MANAGEMENT OF ACQUIRED AOS AND DYSARTHRIA

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NECESSARY for AOS Diagnosis
(McNeil et al., 2008; Wambaugh et al., 2006)

• Slowed rate of speech production
• Sound Errors
  • Distortions (predominant type)
  • Substitutions and distorted substitutions
  • Omissions, additions (intrusive schwa)
• Prosodic Abnormalities
  • Syllable segregation
  • Equalized stress
Example of pure AOS…
Evidence-based treatments for AOS:
The weight of the evidence supports a strong effect for **articulatory-kinematic** and, to a lesser extent, **rate/rhythm** approaches to AOS treatment.
The most common overall approach for treating AOS

Rationale: Clients w/ AOS need to regain adequate sequencing of articulatory gestures through repeated practice with the correct motor plan/program.
1. Sound Production Treatment (SPT, Wambaugh et al.)

• Work on sound or sound combinations that tend to be in error
• Can conduct at word, phrase, sentence level
• Response-contingent hierarchy
  • Go to next step only if the client makes an error
1. Say *sun*. If correct, have client repeat 5x.
2. If incorrect, show the printed “s”. “Let’s focus on this sound. Say *sun*.”
3. Use **integral stimulation**. “That wasn’t quite it. Watch me, listen to me, say it with me.” Up to 3x.
4. Use **articulatory placement cues**. “Not quite. What you need to do is put your tongue behind your teeth… Let’s try it again.”
5. Go to the next item.
Stimuli examples
(Wambaugh et al., 2013)

- Thermos
- Thunder
- Theory
- Thicken
- Thirty
- Thirteen
- Thimble
- Thesis
- Thyroid
- Thirsty
- Charade
- Shallot
- Shaven
- Shellac
- Shepherd
- Sherbet
- Shovel
- Shuttle
- Shipping
- Chenille
- Jacob
- Japan
- Jackal
- Jealous
- Journal
- Judas
- Jewel
- Janet
- German
- Gerbil
- Awake
- Headache
- Invoke
- Bedrock
- Unlock
- O’clock
Systematically studied by Julie Wambaugh and colleagues since 1998.

<table>
<thead>
<tr>
<th>Primary study</th>
<th>Original participant no.</th>
<th>Meta-analysis participant no.</th>
<th>Age (years)</th>
<th>Sex</th>
<th>MPO</th>
<th>Etiology</th>
<th>AOS severity</th>
<th>WAB AQ</th>
<th>Aphasia type</th>
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<td>Wambaugh, Kalinyak-Fliszar, et al. (1998)</td>
<td>P1</td>
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</table>
Nice meta-analysis of SPT:

In a nutshell:

Participants improve sound accuracy in the treated words and maintain these improvements.

May expect generalization to untreated words of the targeted sounds.

• Proprioceptive, pressure and spatial cues provided to client through systematic oral-facial prompts (provided by trained clinician)

  • https://www.youtube.com/watch?v=9yWmZ0cmf8M
  • http://www.youtube.com/watch?v=d3FbTGteVK4
Growing efficacy, but children > adults


http://www.promptinstitute.com/
Even though this isn’t adult-focused…

Kids with aos (n=11) had thicker L supramarginal gyri than controls. After 8 wks of PROMPT treatment, kids w/ aos had significant thinning of that area.
3. Electropalatography

- Biofeedback of tongue positioning
  - https://www.youtube.com/watch?v=JBYZueK5r04
Numerous studies of aos reviewed here. Generally promising, but lacking strong methodology.

But some newer research is coming out…
Positive changes in articulatory accuracy for the 4 participants with aos/aphasia, for the majority of treated sounds.

Generalization to untreated phrases for most trained speech sounds.

2/4 participants showed good long-term maintenance.
As a general tx technique, be as adept as possible with:

- **Integral stimulation**
  - “Watch me, listen to me, say it with me”
  - Maximal support; gradually faded cues
  - Manipulate the timing of stimulus-response interaction
Figure 4–1. Diagram illustrating the dynamic on-line varying of the temporal relationship between the clinician's model and the child's response (adding and fading of cues) during the integral stimulation treatment.

From Caruso & Strand, 1999
Rate and/or Rhythm Treatments

• Rationale: AOS is characterized by disruptions in the timing of speech production

• About 10 studies thus far
  • Metronome, computerized pacing

https://www.youtube.com/watch?v=dSLEv5IT5dA
10 participants with AOS. Articulatory-kinematic tx combined with rate/rhythm tx (hand-tapping in time to the beat of a digital metronome).

