

Session #: 8738

Topic Area: Speech Sound Disorders in Children

Day/Time: Friday, November 13, 2015 from 2:30 PM to 4:00 PM

Title: Accuracy & Consistency of Oro-Facial Prompting for Speech

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Learning outcomes:

1. Discuss the use of electromagnetic articulatory tracking system to assess accuracy and consistency of oro-facial prompting.
2. Discuss oro-facial prompting as a quantifiable skill using accuracy and consistency metrics.
3. Discuss differences in accuracy and consistency of oro-facial prompting as a function of S-LP skill level and training.

Aim: The Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT; e.g. Dale & Hayden, 2013) is a motor speech treatment approach that entails the hierarchical establishment, refinement and integration of normalized movement patterns within several speech subsystems (e.g., mandibular control, labial-facial control, lingual control) through the use of tactile-kinesthetic-proprioceptive (TKP) inputs or prompts to the client's speech articulators (mandible, facial and lingual musculature). The importance and role of TKP inputs delivered by a speech therapist, as during motor speech intervention, is highlighted in a recent study by Dale & Hayden (2013). The PROMPT intervention involves the learning of specific hand orientations, finger placements to target certain oro-facial muscles, control jaw height and so on. TKP feedback is responsible for the acquisition and maintenance of sensory-motor mapping and for the stable execution of movement in speech-motor production (Guenther, 2006). Thus, it is critical that a speech-language pathologist (S-LP) delivering TKP inputs within a sensory-motor treatment framework (e.g., PROMPT) is both accurate and consistent with these inputs. The purpose of the present pilot study was twofold: (a) to evaluate the accuracy and consistency of oro-facial prompting cues by S-LPs and the resulting passive oro-facial movements, and (b) to determine whether or not differences exist in accuracy and consistency as a function of S-LP skill level and training.

Methods:

Participants: Two S-LPs (ID: J.H. Female 25 yrs - 8 months PROMPT experience, completed introductory level training; ID: D.H. Female 70yrs - 35 years of PROMPT experience, Instructor level) provided the prompts in the study, while a 23-year old female with no self-reported speech, language or hearing difficulties served as the participant.

Stimuli: Vowels /i, a, u/ were produced in isolation and in a sequence /ta, ti, ta, tu/ in succession.

Procedures: All Kinematic data were collected with the Electromagnetic Articulograph (AG501; Figure 1) across two days and spaced one week apart. Nine sensors were attached on the participant using a cyanoacrylate-based glue (PeriAcryl®90-3) at the following sites: mandible, tongue tip, tongue body, tongue dorsum, nose bridge, behind the left and right ear mastoid and two sensors 1.5 cm symmetrically on either side of the philtrum on the upper lip. Further, six sensors were placed on the S-LP providing the prompts in the following manner: one each on the thumb, index finger and middle finger and three reference sensors on the dorsal part of the hand. All movement data and acoustic signals were recorded at 250 Hz and 48 kHz, respectively. The movement data were processed with the

“EGUANA” Matlab toolbox (Henriques & van Lieshout, 2013). Movement data were recorded under (a) *active condition*: where the participant repeated the stimulus for approximately 10 times at a self-paced comfortable rate, or (b) *passive condition*: where the participant was passive and the movements were generated solely by the action of the S-LP’s fingers; e.g., depressing the jaw (for vowels) or rounding/retracting the participant’s lips.



Figure 1. Movement data were recorded. Electromagnetic Articulograph system (AG501).

Dependent variables:

Accuracy: Jaw height (in mm) for vowel /a/ was measured when the (active) participant generated mandibular excursion and (passive) whilst S-LP manipulated the participant’s jaw height. Accuracy was estimated by plotting the S-LP generated passive jaw movements for vowel /a/ over the 95% confidence intervals (CI) derived from the participant’s active jaw movements.

Consistency: Kinematic consistency measure was indexed using the cyclic spatio-temporal variability index (cSTI; Van Lieshout et al., 2007), with movement cycles operationally defined as peak-to-peak or valley-to-valley trajectory cycles related to euclidean distance between the two sensors placed 1.5 cm symmetrically on either side of the philtrum on the upper lip. The displacement records for /ti/ (lip retraction) and /tu/ (lip rounding) gestures were time (to 1000 points) and amplitude normalized (*z-score* transformed). From these records, 50 standard deviations were obtained at 2% intervals on the normalized axis and then summed to give the cSTI score. Additionally, a cSTI measure based on velocity trajectories were derived from numerical differentiation of the net distance between the thumb and index finger of the S-LP providing the prompts.

