Effectiveness of Speech Motor Chaining Treatment with Biofeedback Versus Traditional Articulation Approach for Intervention of Residual Rhotic Speech Errors

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Introduction

Speech sound disorders (SSD), with a prevalence rate of 2.3% and 24.6%, are one of the most common communication disorders in children and represent a large portion of caseloads for speech-language pathologists (SLP) (Sugden, Lloyd, Lam, & Cleland, 2019). One of the reasons /r/ is commonly misarticulated is due to tongue constrictions not being easily visible and lack provision of tactile or kinesthetic feedback for the individual to produce the sound (McAllister Byun & Hitchcock, 2012). Variability in tongue shape and complexity across contexts for rhotic sounds can make this target difficult to remediate in children with speech sound disorders.

Residual speech errors can impact an individual's intelligibility or social acceptability which may lead to negative socioemotional consequences making effective intervention essential (Hitchcock & McAllister Byun, 2015). Studies have shown that a relatively high rate of practice trials in speech therapy can be beneficial for learning (Preston & Soto, 2019). Currently, there is limited evidence comparing traditional articulation approach with more intensive structured chaining approaches such as SMC. Traditional articulation approach, which focuses on phonetic perceptions when given an auditory model, may be difficult for individuals with SSDs to distinguish (Shuster, 1998). With acoustic-visual biofeedback providing real-time lingual information about an individual with SSDs productions, it may be beneficial as an additional form of performance feedback during intervention. Lastly, recent research on the effectiveness of traditional articulation approach for generalization for individuals with SSDs is limited which brings to question why many SLPs continue to utilize this approach.

Current approaches, such as speech motor chaining (SMC) or the use of visual-acoustic biofeedback, with foundations in principles of motor learning may bridge the gap from acquisition to generalization for individuals with residual speech sound errors. The current outcome study aimed to examine the following clinical question: In school-aged children with residual rhotic speech sound errors, is visual biofeedback during speech motor chaining therapy more effective in improving speech sound accuracy than traditional articulation therapy?

Research Question

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Motor Learning Approaches for SSDs

Traditional Approach

- Aims to improve intelligibility in the speech of children with SSDs through the following vertical hierarchy: single sound in isolation, syllable level, word level (initial, medial and final), phrase level, sentences, reading paragraphs and conversational level (Van Riper, 1939)

Visual-Acoustic Biofeedback

- Provides a real-time visual representation of an individual's physiological performance during speech by plotting out the specific frequencies and formants of each vocal production.

Speech Motor Chaining

- Training speech movement patterns by establishing accurate production of speech sounds followed by structured levels of speech motor learning using feedback about both acoustic qualities of speech and articulatory actions (Preston, Leece, & Storto, 2019)

Methods

Participant:

- "Abby" (pseudonym), an 8-year old female
- Attending speech therapy since since October 2016 due to concerns with speech intelligibility (began at UNC Clinic in June 2018)
- Receives speech-language services 2x per week for 45 minutes at the UNC Speech-Language Pathology and Audiology Clinic

Treatment 1: Traditional Articulation Approach

- Targets: /ra/, /ri/
- Procedure:
  - Prevocalic /r/ targets were elicited in the initial position at the word level through drill practice
- Schedule:
  - 10 flashcards of each target, repeated 3x each

Treatment 2: Speech Motor Chaining with visual-acoustic biofeedback

- Targets: /ra/, /ri/, /gr/, /dr/
- Procedure:
  - SMC training: elicit targets along five practice level blocks: syllable (containing at least one consonant and vowel), monosyllabic words, multisyllabic words, phrases and self-generated sentences
  - Each block contained 6 trials
  - Use of visual-acoustic biofeedback via the *Speech Therapist's App for /r/ Treatment (staRt)* (Byun et al., 2017)
- Schedule:
  - SMC protocol: At least 5 out of 6 trials must be accurate to continue in the chain

Results

Results show that a clinical change was evident in Abby's accuracy in /r/ targets. Results suggest that both therapy approaches were effective for treatment of rhotic errors for Abby. However, it is important to note that the results from SMC treatment suggest greater gains across various linguistic complexities.

