What do you hope to accomplish for your students with severe phonological disorders?

Markedness and Major Sound Classes

- Markedness
  - Order of least to most markedness
    - Obstruants
      - stops -- fricatives -- affricates
    - Sonorants
      - nasals -- glides -- liquids

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Phonemic/Phonological Perspective

- Severe to profound impairment
- Focus on child’s sound system
- Facilitation of patterns
- Focus on assessment
- Focus on target selection
- Consider stimulability

Target Selection

Based on the Work of Gierut and Colleagues

Six types of Productive Phonological Knowledge displayed by children with phonological disorders (Gierut, 1987)

<table>
<thead>
<tr>
<th>Lexical Representation</th>
<th>Breadth of Distribution</th>
<th>Phonological Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 adult like</td>
<td>all positions, morphemes</td>
<td>none</td>
</tr>
<tr>
<td>2 adult like</td>
<td>all positions/all morphemes</td>
<td>optional or obligatory</td>
</tr>
<tr>
<td>3 adult like</td>
<td>all positions/some morphemes</td>
<td>fossilized forms</td>
</tr>
<tr>
<td>4 adult like</td>
<td>some positions/all morphemes</td>
<td>positional constraint</td>
</tr>
<tr>
<td>5 adult like</td>
<td>some positions/some morphemes</td>
<td>combination of type 3 and 4</td>
</tr>
<tr>
<td>6 non adult like</td>
<td>all positions/all morphemes</td>
<td>inventory constraints</td>
</tr>
</tbody>
</table>

A child displaying Type 1 knowledge of target /s/ would produce this sound correctly in all word positions and for all morphemes. /s/ would never be produced incorrectly.

Examples:
- [si] see
- [sup] soup
- [mesi] messy
- [mis] missing
- [mis] miss
Six types of phonological Knowledge: Type 2
(Gierut et al., 1987)

A child displaying Type 2 knowledge of target /s/ would produce the sound correctly for all morphemes and positions. However, a phonological rule would apply to account for observed alternations between, for example, /s/ and /t/ in morpheme-final position.

Examples:
- [si] see
- [sup] soup
- [mesi] messy
- [ais] ice
- BUT
- [kis][kit] kiss
- [mis][mit] miss

Six types of phonological Knowledge: Type 3
(Gierut et al., 1987)

A child displaying Type 3 knowledge of target /s/ would produce this sound correctly in all positions. However, certain morphemes that were presumably acquired early and acquired incorrectly (fossilized forms) would always be produced in error.

Examples:
- [si] see
- [mesi] messy
- [mis] miss
- BUT
- [mænə] Santa
- [wu] juice

Six types of phonological Knowledge: Type 4
(Gierut et al., 1987)

A child displaying Type 4 knowledge of target /s/ would produce the sound correctly for all morphemes in, for example, initial position. However, production of /s/ would be incorrect for all morphemes in medial and final positions.

Examples:
- [si] see
- [sup] soup
- BUT
- [meti] messy
- [miti] missing
- [mit] miss
- [kit] kiss

Six types of phonological Knowledge: Type 5
(Gierut et al., 1987)

A child displaying Type 5 knowledge of target /s/ would produce the sound correctly in, for example, initial position. However, only some morphemes in this position would be produced correctly. All /s/ morphemes in post-vocalic positions would be produced incorrectly.

Examples:
- [si] see
- [sup] soup
- BUT
- [top] soap
- [tok] sock
- [meti] messy
- [kit] kiss
Six types of phonological Knowledge: Type 6 (Gierut et al., 1987)

A child displaying Type 6 knowledge of target /s/ would produce this sound incorrectly in all word positions and for all morphemes. /s/ would never be produced correctly.

Examples:
- [ti] see
- [tup] soup
- [mitxi] missing
- [mit] miss
- [kit] kiss

Applying Learnability: Target Selection Issues (Gierut et al.)

Critical period through age 8

Focus is on WHAT to work on:
- Stimulable/non-stimulable
- Most/least phonological knowledge
- Early/late developing
- Least/most marked (linguistically complex)

Learnability

- Outside of existing grammar
- Attack strategies
  - Horizontal
  - Vertical

Learnability

“In fact, it has been shown that simpler input actually makes language learning more difficult because the child is provided with only partial information about linguistic structure.”

