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GPS for Speech Sound Disorders: A Roadmap for Intervention




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Dr. Carol Koch
/kouk/



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After attending this session, participants will be able to:

1. Describe key assessment information needed for making intervention decisions
2. Select targets for multiple oppositions, minimal oppositions, and complexity approaches
3. Describe contextual facilitation strategies for elicitation of /j/

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"I never teach my pupils. I only attempt to provide the conditions in which they can learn."
- Albert Einstein

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"**What** is treated is more important than **how** it is taught."
(Gierut, 2005)

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TARGET SELECTION

"**What** is treated is more important than **how** it is taught."
(Gierut, 2005)



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How do we get to our destination???

Which route do we start on?

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• Assessment data needs to give us insight:

- Phonetic inventory: the sounds the child can produce as well as the sounds they cannot produce
- Nature of errors:
 - Atypical? Lisps, backing
 - Developmental?
 - Stimulable?
 - Consistency?
 - Contexts which "facilitate" correct production
 - Collapse?
- Important/relevant
- Impact on intelligibility
- Perceptual skills

Differential Diagnosis

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Differential diagnosis of speech sound disorders

Articulation	Phonological	Motor Speech
<ul style="list-style-type: none"> • Substitution and distortion errors of individual sounds • Limited phonetic inventory 	<ul style="list-style-type: none"> • Predictable, rule-based errors that affect more than one sound • Loss of contrasts • Collapse • Extensive homonymy 	<ul style="list-style-type: none"> • Deficits in motor planning and programming (apraxia) • Execution (dysarthria)

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Differential diagnosis of speech sound disorders

Articulation	Phonological	Motor Speech
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MIXED SPEECH DISORDER

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Components of phonological acquisition to consider, when choosing our route.....

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General Target Selection Approaches or....which route do choose (first)?


1. Traditional developmental approach
 - Developmental (sounds or phonological processes)
 - Stimulability
 - Impact on intelligibility
2. Complexity approach (Nontraditional approach)
 - Guided by complexity and learnability
 - Phonological system is complex, made up of parts:
 - Speech sounds, distinctive features, production features (PMV), syllable shapes, tones, word length, and stress patterns
 - Parts higher in the system are more complex
 - Implicational relationships
 - Child's knowledge is a subset of accomplished speaker
 - Learnability – the more complex the input, facilitates more extensive learning across phonological system

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General Target Selection Approaches or...which route do choose (first)?

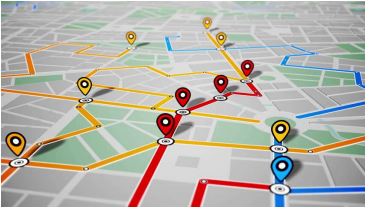
- Cyclical approach**
 - Identify patterns (processes)
 - Focus on patterns for a predetermined time period rather than performance criteria
- Systemic approach**
 - Focus on functions of sounds
 - Focus on contrast of sounds
 - Collapse of contrasts
- Nonlinear approach**
 - Focus on child knowledge about phonological system
 - Segmental tier: sound segments and features
 - Prosodic tier: phrase and stress intonation, word length, word stress, word shape/sequences
- Neuro-network approach**
 - Focus more on outcomes – increased PCC or numbers of phonemes in child's inventory



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Route (Target) selection




- Phonological Processes
- Complexity
- Facilitating Contexts
- Atypical errors
- High frequency sounds/impact on intelligibility
- Developmental Norms
- Stimulability
- Phonetic Inventory
- Consistency
- Phoneme Collapse

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Route (Target) selection based on...

Phoneme Acquisition



6 Years
th (voiceless)

5 Years
r, zh, th (voiced)

4 Years
l, j, ch, s, w, sh, z

2-3 Years
p, b, m, d, n, h, t, k, g, w, ng, f, y

Developmental Norms

Early 13: /b, p, n, m, d, h, w, t, k, g, f, tʃ, j, /
(Age 2-3)

Middle 7: /v, dʒ, l, tʃ, s, f, z, /
(Age 4)

Late 4: /ʒ, ɹ, ð, θ, /
(Age 5-6)

Crowe & McLeod (2020)


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Route (Target) selection based on...

Here is a thought worth considering:

"If all children are acquiring all the consonants of English throughout their toddler and preschool years, perhaps the teaching of any consonant is 'developmentally appropriate'."



6 Years
th (voiceless)

5 Years
r, zh, th (voiced)

4 Years
l, j, ch, s, w, sh, z

2-3 Years
p, b, m, d, n, h, t, k, g, w, ng, f, y

Farnham (2021)

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Route (Target) selection based on...

