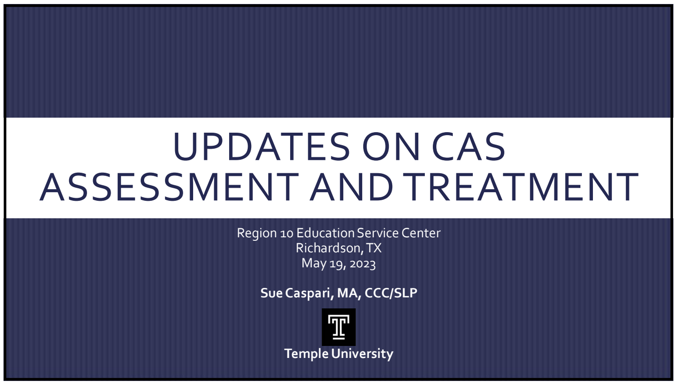
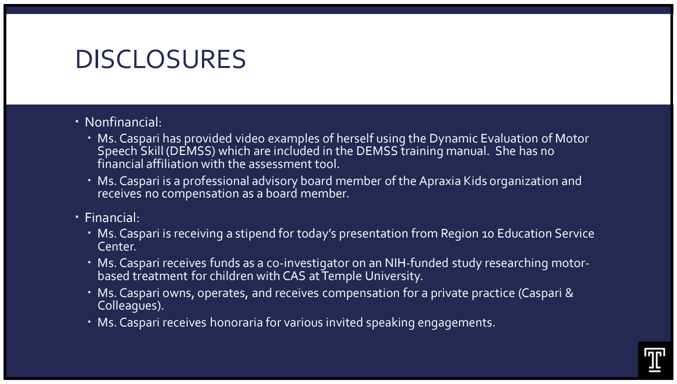


UPDATES ON CAS ASSESSMENT AND TREATMENT

Region 10 Education Service Center
Richardson, TX
May 19, 2023

Sue Caspari, MA, CCC/SLP

Temple University

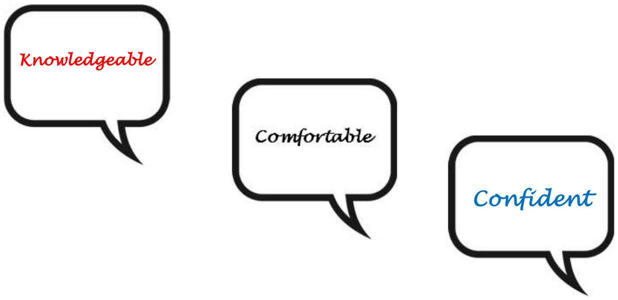


DISCLOSURES

- Nonfinancial:
  - Ms. Caspari has provided video examples of herself using the Dynamic Evaluation of Motor Speech Skill (DEMSS) which are included in the DEMSS training manual. She has no financial affiliation with the assessment tool.
  - Ms. Caspari is a professional advisory board member of the Apraxia Kids organization and receives no compensation as a board member.
- Financial:
  - Ms. Caspari is receiving a stipend for today's presentation from Region 10 Education Service Center.
  - Ms. Caspari receives funds as a co-investigator on an NIH-funded study researching motor-based treatment for children with CAS at Temple University.
  - Ms. Caspari owns, operates, and receives compensation for a private practice (Caspari & Colleagues).
  - Ms. Caspari receives honoraria for various invited speaking engagements.

CHILDHOOD APRAXIA OF SPEECH (CAS)

Type ONE WORD in the question box to describe CAS



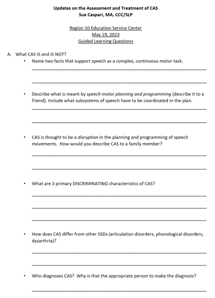
Knowledgeable

Comfortable

Confident

OVERVIEW

- What CAS IS and IS NOT
- Can we diagnose CAS in a speech-language evaluation conducted in a school setting or is this a medical diagnosis?
- What do we need to be able to document to make that diagnosis?
- How to talk to a parent about CAS – if I suspect that a student has CAS, can I talk about this without documentation? How much information should I share?
- Functional and effective therapy strategies
- How to write a goal for a child with CAS
- I have a high caseload…how am I going to provide services for this student? What kind of service levels are recommended -- what kind of service level is possible in a school setting?



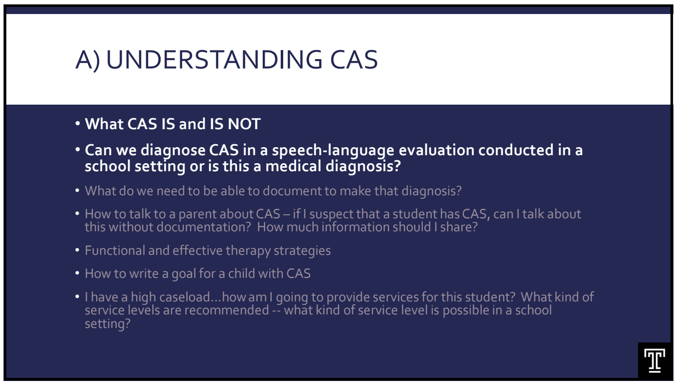
Updates on the Assessment and Treatment of CAS
Sue Caspari, MA, CCC/SLP

Region 10 Education Service Center
May 19, 2023
Guided Learning Questions

A. What CAS IS and IS NOT?
- Name two facts that support speech as a complex, continuous motor task.
- Describe what is meant by *speech motor planning and programming* (describe it to a friend). Include what subsystems of speech have to be coordinated in the plan.
- CAS is thought to be a *disruption* in the planning and programming of speech movements. How would you describe CAS to a family member?
- What are 3 primary DISCRIMINATING characteristics of CAS?
- How does CAS differ from other SSDs (articulation disorders, phonological disorders, dysarthria)?
- Who diagnoses CAS? Why is that the appropriate person to make the diagnosis?

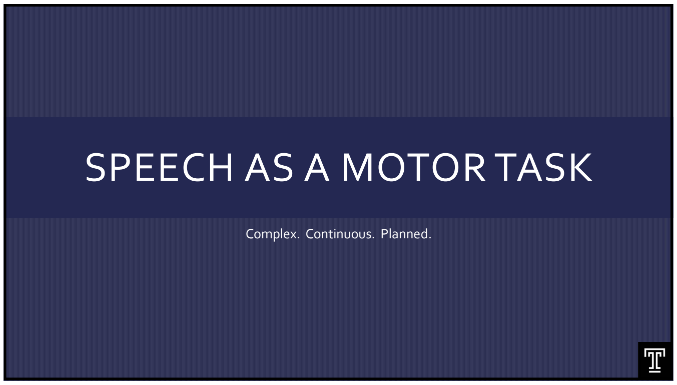
REFLECTIONS

- Complete as we go along
- Take breaks to reflect



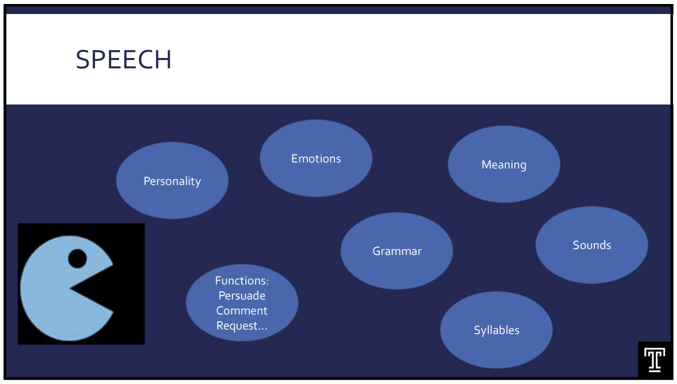
A) UNDERSTANDING CAS

- **What CAS IS and IS NOT**
- **Can we diagnose CAS in a speech-language evaluation conducted in a school setting or is this a medical diagnosis?**
- What do we need to be able to document to make that diagnosis?
- How to talk to a parent about CAS – if I suspect that a student has CAS, can I talk about this without documentation? How much information should I share?
- Functional and effective therapy strategies
- How to write a goal for a child with CAS
- I have a high caseload…how am I going to provide services for this student? What kind of service levels are recommended -- what kind of service level is possible in a school setting?



SPEECH AS A MOTOR TASK

Complex. Continuous. Planned.