(Gierut, 2007 p.8)
Target Selection based on Phonological Knowledge  
(Dinnsen & Elbert, 1984; Elbert et al., 1984; Gierut et al., 1987)

- Target selection based on sounds with most phonological knowledge provides faster generalization of the target sound to other contexts.
- Target selection based on least phonological knowledge provided greater generalization to other sounds and sound classes.

Implications for target selection based on Stimulability  
(Powell, Elbert & Dinnsen, 1991)

- Targeting stimulable sounds provides faster generalization of production of the target sound in other contexts.
- Targeting non-stimulable sounds provides more widespread generalization to other sounds and sound classes.

Target selection based on Order of Acquisition of Sounds  
(Gierut, Morrisette, Hughes, Rowland, 1996)

- Greater learning occurred for later developing sounds.
- Later developing sounds showed more continued improvement post treatment.
- Teaching later developing sounds produced greater system wide change.

Target selection based on Order of Acquisition of Sounds  
(Gierut, Morrisette, Hughes, Rowland, 1996)

- Targeting early developing sounds provided greater generalization of the sound to other contexts.
- Targeting later developing sounds provided greater generalization to other sounds and sound classes.
Target Selection Based on Order of Acquisition & Phonological Knowledge

- Children treated on early developing/greater knowledge sounds showed greater progress toward acquisition of target sounds during therapy sessions.
- Generalization to other untreated sounds was similar for the two groups.
- Both groups added approximately 2.5 untreated phonemes to their inventories (range 0-7).

Target Selection Based on Order of Acquisition & Phonological Knowledge

- Improvement occurred for untreated stimulable phonemes, but little improvement occurred for untreated unstimulable phonemes.
- Confirmed the need to find ways to help children imitate sounds.

Clusters- the highest level of difficulty

- Hypothesis based on Gierut’s work:
  - Teaching two new sounds in a cluster may result in acquisition of two new sounds and clusters.
- Results:
  - If the child had some knowledge of the sounds and no sequences, learning occurred.
  - If the child had sequences and inventory constraints for the sounds, learning occurred.
  - If the child had inventory constraints for the sounds and did not have sequences, learning did not occur.

Complexity Hierarchy in a Nutshell

- True Clusters (not s+stop sequences)
- Affricates
  - Singleton
Clusters & Adjuncts  
(Gierut, 1999)
- Adjuncts (s-stop clusters) are less marked (easier) than other clusters and therefore do not generalize to clusters.
- More marked clusters generalize to many clusters. /fl/ to /pl/, /br/, /kw/
- Less marked clusters generalize only to in-class clusters, not to others.
  - /pl/ to /bl/, /kl/, /gl/

Influence of Word Frequency on Phonological Change  
(Morrisette & Gierut, 2002)
Treatment of high frequency words resulted in greater generalization to treated and untreated sounds within and across sound classes

Summary of Gierut’s efficacy studies
- Two new sounds promote greater generalization than one
- Maximal differences in place-voice-manner between the two target sounds promote greater generalization than few differences
- Major Class difference promotes greater generalization than nonmajor differences
  - Major class: obstruent paired with sonorant
  - Nonmajor class: Obstruent paired with obstruent or sonorant paired with sonorant

Designing Therapy  
(Fey, 1992)
Fey’s Principles for phonological intervention:
- modification of groups of sounds that share a common pattern
- less emphasis on correct sound production and focus on neutralized contrasts
- more emphasis on using speech sounds for communication purposes
Principles of Phonological Intervention (Fey, 1992)

“I believe that there is only one therapy procedure that embodies all of the three principles ... the notion of minimal contrasts ... and the functional use of speech to transmit unambiguous messages.”