Phonological Patterns

Suppressed by Age 3-3 ½ years	Suppressed by Age 4- 4 ½ years
Assimilation	2-element Cluster Reduction
Pre-vocalic voicing	Deaffrication
Devoicing	Stopping of Affricates
Final Consonant Deletion	Gliding
Weak Syllable Deletion	th simplification (assimilation)
Stopping of Fricatives	
Fronting	

Developmental Norms and Phonological Processes


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Route (Target) selection based on...

Phonological Processes

- Phonological processes offer a pattern of simplifications
- Targets are designed to reduce the frequency of occurrence of the phonological processes



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Route (Target) selection based on...



Developmental Norms

Developmental Errors

- Follows a developmental progression
- May be more stimutable
- Consistent with eligibility criteria
- Limited generalization to untreated targets

Nondevelopmental Errors

- May not emerge without intervention
- May facilitate progress on earlier developing phonemes



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Implications for Route (Target) selection based on...

Phonological Processes

- Targeting patterns of errors that occur at greater than 40% frequency of occurrence
- Generalization within and across patterns

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Implications for Route (Target) selection based on...


Stimulability

Stimulable

- Child has knowledge of sound
- Early success
- May enhance motivation
- Low resilience kids
- May emerge without intervention

Not stimutable

- Child has limited or no knowledge of sound
- May be difficult to have early success
- May promote change in earlier developing phonemes
- Need to consider: age, resiliency, cognitive level, maturity, attention, personal factors



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Implications for Route (Target) selection based on...


Phonetic Inventory

Phonetic Inventory - present

- Build on knowledge of sounds
- Build on accurate motor plans
- Can use to establish movement patterns

Phonetic Inventory – not present

- Child has no knowledge
- Need to establish new motor plans
- Expand phonetic inventory
- May be difficult to have early success
- May promote change in earlier developing phonemes
- Need to consider: age, resiliency, cognitive level, maturity, attention, personal factors (motivation)



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Route (Target) selection based on...

Consistency

Consistency of Errors

- Each time an error is made on a target phoneme, is the error the same or varied?
- Same errors indicate use of a "rule" – the wrong rule, but a rule
 - This means something from a linguistic perspective
- Varied errors, or inconsistent errors reflect some, but limited, knowledge of target sound



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Implications for Route (Target) selection based on...

Consistent Errors

- Address consistent application of the wrong rule
- May reflect phonological processes
- May not involve stimutable sounds
- Progress may be slow

Inconsistent Errors


- Addresses sounds for which the child has some knowledge
- Progress may be observed fairly quickly
- Inconsistent errors impact intelligibility




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Implications for Route (Target) selection based on...

Atypical Errors 


- Typically do not change without intervention
- Anterior lisps
- Lateral lisps
- Backing



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Implications for Route (Target) selection based on...

High frequency/ impact on intelligibility 



- Relevant targets – high frequency words in child's daily activities
- High frequency words will be practiced more often
- Success in carryover would result in positive reinforcement
- May lead to more successful communication interactions
- Phoneme deletions significantly impact intelligibility and should be addressed directly early and often

Most frequent phonemes in conversational English:
/i, s, t, l, n/

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- Hang on tight...it's going to be a bumpy ride!

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Minimal Pairs Used in the Contrast Approaches

- Minimal pairs:
 - approach that emphasizes word pairs that differ by one phoneme
 - Typically highlighted the error and the target
 - Emphasizes the change in meaning as a result of the error
 - Eliminate homonymy – words that sound the same as a result of the error

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Minimal Pair Contrast Therapy

- Most phonemic approaches utilize minimal word pairs, pairs of words that differ by a single phoneme
- The pairs create a contrast to illustrate to the child how different sounds can create different meanings (function)
- Often involves production practice and instruction (form)

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Let's look at phonemes:

- Phonemes are made up of features
- The combination of features makes them different
- Phonemes are characterized by the acoustic and production features:
 - Distinctive features
 - Place-Manner-Voicing
- Comparisons can be made for the number of feature differences between two contrasted phonemes

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Further examination of the features of minimal pairs....


- Initially, word pairs selected that differed by one phoneme
- Over the past 25 years, the minimal pairs approach has evolved and diversified
- Consideration to the ways in which the words differ by one phoneme
- Minimal Pairs Therapy is the basis for the Contrast Approaches for Therapy

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toe



sew

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A Closer Look

Not all minimal pairs are the same!

- Consider the following minimal pairs:
 - Key and tea
 - My and buy
 - Two and do
 - Keys and cheese
 - Go and sew

All are minimal pairs – they differ by one phoneme.

