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Treatment for Speech Sound Disorders along the Continuum of Motor Planning/ Programming Deficits

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October 27, 2014

Learner Outcomes

- Describe the causes of speech sound disorders in children, and explain the continuum of motor planning/programming deficits that may contribute to a speech sound disorder.
- Explain and demonstrate use of Dynamic Temporal and Tactile Cueing (DTTC) as a treatment approach for severe motor planning/programming deficits.
- Describe the use of integrated phonological and motor approaches for the treatment of speech sound disorders.
- Explain how to incorporate the principles of motor learning to maximize the effectiveness and efficiency of treatment for children with speech sound disorders.

Introduction: Speech Sound Disorders

- "umbrella term referring to any combination of difficulties with perception, motor production, and/or the phonological representation of speech sounds and speech segments (including phonotactic rules that govern syllable shape, structure, and stress, as well as prosody), that impact speech intelligibility."
- Etiologies:
  - Motor-based (apraxia; dysarthria)
  - Structurally-based (e.g., cleft palate)
  - Syndrome or condition-related (e.g., Down syndrome)
  - Sensory-based (e.g., hearing impairment)
    - (ASHA, 2014)

Speech Sound Disorders (con't)

- Articulation disorders
  - Impact the form of speech sounds
  - Production-based impairment
- Phonological disorders
  - Impact the way speech sounds function within a language
  - Linguistic level of impairment

Prevalence

- Speech sound disorders occur in about 15% of 3-year-old children.
  - (Campbell et al. 2003)
- By age 6, approximately 3.8% of those same children will continue to have impaired speech production skills.
  - (Shriberg et al., 1999)
- More recent study reported that 18% of 8-year-olds had unresolved speech sound errors.
  - (Roulstone et al., 2009)

Model of Speech Production

cognition

Conceptualization
- Think of something to say

language

Lexical Retrieval
- Find the word

Phonological Planning
- Find the sound structure of the word

speech

Motor Planning
- Specify articulatory configurations/ movements for sensory speech goals

Motor Programming
- Specify the coordinated patterns of muscle contractions

➔ **Articulation**
- Includes feedback processing

e.g., Levelt et al. (1999), Van der Merwe (2009)

Praxis

- The ability to volitionally plan and program complex, highly sequenced motor skills to achieve specific movement goals
- Sensorimotor skill
  - Auditory and (especially) proprioceptive processing is necessary

Childhood Apraxia of Speech (CAS)

- Inefficient praxis abilities
  - Some ability to plan/program movement
  - Continuum of difficulties with planning and programming movement sequences underlying speech production
- Approximately 5% of children with speech sound disorders exhibit characteristics of CAS
  - (Strand, 2010)

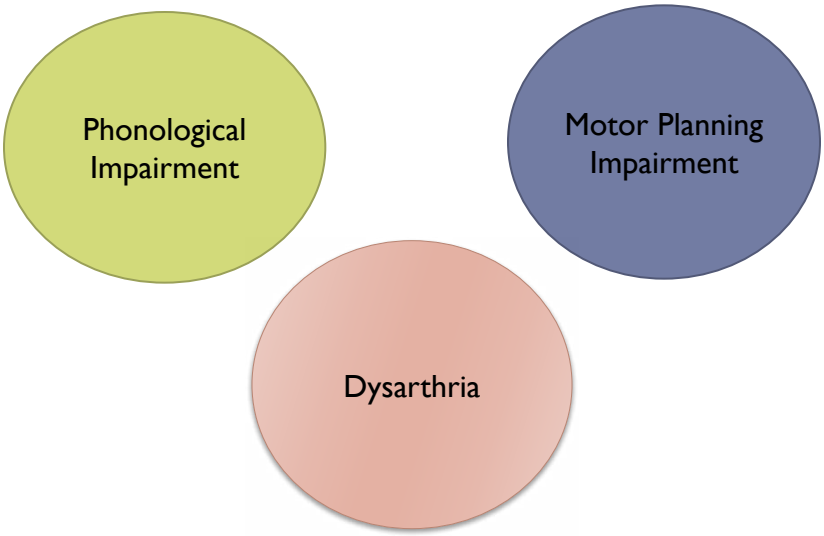
Key Diagnostic Markers of CAS

- Inconsistent errors on consonants and vowels in repeated productions of syllables or words
- Lengthened and disrupted coarticulatory transitions between sounds and syllables
- Inappropriate prosody, especially in the realization of lexical or phrasal stress
  - (ASHA, 2007)