SPEECH

Personality

Emotions

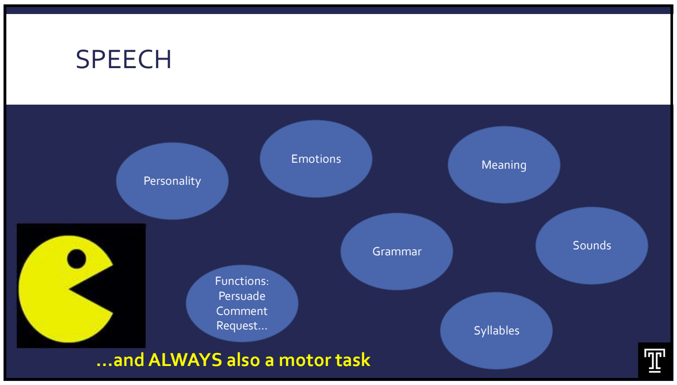
Meaning

Grammar

Sounds

Functions:
Persuade
Comment
Request…

Syllables



SPEECH

Personality

Emotions

Meaning

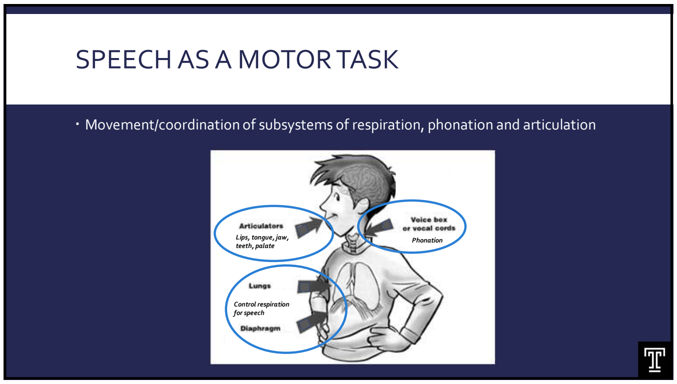
Grammar

Sounds

Functions:
Persuade
Comment
Request…

Syllables

…and ALWAYS also a motor task



SPEECH AS A MOTOR TASK

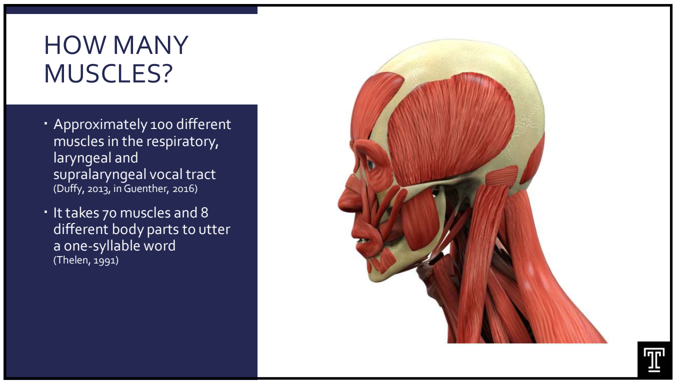
- Movement/coordination of subsystems of respiration, phonation and articulation

Articulators
Lips, tongue, jaw, teeth, palate
Voice box or vocal cords
Phonation
Lungs
Control respiration for speech
Diaphragm

"Speech production is a *complex* fine motor task" (Grigos, 2016)

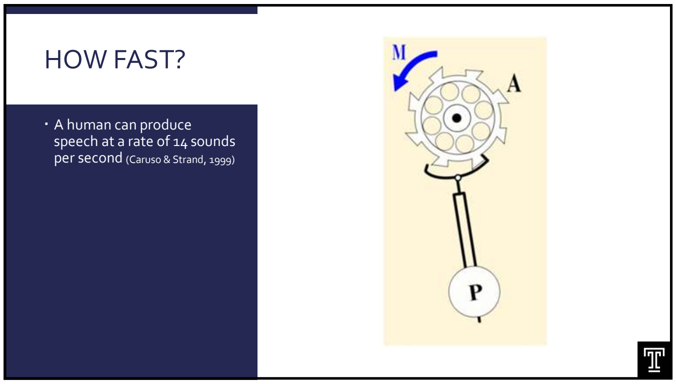
Complex. Continuous. Planned.

COMPLEX



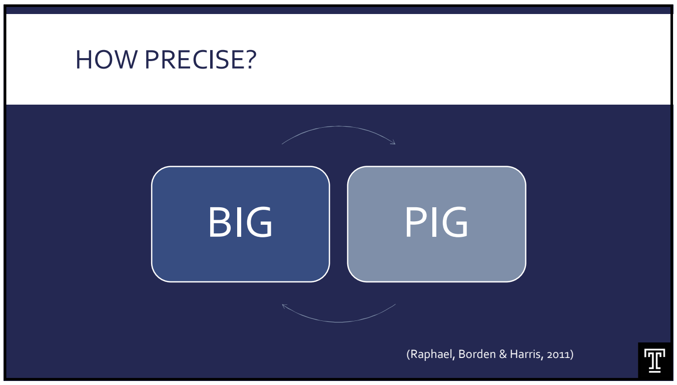
HOW MANY MUSCLES?

- Approximately 100 different muscles in the respiratory, laryngeal and supralaryngeal vocal tract (Duffy, 2013, in Guenther, 2016)
- It takes 70 muscles and 8 different body parts to utter a one-syllable word (Thelen, 1991)



HOW FAST?

- A human can produce speech at a rate of 14 sounds per second (Caruso & Strand, 1999)



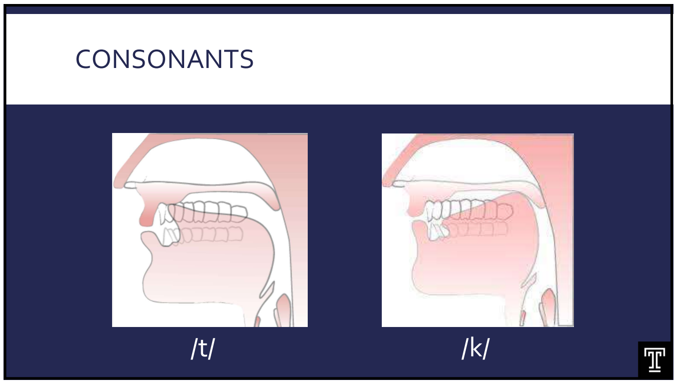
HOW PRECISE?

BIG

PIG

(Raphael, Borden & Harris, 2011)

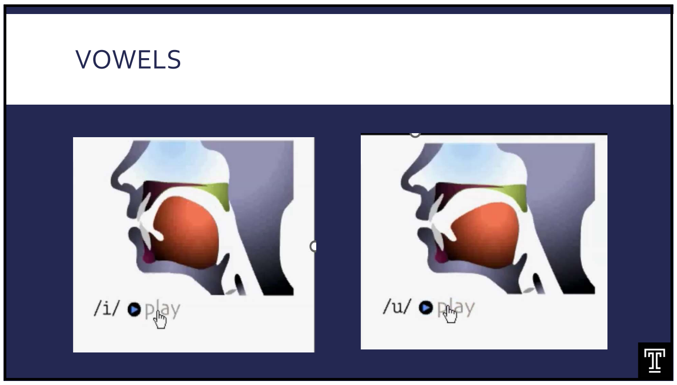
CONTINUOUS



CONSONANTS

/t/

/k/



VOWELS

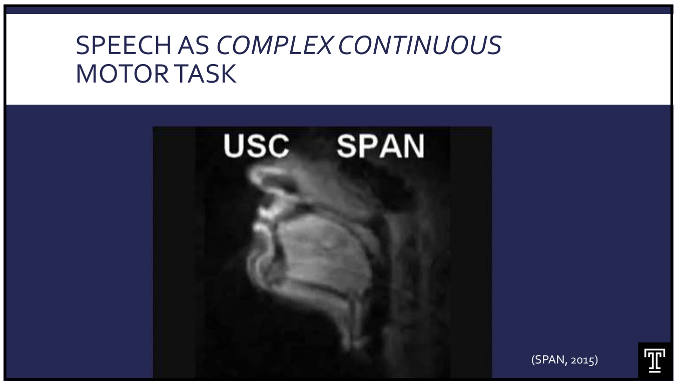
/i/ play
/u/ play

SPEECH = CONTINUOUS MOVEMENT GESTURES FROM ONE POSTURE TO THE NEXT

SPEECH GRAPHICS

SPEECH = CONTINUOUS MOVEMENT GESTURES FROM ONE POSTURE TO THE NEXT

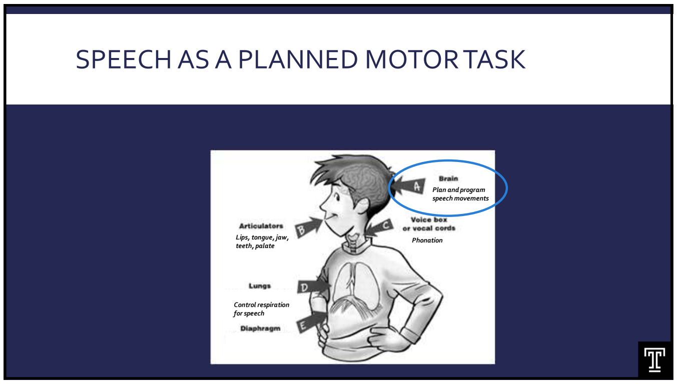
SPEECH GRAPHICS



SPEECH AS *COMPLEX CONTINUOUS* MOTOR TASK

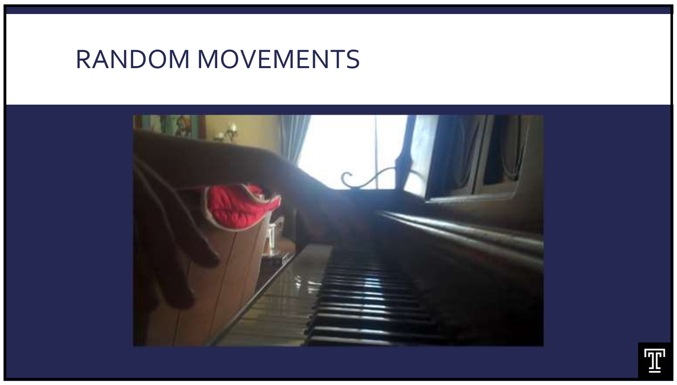
(SPAN, 2015)