Minimal Pairs

Definition:
Two words having differing meanings that differ by only one phoneme

Selection of Words for Target Sound Practice

Types of Contrasting Pairs

- Target versus substituted sound
- Target versus another established sound
- Two new target sounds
- Multiple targets versus substituted sounds
Types of Feature Oppositions in Minimal Pairs

Minimal Oppositions
Child’s error contrasted to target

[we] ray
[wek] rake
[tot] coat

Maximal Oppositions:
Multiple features contrasted

run pun
sew go
fast last
cone phone
show bow

Target Selection:
Nature of Oppositions (Gierut, 1989)

Single child study:
initial consonant deletion with nearly complete phonetic inventory except /f, v, r/
/m, b, w, j/ used in initial position
Paired a sound that he used in the initial position contrasted with a maximally different sound: e.g. /s/ contrasted with /m, b, w/
The child learned 16 new initial consonants with only 3 sets of maximal oppositions.
The child reorganized his phonological system to include word initial consonants.
Target Selection: Nature of Oppositions (Gierut, 1990)

- Differential Learning of Phonological Oppositions
  - 3 subjects - missing sounds:
    - 1: /θ, γ, s, z, ʃ, tʃ, ctʃ, l, r/
    - 2: /k, g, ʃ, ɣ, ɣ, l, r/
    - 3: /k, q, ɣ, ɣ, z, tʃ, ctʃ, l, r/
  - Paired a sound that they used with a maximally different sound and with a minimally different sound in two conditions.

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Hierarchy of Pair Effectiveness:

1. multiple and major class distinctions
2. multiple distinctions
3. few distinctions

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Target Selection: Nature of Oppositions (Gierut, 1990)

For 3 children, paired a sound that they used with a maximally different sound and with a minimally different sound in two conditions.

- Maximal pairs resulted in greater improvement in target sounds, more additions of untreated sounds and less over generalization to known sounds.
- Learning was enhanced by maximal differences and major class distinctions.

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Target Selection: Nature of Oppositions (Gierut, 1992)

Greatest widespread system change:

- minimal pairs comparing two new phonemes differing by maximal and major class features.

  The major class distinction may be more important than the number of features.

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The Phonology Funnel
(Farnham, 2011)

Decision Process
1. Least Productive Phonological Knowledge
2. Nonstimulable Phonemes
3. Later Acquired Phonemes
4. Most Linguistically Complex Phonemes

Principles for making this work in the real world

A Winning Formula (Rvachew, 2004):
- traditional articulation therapy
  + perceptual training
  + training in letter identification
  + training in sound-symbol relationships
  + onset identification
- greater progress than articulation therapy alone.

Principles for making this work in the real world

- Individualized plan:
  - Careful selection of targets - complex, late developing, non-stimulable phonemes
  - Use targets in meaning-based therapy - real words that convey meaning - in maximal contrasts
- General plan for all children:
  - Multiple targets
    - Create stimulable sounds
    - Build a bridge to phonics
    - Use high-frequency words in sentences ASAP

Sticking to the Principles

- Create a bridge to phonics
- Road to the Code
  - Evidence-based practice for phonemic awareness
Sticking to the Principles

- Build a bridge to phonics
- Letter-sound correspondence
- Add a rime to onsets
- Use target sounds or stimulability targets in rime

Use High Frequency Words in Sentences ASAP!

she
she
they
just
can
like
really

Principles for making this work in the real world

- Individualized plan:
  - Careful selection of targets - complex, late developing, non-stimulable phonemes
  - Use targets in meaning-based therapy - real words that convey meaning - in maximal contrasts
- General plan for all children:
  - Multiple targets
  - Create stimulable sounds
  - Build a bridge to phonics
  - Use high-frequency words in sentences

Ramifications for Assessment

The selection of treatment targets based on phonological assessment has the potential to maximize treatment outcome, and therefore, plays a major role in treatment efficacy.

Williams, 2002
• Choose an assessment with a large sample of words and one phoneme in multiple contexts
• Language Sample
• Phonetic Inventory
Anna - Errors

Significant phonologic processes: initial consonant deletion, final consonant deletion, deletion of all fricatives, gliding, cluster reduction, syllable deletion.

