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2018 Nancy McKinley Lecture Series: Evaluating and Enhancing Children's Phonological Systems

Guest Editor: Linda R. Schreiber, M.S., CCC-SLP, BCS-CL, ASHA Fellow

In partnership with University of Wisconsin – Eau Claire

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Evaluating and Enhancing Phonological Skills in Special Populations

Lesley Magnus, PhD, CCC-SLP

Moderated by:
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Evaluating and Enhancing Phonological Skills in Special Populations

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Disclosure

- Financial
  - Received financial compensation from Speechpathology.com for this presentation
- Nonfinancial
  - No nonfinancial relationships to disclosure

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Learning Outcomes

- Describe major phonological deficiencies in special populations.
- Identify optimal treatment targets to facilitate the development of phonological skills in special populations.
- Describe at least one phonological approach to intervention with special populations.

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Some Concerns/Considerations for Our Clients With Phonological Disorders

- Critical age" hypothesis (5;6) (Bishop & Adams, 1990)
- "Matthew effects" (Stanovich, 1986)

- Later years – some common difficulties
  - > Reading (decoding, comprehension, and fluency)
  - > Spelling and writing
  - > "Multisyllabicity"
  - > Imprecise speech and subtle errors
  - > Word finding

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Target Selection for Phonological Intervention

- Developmental expectations
- Phoneme frequency
- Stimulability/consistency
- INTELLIGIBILITY
- Deviancy
- Social factors
- Lexical properties

Prather et al., 1975; Hodson, 2010; Pena-Brooks & Hegde, 2007)

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Major Recommendations for Intelligibility

1. Identify CONSISTENT broad DEVIATIONS
2. Determine PRIORITIES (clients, time, individual/group)
3. Select OPTIMAL targets (patterns, phonemes, words)
4. Increase COMPLEXITY gradually
5. FACILITATE development of AWARENESS
   - Auditory, kinesthetic, semantic
6. Incorporate:
   - Slight AMPLIFICATION (a few minutes and as needed)
   - Tactile cues (as needed)
   - Models (particularly for new target)
7. Include pragmatics and other communication aspects as needed

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Potential Optimal "Primary" Target Patterns* for Beginning Cycles (Hodson)

Word structures (OMITTED segments)

- "SYLLABLENESS" (i.e., number of vowels/diphthongs)
  - Compound words (e.g., cowboy, baseball)
  - 3-syllable/word combinations (e.g., cowboy hat, baseball bat)
- SINGLETON consonants (syllable/word structures)
  - CV (word-initial /p,b,m,w/ if lacking prevocalic Cs)
  - VC (voiceless final stops /p, t, k/; final /m, n/ if lacking)
  - VCV (e.g., apple)

/s/* CLUSTERS (for omissions, NOT substitutions/distortions)

- Word-initial (e.g., /sp/, /st/, /sm/)
- Word-final (e.g., /ts/, /ps/)

Anterior/posterior CONTRASTS (when stimulable)

- VELARS (if "fronter")
  - Word-final /k/ (before prevocalic velars; never final /g/)
  - Word-initial /k, g/ (occasionally /h/)
- ALVEOLARS (if "backer"; sometimes labials)

Facilitation of LIQUIDS (even if not stimulable)

- Word-initial /l/ (preceded by week of tongue-tip clicking)
- Word-initial /r/ (suppress gliding initially)

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Considerations When Treating Any Client, Especially Special Populations

- Anatomical structures
- Neurological factors
- Hearing loss
- Language skills
- Personal characteristics

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General Principles of Treatment for Special Populations

- Differentiate developmental error patterns from those attributable to the special condition
- Work to remediate the special sensory, motor, or intellectual conditions of the child
- Error patterns should be analyzed and prioritized according to their effect on intelligibility
- Treatment for some error patterns may be deferred if the child's special condition is likely to impede progress