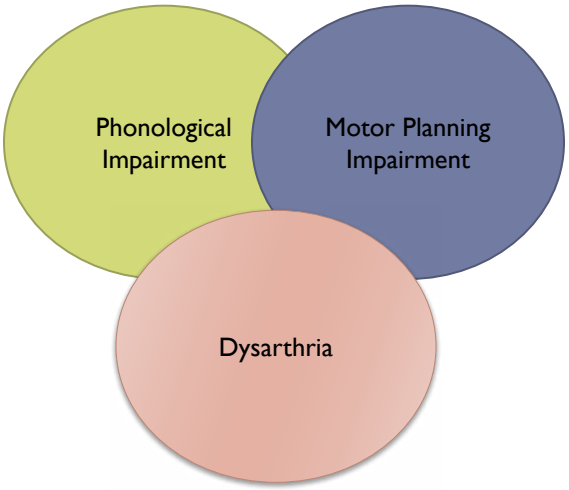
Phonological Patterns/Processes

- Describe the patterned modifications of the adult model by normally developing children
- Child simplifies the complex adult model by substituting sounds that are within his/her phonetic repertoire
- Describe the sound error patterns found in the speech of children diagnosed with a phonological disorder
  - (Pena-Brooks & Hegde, 2007)

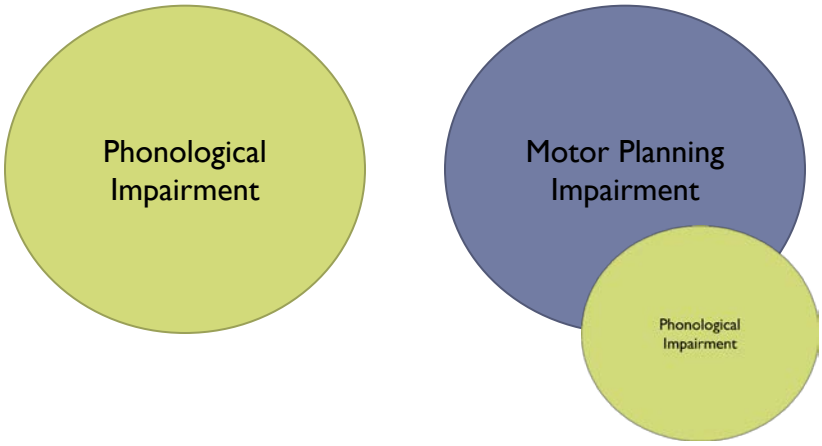
Differential Diagnosis



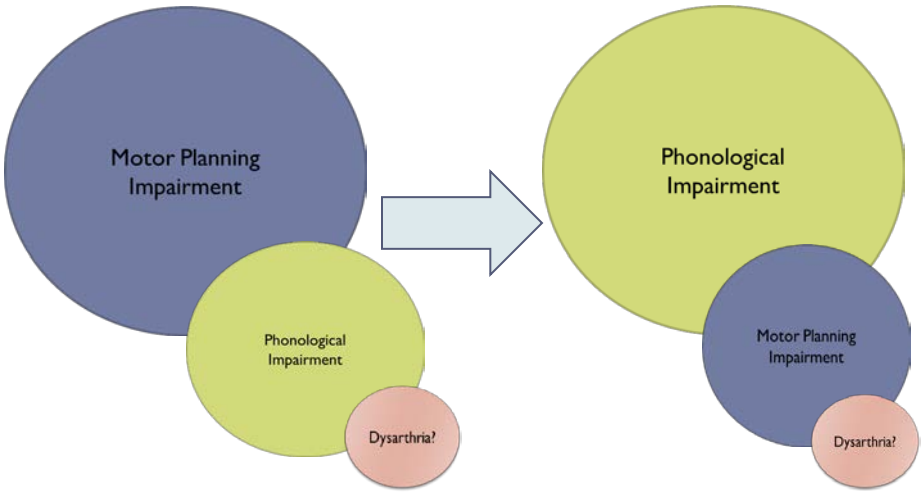
Differential Diagnosis



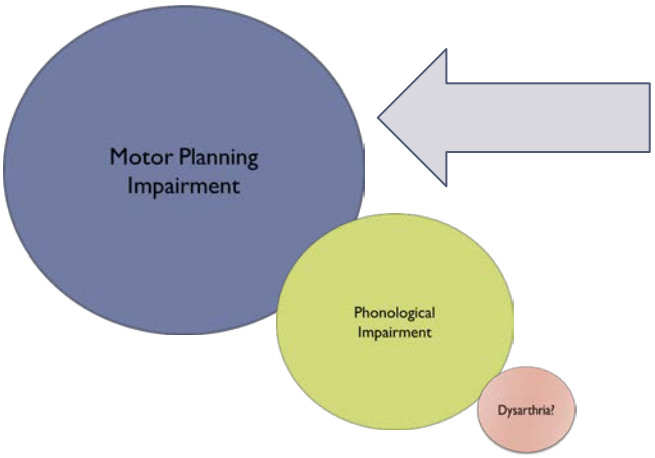
Differential Diagnosis?



Relative Contribution?



Primary Diagnosis = CAS



- 3 or 4-year olds
- Nonverbal or highly unintelligible
- Normal to near-normal cognition
- High reliance on gestures
- Start with a primarily motor-based approach!

