Preliminary Data on the Use of Type of Feedback in the Training of a Novel Speech Sound

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Disclosure

- There are no relevant financial or nonfinancial relationship(s) within the products or services described, reviewed, evaluated or compared in this presentation.
Learning Outcomes

- Compare and contrast traditional approach to articulation with the proposed approach that utilize limb motor learning principles.
- Describe schema theory and the establishment of a Generalized Motor Program
- Provide examples of verbal feedback that could help clients retain and generalize target speech sounds
- Access literature that supports the use of limb motor learning principles for the speech sound production training and speech language therapy
Articulation treatment may involve demonstrating how to produce the sound correctly, learning to recognize which sounds are correct and incorrect, and practicing sounds in different words.

http://www.asha.org/public/speech/disorders/SpeechSoundDisorders/
Biomechanical Feedback: fosters knowledge of the process (KP)
  ◦ Direct instruction in phoneme production (Klein, 1995)

Examples
  ◦ “Put your tongue tip on your teeth and blow lightly.”
  ◦ “Press your lips together tightly.”
  ◦ “Bring the back of your tongue to your hard palate.”
What is Motor Learning?

- A set of processes associated with practice or experience leading to relatively permanent changes in the capability for movement
  - Inferred, not observed directly
  - Result of practice/exposure

(Schmidt & Lee, 2005)
Generalized Motor Program

Recall Schema → Recognition Schema

Recall Schema

Recognition Schema
Principles of Motor Learning (PML)

- Motor sequences are developing schema
  - Establish initial conditions
  - Timing/amplitude of muscle contractions
  - Proprioception
  - INDEPENDENTLY evaluate outcome
PML: Promote Retention and Transfer

- Fosters knowledge of the *result* (KR)

- *PML for feedback*
  - Low frequency (not high)
  - Delayed (not immediate)
  - Self-controlled (not instructor-controlled)
  - Knowledge of Results (not knowledge of performance)

- *PML with practice*
  - Increase amount
  - Distributed (not massed)
  - Variable (not constant)

(Maas et al., 2008)
Current Research

- Hula and colleagues, 2008
  - Frequency of feedback
  - Results: low frequency feedback most effective

- In-Sop and colleagues, 2012
  - Manipulation of practice aspects
  - Results: delayed, reduced feedback most effective
Purpose of Study

- Evaluate *type of feedback* in the training of a novel speech sound.
  - Traditional (BIO) feedback
  - Motor Learning (PML) feedback

- University of Hawaii at Manoa IRB #21219
Research Question

- Which articulation training approach (BIO or PML) most effectively helps native English speaking adults retain and transfer the novel sound [ɬ]?

  - $H_A$: Participants receiving articulation training in the PML group will produce [ɬ] with greater accuracy as compared to participants in the BIO group at both the retention and transfer time points.
  
  - $H_0$: There will be no difference between articulation training approaches in the accuracy of productions of [ɬ] at the retention and transfer time points.
Participants

- N = 12
  - BIO: 4F, 2M
  - PML: 5F, 1M
- 18-35 years old
  - BIO: $M = 29.5$, $SD = 4.5$
  - PML: $M = 28.2$, $SD = 4.2$
- No neurologic pathology
- No speech, language, or hearing disorders
- Never experienced speech-language therapy
- English speakers
Procedures

- Materials/Procedures
  - Screening
    - Oral Mechanism Examination (Shipley & McAfee, 2008)
    - Articulation/Language Screening (GFTA-2, CELF-3 Screener)
    - Language and Music Training Hx
      - Matched pair → randomly assigned to BIO or PML
  - Timeline of Experimental Procedures
    - Pre-training (baseline)
    - Training
    - Post-training
    - Retention – 50 minutes after post-training
    - Transfer
Training Target

- Novel sound $\rightarrow /ɬ/ $
  - Voiceless alveolar lateral fricative
  - Appears in Navajo
    - (Ladefoged, 2005)

- 1.5-2.5-hour session
  - Training in trials of 10, stopped at 90% accuracy
Stimuli

- Vowels: /æ, i, u, ɑ/
- Pre, Post, Training, Retention
  - $V_1C_{V_1}$: /æ ɬ æ/
- Transfer
  - $V_1C_{V_2}$: /i ɬ u/
## Feedback Statements