However, consideration must be given to HOW they are different.

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key



tea

place

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toe




sew


manner

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bat



pat

voicing

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keys cheese

place and manner

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go sew

place-manner-voicing

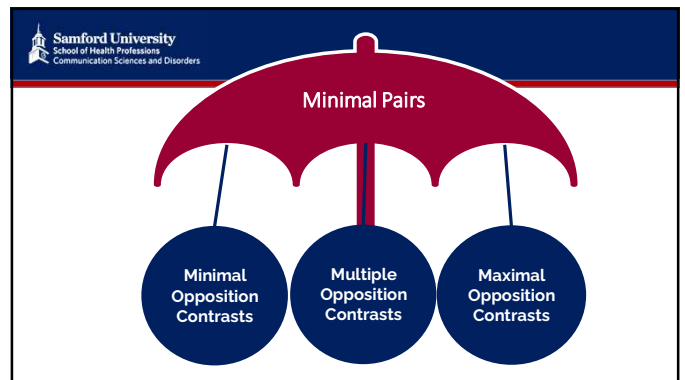
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Over time.....

- Researchers began to examine HOW minimal pairs differed
- Minimal pairs has served as the basis for the Contrast Approaches:
 - Minimal oppositions
 - Multiple oppositions
 - Maximal oppositions
- ALL utilize minimal pairs for treatment targets
- How the pairs are different serves as the basis for each of the approaches

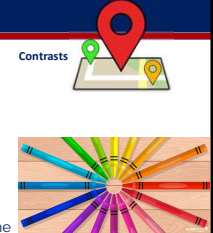
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Route (Target) selection based on...



Contrasts


Contrasts (minimal pairs)

- Primary goal is to develop phonemic distinctions in words
- Words are contrasted to highlight the differences
- Interventions have evolved from variations of minimal-pairs treatment
- Often contrast the error and the target
- Minimal contrasts: produce one feature correctly to make the contrast - **A TINY TARGET**
- Maximal contrasts: 3 or 4 features must be produced correctly - **A LARGE TARGET**

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Implications for Route (Target) selection based on...



Contrasts

Minimal Oppositions Contrasts

- Contrast words that differ by one phoneme with one feature difference (PMV)

Multiple Oppositions Contrasts

- Contrasts a preferred phoneme with several (3-5) phonemes from different sound classes
- Promotes generalization within and across classes

Maximal Oppositions Contrasts

- Contrast words that differ by one phoneme across many features (PMV and sonorant/obstruent)

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Route (Target) selection based on...

Minimal Oppositions Example:

t/k:

Place

Contrasts

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Route (Target) selection based on...

Minimal Oppositions Example

t/s:

Manner

Contrasts

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Another way to think about creating minimal pairs for the contrast approaches:

What components are used to create minimal pairs?

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Minimal Oppositions Example

Coughing camel - "k"

Tick tock - "t"

"ache"

"ick"

kale - tail

"ail"

cab - tab

"ab"

kite - tight

"ite"

coat - tote

"oat"

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Route (Target) selection based on...

Phoneme Collapse


Phoneme Collapse

- A phoneme collapse occurs when one sound is used to represent itself as well as other sounds
- One phoneme is the substitution for many phonemes
- Extensive homonymy
- Suggests that child does not use phonemes "contrastively"
- Multiple Oppositions Contrasts

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Implications for Route (Target) selection based on...

Phoneme Collapse 

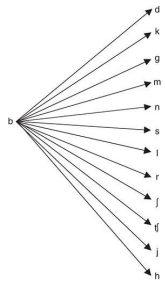
Phoneme Collapse

- Target many phonemes in contrast sets
- System-wide change
- Broad range of features for target sets
- Targets selected across several manners of production
- Significant cognitive load due to large number of "new" vocabulary items

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Sample Phoneme Collapse

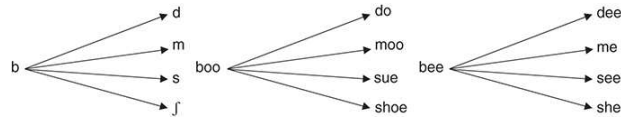


- STOPS
- NASALS
- FRICATIVES
- LIQUIDS
- AFFRICATES
- GLIDE

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Sample Treatment Set for Multiple Opposition Contrasts

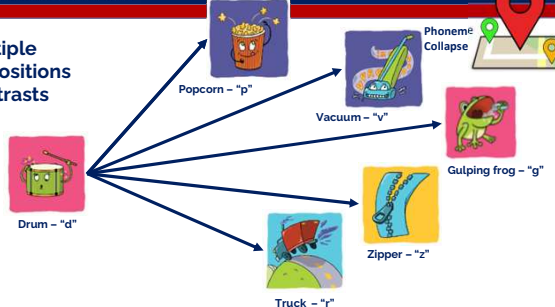


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Route (Target) selection based on...