Treatment for CAS

- Murray, McCabe, & Ballard (2013)
  - Systematic review of single-case experimental treatment studies for CAS
  - Three approaches determined to have <u>preponderant</u> evidence (i.e., positive effects of treatment are "probably true")
    - Integral Stimulation/Dynamic Temporal and Tactile Cueing
    - Rapid Syllable Transition Treatment (7-10 years of age)
      - (Ballard, Robin, McCabe, & McDonald, 2010)
    - Integrated Phonological Awareness Intervention

Treatment for CAS

- Dynamic Temporal and Tactile Cueing (DTTC)
  - Focuses on increasing motor speech skill
  - Incorporates principles of motor learning
  - Integral stimulation
    - "Watch me, listen to me, do what I do"
  - Best for children with severe speech sound disorders (i.e., CAS), younger children, older children with limited verbal communication
    - Uses a multidimensional scoring system
      - (Strand et al., 2006)
  - Success with children with phonological impairment with some evidence for delayed motor planning/programming skills
      - (McCauley & Strand, 1999)

DTTC Procedures

- Core functional vocabulary
  - First names: Jefferson; Jackson; Marissa
  - Last names: Shilling; Vonesh; Worthington
  - Transformers: Bumble Bee; Megatron
  - Superheroes: Captain America; Spiderman
- Theory: Core set of words serves as a vehicle for maturation of motor planning/programming substrates
    - (Strand, 2010)

DTTC Procedures

- Cueing hierarchy of temporal delay – going back and forth constantly, depending on child's success
  - Simultaneous production – producing utterance slowly and together; fade to a mime
  - Immediate repetition – direct imitation
  - Repetition after delay (my turn, you wait) – may need to add mime
  - Spontaneous production
    - (Strand, 2010)

Functional Core Vocabulary

- Single Words
  - Simple versus complex
- Multisyllabic Words
  - Spelling words
  - Core curriculum vocabulary words
- Phrases/Sentences
  - Ensure correct lexical and sentential stress

Specific Procedures of DTTC

- Therapist says utterance while child watches your face – child repeats (treatment probe)
- If child is unsuccessful, move to simultaneous production (first step) – continue until child can easily produce the utterance with the therapist
- Slowly fade simultaneous cue – decrease your loudness until just miming the utterance
- Move to immediate repetition – provide auditory model while ensuring child is watching your face – increase rate to normal
- Add a delay (2-3 seconds)
- Work to elicit spontaneously

Treatment Probes versus Cueing Hierarchy

- Say "eat" (treatment probe) = data collection
  - Child produces target incorrectly (vowel error) – wait 3 seconds before responding to child (score response)
  - Say "nice working/trying, but let's do it slowly and together"
- Begin cueing hierarchy here = TREATMENT (no data collection)!
  - Slow, simultaneous productions (usually stay here for a while during initial phases of treatment)
  - Slowly fade simultaneous cue – decrease your loudness until just miming the utterance
    - You will have a 'sense' of when to move to the final probe during each trial
- Immediate repetition
  - Say "okay, now you say 'eat'"(treatment re-probe) = data collection (score response)

Video 1 Example: DTTC

- "Eat"

Speech Sound Disorders

- Preston, Hull, & Edwards (2013)
  - Could preschool (ages 4-5) speech sound error patterns predict school-age (ages 8-9) phonological awareness, literacy, and articulation scores?
    - Atypical speech sound errors include substitutions and syllable structure errors generally not found in normal development (e.g., deleting initial consonants, backing of alveolars to velars, glottal replacement of oral consonants, and fricatives replacing stops).
    - Such errors reflect weak or poorly defined phonological representations, with the potential for long-term weaknesses in the areas of reading and spelling.
    - Distortion errors (e.g., dentalized /s/; derhoticized /r/) reflect an imprecision in the detailed specifications for a sound.
    - May suggest long-term difficulties in refining articulatory targets.

Speech Sound Disorders

- Results:
  - The number of preschool atypical errors per consonant was correlated with school-age phonological awareness skills.
  - Greater production of atypical errors in preschool was associated with lower phonological awareness skills (and thus, lower early literacy skills that depend upon such skills).
  - Children who produced more distortions (i.e., /s, z/) in preschool had lower articulation scores on the GFTA-2 at age 8 years of age.
    - (Preston et al., 2013)

Speech Sound Disorders

- Treatment suggestions:
  - Children who produce a high proportion of atypical phonological errors might benefit from the inclusion of early phonological awareness training as part of their speech-language intervention plan.
  - Early distortion errors may become solidified motor templates that are resistant to change.
    - Suggest monitoring distortion errors or directly treating distortion errors in preschool-age children to prevent the persistence of these errors.
      - (Preston et al., 2013)

3;8 year-old boy

- Started treatment on 4/1/2014
  - Attended a total of 24 (30 minute) sessions
  - Spring and summer semesters (April – July 2014)
- Primary diagnosis = CAS (severe)
  - Limited consonant repertoire
  - Deletion of initial consonants
  - Inconsistent productions
  - Inappropriate prosody
  - Frank vowel errors
  - Voicing errors (i.e., /b/ for initial /p/; /g/ for initial /k/; /k/ for final /g/)
- Also, exhibits a mild to moderate expressive language delay