S.Long – Marquette University, 2015

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"All cases are unique and very similar to others"

T. S. Elliot

The Cocktail Party

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So What About Special Populations

- Down syndrome
- Cerebral palsy
- Hearing impaired (Hard of Hearing)
- Clefting/craniofacial anomalies
- Childhood apraxia of speech
- Autism spectrum disorder
- Stuttering

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Children With Down Syndrome

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Down Syndrome (DS)

- Characteristics of speech
- Speech difficulties often include strength, timing, and coordination of articulation
- Intelligibility issues
- The prelinguistic stage typically lasts longer than 12-18 months for individuals with Down syndrome
- This stage also usually emerges later for infants with Down syndrome when compared to their typically developing peers

(Roberts et al., 2007; Stoel-Gammon, 2001)

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Babbling → Syllable Shape → Phonemes

- Babbling is delayed in infants with Down syndrome
  - Babble just as frequently as infants with typical development (Stoel-Gammon, 2001)
- Babies with Down syndrome similar to babies with typical development in syllable structure
  - Produced most CV syllable shapes
  - Labial stops + vowel (e.g., "pa") and alveolar stops + vowel ("da")
  - Preference for stops, nasals, and glides when producing consonants in their early babbling

(Ramsdell et al., 2012; Stoel-Gammon, 2001)

- Children with DS showed mastery of phonemes at later ages than suggested by current articulation normative data (Fabiano-Smith & Goldstein, 2010; Kumin, 2003)

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"Children with Down syndrome tend to be highly unintelligible when compared to other speakers"

"In summary, children with Down syndrome develop phonological systems in a MANNER SIMILAR to their typically developing peers; however, development is typically DELAYED"

Rupela & Manjula, 2007

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Phonological Deviations: Down Syndrome

- Deviations used by children with Down syndrome also generally mirror those used by children with typical development
- Each child is unique and will demonstrate deviations unique to his/her individual case; however, some deviations appear to be prominent
  - Cluster reduction and final consonant deletion observed most frequently in the speech of children with Down syndrome

(Stoel-Gammon, 2001; Rupela & Manjula, 2007; van Bysterveldt et al., 2010)

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Intervention

- Numerous cases at our MSU CDC with clients whose intelligibility and sound production skills increase using cycles but at a much slower and protracted rate
- Focused auditory input/stimulation
- Cycles
  - Modified – more time on one pattern but still cycling (generally double the time)

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Faith S. - HAPP-3 Percentages

Phonological Deviations	Pretest	2 blocks Tx	6 blocks Tx
Omissions			
• Syllables	50*	36	0
• Consonant Sequences	133*	89*	79*
• Prevocalic singletons	5	0	0
• Intervocalic Singletons	33	16	29
• Postvocalic Singletons	100*	68*	16
Consonant Category Deficiencies			
• Liquids	100*	91*	47*
• Nasals	83*	58*	33
• Glides	66*	50	30
• Stridents	89*	72*	55*
• Velars (Fronting)	100*	60*	45*
• Anterior nonstridents (Backing)	43*	43*	13
* > 40%	9	7	4

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Children With Cerebral Palsy (CP)

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CP is a Neuromuscular Impairment

- Different types
- Impairment is likely in all speech systems: respiration, phonation, resonance, articulation, prosody
- Intellectual disability often co-exists
- Nonspeech communication (AAC) is a viable alternative

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Phonological Deviations: Cerebral Palsy

Related to Temporal Control

- Fronting
- Backing
- Stopping
- Gliding
- Fricative errors
- Vowelization of /l,r/
- Nasalization

Related to Errors of Motor Control

- Voicing difficulties
- Voiced/voiceless cognates
- Prevocalic voicing
- Consonant cluster reduction
- Final consonant deletion
- Stopping of fricatives or frication of stops
- Weak syllable deletions

(Milloy et al., 1990)

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Children Hearing Loss

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More children with hearing loss (HL) in the public schools