Metronome was set to a rate approx. 50% reduction of typical rate of syllable production.

Modest additional gains from rate/rhythm tx were seen for the majority of speakers.
Effectiveness of metrical pacing in the treatment of apraxia of speech

Bettina Brendel & Wolfram Ziegler

To cite this article: Bettina Brendel & Wolfram Ziegler (2008) Effectiveness of metrical pacing in the treatment of apraxia of speech, Aphasiology, 22:1, 77-102, DOI: 10.1080/02687030600965464

• Synchronize articulation of utterance to computer controlled pacing task.
• Tones represented syllable onsets
• Across 10 participants, found significant improvements in speech rate, fluency and articulation
Too early to tell....
On to Dysarthria....

• Here’s your little quiz.... 😊
Think SUBSYSTEMS

- Respiration
- Phonation
- Articulation
- Resonance
- Prosody

Are these systems weak / insufficient?
Are these systems poorly controlled?
Hierarchy of subsystem management

1st order
- Respiration
- Resonance

2nd order
- Phonation + RATE
- Articulation

3rd order
- Prosody
Tx of Respiratory-Phonatory Issues from WEAKNESS

- Breathing against resistance: minimum goal is 5 cm depth for 5 sec (Hixon et al., 1982)

- Respiratory Muscle Strength Training (RMST)
  - 4 week program developed by Christine Sapienza and colleagues
  - Increase the strength of the expiratory muscles using an expiratory muscle strength training device
Functional outcomes associated with expiratory muscle strength training: Narrative review

Helena Laciga, MA;¹ John C. Rosenbek, PhD;¹ Paul W. Davenport, PhD;² Christine M. Sapienza, PhD³
Departments of ¹Speech, Language, and Hearing Sciences, and ²Physiological Sciences, University of Florida, Gainesville, FL; ³College of Health Sciences, Jacksonville University, Jacksonville, FL; Brain Rehabilitation Research Center, Malcom Randall Department of Veterans Affairs Medical Center, Gainesville, FL; and Brooks Rehabilitation Hospital, Jacksonville, FL

A Combined Inspiratory and Expiratory Muscle Training Program Improves Respiratory Muscle Strength and Fatigue in Multiple Sclerosis

Andrew D. Ray, PT, PhD,⁰ Supriya Udhoji, OTR/L, MS,⁰ Terry L. Mashtare, PhD,⁰ Nadine M. Fisher, EdD⁰
From the ⁰Department of Rehabilitation Science, School of Public Health and Health Professions, University at Buffalo, Buffalo, NY; and

Respiratory muscle strength training applications
Christine M. Sapienza

Department of Communication Sciences and Disorders, University of Florida and The Brain Rehabilitation Research Center, Malcom Randall VA, Gainesville, Florida, USA
Correspondence to Dr Christine M. Sapienza, PhD, Department of Communication Sciences and Disorders, P.O. Box 117420, Gainesville, FL 32611, USA
Tel: +352 390 2046 x233; fax: +352 846 0243; e-mail: sapienza@csd.ufedu

Current Opinion in Otolaryngology & Head and Neck Surgery 2008, 16:216–220

Purpose of review
To provide an overview of respiratory muscle strength training approaches for speech disorders.

Recent findings
Little examination of respiratory muscle training for the rehabilitation of speech has occurred. Less than a handful of studies discuss the use of inspiratory resistive training for individuals with upper airway disorders including cranial nerve paralysis and paradoxical vocal cord dysfunction. Case studies and case series have indicated a positive outcome for maximum phonation time and intelligibility scores of communication effectiveness. Additional studies are needed to establish the benefits of inspiratory resistive training for speech disorders.
Consult with physician before starting client on this program...

- If they are pregnant or suspect they may be pregnant
- If they have untreated hypertension
- If they have recently had a stroke
- If they have any cardiac abnormalities
- If they have emphysema, asthma, or chronic obstructive lung disease
- If they have ever experienced a collapsed lung
- If they have had surgery to the head or neck
- If they have untreated gastroesophageal reflux disease
Tx of Respiratory-Phonatory Issues from lack of COORDINATION/CONTROL

- Teach appropriate speech-breathing pattern; practice with stimuli of increasing length

- **Instrumental feedback** (e.g., Respitrace) can be useful for this activity
You wish to know all about my grandfather. * Well, he is nearly 93 years old, * yet he still thinks as swiftly as ever. * He dresses himself in an ancient, black frock coat, * usually minus several buttons.
What respiratory approach would you likely take with these clients?
Tx of Respiratory-Phonatory Issues: The latest on LSVT LOUD…