3;8 year-old boy

- **Short-Term Goal #1**
  - *Child will accurately produce a core set of monosyllabic target words with a vowel and whole-word accuracy rating of at least "1" across three consecutive sessions.*

Video 2: DTTC

- "Hot"

Sampling of Pre-/Post-Treatment Data

Baseline Data

4/1/2014	Vowel Accuracy	Whole-Word Accuracy	
me	0	0	Vowel error
dog	0	0	ICD; post-vocalic devoicing
hot	2	0	ICD
eat	0	0	Vowel error
done	1	0	ICD; vowel distortion
fun	2	2	
pan	2	1	Pre-vocalic voicing

Final Probe Data

7/29/2014	Vowel Accuracy	Whole-Word Accuracy	
me	0	0	Vowel error
dog	2	2	
hot	2	0	ICD
eat	0	0	Vowel error
done	2	2	
fun	2	2	
pan	2	1	Pre-vocalic voicing

- Final probe data:
  - Increase in correct production of initial /d/ in trained CVC words
  - Correct voicing of final /g/
  - No improvement in the vowel /i/
  - No improvement in production of initial /h/
  - Continued mastery of "fun" (despite no direct treatment of this stimulus item)

0 = Incorrect

1 = Minor feature off/mild vowel error

2 = Correct

Sampling of Post-Treatment Transfer Data

7/29/2014	Vowel Accuracy	Whole-Word Accuracy	
bee	1	1	Mild vowel error only
see	1	1	Mild distortion of vowel and consonant
fee	1	1	Mild vowel distortion only
dot	2	2	
dock	2	2	
cat	2	2	
cop	2	2	
fog	2	2	
pun	2	1	Pre-vocalic voicing
pad	2	2	

0 = Incorrect

1 = Minor feature off/mild vowel error

2 = Correct

- Transfer data:
  - Slight increase in correct production of /i/ vowel (mild distortion only)
  - Increase in correct production of initial /d/ in untrained CVC words
  - Correct voicing of initial /k/ and final /g/
  - Slight improvement of voicing feature for /p/

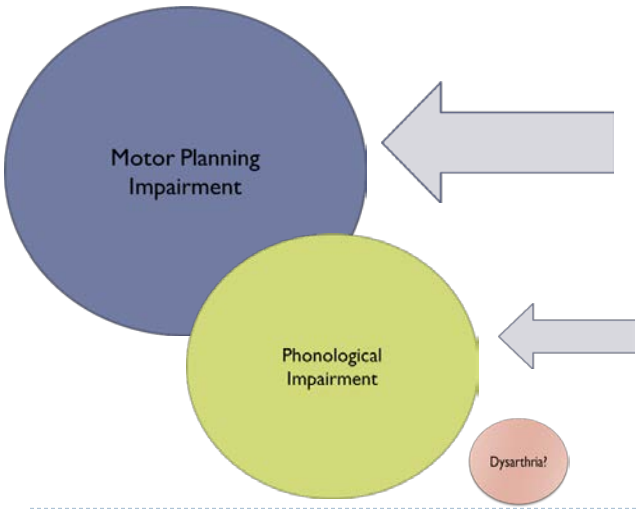
Summary: 3;8 year-old boy

- Diagnoses (July 29, 2014) :
  - Continues to present with severe CAS and mild to moderate expressive language delay
- Recommendations:
  - Continue motor speech treatment (DTTC) focused on increased whole-word accuracy of a functional core vocabulary
  - Continue to increase MLU and functional communication skills
  - Target phonological awareness skills

Update: Fall 2014 Semester

- Produces /h/ in the initial position of single words in 5/6 opportunities during treatment sessions
  - Additional target = "hot day"
- Consistent mild vowel error with /i/ (score of "1")
  - Continues to show improvement with each treatment session, particularly with target word "eek"
- Working on "sh" sound in functional core vocabulary (i.e., "shark";"shirt")
  - Can produce these words with only minor /r/ distortion during DTTC procedures with maximal verbal cueing
- Basic phonological awareness activities with beginning sounds
  - (/p/;"sh")
- Continued attempts at production of /s/ and /z/
  - Sucks air inward for production of these sounds
- MLU (at baseline) = 2.0 morphemes
  - Working to increase length and complexity of utterances

CAS = Predominating Diagnosis



- 4 – 5 year olds
- Highly verbal but still highly unintelligible, particularly in connected speech
- Normal to near-normal cognition
- Combined motor and phonological approach, with emphasis on phonological awareness skills!