Results & Discussion:

The accuracy data revealed that D.H.’s (more experienced with PROMPT intervention) induced passive jaw excursions were most often (8 of 10 attempts) within the 95% CIs of active jaw movements made by the participant. In comparison, none of J.H.’s (less experienced with PROMPT intervention) induced passive jaw excursions were within this range, either on day 1 or day 2 of testing (Figure 2). Consistency findings derived from the thumb and index finger of the S-LP’s providing the prompts indicated that both D.H. and J.H. had multi-peaked velocity trajectories that resulted in high cSTI values (J.H./ti/ = 41.36, D.H. /ti/ = 28.3; J.H. /tu/ = 25.67, D.H. /tu/ = 29.22). The presence of multi-peaked velocity trajectories is indicative of a sensory feedback-driven motor control strategy (Adams et al., 1993), possibly to allow for online hand/finger adjustments during prompting.

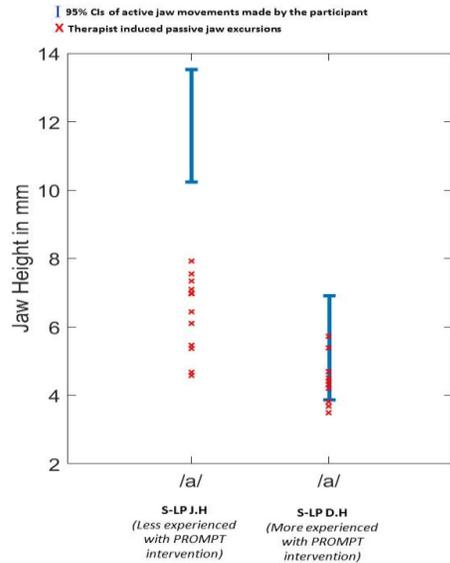


Figure 2. S-LP generated passive jaw movements for vowel /a/ plotted over the 95% CI derived from the participant's active jaw movements.

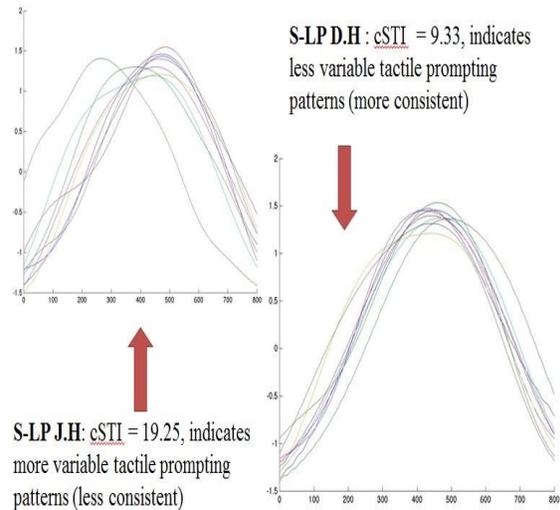


Figure 3. cSTI based on upper lip displacement trajectories from sensors placed symmetrically on either side of the philtrum.

Interestingly, the resulting passive oro-facial movements demonstrated that D.H.'s cSTI values related to lip rounding (/tu/ day 1 = 12.6 and day 2 = 10.1) and lip retraction (/ti/ day 1 = 11.4 and day 2 = 9.3) gestures were lower than J.H.'s values (/tu/ day 1 = 19.4 and day 2 = 18.3; /ti/ day 1 = 11.4 and Day 2 = 19.2), both within and across days (Figure 3). Overall, these preliminary findings indicate that a S-LP with more prompt intervention experience is not only more accurate in judging the range of jaw motion of a participant, but is also more consistent in inducing oro-facial movements in a participant, both within and across days, relative to a S-LP with less experience. The results from this preliminary study suggest that providing adaptive oro-facial sensory cues/prompts to induce accurate and consistent passive oro-facial movements may require considerable practice and advanced clinical training.

References:

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- Dale, P., & Hayden, D. (2013). Treating speech subsystems in CAS with tactual input: The PROMPT approach. *American Journal of Speech Language Pathology*, 22(4), 644-661.
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