PLANNED

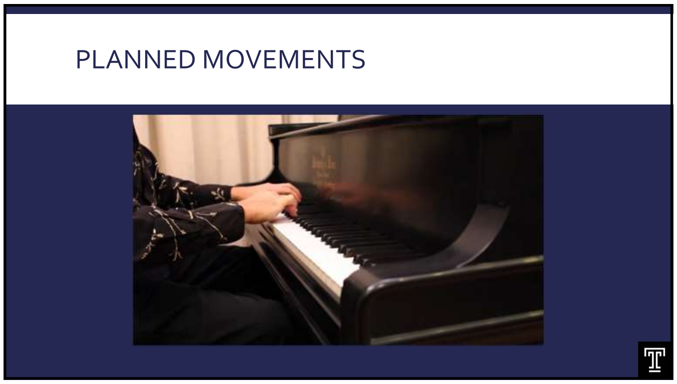


SPEECH AS A PLANNED MOTOR TASK

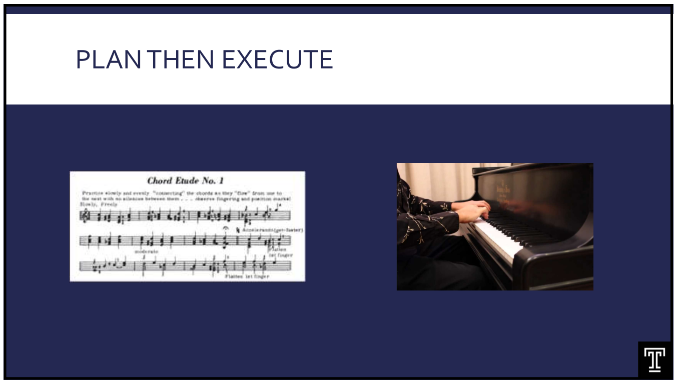
A
Brain
Plan and program speech movements
B
Articulators
Lips, tongue, jaw, teeth, palate
C
Voice box or vocal cords
Phonation
D
Lungs
Control respiration for speech
E
Diaphragm



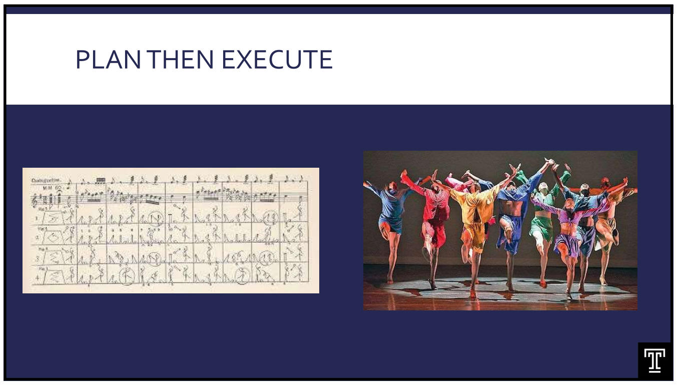
RANDOM MOVEMENTS



PLANNED MOVEMENTS



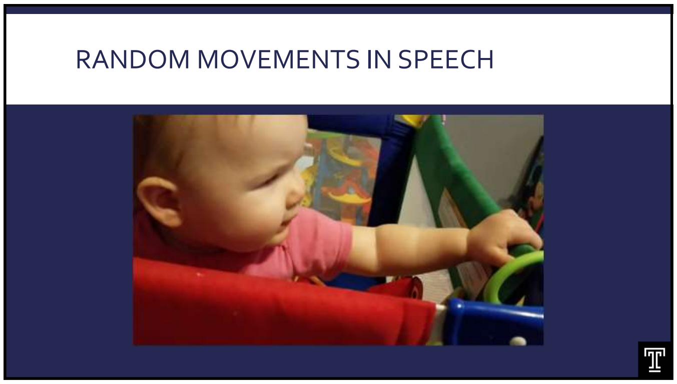
PLAN THEN EXECUTE



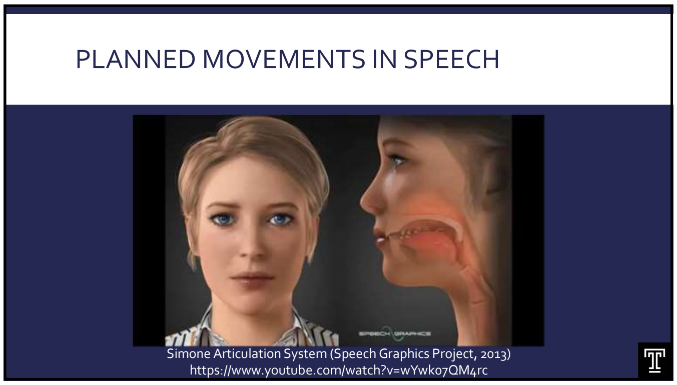
PLAN THEN EXECUTE

PLAN THEN EXECUTE

UNDESIRABLE
DESIRABLE
UNDESIRABLE
Pull hook
Hook
Pull
Fade
Straight
Draw
Push
Slice
Push Slice

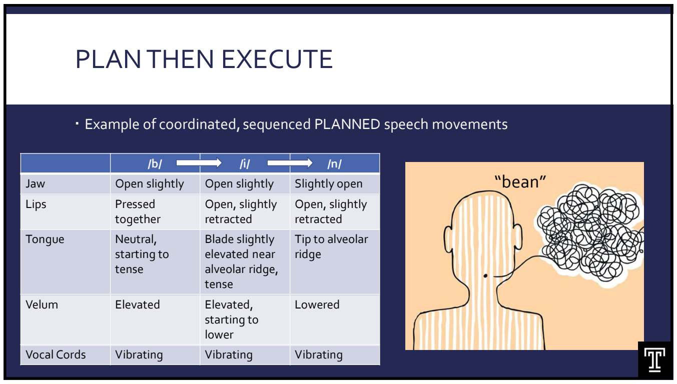


RANDOM MOVEMENTS IN SPEECH



PLANNED MOVEMENTS IN SPEECH

Simone Articulation System (Speech Graphics Project, 2013)
https://www.youtube.com/watch?v=wYwk07QM4rc



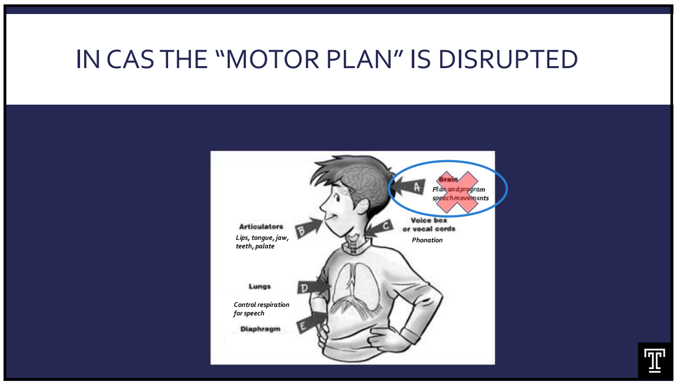
PLAN THEN EXECUTE

- Example of coordinated, sequenced PLANNED speech movements

	/b/ →	/i/ →	/n/
Jaw	Open slightly	Open slightly	Slightly open
Lips	Pressed together	Open, slightly retracted	Open, slightly retracted
Tongue	Neutral, starting to tense	Blade slightly elevated near alveolar ridge, tense	Tip to alveolar ridge
Velum	Elevated	Elevated, starting to lower	Lowered
Vocal Cords	Vibrating	Vibrating	Vibrating

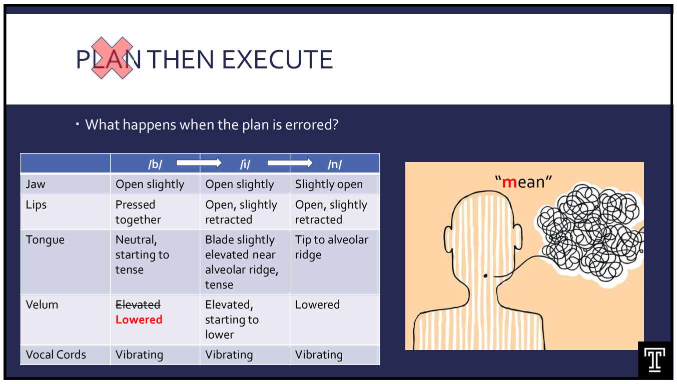
WHAT IS CAS?

Disruption in the motor PLAN for speech movements



IN CAS THE "MOTOR PLAN" IS DISRUPTED

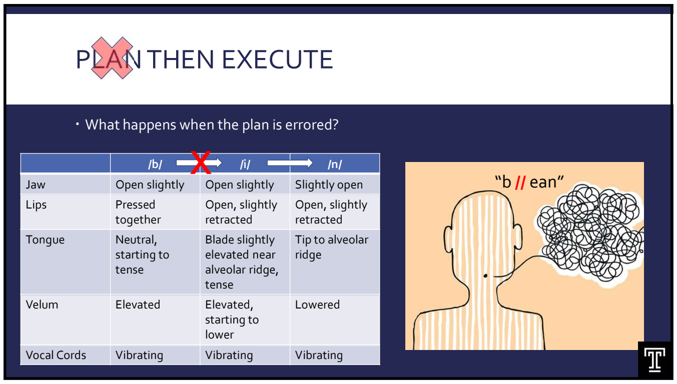
A
Brain
Plan and program speech movements
B
Articulators
Lips, tongue, jaw, teeth, palate
C
Voice box or vocal cords
Phonation
D
Lungs
Control respiration for speech
E
Diaphragm



PLAN THEN EXECUTE

- What happens when the plan is errored?