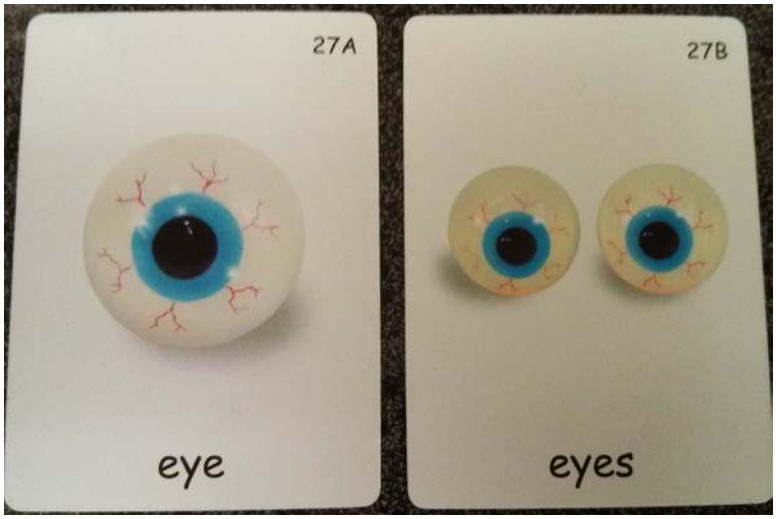
4;8 year-old boy

- **Short-Term Goal #1**
  - *Client will accurately produce final consonants at the single word level in 8 out of 10 opportunities without cues over 3 consecutive sessions.*

4;8 year-old boy

- Diagnoses:
  - Moderate to severe childhood apraxia of speech (CAS) = primary diagnosis
    - Persistence of final consonant deletion
    - Addition of schwa
    - Unusual phonological processes (e.g., backing of fricatives)
    - Limited phonemic inventory (entire sound classes not present)
    - Frank vowel errors
    - Inconsistent errors with repeated attempts of same stimulus item
    - Difficulty with coarticulatory transitions between sounds and syllables
    - Prosodic errors (e.g., segmentation; incorrect lexical stress)
  - Mild-moderate expressive language delay
  - Speech intelligibility = 20% at baseline

Video 3: DTTC with Minimal Pairs



Video 4: DTTC with Co-Articulation

- "Eat-Toe"

Sampling of Pre-/Post-Treatment Data

Target	Production 1	Production 2	Production 3
Eyes	/ɑɪ/	/ɑɪ/	/ɑɪ/
Final	/ɑɪz/	/ɑɪ/	/ɑɪz/
Bus	/bʌ/	/bʌ/	/bʌ/
Final	/bʌ/	/bʌ/	/bʌs/
Buzz	/bʌ/	/bʌ/	/bʌ/
Final	/bʌz/	/bʌz/	/bʌʒ/
Bug	/bʌ/	/bʌ/	/bʌ/
Final	/bʌ/	/bʌ/	/bʌ/
Spider	/bɑɪdɚ/	/bɪsdɚ/	/bɪdɚ/
Final	/spɑɪdɚ/	/ spɑɪdɚ /	/ spɑɪdɚ /
Dave	/deɪ/	/deɪ/	/deɪ/
Final	/deɪ/	/deɪv/	/deɪv/

- Slight increase in production of final consonants from his baseline performance (0%) to final probe performance (13%).
  - No improvement for final stops
- Correctly produced final /v/, /s/, and /z/ but productions were inconsistent.
- Whole-word accuracy on all target stimuli, including those with vocalic /r/, increased from 6% to 22%.
- Increased production of /sp/ blends from his baseline performance (0%) to his final probe performance (75%).

Sampling of Post-Treatment Transfer Data

Nice	/nɑɪ/	Shake	/deɪ/
Rose	/wo/	Shop	/gap/
Four	/gɔr/	Sheet	/dɪ/
Fat	/dæ/	Ship	/dɪp
Leaf	/hi/	Shoe	/gu/
Laugh	/hɑ/	Slip	/sɪ/
Beef	/bi/	Snail	/snɛdəl/
Vote	/wo/	Snow	/wo/
Vest	/bʌ/	Ski	/si/
Vase	/deɪ/	Store	/gɔr/
Call	/ka/	Spin	/bɪ/

- No transfer of final consonants (/s/, /z/, /v/)
- Minimal transfer of /s/ blends
- Correct production of vowels in 95% of opportunities
- Speech intelligibility increased from 20% to 40% for a familiar listener, but only to 25% for an unfamiliar.

Summary: 4;8 year-old boy

- Diagnoses:
  - Moderate to severe childhood apraxia of speech (CAS)
  - Mild-moderate expressive language delay
- Recommendations (speech production only):
  - Continue speech-language pathology services at NAU during the Fall semester, including involvement in both individual therapy sessions and the Preschool Social Language Group (PSLG).
  - Begin integrating Lindamood Phoneme Sequencing (LiPS) program for reading, spelling, and speech to further develop sensory awareness of accurate sound/word productions, and increase phonological awareness skills.

Summary: 4;8 year-old boy (con't)

- Continue targeting accurate productions of final consonants at the single word level through use of:
  - DTTC therapy
  - Integrated phonological awareness approach
  - Minimal pair contrast therapy
  - Perceptual training
  - Co-articulation therapy
- Continue targeting accurate productions of velar (/k, g/ and fricative (/f, v/;"sh") sounds in initial and final positions at the single word level using verbal, visual, and tactile cueing.
- Begin targeting internal discrimination of final consonants through use of minimal pairs and video/audio feedback.