"All children with middle ear pathology do not have speech and language disorders; however, the majority of children with speech and language disorders have had middle ear pathology"

Otitis Media

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Hearing Loss

- Children with severe hearing loss generally experience considerable difficulty developing intelligible speech
- Middle ear pathology – conductive loss
- Sensorineural loss
  - Hearing aids
  - Cochlear implants

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Speech and Language in Individuals With Hearing Loss

- Prelinguistic communicative abilities of toddlers with hearing loss and without hearing loss during the second year of life (Zaidman-Zait and Dromi, 2007)
- Modes of communication
- Utterance length
- Language level

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Babbling → SS → Phonemes

- Vocalizations of infants with severe/profound HL were similar to their peers with normal hearing until approx. 6 months – vegetative sounds, cooing, and vocal play (Oller et al., 1988)
- Infants with a HL were likely to exhibit a later onset of canonical babbling (Oller et al., 1988; Lynch et al., 1989)
- Children with HL had smaller consonant-vowel (CV) syllable shapes inventories (Stoel-Gammon, 1988) or different VC usage, as children with HL produced fewer final consonants (Chenausky et al., 2008)

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Speech Deviations in Individuals With a Hearing Loss

- Distortions of sounds
- Omissions of initial and final consonants
- Consonant cluster reduction
- Substitution of voiced consonants for voiceless consonants
- Omissions of /s/ in almost all positions of words
- Substitution of nasal consonants for oral consonants
- Increased duration of vowels
- Imprecise production of vowels
- Epenthesis

(Hegde, 2010)

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Leila K. (3;4) – HAPP-3

Phonological Deviations	% of occurrence
Omissions	
Syllables	50*
Consonant sequences	100*
Prevocalic singletons	11
Intervocalic singletons	43*
Postvocalic singletons	53*
Consonant Category Deficiencies	
Liquids	100*
Nasals	62*
Glides	70*
Stridents	43*
Velars	36
Anterior nonstridents [backing]	67*

Total Occurrences of Major Phonological Deviations Score 158

PROFOUND

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Cochlear Implants

- Electronic devices surgically placed in the cochlea and other parts of the ear
- Devices deliver the sound directly to the acoustic nerve endings in the cochlea
- Different from hearing aids
  - Hearing aids deliver amplified sound to the ear canal

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Speech Sound Acquisition in Individuals With Cochlear Implants

- Experience similar early stages of consonant phoneme productions and language development as their normal hearing peers (Schremm et al., 2010)
- The order of consonant acquisition obtained by children with cochlear implants similar to the children with normal hearing (Flipsen, 2011)

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Intervention

- Assessment and intelligibility sampling of children participating in two semesters of cycles intervention indicated substantial improvements
  - TOMPD scores and number of errors decreased

(Braeuer & Hodson, 2012)

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Children With Craniofacial Anomalies

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Craniofacial Anomalies

- Prevalence – 1:500 to 1:750
- Common difficulties associated with craniofacial anomalies include:
  - Cognitive deficits
  - Clefting –
    - > Lip, palate, both
    - > Velopharyngeal functioning
  - Hearing loss and/or fluctuating middle ear disease

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Cognitive Deficits and Craniofacial Anomalies

- More than 400 syndromes associated with clefting
- Deficits are variable
- Combining craniofacial anomaly and cognitive deficit results in the possibility of many phonological errors
  - Typical deviations:
    - > Omissions
    - > Substitutions
    - > Distortions

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Craniofacial Anomalies and Development

- Children with clefting tend to use more sonorants (nasals, liquids, glides, vowels)
- Children with clefting tend to make semantic choices based on their structural differences; therefore, they make word choices based on the sounds they can produce
- Children without velopharyngeal inadequacy (VPI) often "catch up" in development but continue to have difficulty with high pressure consonant productions

(Chapman, 1991; Hardin-Jones & Jones, 2005; Scherer et al., 2008)