	/b/ →	/i/ →	/n/
Jaw	Open slightly	Open slightly	Slightly open
Lips	Pressed together	Open, slightly retracted	Open, slightly retracted
Tongue	Neutral, starting to tense	Blade slightly elevated near alveolar ridge, tense	Tip to alveolar ridge
Velum	~~Elevated~~ Lowered	Elevated, starting to lower	Lowered
Vocal Cords	Vibrating	Vibrating	Vibrating



PLAN THEN EXECUTE

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Vocal Cords	Vibrating	Vibrating	Vibrating

ASHA
American
Speech-Language-Hearing
Association

DEFINITION

- "Childhood apraxia of speech (CAS) is a neurological childhood (pediatric) speech sound disorder in which the precision and consistency of **movements underlying speech** are impaired . . . The core impairment in planning and/or programming spatiotemporal parameters of movement sequences **RESULTS IN** errors in speech sound production and prosody" (ASHA 2007)

KEY FEATURES OF CAS (ASHA, 2007)

Inconsistent errors on consonants and vowels in repeated productions of syllables or words

Vowel errors

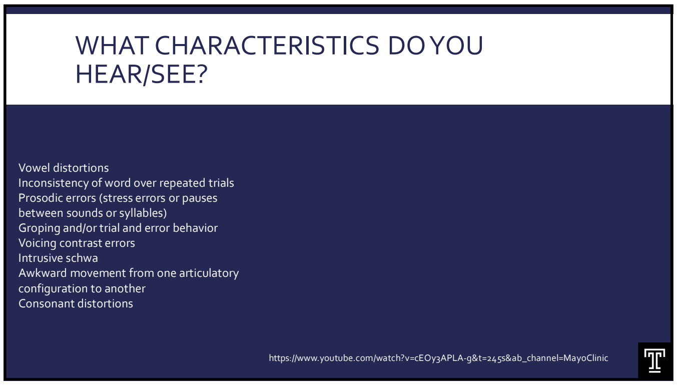
Lengthened and disrupted coarticulatory transitions between sounds and syllables

Inappropriate prosody, especially stress errors

DISCRIMINATING CHARACTERISTICS

- Characteristics most discriminative of CAS
  - Vowel distortions
  - Inconsistency of word over repeated trials
  - Prosodic errors (stress errors or pauses between sounds or syllables)
  - Groping and/or trial and error behavior
  - Voicing contrast errors
  - Intrusive schwa
  - Awkward movement from one articulatory configuration to another
  - Consonant distortions

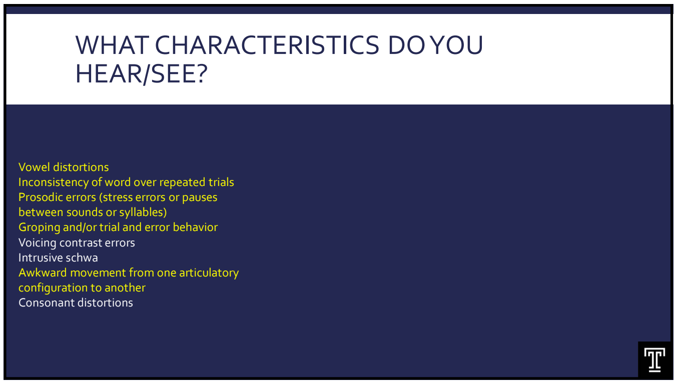
(Strand, 2019)



WHAT CHARACTERISTICS DO YOU HEAR/SEE?

Vowel distortions
Inconsistency of word over repeated trials
Prosodic errors (stress errors or pauses between sounds or syllables)
Groping and/or trial and error behavior
Voicing contrast errors
Intrusive schwa
Awkward movement from one articulatory configuration to another
Consonant distortions

https://www.youtube.com/watch?v=cEOy3APLA-g&t=245s&ab_channel=MayoClinic



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Prosodic errors (stress errors or pauses between sounds or syllables)
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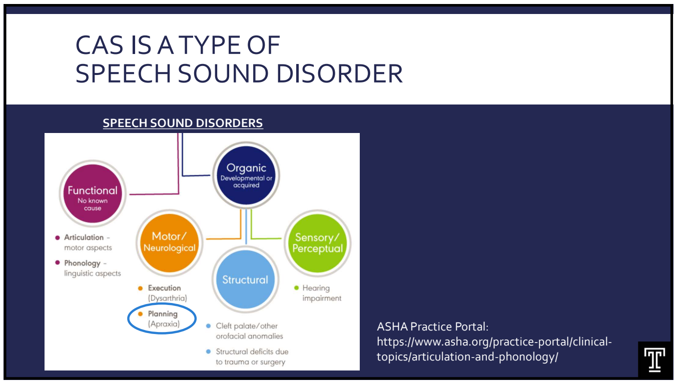
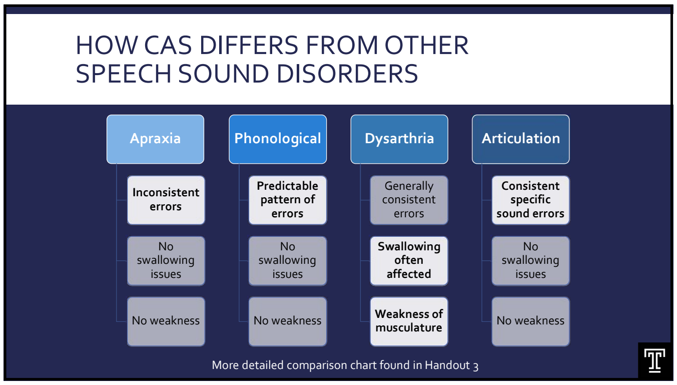


CAS IS A TYPE OF SPEECH SOUND DISORDER

SPEECH SOUND DISORDERS

Functional
No known cause
Articulation – motor aspects
Phonology – linguistic aspects
Organic
Developmental or acquired
Motor/ Neurological
Execution (Dysarthria)
Planning (Apraxia)
Structural
Cleft palate/other orofacial anomalies
Structural deficits due to trauma or surgery
Sensory/ Perceptual
Hearing impairment

ASHA Practice Portal:
https://www.asha.org/practice-portal/clinical-topics/articulation-and-phonology/



HOW CAS DIFFERS FROM OTHER SPEECH SOUND DISORDERS

Apraxia	Phonological	Dysarthria	Articulation
Inconsistent errors	Predictable pattern of errors	Generally consistent errors	Consistent specific sound errors
No swallowing issues	No swallowing issues	Swallowing often affected	No swallowing issues
No weakness	No weakness	Weakness of musculature	No weakness

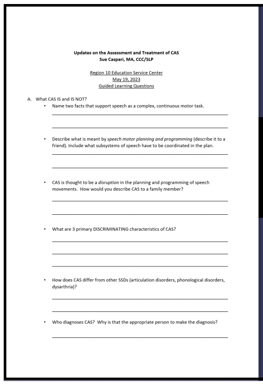
More detailed comparison chart found in Handout 3

WHO DIAGNOSES CAS?

WHO DIAGNOSES CAS?

- It is the certified speech-language pathologist who is responsible for making the primary diagnosis of CAS, for designing and implementing the individualized and intensive speech-language treatment programs needed to make optimum improvement, and for closely monitoring progress (ASHA Position Statement on CAS, ASHA, 2007)

https://www.asha.org/policy/PS2007-00277/



Updates on the Assessment and Treatment of CAS
Sue Caspari, MA, CCC/SLP

Region 10 Education Service Center
May 19, 2023
Guided Learning Questions

A. What CAS IS and IS NOT?
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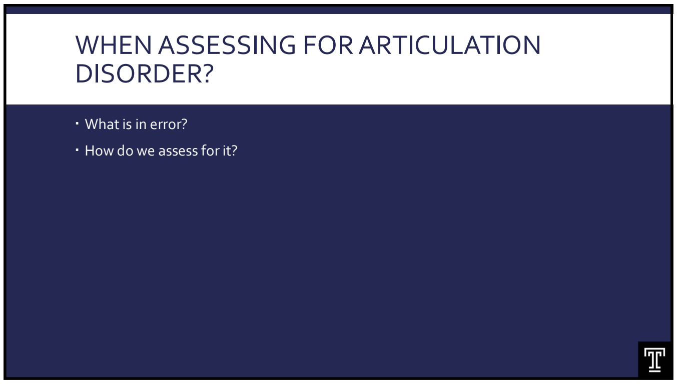
  - How does CAS differ from other SSDs (articulation disorders, phonological disorders, dysarthria)?
  - Who diagnoses CAS? Why is that the appropriate person to make the diagnosis?

REFLECTIONS “A”

B) DIAGNOSING CAS

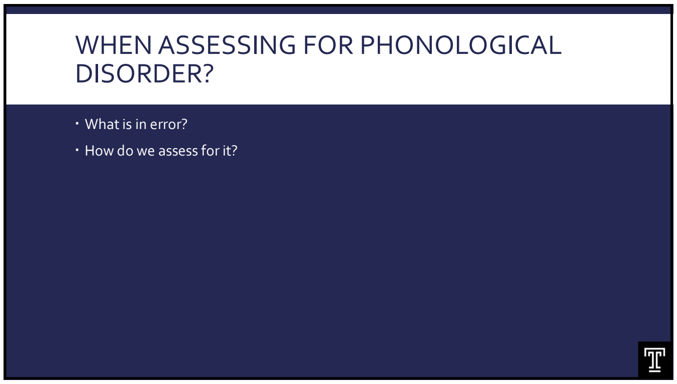
- What CAS IS and IS NOT
- Can we diagnose CAS in a speech-language evaluation conducted in a school setting or is this a medical diagnosis?
- **What do we need to be able to document to make that diagnosis?**
- **How to talk to a parent about CAS – if I suspect that a student has CAS, can I talk about this without documentation? How much information should I share?**
- Functional and effective therapy strategies
- How to write a goal for a child with CAS
- I have a high caseload…how am I going to provide services for this student? What kind of service levels are recommended -- what kind of service level is possible in a school setting?