Update: Fall 2014 Semester

- LiPS program:
  - Lip popper
  - Tongue tapper
  - Tongue kicker (scraper)
- Phonological awareness activities
  - Phoneme identity (beginning and final sounds)
- Producing final sounds
  - 2/10 opportunities spontaneously
  - 10/10 opportunities with verbal cues (via DTTC procedures)
- Producing initial /s/ blends with maximal cueing techniques
- Stimulable for /l/ in isolation but will delete in initial position in single words unless provided with maximal cueing using DTTC procedures

Integrated Phonological Awareness Approach

- McNeill, Gillon, & Dodd (2009)
  - Evaluated the effectiveness of an integrated phonological awareness approach in increasing speech production, letter knowledge, and phonological awareness skills in 12 children with CAS.
  - The aim of this approach was to:
    - Suppress the use of targeted speech error patterns in trained and untrained words
    - Suppress the use of targeted speech error patterns during connected speech
    - Increase the phonological awareness of trained and untrained words containing the target speech error pattern
    - Increase letter-sound knowledge, real-word and non-word decoding, and spelling ability

Integrated Phonological Awareness Approach

- McNeill, Gillon, & Dodd (2009)
  - One speech error pattern was targeted in each intervention block for each child
  - A long cycle of intervention was used for each speech pattern (i.e., 12 sessions over 6 weeks)
  - Speech probes: 10 trained and 5 untrained words
  - Phoneme awareness probes: 10 trained and 5 untrained words
  - Personal narrative production task
- Treatment sessions
  - 24 individual 45-minute sessions over 18 weeks
    - Intervention block (12 sessions over 6 weeks, 2 sessions/week)
    - 6-week withdrawal block
    - Second intervention block (12 sessions over 6 weeks, 2 sessions/week)

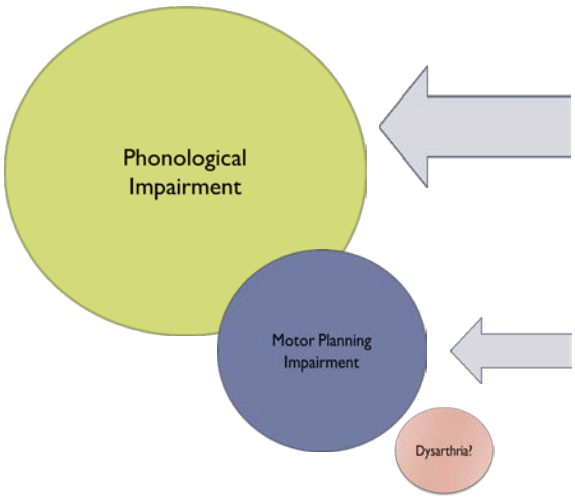
Integrated Phonological Awareness Approach

- Treatment sessions: Phonological awareness tasks
  - Letter-sound knowledge
  - Phoneme identity
  - Segmentation and blending
  - Manipulation
  - http://www.education.canterbury.ac.nz/people/gillon/resources.shtml
    - (McNeill et al., 2009)

Combined Motor and Phonological Awareness Approach

- Dynamic Temporal and Tactile Cueing
- Core vocabulary
  - Targets specific to phonological awareness training
  - Targets to address the addition of sound classes not consistently produced in phonemic repertoire (more complex)
    - (e.g., Maas & Farinella, 2012)
- Phonological awareness tasks
  - Letter-sound knowledge
  - Phoneme identity
  - Segmentation and blending
  - Manipulation
    - (McNeill et al., 2009)

Phonological Impairment = Primary Dx



- 5+ year-olds
- Phonological patterned errors predominate (persist well past age-appropriate timelines)
- Generally intelligible, particularly when conversational context is known
- Occasional vowel errors
- Residual articulation errors
  - /s, z/, /r/, and/or /l/
- Prosodic abnormalities, particularly during multisyllabic word productions
  - e.g., segmentation

5;2 year-old boy

- **Short-Term Goal:**
  - *By July 2014, client will independently produce a core set of functional vocabulary words with a whole-word accuracy rating of "2" at the phrase level, over three consecutive sessions.*

5;2 year-old boy

- Diagnoses:
  - Mild to moderate speech sound impairment characterized by difficulties in phonological skill acquisition and mild planning/programming deficits
    - Persistence of age-inappropriate phonological patterns (i.e., velar fronting; final consonant deletion; inconsistent final sound substitutions)
    - Inconsistent vowel errors
    - Inconsistent voicing errors
    - Segmentation and equalized stress noted inconsistently on multisyllabic word productions
- Attended 11/18 sessions (30 minute, individual sessions at the NAU Speech-Language-Hearing Clinic)