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Craniofacial Anomalies and Development

- The majority of phonological errors that occur in individuals with craniofacial anomalies are a result of **learned compensatory patterns** acquired due to structural problems
- The incorrect rules they learn become habituated so individuals continue to use faulty phonological deviations
- Attempt normal phonological development but structural deviations interfere

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Phonological Deviations

Phonological Deviations	Number	% of occurrences
• Stridents	50	67.98
• Liquid /r/	47	76.14
• Consonant Sequence Omissions	47	55.90
• Liquid /l/	46	65.98
• Velars	42	42.64
• Postvocalic Singleton Omissions	38	21.60
• Glides	36	26.60
• Nasals	30	12.00
• Prevocalic Singleton Omissions	26	6.68
• Syllable Omissions	17	3.12

APP-R (1986)

(Magnus et al., 2011)

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Clefting and Intelligibility

- Intelligibility influenced by numerous variables:
  - Developmental articulation errors
  - Nasal emissions
  - Resonance
  - Rate/fluency of speech
  - Compensatory articulation

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Craniofacial Anomalies and Hearing

- Patients born with craniofacial anomalies may have associated malformations of the external or middle ear
  - Microtia, aural atresia, eustachian tube dysfunction
  - Reconstruction of auditory canal, hearing aids, treatment of the middle ear effusion
- Abnormalities of the inner ear less common
  - SNHL → cochlear implant

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Intervention

- Developmental sequence
  - Stops, nasals, glides
  - Continuants vs. stops
- Anatomical sequence
  - Front to back
  - Avoid compensatory articulation
- Voicing
  - Sometimes voiced is easier than voiceless
- Visual, auditory, and tactile cues

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Childhood Apraxia of Speech (CAS)

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Development of Speech

- Parents indicated restricted phonetic diversity, consonant-vowel sequences, and suprasegmental patterns in babbling (Davis & Velleman, 2000; Highman et al., 2008)
- "Quiet babies" (Maassen, 2002)
- Parents reported reduced vocalizations and babbling as well as a delay in first words or/and two-word combinations (Highman et al., 2008)

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CAS vs. Speech Delay or Other Speech Sound Disorders

- Many of the behaviors and signs associated with CAS are also found in children with more broadly defined speech sound disorders. Additionally, it is important that the diagnosis of CAS not be based solely on the severity of a child's speech sound disorder, as this may result in over-diagnosis. (McCabe et al., 1998)
- CAS is considered to be a low prevalence speech disorder in children. In fact, researchers and professionals believe CAS is a rare speech disorder.
  - That means that out of all children with speech problems, few have CAS.
  - It also means that other types of speech problems are much more likely in children than is CAS.
  - Research in this area has been limited, but there are estimates that on a typical SLPs caseload of preschool children with speech sound disorders, only 3–5% of them would likely have apraxia of speech. (CASANA)

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CAS and Phonological Disorders

- **Children with CAS and children with phonological disorders often demonstrate** reduced phonetic and phonemic variations
- **One way to differentiate between the two disorders is to look at** vowel productions **because children with CAS often show relatively few vowels and less vowel differentiation than children with phonological disorders**
- **Children with CAS may also show more** inconsistent errors over repeated trials **and more nondevelopmental types of errors**
  - Use of favorite sound, glottal replacement, initial consonant deletion, idiosyncratic cluster reduction
- **Children with CAS may occasionally demonstrate groping behaviors for articulatory positions for utterances they have not previously produced, along with** lexical stress errors **and segmentation of** multisyllabic words

(Strand & McCauley, 2008)

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Components for Intervention

- "Syndrome"
  - Includes both difficulty with sound production but also with other aspects of language
    - Motor-based components
    - Linguistic components

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Theoretical Perspectives of Causality