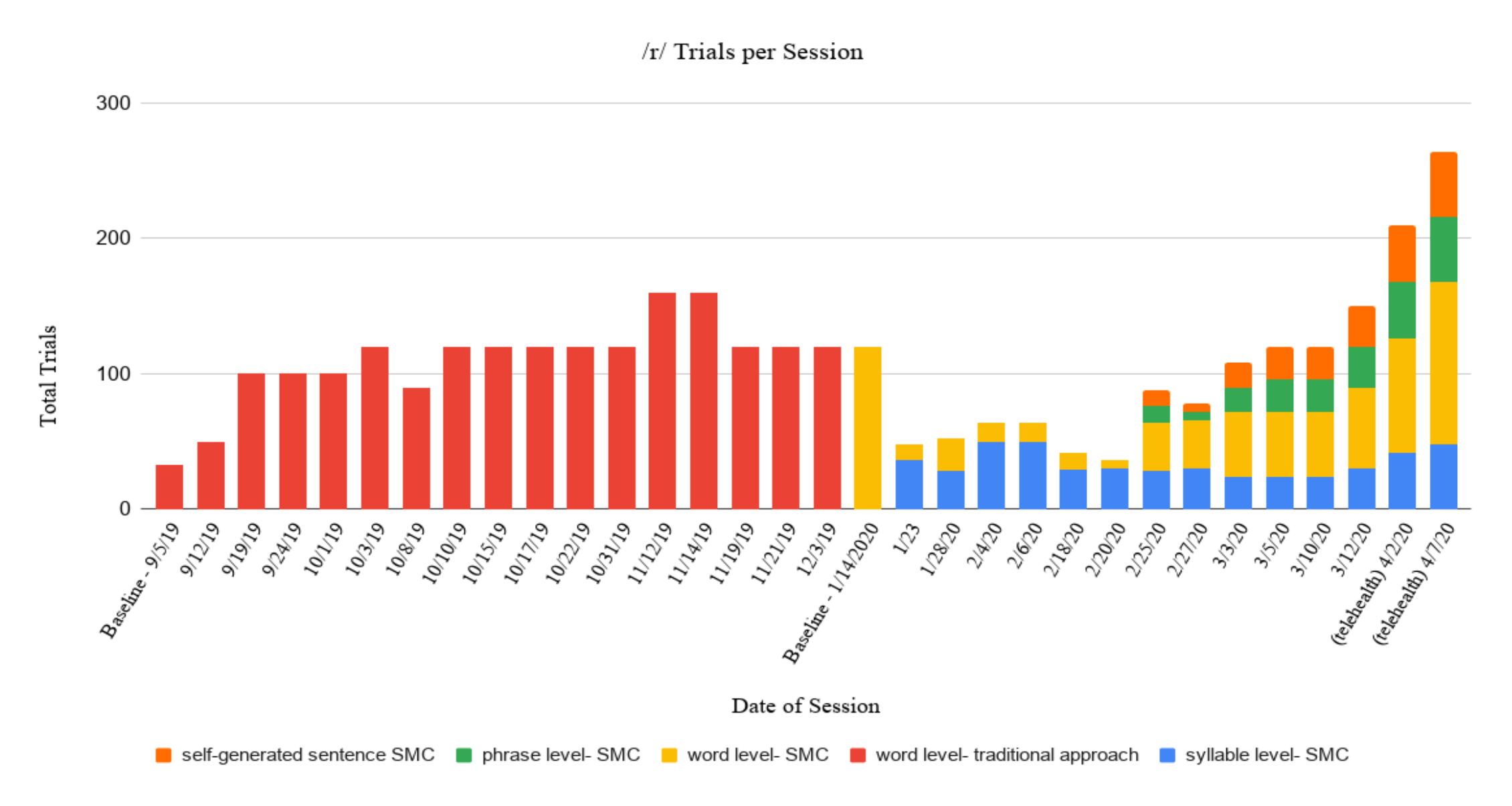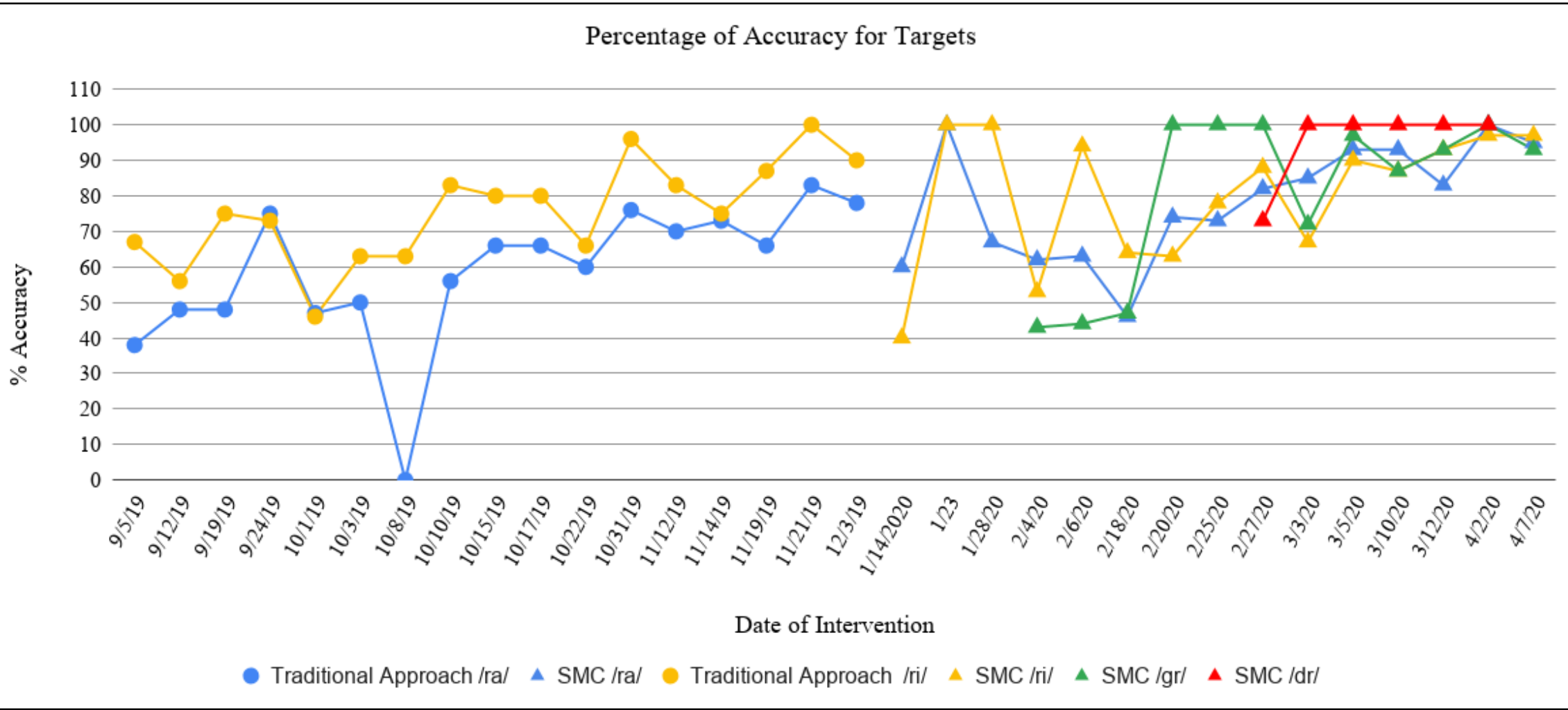*Figure 1. Total /r/ trials per session*

Figure 2. Comparison of Accuracy for Treatment Targets

Implications for SLPs

Traditional motor approaches require learners to achieve a predetermined criterion (i.e. 80% accuracy) prior to moving to a more complex task. SMC provides a more adaptive framework that quickly adjusts based on the success of the learner. This intensive approach may improve speech sound accuracy for individuals with residual speech sound errors. Evidence suggests that this approach can achieve speech sound acquisition and generalization with the addition of visual-acoustic biofeedback. Intensive treatment may provide high dosage of treatment which can be advantageous to unlearn motor patterns in error and replace it with a new pattern. SMC allows for expanding linguistic and prosodic complexity in addition to variability in feedback type and frequency thus leading to a greater potential for generalization. When complemented with motor-based approach, visual-acoustic biofeedback could provide individuals with residual rhotic errors with the additional feedback they need and would not be gaining with traditional therapy alone.

References available upon request