Multiple Oppositions Contrasts 



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Multiple Oppositions Example

 Drum - "d"	 "et"	Debt Pet Vet Get Zet Rett	 "oze"	Doze Poze Voes Goes Zoes Rose
 Popcorn - "p"	 "eel"	Deal Peel Veal Geal Zeal Real	 "ide"	Died Pied Vied Guide Zide Ride
 Vacuum - "v"	 Zipper - "z"	Dump Pump Vump Gump Zump Rump	 Truck - "r"	Dip Pip Vip Gip Zip Rip
 Gulping frog - "g"	 "ump"			

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Route (Target) selection based on...

Facilitating Context 

Facilitating Context


- Sounds that surround a target may help achieve the articulatory posture and movement needed for an accurate production
- Very helpful when "place" of articulation is difficult to achieve
- Think about where the articulators need to be for the target sound
- Then identify successful sounds that are similar place of articulation

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What is Contextual Facilitation?

Paying attention to phonetic context – position of articulators in speech sounds that might influence correct articulatory posture for the target sound. Use facilitative vowels or consonants.




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How do we do Contextual Facilitation?

Pay close attention to the articulatory posture that you need to change. What is the child doing that is contributing to the error production? What does the tongue need to be doing?

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coarticulation **assimilation**


Concept that articulators are continually moving into position for other segments over a stretch of speech

Adaptive articulatory changes through which one speech sound becomes similar or identical to a neighboring sound segment

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Implications for Route (Target) selection based on...


Facilitating Context 


- Build from existing skills
- Utilize accurate sounds to "help"
- Each targeted word an opportunity for correct production

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Implications for Route (Target) selection based on...

Think about what needs to change about the error. **Facilitating Context** 



Facilitating contexts for interdental /s/


Facilitating contexts for fronting of velars t/k

Facilitating contexts for production of /r/

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Route (Target) selection based on...

Complexity 


- Target selection based on complexity:
 - Late-acquired sounds
 - Implicationally marked
 - Fricatives,
 - Affricates,
 - Voiced obstruents (affricates, fricatives, stops)
 - Liquids
 - True clusters
 - Small sonority difference clusters
 - Three element clusters
- Least knowledge, and
- Non-stimulable
- Maximal Contrasts

System wide change: Multiple forms of generalization

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Route (Target) selection based on...

Target selection **Complexity** 

Targeting this:

- Marked (more complex)
 - Fricatives
 - Affricates
 - Voiced obstruents (affricates, fricatives, stops)
 - Liquids
 - True clusters
 - Small sonority difference clusters
 - True clusters
 - Three element clusters

Can lead to improvements in this:

- Unmarked Sound Classes (less complex)
 - Stops
 - Fricatives
 - Voiceless obstruents (affricates, fricatives, stops)
 - Nasals
 - Affricates
 - Large sonority difference clusters
 - Adjunct clusters
 - Two-element clusters

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Route (Target) selection based on...

Complexity

Sonority Sequencing Principle

- Vowels
- Glides
- Liquids
- Nasals
- Fricatives
- Affricates
- Stops

MOST

LEAST

SONORITY → NUCLEUS → SONORITY

ONSET NUCLEUS CODA

When a cluster follows the SSP:
/p/ → /e/ → /l/

Example: "plate"

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Route (Target) selection based on...

Complexity

Sonority Rankings and values:

Sonority Ranking	Values
Voiceless stops and affricates	7
Voiced stops and affricates	6
Voiceless fricatives	5
Voiced fricatives	4
Nasals	3
Liquids	2
Glides	1

Sonority Sequencing Principle:
Sonority (resonance) rises in the onset, peaks at the nucleus, and falls in the coda;
Therefore – onset clusters must have rising sonority

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Route (Target) selection based on...

Complexity

Sonority Rankings and values:

Sonority Ranking	Values
Voiceless stops and affricates	7
Voiced stops and affricates	6
Voiceless fricatives	5
Voiced fricatives	4
Nasals	3
Liquids	2
Glides	1

/s/ -2 /p/ +5 /l/

Calculate difference: 7-2=5

Calculate difference: 7+5=2

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Implications for Route (Target) selection based on...