DOCUMENTATION OF CAS



WHEN ASSESSING FOR ARTICULATION DISORDER?

- What is in error?
- How do we assess for it?



WHEN ASSESSING FOR PHONOLOGICAL DISORDER?

- What is in error?
- How do we assess for it?

WHEN ASSESSING FOR CAS?

- What is in error?
- How do we assess for it?

CRITICAL COMPONENT IN CAS ASSESSMENT

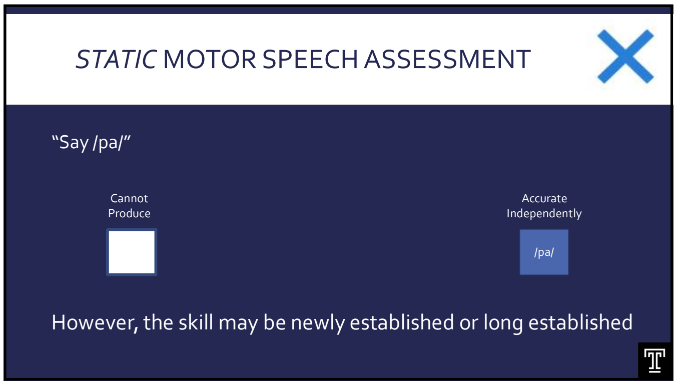
Motor Speech Assessment
- Documents the discriminating characteristics of CAS
  - ?
  - ?
  - ?
  - ?

STATIC MOTOR SPEECH ASSESSMENT

✕

Static Assessment – evaluates the system without support

(Vgotsky, 1978; Bain & Olswang, 1995)



STATIC MOTOR SPEECH ASSESSMENT

"Say /pa/"

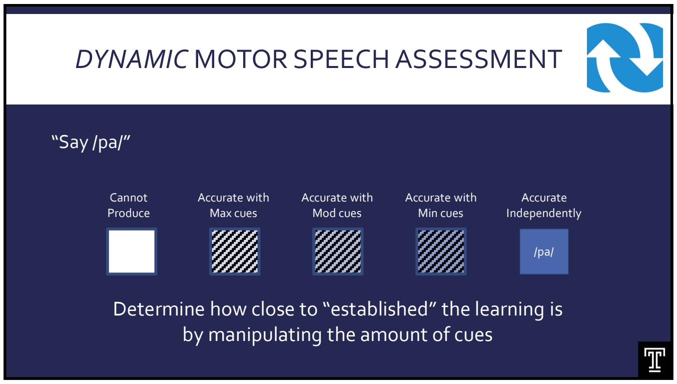
Cannot Produce	Accurate Independently
☐	/pa/

However, the skill may be newly established or long established

DYNAMIC MOTOR SPEECH ASSESSMENT

Dynamic Assessment – evaluates the system when given support

(Vgotsky, 1978; Bain & Olswang, 1995)

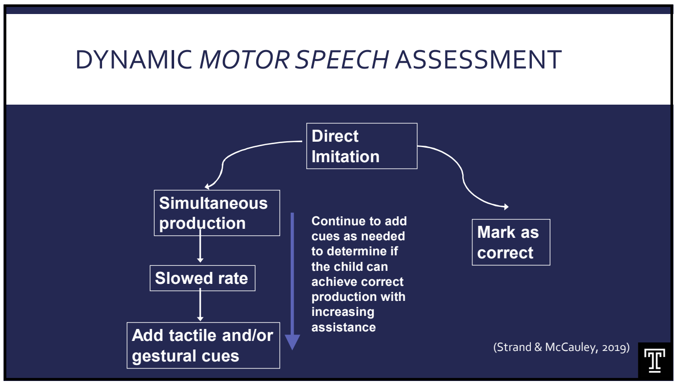


DYNAMIC MOTOR SPEECH ASSESSMENT

"Say /pa/"

Cannot Produce	Accurate with Max cues	Accurate with Mod cues	Accurate with Min cues	Accurate Independently
☐	▨	▨	▨	/pa/

Determine how close to "established" the learning is by manipulating the amount of cues



DYNAMIC *MOTOR SPEECH* ASSESSMENT

Direct Imitation

Simultaneous production

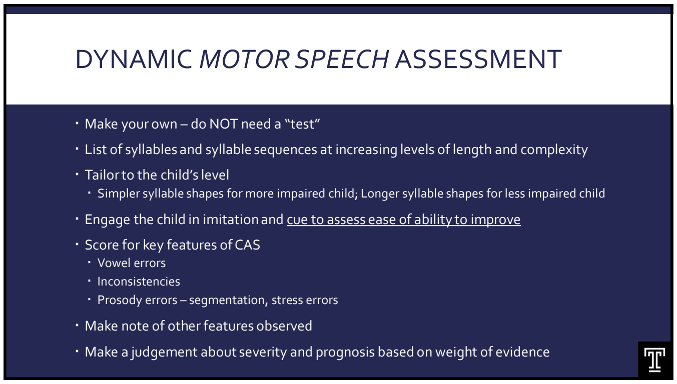
Slowed rate

Add tactile and/or gestural cues

Continue to add cues as needed to determine if the child can achieve correct production with increasing assistance

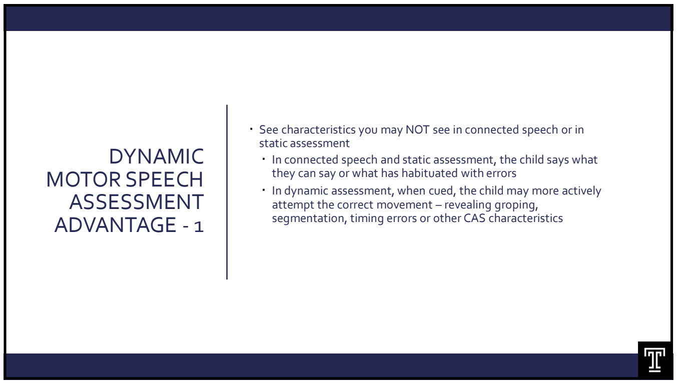
Mark as correct

(Strand & McCauley, 2019)



DYNAMIC *MOTOR SPEECH* ASSESSMENT

- Make your own – do NOT need a "test"
- List of syllables and syllable sequences at increasing levels of length and complexity
- Tailor to the child's level
  - Simpler syllable shapes for more impaired child; Longer syllable shapes for less impaired child
- Engage the child in imitation and cue to assess ease of ability to improve
- Score for key features of CAS
  - Vowel errors
  - Inconsistencies
  - Prosody errors – segmentation, stress errors
- Make note of other features observed
- Make a judgement about severity and prognosis based on weight of evidence



DYNAMIC MOTOR SPEECH ASSESSMENT ADVANTAGE - 1

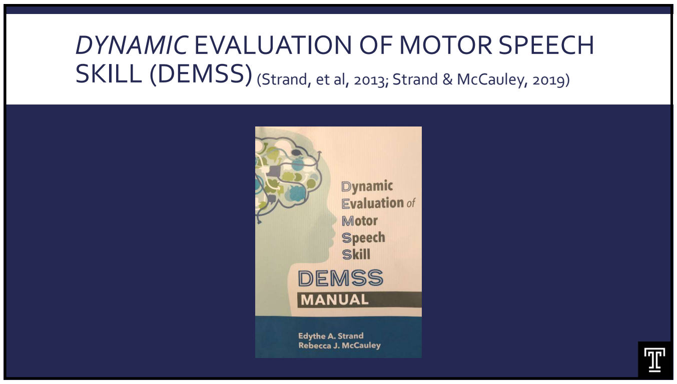
- See characteristics you may NOT see in connected speech or in static assessment
  - In connected speech and static assessment, the child says what they can say or what has habituated with errors
  - In dynamic assessment, when cued, the child may more actively attempt the correct movement – revealing groping, segmentation, timing errors or other CAS characteristics

DYNAMIC MOTOR SPEECH ASSESSMENT ADVANTAGE - 2

- Better judge severity and prognosis
  - Mild severity and good prognosis
    - If child produces accurate movements with min-mod cues
    - Evidence they can quickly benefit from therapy
  - More severe and more guarded prognosis
    - If child requires max cues to accurately produce target or fails to improve even with cueing

DYNAMIC MOTOR SPEECH ASSESSMENT ADVANTAGE - 3

- Helps with treatment planning
  - Learn types of cues that are likely to facilitate improvements in treatment
  - Helps with choice of targets/optimum challenge level
    - Syllable length where child is breaking down
    - Sounds the child has in their phonetic inventory (including vowels)



DYNAMIC EVALUATION OF MOTOR SPEECH SKILL (DEMSS) (Strand, et al, 2013; Strand & McCauley, 2019)

DYNAMIC EVALUATION OF MOTOR SPEECH SKILL (DEMSS) (Strand, et al, 2013; Strand & McCauley, 2019)