The Phonology Funnel

Target Words and Pairs

she (high frequency) | sh/r contrast | ch/r contrast | l/s contrast
--- | --- | --- | ---
shake - rake | shock-rock | chick - Rick | lip - sip
shack - rack | shoe - Roo | chap - wrap | Lou - Sue
shore - roar | ship - rip | chime - rhyme | line - sign

Target Words and Pairs - eliciting initial fricatives

<table>
<thead>
<tr>
<th>sh/k, g contrast</th>
<th>sh/l contrast</th>
<th>s/l contrast</th>
<th>ch/l contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>shape - cape</td>
<td>ship - lip</td>
<td>sip - lip</td>
<td>chip - lip</td>
</tr>
<tr>
<td>shoe - goo</td>
<td>jar - car</td>
<td>sock - lock</td>
<td>chalk - lock</td>
</tr>
<tr>
<td>shook - cook</td>
<td>Jack - pack</td>
<td>Sam - lamb</td>
<td>chime - lime</td>
</tr>
</tbody>
</table>
Typical Therapy Session

- Stimulability training/Phonetic inventory - 5 minutes or less - phonics component: letter-sound correspondence
- Phonologic awareness (Say-it and Move-it) with contrast pairs - 5-8 minutes
- Maximal opposition contrast pairs and sets - 10 minutes in a game-like format, optimizing number of responses
- Target sounds in high frequency words in sentences - 5-10 minutes

Writing Goals

- Think in terms of intelligibility
- Clearly define intelligibility in the goal - e.g. “The percentage of words spoken correctly during a 10-minute language sample.”
- Objectives may be written with respect to maximal pairs, processes, or specific phonemes

Anna - Annual Goal

During a spontaneous language sample of at least 50 utterances, at least 60% of the words Anna uses will be spoken correctly.
**Anna - Sample Objectives**

**Stimulability/phonetic inventory:**

Anna will imitate the consonants of English in isolation at least 80% accurately (number of consonants imitated correctly/23).

**Anna - Sample Objectives**

**Bridge to phonics and production in segments and/or words (Say It and Move It activity)**

Anna will segment 3-5 phoneme words in phonemes 6/8 trials with a model.

Anna will imitate high contrast word pairs targeting initial or final consonant deletion (are/far/car, eye/ice) 8/10 trials.

**Anna - Sample Objectives**

**Production in words (sound production activity)**

Anna will imitate target consonants in high contrast word pairs with 80% accuracy. Target consonants to include [f, ñ, tʃ, s, θ, ð, r, v].

Anna will produce familiar high contrast word pairs without a model with 80% accuracy. Target consonants to include [f, ñ, tʃ, s, θ, ð, r, v].

**Anna - Fall**

**Significant phonologic processes:** initial consonant deletion, final consonant deletion, deletion of all fricatives, gliding, cluster reduction, syllable deletion.
September -
- [ɾ/r] contrasts
- initial fricatives were very difficult - few successful productions

October -
- difficulty with voiceless onset + vowel ([tʃ/r] pairs)
- finally stimulable for all consonants ([ɾ] mild distortion)
- blended [s] into whispered vowel in CV syllables

November -
- producing isolated [ʈʃ], but could not sequence to vowel
- began to blend [ɾ] + vowel, produced initial [s] in words

December -
- [ʃ] vowel successfully sequenced, and some other fricatives with cues and model

January -
- adding initial fricatives in practice words independently
- approximating [ɾ]

February -
- using initial [ʃ] without effort
- using medial fricatives independently
- using [s] clusters independently
- using final [s, z] in formulaic sentences

March -
- reduced final deletion and stopping
- stimulable for final [s, z] - “does” - high frequency practice
- end of March - only one medial deletion noted; consistently deleted 3rd person [s] in conversation, but used correctly in practice sentences

April and May -
- “cleaning up” errors
**Anna - Spring**

**Consonant Chart**

<table>
<thead>
<tr>
<th>Obstruent</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stops</td>
<td>p, b</td>
<td>t, d</td>
<td>k, g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricatives</td>
<td>f, v</td>
<td>s, z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affricates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasals</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glides</td>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Red - all positions, all morphemes  
Black - 1-2 positions

Significant phonologic processes: gliding, stopping [d/ð], deaffrication [ʃ/ʧ], initial and final consonant deletion, weak syllable deletion, cluster reduction.