Baseline Data

- Initial target-word probe data (6-10-2014)
  - Produced 0/5 functional core vocabulary words with a whole-word accuracy rating of "2".
- Final target-word probe data (7-24-2014)
  - Produced 2/5 functional core vocabulary words with a whole-word accuracy of "2" at the phrase level.
    - 0 = incorrect; 1 = minor feature off; 2 = correct

Language/Motor-based Treatment Approach

- Small core functional vocabulary:
  - Sand (Sandman)
  - Hide
  - Bad (bad guy)
  - Cape (Batman or Superman's cape)
  - Cave
- Stimulus words were targeted (using DTTC) in narrative-based activities
  - Story recall tasks (superheroes)
  - Self-generated narratives (superheroes)

Video 5: Integral Stimulation

- Successive productions without intervening stimulation and without auditory or visual cues (Step 4)
  - (Rosenbek et al., 1973)
- "A long cape"

Superman will save the day and fight the bad guy!

Video 6: Integral Stimulation

- Successive productions without intervening stimulation and without auditory or visual cues (Step 4)
  - (Rosenbek et al., 1973)
- "He is bad"

Pre-/Post-Treatment Data (Final Probe)

Stimulus (3 productions at final probe)	Vowel Baseline	Vowel Final Probe	Whole-Word Accuracy Baseline	Whole-Word Accuracy Final Probe	Examples
Sand	2	2,2,2	0	0,0,0	Baseline: /sæn/ Final Probe: /sæn/
Hide	2	2,2,2	0	2,2,2	Baseline: /haɪ/ Final Probe: /haɪ/
Bad	2	2,2,2	0	2,2,2	Baseline: /bæ/ Final Probe: /bæd/
Cape	0	0,0,0	0	0,0,0	Baseline: /teɪp/ Final Probe: /teɪp/
Cave	0	0,0,0	0	0,0,0	Baseline: /teɪ/ Final Probe: /teɪ/

0 = Incorrect

1 = Minor feature off/mild vowel error

2 = Correct

Final Probe Data (Post-Treatment)

Phrase Level: ***Final Probe***

Target Phrase (3 productions)	Vowel	Whole-Word Accuracy
A long **c**ape	0,0,0	0,0,0
He is ba**d**	2,2,2	2,2,2
Run and hi**de**	2,2,2	2,2,2
Made of sa**nd**	2,2,2	0,0,0
A creepy **c**ave	0,0,0	0,0,0

Transfer Data: ***Final Probe***

Target Word (3 productions)	Vowel	Whole-Word Accuracy
Kate	0,0,0	0,0,0
Ba**t**	2,2,2	2,2,2
Hy**pe**	2,2,2	2,2,2
Sa**t**	2,2,2	2,2,2
Kite	2,2,2	0,0,0

Summary: 5;2 year-old boy

- Continues to present with a mild speech sound impairment, primarily in the area of phonological skill acquisition, but compromised by mild motor planning/programming deficits
  - Eliminated deletion of final /d/ in CVC targets
  - Deletion of final /d/ not observed during spontaneous speaking interactions in final therapy sessions.
  - Increased consistency of final /t/ in CVC (untrained) targets
  - Lack of generalization of correct production of initial /k/ and /g/ noted during final probe data (i.e., retention and transfer).
- Consider principles of motor learning with regard to how we practice (e.g., use of random practice; reduced feedback frequency).
- Increase emphasis on semantic awareness contrasts (e.g., minimal pairs), as well as ensuring vowel accuracy and prosodic accuracy in stimulus word productions.

Success Story!

- John: 7; 8 year-old (at present)
  - Started treatment at the NAU Speech-Language-Hearing Clinic at 3 years of age.
- Diagnoses:
  - Markedly severe CAS (non-verbal)
  - Severely impaired expressive language skills
  - Moderately severe bilateral low-tone at rest
  - Receptive language within the normal range

John's Treatment

- Summer 2010 (8 weeks)
  - 1:1 3x/week (30 minute sessions)
  - Small functional core vocabulary/DTTC
    - Hi, bye, mine, Mama, off, do, go, eat, toys
- Fall 2010 (15 weeks)
  - 1:1 2x/week (45 minute sessions)
  - Additions to core functional vocabulary/DTTC
    - Hannah, Risa, Grace, blue, bike, play, cookie, John, Batman
  - Expressive language goals (increase MLU and use of age-appropriate grammatical markers)
    - -ing, -s, 's, -ed (motor speech not targeted)

John's Treatment (con't)

- Spring 2011(15 weeks): Age 4;10
  - Additions to core vocabulary + added emphasis on prosodic accuracy
    - Marisa, number, three, four, five, Jack, the, that, stop
  - Increase expressive language primarily through sequencing activities
    - (MLU = 3.8 – 4.1by the end of the semester)
  - Implemented Lidcombe program (primarily home-based program) for incipient stuttering
- Summer 2011(8 weeks)
  - Participated in Literacy Camp at NAU Speech-Language-Hearing Clinic 2x/week (2-hour sessions)