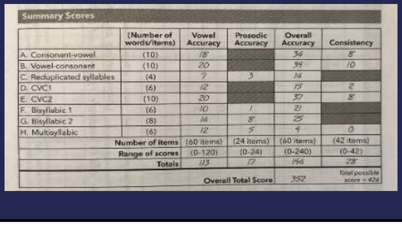
- 3+ years (with severe impairment)
  - Suspect they will have difficulty producing words between 1-3 syllables in length
- Repeat real words 1-3 syllables in length (VC, CV, CVC, CVCV, 3 syllable)
  - Mostly early- & middle-developing consonants and all vowels & diphthongs
  - No consonant clusters
- Cue errors, and listen for key features of CAS
  - Inconsistencies, vowel errors, prosodic errors, and judge overall articulatory accuracy
- Criterion referenced assessment
  - Calculate a "score" and compare it with a range of scores associated with increasing likelihood that performance is consistent with CAS
- Probability of correct classification of CAS (average sensitivity) – 94%
  - Unlikely to over-diagnose, but a few children with CAS may not be identified

DEMSS

Model	Use a moderate to slightly slow, but natural, rate and natural prosody
Direct	Direct the child's attention to your face
Instruct	Give specific instructions: "Watch my face and then try to say what I say. I will help you if it is a hard one."
Cue	Provide systematic cueing as child makes repeated attempts at productions of words
Score	Score for key features of CAS

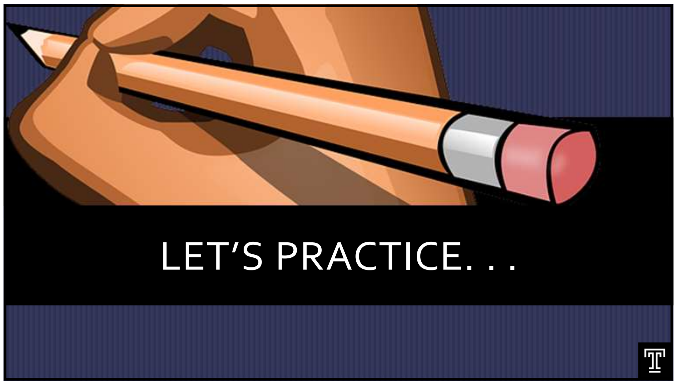
DEMSS

- When you are finished - you have profile of child's abilities at different syllable lengths



Summary Scores

	(Number of words/items)	Vowel Accuracy	Prosodic Accuracy	Overall Accuracy	Consistency
A. Consonant-vowel	(10)	18		34	8
B. Vowel-consonant	(10)	20		39	10
C. Reduplicated syllables	(4)	7	3	14	
D. CVC1	(6)	12		15	2
E. CVC2	(10)	20		37	8
F. Bisyllabic 1	(6)	10	1	21	
G. Bisyllabic 2	(8)	14	8	25	
H. Multisyllabic	(6)	12	5	4	0
	Number of items	(60 items)	(24 items)	(60 items)	(42 items)
	Range of scores	(0-120)	(0-24)	(0-240)	(0-42)
	Totals	113	17	164	28
			Overall Total Score	352	Total possible score = 426



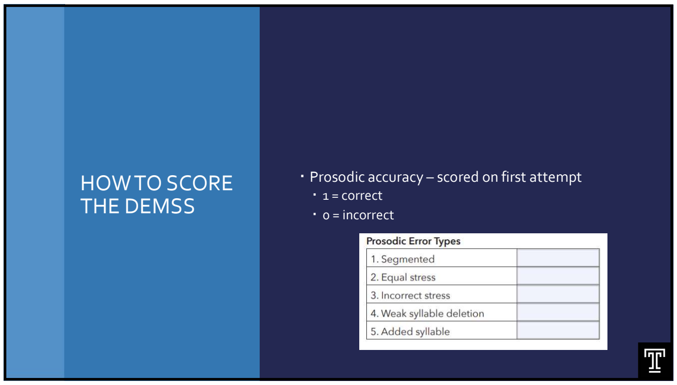
LET'S PRACTICE. . .

VOWEL PROSODY ACCURACY CONSISTENCY

HOW TO DO THE DEMSS

HOW TO SCORE THE DEMSS

- Vowel accuracy – scored on first attempt (stressed vowel only)
  - 2 = you are sure the vowel is produced accurately
  - 1 = you are unsure if it was accurate
  - 0 = you are sure it was a vowel distortion

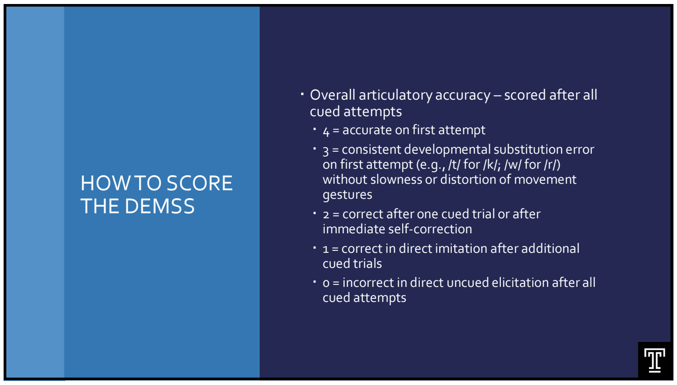


HOW TO SCORE THE DEMSS

- Prosodic accuracy – scored on first attempt
  - 1 = correct
  - 0 = incorrect

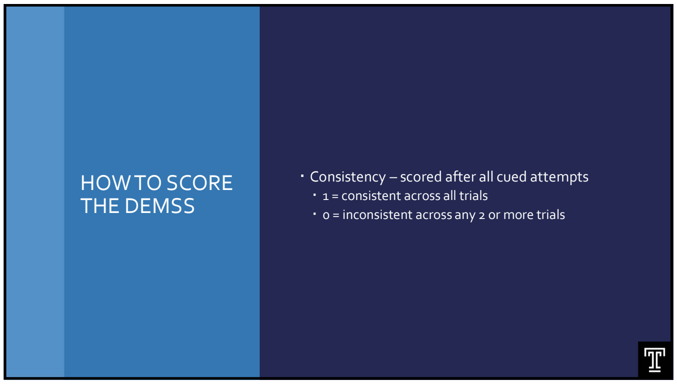
Prosodic Error Types

1. Segmented	
2. Equal stress	
3. Incorrect stress	
4. Weak syllable deletion	
5. Added syllable	



HOW TO SCORE THE DEMSS

- Overall articulatory accuracy – scored after all cued attempts
  - 4 = accurate on first attempt
  - 3 = consistent developmental substitution error on first attempt (e.g., /t/ for /k/; /w/ for /r/) without slowness or distortion of movement gestures
  - 2 = correct after one cued trial or after immediate self-correction
  - 1 = correct in direct imitation after additional cued trials
  - 0 = incorrect in direct uncued elicitation after all cued attempts



HOW TO SCORE THE DEMSS

- Consistency – scored after all cued attempts
  - 1 = consistent across all trials
  - 0 = inconsistent across any 2 or more trials

OTHER OBSERVATIONS ON THE DEMSS

Note

Inconsistent voicing errors		Trial or error		Difficulty with multisyllabic words	
Groping		Vowel or consonant distortion		Awkward movement transitions	
Intrusive schwa		Lexical stress errors			
Slow rate		Segmentation			

PRACTICE SCORING THE DEMSS
7 YEAR OLD MALE – CV, 3-SYLL

- Practice
  - Have child say target
  - Score vowel/prosody
  - Dynamic cueing up to 6 more trials (any cues allowed)
  - Obtain a final trial without cues in direct imitation
  - Score consistency and accuracy after all trials

PRACTICE SCORING THE DEMSS
7 YEAR OLD MALE - CV

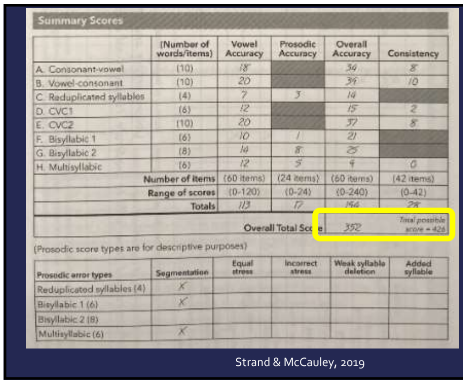
	Initial Attempt			After Cueing	
	Vowel Accuracy (score 2, 1, 0)	Prosodic Accuracy (score 1 or 0)	Articulatory Accuracy (score 4, 3, or 2)	Articulatory Accuracy (score 2, 1, or 0)	Consistency (score 1 or 0)
Me					
Toy					

Strand & McCauley, 2019

PRACTICE SCORING THE DEMSS
7 YEAR OLD MALE – 3 SYLLABLE WORDS

	Initial Attempt			After Cueing	
	Vowel Accuracy (score 2, 1, 0)	Prosodic Accuracy (score 1 or 0)	Articulatory Accuracy (score 4, 3, or 2)	Articulatory Accuracy (score 2, 1, or 0)	Consistency (score 1 or 0)
Potato					
Video					

Strand & McCauley, 2019



Summary Scores

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C. Reduplicated syllables	(4)	7	3	14	▨
D. CVC1	(6)	12	▨	15	2
E. CVC2	(10)	20	▨	37	8
F. Bisyllabic 1	(6)	10	1	21	▨
G. Bisyllabic 2	(8)	14	8	25	▨
H. Multisyllabic	(6)	12	5	9	0
Number of items		(60 items)	(24 items)	(60 items)	(42 items)
Range of scores		(0-120)	(0-24)	(0-240)	(0-42)
Totals		113	17	194	28
Overall Total Score				352	Total possible score = 426