<table>
<thead>
<tr>
<th>BIO group (KP)</th>
<th>PML group (KR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull your cheeks back and open your mouth as if you’re smiling.</td>
<td>That’s good. That was the target response.</td>
</tr>
<tr>
<td>Put the right and left edges of your tongue along your molars.</td>
<td>You’ve missed the target response.</td>
</tr>
<tr>
<td>Spread your tongue out so you have it on both sides of your mouth.</td>
<td>That’s not bad.</td>
</tr>
<tr>
<td>Make sure the sides of your tongue are down.</td>
<td>Direct the airstream over the sides of your tongue.</td>
</tr>
<tr>
<td>Bring your tongue tip up- it should be inside your mouth against that bumpy ridge.</td>
<td>You shouldn’t hear a buzzing sound; you should only feel the airflow.</td>
</tr>
</tbody>
</table>
- Baseline data established
Pre-training

Training
- Feedback given to participants randomly; rate: after 50% of responses
- Training STOPPED after participants reached 90% accuracy

Post-training

Retention

Transfer
Pre-training

Training

Post-training

• Post-training data collected

Retention

Transfer
• Retention data collected
• Target sound production in a different phonetic context
Variables

- Dependent variable: accuracy of [\( \bar{\text{I}} \)]
- Independent variable:
  - Between-subjects: Group (BIO or PML)
  - Within-subjects: Time (pre-training, post-training, retention, and transfer)

Analysis plan

- Descriptive statistics
- Difference Scores (change from baseline)
  - Mixed ANOVA (significance set at \( p < .10 \))
BIO: Accuracy (%) over Time

PRE POST RETENTION TRANSFER
PML: Accuracy (%) over Time
Mean Accuracy (%): Group x Time

<table>
<thead>
<tr>
<th></th>
<th>PML</th>
<th>BIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE</td>
<td>20.8</td>
<td>44.3</td>
</tr>
<tr>
<td>POST</td>
<td>86.7</td>
<td>81.1</td>
</tr>
<tr>
<td>RTN</td>
<td>90.2</td>
<td>65.7</td>
</tr>
<tr>
<td>TRANSFER</td>
<td>86.1</td>
<td>56.7</td>
</tr>
</tbody>
</table>

PRE, POST, RTN, TRANSFER

PML, BIO
Results

- **Difference Scores**
  - How much improvement/decline did the participant have over time in comparison to baseline?
    - 1. post – pre
    - 2. retention – pre
    - 3. transfer – pre

- **Mixed ANOVA**
  - *Group*: $F(1, 10) = 4.378, p = .063$, partial $\eta^2 = .304$
  - *Time*: $F(2, 20) = 2.928, p = .077$, partial $\eta^2 = .227$
  - *Time x Group*: $F(2, 20) = 2.942, p = .076$, partial $\eta^2 = .227$
Accuracy (%) Difference Scores

- **POST**: 65.9 (PML) vs. 36.8 (BIO)
- **RETENTION**: 69.4 (PML) vs. 21.4 (BIO)
- **TRANSFER**: 65.3 (PML) vs. 12.4 (BIO)

★ indicates a significant difference.
Paired Comparisons

- PML vs BIO Post: $p = .2406$
- **PML vs BIO Retention: $t(10) = 2.3427, p = .0411$**
- **PML vs BIO Transfer: $t(10) = 2.5543, p = .0287$**

- PML: Time ($p = .433$)
- BIO: Time $F(2, 10) = 3.16, p = .086$
  - Post-Retention: NS
  - **Post-Transfer: Sig**
  - Retention-Transfer: NS
Results Summary

- PML and BIO increased performance after training of target sound compared to pre-training.
- PML demonstrated less variability in accuracy compared to BIO.
- PML exhibited significantly higher accuracy in the production of the target sound at retention and transfer than participants in BIO.
- PML maintained gains in accuracy while BIO lost gains at retention and transfer.
Discussion

- Preliminary data
  - KR feedback facilitates better transfer and retention of a novel speech sound than KP feedback
  - Clients are NOT told what to do with their articulators, and are able to develop their own GMPs for novel sound production.
  - This could lead to better long-term learning of novel motor sequences
Recommendations for the Clinician

- Consider and *understand* these principles.
  - Differentiate between *training* and *transfer*!
    - Where does “80% accuracy” get a client after session is over?
- Stay tuned to literature - this is a shift in framework
- How do you give feedback?
  - Can you put more responsibility on clients to formulate their own internal representation?
- Speech-language therapy shouldn’t always be comfortable
  - Consider how to change the environment to promote the retention and transfer outside of the therapy setting.
Study Limitations

- Small Sample
- Auditory-Perceptual Judgment
  - Was I really consistent in judging accuracy?
  - Some would say this is “gold standard”
- Providing Models
  - Did a visual cue help?
- Human Error
  - Did I provide non-verbal cues to participants?
References

References

- MacNeilage (1977) in Kent and Minifie, p. 123 (waiting on specifics from Dr. Colette Coleman)
References

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