Great summary on research to date in:

**Intensive voice treatment in Parkinson’s disease: Lee Silverman Voice Treatment**

Shimon Sapir, Lorraine O. Ramig & Cynthia M. Fox
## Treatment outcomes in PD: across parameters

<table>
<thead>
<tr>
<th>Acoustic Variables</th>
<th>Support</th>
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<tbody>
<tr>
<td>• Improved SPL</td>
<td>Ramig, Countryman, Thompson, Horii, 1995;</td>
</tr>
<tr>
<td>• Improved F0 variation</td>
<td>Ramig, et al., 1996;</td>
</tr>
<tr>
<td>• Improved speech rate</td>
<td>Ramig, et al., 2001;</td>
</tr>
<tr>
<td>• Improved formant centralization ratio</td>
<td>Ramig, Sapir, Fox, Countryman, 2001;</td>
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<td>Whitehill, Kwan, Lee, Chow, 2001;</td>
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## Treatment outcomes in PD: across parameters

<table>
<thead>
<tr>
<th>Perceptual Variables</th>
<th>Support</th>
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</thead>
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<tr>
<td>• Reduced monotone</td>
<td>Ramig, Countryman, Thompson, &amp; Horii, 1995</td>
</tr>
<tr>
<td>• Improved intelligibility</td>
<td>Baumgartner, Sapir, &amp; Ramig, 2001</td>
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<tr>
<td>• “Easier to follow”</td>
<td>Sapir, et al., 2002</td>
</tr>
<tr>
<td>• Improved voice quality</td>
<td>Cannito, et al., 2012</td>
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<td>• Improved communicative participation (self-reported)</td>
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### Treatment outcomes in PD: across parameters

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<th>Neural Variables</th>
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<tr>
<td>• Activation pattern changes in cortex and subcortical areas</td>
<td>Liotti, et al., 2003</td>
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<tr>
<td></td>
<td>Narayana, et al., 2010</td>
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### Treatment outcomes in PD: across parameters

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<tr>
<td>• Improved vocal adduction with no increase in laryngeal tension</td>
<td>Smith, et al., 1995</td>
</tr>
<tr>
<td>• More efficient swallow</td>
<td>Countryman, Hicks, Ramig, &amp; Smith, 1997</td>
</tr>
<tr>
<td>• Improvement in maximum capacity tongue function</td>
<td>Ramig &amp; Dromey, 1996</td>
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<tr>
<td>• Improved frequency and variation of facial expressions</td>
<td>El-Sharkawi, et al., 2002</td>
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<td></td>
<td>Ward, Theodoros, Murdoch, &amp; Silburn, 2000</td>
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<tr>
<td></td>
<td>Spielman, Borod, &amp; Ramig, 2003</td>
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<td>Dumer, et al., 2014</td>
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## Treatment outcomes in PD: across parameters

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<th>Treatment Accessibility</th>
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<td>Telepractice</td>
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<td>LSVT eLOUD</td>
<td>Constantinescu, et al., 2011</td>
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<td>Companion Software</td>
<td>Howell, Tripolili, &amp; Pring, 2009</td>
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<td>Alternate dosing</td>
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<td>Spielman, Ramig, Mahler, Halpern, &amp; Petska, 2007</td>
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<td>McAuliffe, 2008</td>
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Applications beyond PD

Flaccid, spastic, UUMN, and mixed dysarthrias

Non-progressive etiology (stroke and TBI)

- Improved: loudness, articulatory precision, & speech intelligibility
- Increased: loudness levels in sustained phonation, conversation & reading
- Increased F0 range (pitch)

Mahler, Ramig, & Fox, 2009
Mahler, 2009; Mahler and Ramig, 2012
Youssef, Anter, & Hassen, 2015
Applications beyond PD

Multiple Sclerosis

• Improved: sound pressure level in speech tasks & perceptual ratings of voice loudness

  Sapir et al., 2001

Pediatric Population

• Cerebral Palsy, Down syndrome
• Increased SPL; improved speech intelligibility

  Fox, Boliek, & Ramig, 2005; Chan, Chin, & Kaytor, 2011
  Fox & Boliek, 2012; Mahler & Jones, 2012; Fox & Boliek, 2015
Please don’t put all of your eggs in the LSVT basket. Sometimes amplification is a good option!
Evaluation of Speech Amplification Devices in Parkinson’s Disease