---

**Which children are candidates?**

- **Children with multiple speech sound errors**
- **Trial therapy is essential to differential diagnosis of apraxia vs. phonological disorders**
- **Children with substitutions**
- **Children with deletions - Deletions should be addressed early**
- **Children with both phonological and cognitive disabilities**
- **Children with severe apraxia**

---

**Remember - the cascade starts in the heights!**

---

**REFERENCES**


REFERENCES


REFERENCES


REFERENCES


<table>
<thead>
<tr>
<th>Clusters:</th>
<th>Clusters:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasals</td>
<td>Nasals</td>
</tr>
<tr>
<td>[l]</td>
<td>[l]</td>
</tr>
<tr>
<td>[r]</td>
<td>[r]</td>
</tr>
<tr>
<td>[s]</td>
<td>[s]</td>
</tr>
<tr>
<td>[w]</td>
<td>[w]</td>
</tr>
</tbody>
</table>

**Using Productive Phonological Knowledge**

**Phonemic Inventory – Lexical Testing**

<table>
<thead>
<tr>
<th>Initial</th>
<th>Medial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>[p]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[b]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[t]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[d]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[k]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[m]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[n]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ŋ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[f]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Phonetic Inventory
(Ward, 1998)

<table>
<thead>
<tr>
<th>Name __________________________________                Date _____________________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Articulation Test</strong></td>
</tr>
<tr>
<td><strong>Spontaneous Sample</strong></td>
</tr>
<tr>
<td><strong>Initial</strong></td>
</tr>
<tr>
<td>[p]</td>
</tr>
<tr>
<td>[b]</td>
</tr>
<tr>
<td>[t]</td>
</tr>
<tr>
<td>[d]</td>
</tr>
<tr>
<td>[k]</td>
</tr>
<tr>
<td>[m]</td>
</tr>
<tr>
<td>[n]</td>
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<tr>
<td>[ŋ]</td>
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<tr>
<td>[f]</td>
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<tr>
<td>[v]</td>
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<tr>
<td>[s]</td>
</tr>
<tr>
<td>[z]</td>
</tr>
<tr>
<td>[ʃ]</td>
</tr>
<tr>
<td>[ʒ]</td>
</tr>
<tr>
<td>[θ]</td>
</tr>
<tr>
<td>[ð]</td>
</tr>
<tr>
<td>[h]</td>
</tr>
<tr>
<td>[ʃ]</td>
</tr>
</tbody>
</table>
Clusters:

Nasals

[ŋ]  ______________  ______________  ______________

[ʃ]  ______________  ______________  ______________

[s]  ______________  ______________  ______________

[z]  ______________  ______________  ______________

[j]  ______________  ______________  ______________

[l]  ______________  ______________  ______________

[r]  ______________  ______________  ______________

[w]  ______________  ______________  ______________

[j]  ______________  ______________  ______________

[l]  ______________  ______________  ______________
<table>
<thead>
<tr>
<th>Student __________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE I</strong></td>
</tr>
<tr>
<td>p t k</td>
</tr>
<tr>
<td>b d g</td>
</tr>
<tr>
<td>m n η</td>
</tr>
<tr>
<td>f s j θ h</td>
</tr>
<tr>
<td>v z ʒ ð</td>
</tr>
<tr>
<td>tf dʒ</td>
</tr>
<tr>
<td>w j</td>
</tr>
<tr>
<td>r l</td>
</tr>
<tr>
<td><strong>TYPE IV</strong></td>
</tr>
<tr>
<td>p t k</td>
</tr>
<tr>
<td>b d g</td>
</tr>
<tr>
<td>m n η</td>
</tr>
<tr>
<td>f s j θ h</td>
</tr>
<tr>
<td>v z ʒ ð</td>
</tr>
<tr>
<td>tf dʒ</td>
</tr>
<tr>
<td>w j</td>
</tr>
<tr>
<td>r l</td>
</tr>
</tbody>
</table>
Stimulability Practice List

1. m
2. b
3. p
4. w
5. f
6. v
7. th (θ)
8. th (ð)
9. t
10. d
11. n
12. l
13. s
14. z
15. sh (ʃ)
16. zh (ʒ)
17. ch (ʧ)
18. j (ʤ)
19. y (j)
20. r
21. er (ɜ)
22. k
23. g
24. h