Complexity

Sonority Sequencing Principle:

Word initial clusters reduce to the LEAST sonorous consonant:
"clean" becomes "kean"
/k/ is a stop which is less sonorous than the liquid /l/

Word final clusters reduce to the MOST sonorous consonant:
"bend" becomes "ben"
/n/ is a nasal, which is more sonorous than the top /d/

- Vowels
- Glides
- Liquids
- Nasals
- Fricatives
- Affricates
- Stops

MOST

LEAST

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Implications for Route (Target) selection based on...

Complexity

Sonority Sequencing Principle:

/s/ + stop clusters violate the SSP!

/s/ is typically deleted from word-initial /s/ + stop clusters
"stop" becomes "top"

/s/ is typically retained in word final /s/ + stop clusters
"nest" becomes "nes"

- Vowels
- Glides
- Liquids
- Nasals
- Fricatives
- Affricates
- Stops

MOST

LEAST

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Route (Target) selection based on...

Complexity

Adjunct Clusters (negative sonority – violates sonority sequencing principle); Less marked	Sonority Difference	2-Element Clusters
	-2	/sp/ /st/ /sk/
	+2	/sm/ /sn/ /mj/
More Marked	+3	/tʃ/ /tʃl/ /sʃ/ /θl/ /pʃ/ /vʃ/
	+4	/b/ /g/ /bʌ/ /dʌ/ /gʌ/ /sw/ /fj/
	+5	/p/ /k/ /pʌ/ /tʌ/ /kʌ/ /bʃ/ /dʌ/
Less Marked	+6	/tw/ /kw/ /p/ /k/

Prioritizing true clusters: +3 and +4 may effect better system-wide change

3-element clusters:
/skw/ /spʃ/ /stʃ/ /skʃ/ /skw/

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Route (Target) selection based on...

Complexity

• Target selection based on maximal contrasts:

- Remember: built on concept of minimal pairs
- Differ across – place, manner, voice and major sound class (sonorant vs. obstruent)
- A few examples:
 - /l/ with /s/: a palatal voiced liquid sonorant and an alveolar voiceless fricative obstruent
 - /l/ with /θ/: an alveolar voiced liquid sonorant and an interdental voiceless fricative obstruent
 - /l/ with /k/: a palatal voiced liquid sonorant and a velar voiceless stop obstruent

SONORANTS

- Vowels
- Glides
- Liquids
- Nasals

OBSTRUENTS

- Fricatives
- Affricates
- Stops

MOST

LEAST

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Route (Target) selection based on...

Maximal Opposition – Empty Set

• k/l:

Complexity

Robert E. Lee

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Route (Target) selection based on...

Maximal Opposition

• k/m:

• A new phoneme and a functional phoneme with a major class feature difference

Complexity

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Route (Target) selection based on...

Maximal Oppositions Example

Coughing – "k"

Singing – "l"

"ache"

"ash"

"eep"

"ick"

"ab"

"ace"

case lace

kick lick

kite lite

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Where to begin with route (target) selection?

Needs immediate success for motivation?

- Stimulable sounds; Developmental expectations
- Simple word shapes with phonetic inventory; Core vocabulary; Empty set; Contrast Approaches; Complex targets
- Stimulable sounds; Facilitating contexts

Small phonetic inventory? Limited intelligibility?

A few residual errors? Atypical errors?

A collapse of contrasts?

Phonological processes?

Not stimulable for error sounds?

- Multiple oppositions
- Phonological processes; Minimal pair sets – Contrast Approaches
- Facilitating contexts; Cognate pairs

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Route (Target) Selection Considerations

Needs immediate success for motivation?

Stimulable sounds; Developmental expectations


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Route (Target) Selection Considerations

Small phonetic inventory? Limited intelligibility?

Simple word shapes with phonetic inventory;
Core vocabulary;
Empty set;
Contrast Approaches;
Complex targets




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Route (Target) Selection Considerations

A few residual errors? Atypical errors?

Stimulable sounds;
Facilitating contexts




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Route (Target) Selection Considerations

A collapse of contrasts?

Multiple oppositions




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Route (Target) Selection Considerations

Phonological processes?

Phonological processes;
Minimal pair sets – Contrast Approaches



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Route (Target) Selection Considerations

Not stimulable for error sounds?

Facilitating contexts;
Cognate pairs

Remember to provide as much information as possible:

- Auditory model
- Visual cues
- Rich description - metaphors
- Phonetic placement cues
- Physical prompts
- Physical manipulation
- Facilitating context



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Therapy Resources



<https://adventuresinspeechpathology.com/product/the-complexity-approach-for-speech-therapy/>

<https://www.bjoremspeech.com/>

<https://scippapp.com/>

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QUESTIONS?

“What is treated is more important than how it is taught.”

Feel free to contact me anytime!
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