Monika D. Andreetta, Scott G. Adams, Allyson D. Dykstra, and Mandar Jog

American Journal of Speech-Language Pathology • Vol. 25 • 29–45 • February 2016
Velopharyngeal Impairment

- For more mild weakness/incoordination:
  - Modifying pattern of speaking (e.g., slow rate, overarticulate)
  - Resistance treatment **during speech**
    - Continuous Positive Airway Pressure (CPAP)

An Evaluation of Continuous Positive Airway Pressure (CPAP) Therapy in the Treatment of Hypernasality Following Traumatic Brain Injury
A Report of 3 Cases

Louise M. Cabill, BSpThy, PhD; Aimee B. Turner, BSpPath; Penelope A. Stabler, BSpPath; Paula E. Addis, BSpThy; Deborah G. Theodoros, PhD; Bruce E. Murdoch, PhD, DSc
• Feedback to ↓ nasal airflow & hypernasality
  • From mirror, See-Scape
  • Biofeedback, e.g., nasometry

http://www.kayelemetrics.com/
Prosthetic management still considered standard for more severe VP dysfunction

- Palatal lift

- Nasal obturator
  (Hakel et al., 2004; Suwaki et al., 2008)

Prosthodontic Management of Velopharyngeal Dysfunction in Speakers With Neurological Conditions

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Mark Hakel

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College of Dentistry, University of Nebraska Medical Center
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Institute for Rehabilitation Science & Engineering, Madonna Rehabilitation Hospital
Lincoln, NE

Disclosures

Financial: David Beukelman, Mark Hakel, Susan Koch Fager, Julie Marshall, and Chase Pfeifer have no relevant financial interests to disclose.
Nonfinancial: David Beukelman, Mark Hakel, Susan Koch Fager, Julie Marshall, and Chase Pfeifer have no relevant nonfinancial interests to disclose.

Abstract

The purpose of this article is to describe the use of palatal lift and nasal obturator interventions for children and adults with velopharyngeal dysfunction due to neurological conditions. These intervention procedures are illustrated with brief summaries of an adult and a child with velopharyngeal dysfunction due to traumatic brain injury. The use of 3D printing to produce nasal obturators is introduced.
On to…Rate, Articulation and Prosody
“Rigid” Rate Control Techniques

• One-word-at-a-time-style; more severe clients
  • Hand/finger tapping

• Pacing boards

• Alphabet board supplementation
• Metronome

App!
http://www.webmetronome.com
Effect of Rate Control on Speech Production and Intelligibility in Dysarthria

Gwen Van Nuffelen  Marc De Bodt  Jan Vanderwegen  Paul Van de Heyning
Floris Wuyts
Antwerp University Hospital, Edegem, Belgium

Findings: Best methods were alphabet board, hand tapping and pacing board (versus DAF and “slower on demand”)
Rate Control Techniques that Preserve Prosody

- **Rhythmic Cueing**
  - Clinician points to words in a printed passage in a rhythmic fashion
  - Computerized pacing (e.g., Speech Pacesetter app!)

- Set target durations for sentences with **visual feedback**
For Articulation Issues

IOPI (Iowa Oral Performance Instrument)

- There is sufficient evidence to support IOPI as a suitable tool for measuring tongue strength and endurance (based on 38 studies of tongue strength, 15 of tongue endurance).
- Can be used for tx in select cases…


A Systematic Review and Meta-analysis of Measurements of Tongue and Hand Strength and Endurance Using the Iowa Oral Performance Instrument (IOPI)

Valerie Adams • Bernice Mathisen • Surinder Baines • Cathy Lazarus • Robin Callister

Received: 2 August 2012 / Accepted: 23 January 2013 / Published online: 7 March 2013
© Springer Science+Business Media New York 2013
Behavioral Articulation Treatment

Strengthening ("oral motor") exercises?

Still controversial
Before doing any nonspeech oral motor exercises, read this article first!


