What is biofeedback?

- “Biofeedback is a means of supplying an individual with information that is not normally available at a conscious level” (Shuster, Ruscello & Toth, 1995, p. 37)
- See David Ruscello’s body of work for a review in the area of speech production
- Recent surge of literature in the area of electropalatography and ultrasound.

Why use biofeedback?

<table>
<thead>
<tr>
<th>Theoretical motivation</th>
<th>Empirical Support</th>
<th>Clinical Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>• DIVA model</td>
<td>• Growing support for visual biofeedback</td>
<td>• Used for decades in many areas of SLP despite limited data</td>
</tr>
<tr>
<td>• Dynamic Systems Theory</td>
<td>• Need for increased research for tactile/kinesthetic feedback</td>
<td>• Though most speech sound targets may benefit from biofeedback, certain sound and sequences (e.g., /r/) may require enhanced feedback given the lack of visual and proprioceptive feedback typically available to the speaker</td>
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<tr>
<td>• Oral Placement Disorder</td>
<td></td>
<td>• Some biofeedback methods can also address prosodic characteristics of speech</td>
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<td>• Principles of Motor Learning</td>
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Auditory Biofeedback

- Heavily relied upon in speech-language pathology
- Feedback from client and clinician
- Amplification of signal
- Emphasis/prosodic stress
Visual Biofeedback
- Electropalatography (EPG): Complete Speech System
- Ultrasound: Interson Portable Small Probe
- Acoustic Waveforms/Spectral Feedback: MultiSpeech and other acoustic programs and applications such as LingWaves by TheraVox
  http://www.youtube.com/watch?v=FfhynczIsiw
- Mirrors, clinician model, etc.

Tactile-Kinesthetic Biofeedback
- Hand prompts: PROMPTs for Restructuring Oral Muscular Phonetic Targets
- Manual Mimicry Cues (pp. 3 - 4)
  - Tools to guide articulator placement
    - Speech Buddies
    - www.speechbuddy.com
    - Tongue depressors, straws, taffy, dowel rods, etc.
    - Appliances

Disadvantages of Instrumentation-Dependent Biofeedback to Consider
- Cost
- Lack of availability
- Lack of training
- May be viewed as invasive by clients, caregivers, school districts, etc.
- Tools such as EPG, ultrasound, Speech Buddies are not useful beyond single word level

Clinical Implications and Research
- A-B-A-B treatment design was used in treating a 9.25 year old female with a diagnosis of severe childhood apraxia of speech.
- Targeted treating the speech gestures /tq/ and /eʃ/ using ultrasound biofeedback as determined by independent and relational analysis.
- Subject consistently backed anterior productions (i.e. /k/ for /t/).
- Results:
  o Improvement from baseline to treatment phase per analysis of the biofeedback of both targets.
  o Percent Consonants Correct (PCC) increased from baseline to treatment phase for speech gestures.
Improvements in untrained target probes (i.e. /ti/) were also noted as related to the /tq/.

Discussion:
- Results extended the literature supporting the effectiveness of ultrasound biofeedback for an individual with residual speech sound errors or persisting errors from CAS varying from mild to moderate severity.
- Also supports use of visual ultrasound biofeedback to treat anterior/posterior contrasts.

Select References


Manual Mimicry: Select Examples

Bilabial plosive start position

Bilabial plosive end position

/r/ start position

/r/ end position
<table>
<thead>
<tr>
<th>/s/-cluster start position</th>
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</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image of hand movement" /></td>
<td><img src="image2.png" alt="Image of hand movement" /></td>
</tr>
<tr>
<td>/o/</td>
<td>velar stop</td>
</tr>
</tbody>
</table>

![Image of hand movement](image3.png)

![Image of hand movement](image4.png)