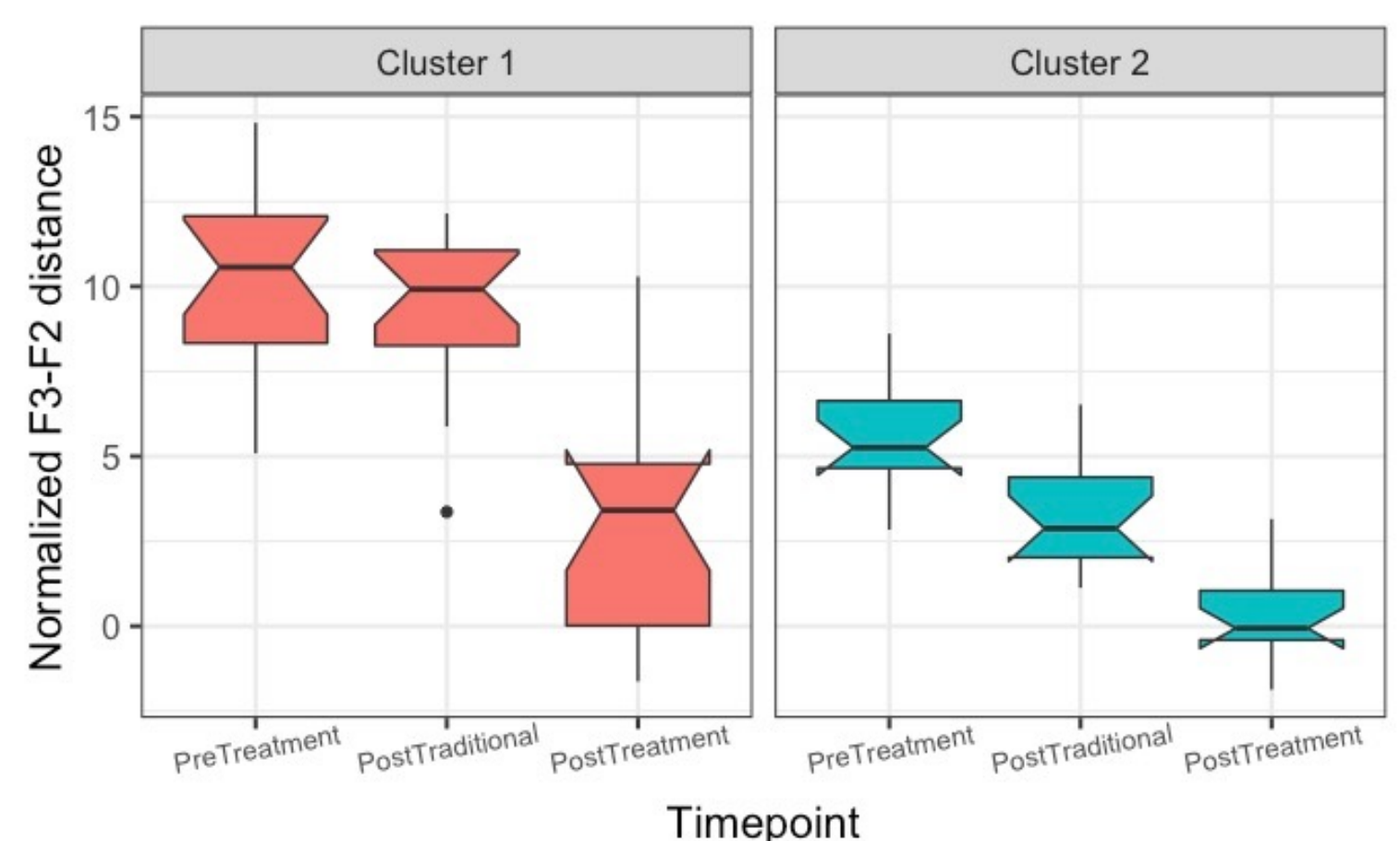
1. Yes, stimulability increases overall:

- Normalized mean F3–F2 on the stimulability probe significantly decreased over the course of treatment ($\beta = -4.35$, $SE = 0.56$, $r^2 = .47$, $p < 0.0001$).
- A lower F3–F2 indicates greater acoustic accuracy.



2. Yes, relative magnitude of change is predictable:

- A model-based clustering analysis identified two groups within our data:
 - Cluster 1 = Low stimulability at baseline
 - Cluster 2 = High stimulability at baseline
- The low-stim group made minimal progress in traditional treatment but improved in biofeedback.
- The high-stim group showed similar amounts of progress in traditional and biofeedback phases.



3. No correlations with predictors:

- Neither participants' phonological awareness nor auditory acuity were significantly correlated with normalized mean F3–F2.

Looking forward: Consistent with Volin (1998), participants who were more stimuable at baseline showed a smaller relative response to biofeedback treatment. A third potential trend of response was identified (dotted red lines in figure 1). Future research should use larger sample sizes to explore differences between these groups and predictors of their response to different treatment types.