- Some take home messages from Clark, 2003:
  - Difference between strength, power and endurance
  - Improvements come from overload
  - Effects **highly specific** to trained behavior

- **Best candidates?** Non-progressive flaccid dysarthria

- **Not appropriate for?** Those with poor recovery from fatigue
Behavioral Articulation Treatment

• Biofeedback

• Recent success with electropalatography (EPG) (more evidence for children)
Electropalatography in the description and treatment of speech disorders in five children with cerebral palsy

ANN NORDBERG¹, GÖRAN CARLSSON², & ANETTE LOHMANDER³

¹Division of Speech and Language Pathology, Department of Clinical | Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Sweden, ²Department of Paediatrics, University of Schleswig-Holstein,

Brain Injury, October 2007; 21(11): 1183–1193

Electropalatography treatment for articulation impairment in children with dysarthria post-traumatic brain injury

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The use of electropalatography (EPG) in the assessment and treatment of motor speech disorders in children with Down’s syndrome: Evidence from two case studies

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Clear Speech

Rate reduction and purposeful overarticulation (as if speaking in noisy environment or with someone who is HOH)
Clear Speech

Research Note

Be Clear: A New Intensive Speech Treatment for Adults With Nonprogressive Dysarthria

Stacie Park, Deborah Theodoros, Emma Finch, and Elizabeth Cardell

Table 1. Participant characteristics.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Sex</th>
<th>Age</th>
<th>Etiology</th>
<th>Dysarthria severity level</th>
<th>Primary dysarthria type</th>
<th>Time postonset</th>
<th>Cognitive impairments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>32</td>
<td>TBI-MVA</td>
<td>Mild–Moderate</td>
<td>Flaccid–ataxic</td>
<td>78 months</td>
<td>Divided attention, memory</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>43</td>
<td>CVA</td>
<td>Severe</td>
<td>Flaccid–ataxic</td>
<td>30 months</td>
<td>Memory</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>26</td>
<td>Penetrating TBI</td>
<td>Mild–Moderate</td>
<td>Ataxic</td>
<td>13 months</td>
<td>Verbal fluency, visual memory, visuo-spatial memory</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>39</td>
<td>TBI-MVA</td>
<td>Mild–Moderate</td>
<td>Ataxic</td>
<td>36 months</td>
<td>Processing speed, complex planning and problem solving, divided attention</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>22</td>
<td>TBI</td>
<td>Mild–Moderate</td>
<td>Ataxic</td>
<td>22 months</td>
<td>Processing speed, memory, divided attention, planning</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>18</td>
<td>TBI-MVA</td>
<td>Moderate–Severe</td>
<td>Spastic–ataxic</td>
<td>10 months</td>
<td>Verbal concepts, mental control, recall</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>50</td>
<td>CVA</td>
<td>Mild–Moderate</td>
<td>Hypokinetic</td>
<td>10 months</td>
<td>WNL</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>51</td>
<td>TBI-MVA</td>
<td>Mild–Moderate</td>
<td>Spastic</td>
<td>12 months</td>
<td>Memory, attention, planning, organization</td>
</tr>
</tbody>
</table>
Impact of Clear, Loud, and Slow Speech on Scaled Intelligibility and Speech Severity in Parkinson’s Disease and Multiple Sclerosis

Kris Tjaden, Joan E. Sussman, and Gregory E. Wilding

An investigation of clear speech effects on articulatory kinematics in talkers with ALS

Mili Kuruvilla-Dugdale and Miguel Chuquilin-Arista

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Department of Neurology, University of Florida, Gainesville, FL, USA
Treatment of Prosodic Deficits

• **Contrastive stress tasks**
  - John loves Mary. Does John *hate* Mary? **John LOVES Mary.**

• **Referential tasks**
  - Client reads phrases/sentences with **stressed targets** that are unknown to the clinician

• **Feedback** of pitch, loudness, duration can be helpful (e.g., Visi-Pitch program)

“Real-Time Pitch”

“Sona-Speech II”
And last, but certainly not least....

- Supported Communication
  - Speaker Strategies
  - Partner Strategies
  - Supplements such as alphabet boards if needed....
Some Speaker Strategies

- Get partner’s attention
- Set the topic; don’t shift topic abruptly
- Use grammar to enhance message
- Use gestures
- Use turn maintenance signals
- Discuss important topics when energy level at highest
- Choose a conducive environment
Some Partner Strategies

• DO NOT PRETEND THAT YOU UNDERSTAND!

• Pay attention to the speaker
• Avoid communication over long distances
• Maintain topic identity; piece together clues
• Allow adequate processing/speaking time
• Check hearing
Decide on strategies for resolving communication breakdowns…

• Needs to be negotiated ahead of time:
  • Guessing?
  • Finishing sentences?
  • Speaking for?
  • Shadowing?
Ways to Manage Communication Breakdowns

**Speaker:**
- Ask if listener is understanding
- Repeat message; if repetition fails, rephrase the message
- Use writing, finger/verbal spelling, alphabet board, etc.