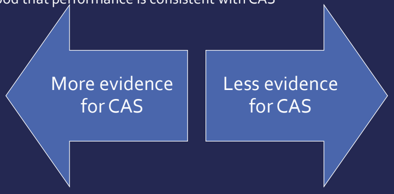
(Prosodic score types are for descriptive purposes)

Prosodic error types	Segmentation	Equal stress	Incorrect stress	Weak syllable deletion	Added syllable
Reduplicated syllables (4)	X				
Bisyllabic 1 (6)	X				
Bisyllabic 2 (8)					
Multisyllabic (6)	X				

Strand & McCauley, 2019

SCORING RANGE

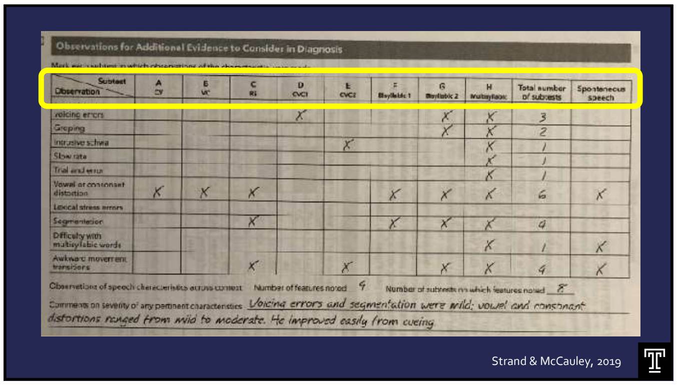
- Compare child's SCORE with a range of scores associated with increasing likelihood that performance is consistent with CAS



More evidence for CAS

Less evidence for CAS

0 - - - - - - - - - - - - - - - - 426



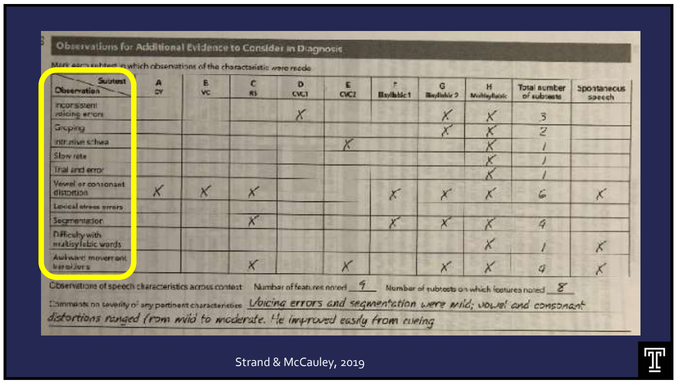
Observations for Additional Evidence to Consider in Diagnosis

Subtest / Observation	A CV	B VC	C RS	D CVC1	E CVC2	F Bisyllabic 1	G Bisyllabic 2	H Multisyllabic	Total number of subtests	Spontaneous speech
voicing errors				X			X	X	3	
Groping							X	X	2	
Intrusive schwa					X			X	1	
Slow rate								X	1	
Trial and error								X	1	
Vowel or consonant distortion	X	X	X			X	X	X	6	X
Lexical stress errors										
Segmentation			X			X	X	X	4	
Difficulty with multisyllabic words								X	1	X
Awkward movement transitions			X		X		X	X	4	X

Observations of speech characteristics across context Number of features noted 9 Number of subtests on which features noted 8

Comments on severity of any pertinent characteristics Voicing errors and segmentation were mild; vowel and consonant distortions ranged from mild to moderate. He improved easily from cueing

Strand & McCauley, 2019



Observations for Additional Evidence to Consider in Diagnosis

Mark each subtest in which observations of the characteristic were made

Subtest / Observation	A CV	B VC	C RS	D CVC1	E CVC2	F Bisyllabic 1	G Bisyllabic 2	H Multisyllabic	Total number of subtests	Spontaneous speech
Inconsistent voicing errors				X			X	X	3	
Groping							X	X	2	
Intrusive schwa					X			X	1	
Slow rate								X	1	
Trial and error								X	1	
Vowel or consonant distortion	X	X	X			X	X	X	6	X
Lexical stress errors										
Segmentation			X			X	X	X	4	
Difficulty with multisyllabic words								X	1	X
Awkward movement transitions			X		X		X	X	4	X

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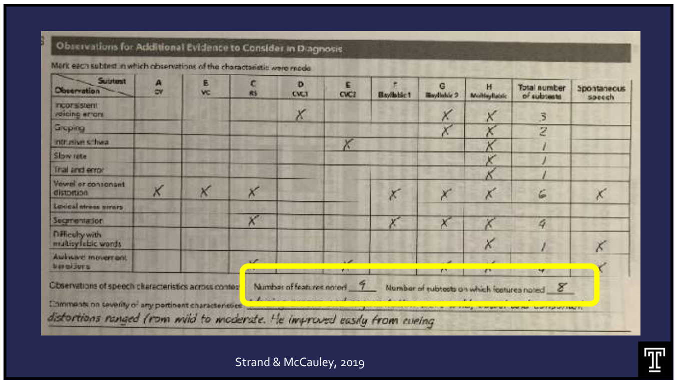
Strand & McCauley, 2019



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Groping							X	X	2	
Intrusive schwa					X			X	1	
Slow rate								X	1	
Trial and error								X	1	
Vowel or consonant distortion	X	X	X			X	X	X	6	X
Lexical stress errors										
Segmentation			X			X	X	X	4	
Difficulty with multisyllabic words								X	1	X
Awkward movement transitions			X		X		X	X	4	X

Observations of speech characteristics across context Number of features noted 9 Number of subtests on which features noted 8

Comments on severity of any pertinent characteristics

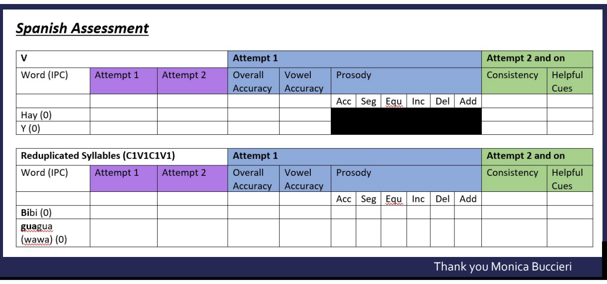
distortions ranged from mild to moderate. He improved easily from cueing

Strand & McCauley, 2019

DYNAMIC MOTOR SPEECH ASSESSMENT SUMMARY

- Use the DEMSS or make your own
- List of syllables and syllable sequences at increasing levels of length and complexity
- Tailor to the child's level
- Ask the child to imitate each word
- If errored, cue several times to try to obtain a correct production
- Score for key features of CAS
  - Vowel accuracy
  - Prosodic Accuracy
  - Consistency

MAKE YOUR OWN MOTOR SPEECH ASSESSMENT



Spanish Assessment

V			**Attempt 1**								**Attempt 2 and on**	
Word (IPC)	Attempt 1	Attempt 2	Overall Accuracy	Vowel Accuracy	Prosody						Consistency	Helpful Cues
					Acc	Seg	Equ	Inc	Del	Add		
Hay (0)												
Y (0)												

Reduplicated Syllables (C1V1C1V1)			**Attempt 1**								**Attempt 2 and on**	
Word (IPC)	Attempt 1	Attempt 2	Overall Accuracy	Vowel Accuracy	Prosody						Consistency	Helpful Cues
					Acc	Seg	Equ	Inc	Del	Add		
Bibi (0)												
guagua (wawa) (0)												

Thank you Monica Buccieri

DYNAMIC MOTOR SPEECH ASSESSMENT SUMMARY

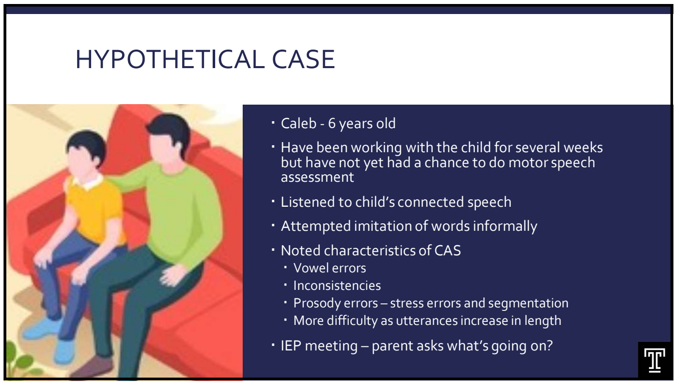
Strengths

- Helps identify key features of CAS
  - Differential diagnosis
- Supports treatment planning
  - Enables you to identify the syllable length at which the child is breaking down
  - Determine what cues are most helpful
- Enables you to determine how stimulable the child is
  - Prognostic indicator

Weaknesses

- Can take a long time for some kids
- Requires the child to "work" – you need to provide reinforcers to keep them going

TALKING TO A PARENT WHEN YOU "SUSPECT" CAS



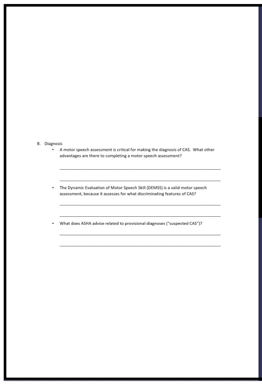
HYPOTHETICAL CASE

- Caleb - 6 years old
- Have been working with the child for several weeks but have not yet had a chance to do motor speech assessment
- Listened to child's connected speech
- Attempted imitation of words informally
- Noted characteristics of CAS
  - Vowel errors
  - Inconsistencies
  - Prosody errors – stress errors and segmentation
  - More difficulty as utterances increase in length
- IEP meeting – parent asks what's going on?