John's Treatment (con't)

- Fall 2011 – Summer 2012 (38 weeks)
  - Continued treatment plan (expand expressive language skills; increase motor speech production skills using DTTC; monitor stuttering behaviors; increased focus on narrative language skills)
- Fall 2012 – Spring 2013 (30 weeks)
  - Targeted complex functional core vocabulary with emphasis on whole-word and prosodic accuracy
    - Metroplex, Optimus Prime, Demolisher, Ironhide, crane, grandmother, crayon, dragon, grapes, Leonardo, Flame Slinger, Stump Smash, Stealth Elf, etc., etc., etc., etc.)
  - Continued expansion of narrative discourse skills (following Applebee's levels)
  - John is now required to give presentations about Skylander characters to groups of graduate students using a 'louder' voice
  - Continued working towards correct use of age-appropriate grammatical markers during narrative language activities and group presentation activities
- Summer 2013 (8 weeks)
  - Received 1:1 treatment for tongue thrust (speech and non-speech tasks [i.e., resting tongue posture; reverse swallow])

End of Spring Semester 2013

John's Current Status

- Spring 2014
  - Residual errors addressed with school-based SLP
    - /l/ and /str/ blends in connected speech
    - Inconsistent errors on voiced and voiceless "th"
    - Occasional difficulties with irregular past-tense verbs
    - Very mild flaccid dysarthria (i.e., mild tongue weakness) = mild articulatory imprecision
      - Does not impact speech intelligibility
- Fall 2014 (age 7; 8)
  - Dismissed from all services; speech-language skills are within normal limits at this time.
    - NAU will address the mild dysarthria using LSVT at a later time.

Lee Silverman Voice Treatment

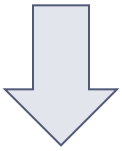
- Children ages 5 to 7 years with dysarthria secondary to spastic cerebral palsy
  - (Fox & Boliek, 2012)
- Children with Down Syndrome
- Intensive voice treatment – LOUD
- Results in increases in speech intelligibility (greater range of motion of the articulators), VP closure, laryngeal closure, and respiratory function for speech production
- Incorporates principles of motor learning (intensity)!

Practice and Feedback (Non-speech motor learning literature)

- Practice
  - Amount: Lots of trials (fewer different targets)
  - Distribution: Spread trials / sessions
  - Variability: Vary phonetic context, rate, elicitation method, setting
  - Order: Practice targets in random order (DTTC = blocked, then random practice)
- Feedback
  - Type: FB on performance and accuracy in beginning, then FB on accuracy alone
  - Frequency: FB only on ≈60% of attempts (DTTC = 100% feedback, then fades frequency)
  - Timing: Wait 2-3 seconds before giving FB

Service Delivery?

- Primary diagnosis = CAS
  - Frequent and intense speech practice!
- 1:1 treatment 4-5 days/week (20-30 minute sessions) for at least 4-6 weeks.



- 1:1 treatment 2-3 days/week (30-45 minute sessions) + 1-2 group sessions/week (30 minute sessions).

School Setting

- 1:1 treatment 3-4 days per week (10-15 minutes sessions) for however long it takes!
- Group treatment 1-[illegible]k (30 minute sessions) for 1+ years = minimal pr[illegible]

- Intensity is the key to success!!!!!

Service Delivery: Principles of Motor Learning

- Precursors to motor learning
  - Establish trust
  - Inform clients of treatment goals
  - Ensure clients understand the tasks and procedures implemented in treatment
  - Ensure clients are focused and motivated to change
    - (Edeal & Gildersleeve-Neumann, 2011)

Service Delivery: Principles of Motor Learning (con't)

- Blocked Practice
  - Best when child is first learning a new skill
  - Slight advantage for younger children; more severe CAS (Maas & Farinella, 2012)
- Random Practice
  - Leads to greater generalization outside the session
  - Slight advantage for older children and less severe CAS (Maas & Farinella, 2012)
- Knowledge of Performance (Feedback)
  - Valuable early on during the learning process
- Knowledge of Results (Feedback)
  - Refers to feedback provided to the client about whether or not the target was produced correctly
  - Most valuable later in treatment after the client has learned the skill and is showing improvement in treatment sessions
    - (Edeal & Gildersleeve-Neumann, 2011)

Fine-motor Activities

- Quick reinforcements during speech production practice:
  - Stringing beads
  - Check marks (golf pencils)
  - Coloring pictures that contain target sound(s) (broken crayons)

Dual-motor Tasking

- LSVT "BIG and LOUD" literature

Speech Intelligibility versus Speech Comprehensibility

- Watch the speaker's face
- Topic cues
- Alphabet board (orthographic cues)
  - Video7
- Specific strategies to resolve communication breakdowns
    - (Yorkston et al., 1996)

Suggestions for Older Pediatric Clients

- Small functional core vocabulary + AAC
- Strategies to promote speech comprehensibility
- Change service delivery model
- Augmentative/alternative communication device (AAC)