- Those who believe origin of CAS is motor-based
  - Own separate diagnostic category
  - Motor-speech/phonetic/programming perspective
- Those who believe origin of CAS is linguistically based
  - Categorized as a language disorder
  - Cognitive-linguistic/phonological/planning perspective

(Shriberg et al., 1997)

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Linguistic Approach

- Involves learning the rules of a language to determine when sounds and sound sequences are used
- Increasing knowledge of sound structures has demonstrated an increase in intelligibility in children with CAS

(Hall, 2000)

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Combined Approach

- Combining motor and phonological learning
- Stimulability training protocol paired with a modified core vocabulary treatment showed favorable outcomes for children with CAS
- Increased inventory
- Increased Percentage of Consonants Correct

(Iuzzini, 2010)

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Children With Autism

~~Is There Any~~ Connection to Phonology?

- Little research on phonological and other vocal characteristics
- Babbling
  - Limited to no vocalizations (Wetherby et al., 2004)
  - Later onset of language milestones
  - Reduced frequency of producing vocal productions with a consonant (Wetherby et al., 1989)
- Phonological development
  - Often reported to be normal or even precocious if they speak (Kjelgaard & Tager-Flusberg, 2001)
  - School-age children with ASD retained residual speech distortion errors on /r/, /l/, and /s/ (Kirkpatrick & Ward, 1984)

Children With Stuttering

Co-Existence

- Children who stutter also have a phonological disorder 30–40% of the time (Nippold, 2002; Wolk et al., 2000; Nippold, 2004; Paden et al., 2002)
- Caution that the co-occurrence of the disorders is not an interaction between the two disorders (Nippold, 2002)
  - No increase in stuttering with an increase in phono errors
  - Severity of stuttering was not worse if phono was +/-
  - No differences in phonological behavior for those who +/- stuttered
  - No difference in fluency for more phonologically challenging words
  - Phonological errors did not occur more in stuttered speech

Phonological Errors

Wolk et al. (1993)	Yairi & Conture (2005)	Louko et al. (1990)
Vocalizations	Liquid deviations	Initial voicing errors
/s/ cluster reduction	Gliding	Initial consonant deletion
Liquid deviations	/s/ cluster reductions	Final consonant deletion
Fronting	Depalatization	Vowel changes
Velarization (backing)	Deaffrication	Glottal replacement
Glottal replacement	Labial assimilation	Backing
	Weak syllable deletion	Labialization

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NSOMEs

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Oral Skills and Programs

- Central concern for SLPs
  - Are there data to support the need to engage in oral-motor activities as part of tx?
  - >Limited data other than anecdotal
  - >Can we say the successes are due to OM exercises or just an increased awareness, stabilization, and instruction
  - If so, what procedures are recommended?

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What to Remember About NSOMEs

- Training just a part of the speech gesture will not transfer to the whole gesture
- Strength is typically not an issue for speaking
- These exercises lack relevancy
- Organization of the brain is task specific
- These exercises do not warm up or wake up the mouth and do not provide "metamouth" awareness
- The research evidence shows that the exercises do not work
  - Oral motor behaviors are not precursors to speech production
  - If you want speech to improve – work on speech!

(Lof, 2010)

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What are major recommendations and suggestions to keep in mind when working with children with highly unintelligible speech?

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Major Recommendations for Intelligibility

1. Identify CONSISTENT broad DEVIATIONS
2. Determine PRIORITIES (clients, time, individual/group)
3. Select OPTIMAL targets (patterns, phonemes, words)
4. Increase COMPLEXITY gradually
5. FACILITATE development of AWARENESS
   - Auditory, kinesthetic, semantic
6. Incorporate:
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Word structures (OMITTED segments)

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- Neurological factors
- Hearing loss
- Language skills
- Personal characteristics

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Research Needs

- Evidence Based Practice for ALL clients
- More studies looking at the viability of phonological intervention principles

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Evaluating and Enhancing Phonological Skills in Special Populations

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