**Listener:**
- Signal as soon as misunderstanding occurs
- If repetition/rephrase fails, listener should communicate exactly what was understood before the speaker tries to communicate again in any modality
- Can try “shadowing” and periodically summarizing
Supplementing Natural Speech: Alphabet boards

YES 1 2 3 4 5 6 7 8 9 0 NO

It starts with... A B C D E F G H I J
I'm not sure.

New word K L M N O P Q R S
I made a mistake I'll start again

I'd like to ask you something T U V W X Y Z ?
Thank you

Yes. No. Maybe. I don't know. Forget it. I have something to say.

I will spell the word.
I will point to the letter as I say the word.

Small Talk
Family
Personal Care
Transportation
Trips
Appointments

Sports
Food
Church
Computers

Shopping
Weather

Please repeat each word I say, so I know you understand.
You misunderstood.
Start over.
This is important!
Wait a minute!
**The latest with using Principles of Motor Learning (PML) in our treatments for people with Motor Speech Disorders**
Support for random practice in healthy speakers
(Adams & Page, 2000; Wong et al., 2013; Scheiner et al., 2014)

Motor speech disorders:
  - **Mixed results**
    - Random better in adults with AOS (Knock et al., 2000)
    - Random = Blocked in adults w/ AOS (Wambaugh et al., 2013, 2014)
  - Combined schedules may be optimal (Wong et al., 2013)
  - Mixed findings in CAS (Maas & Farinella, 2012)
• Evidence in childhood aos that MORE = BETTER (Edeal & Gildersleeve-Neumann, 2011)

• Many MSD treatments recommend a high # of practice trials
PML for SPEECH: Massed vs. Distributed

- Same number of sessions over a longer period (distributed) or shorter period (massed)
- No evidence yet for a distributed practice advantage for adults
  - LSVT for dysarthria from PD (Spielman et al., 2007)
  - Sound Production Treatment for AOS (Wambaugh et al., 2013)
- Slight advantage of distributed practice for retention children with CAS (Thomas, McCabe, & Ballard, 2014)
PML for SPEECH: Varied vs Constant Practice

NO EVIDENCE IN MSD YET
(but good reasons to consider varied practice)
PML for SPEECH: Knowledge of Performance (KP) vs Knowledge of Results (KR)

• Biofeedback KP may enhance learning in AOS (Katz et al., 1999, 2010; McNeil et al., 2010)

• …and in pediatric speech sound disorders (e.g., Hitchcock & McAllister Byun, 2016; Lundeborg & McAllister, 2007; Preston, Brick, & Landi, 2013)

But…
Biofeedback (KP) not always facilitative…

Healthy speakers:
- Ballard, Smith, et al., 2012

- Providing KP (biofeedback) continually during training interfered with retention
PML for SPEECH:
High vs Low Frequency Feedback

- **Benefits for a reduced feedback schedule in healthy speakers** (Steinhauer & Grayhack, 2000; Adams & Page, 2000; Kim, LaPointe, & Stierwalt, 2012)

- **Mixed findings for**
  - Speakers with dysarthria from PD
    - Adams, Page & Jog, 2002
  - Speakers with AOS
  - Children with CAS
    - Maas, Butalla, & Farinella, 2012
Motor Speech Disorders? Little attention.

Austermann Hula, et al. (2008)
- Immediate vs delayed (5 sec) feedback in 2 speakers with AOS.
- 1 of 2 speakers showed enhanced retention with the delay.
Principles of Motor Learning in Treatment of Motor Speech Disorders

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Australia

Richard A. Schmidt
Emeritus, University of California, Los Angeles

Purpose: There has been renewed interest on the part of speech-language pathologists to understand how the motor system learns and determine whether principles of motor learning, derived from studies of nonspeech motor skills, apply to treatment of motor speech disorders. Specific attention is paid to how these principles may be incorporated into treatment for motor speech disorders.

Conclusions: Evidence from nonspeech motor learning suggests that various principles may interact with each other and differentially affect...
Do principles of motor learning enhance retention and transfer of speech skills? A systematic review

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Background: It is well documented in limb motor research that providing the optimal practice and feedback conditions can have positive outcomes for the learning of new movements. However, it remains unclear if the training conditions used for limb movements can be directly applied to the speech motor system of healthy adults and individuals with acquired motor speech disorders. Collectively these practice and feedback conditions are known as the principles of motor learning (PML), and they have recently been applied