WHAT WOULD YOU SAY?

- "…differential diagnosis of CAS in [some cases] may require provisional diagnostic classifications, such as *CAS cannot be ruled out, signs are consistent with CAS*, or *suspected to have CAS*."

https://www.asha.org/policy/PS2007-00277/

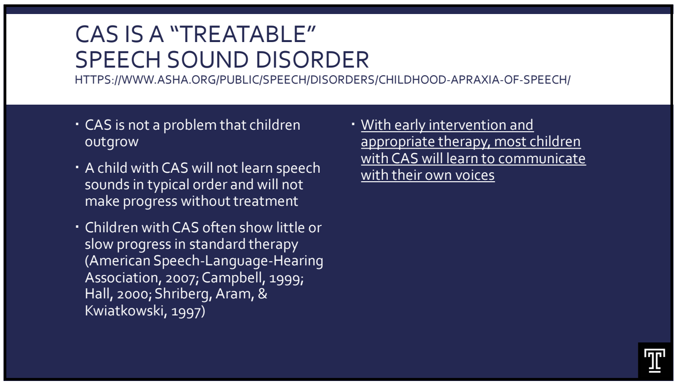


B. Diagnosis
- A motor speech assessment is critical for making the diagnosis of CAS. What other advantages are there to completing a motor speech assessment?
- The Dynamic Evaluation of Motor Speech Skill (DEMSS) is a valid motor speech assessment, because it assesses for what discriminating features of CAS?
- What does ASHA advise related to provisional diagnoses ("suspected CAS")?

REFLECTIONS "B"

C) THERAPY FOR CAS

- What CAS IS and IS NOT
- Can we diagnose CAS in a speech-language evaluation conducted in a school setting or is this a medical diagnosis?
- What do we need to be able to document to make that diagnosis?
- How to talk to a parent about CAS – if I suspect that a student has CAS, can I talk about this without documentation? How much information should I share?
- **Functional, effective and evidence-based therapy strategies**
- **How to write a goal for a child with CAS**
- **I have a high caseload…how am I going to provide services for this student? What kind of service levels are recommended -- what kind of service level is possible in a school setting?**

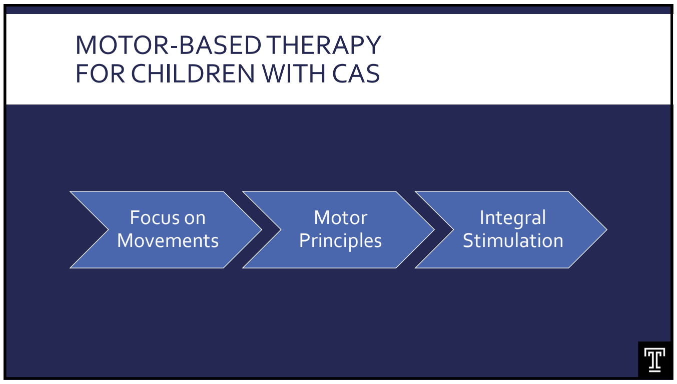


CAS IS A "TREATABLE" SPEECH SOUND DISORDER

HTTPS://WWW.ASHA.ORG/PUBLIC/SPEECH/DISORDERS/CHILDHOOD-APRAXIA-OF-SPEECH/

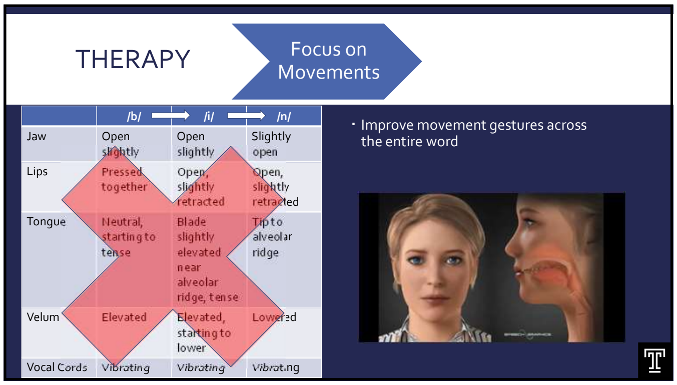
- CAS is not a problem that children outgrow
- A child with CAS will not learn speech sounds in typical order and will not make progress without treatment
- Children with CAS often show little or slow progress in standard therapy (American Speech-Language-Hearing Association, 2007; Campbell, 1999; Hall, 2000; Shriberg, Aram, & Kwiatkowski, 1997)
- With early intervention and appropriate therapy, most children with CAS will learn to communicate with their own voices

THERAPY STRATEGIES



MOTOR-BASED THERAPY FOR CHILDREN WITH CAS

Focus on Movements → Motor Principles → Integral Stimulation

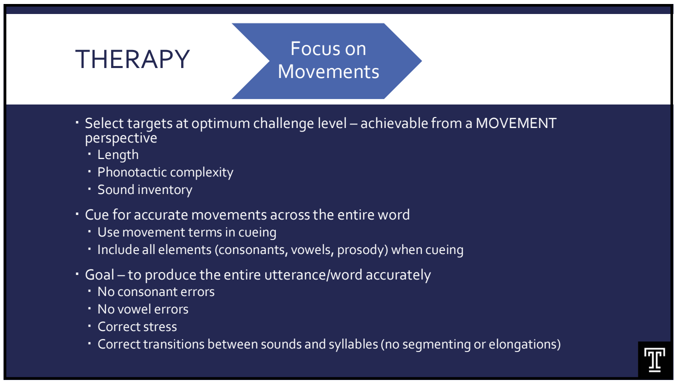


THERAPY

Focus on Movements

	/b/ →	/i/ →	/n/
Jaw	Open slightly	Open slightly	Slightly open
Lips	Pressed together	Open, slightly retracted	Open, slightly retracted
Tongue	Neutral, starting to tense	Blade slightly elevated near alveolar ridge, tense	Tip to alveolar ridge
Velum	Elevated	Elevated, starting to lower	Lowered
Vocal Cords	Vibrating	Vibrating	Vibrating

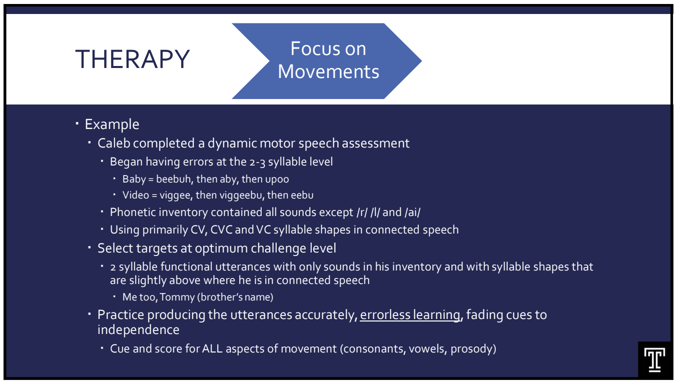
- Improve movement gestures across the entire word



THERAPY

Focus on Movements

- Select targets at optimum challenge level – achievable from a MOVEMENT perspective
  - Length
  - Phonotactic complexity
  - Sound inventory
- Cue for accurate movements across the entire word
  - Use movement terms in cueing
  - Include all elements (consonants, vowels, prosody) when cueing
- Goal – to produce the entire utterance/word accurately
  - No consonant errors
  - No vowel errors
  - Correct stress
  - Correct transitions between sounds and syllables (no segmenting or elongations)



THERAPY

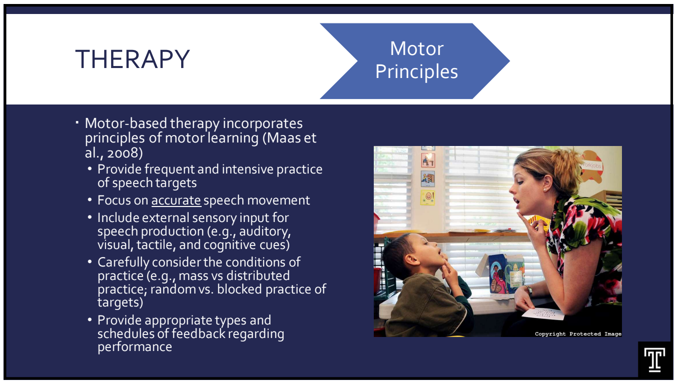
Focus on Movements

- Example
  - Caleb completed a dynamic motor speech assessment
    - Began having errors at the 2-3 syllable level
      - Baby = beebuh, then aby, then upoo
      - Video = viggee, then viggeebu, then eebu
    - Phonetic inventory contained all sounds except /r/ /l/ and /ai/
    - Using primarily CV, CVC and VC syllable shapes in connected speech
  - Select targets at optimum challenge level
    - 2 syllable functional utterances with only sounds in his inventory and with syllable shapes that are slightly above where he is in connected speech
      - Me too, Tommy (brother's name)
  - Practice producing the utterances accurately, errorless learning, fading cues to independence
    - Cue and score for ALL aspects of movement (consonants, vowels, prosody)

THERAPY

Focus on Movements

- Practice listening to errors and giving "movement based" cues



THERAPY

Motor Principles

- Motor-based therapy incorporates principles of motor learning (Maas et al., 2008)
  - Provide frequent and intensive practice of speech targets
  - Focus on accurate speech movement
  - Include external sensory input for speech production (e.g., auditory, visual, tactile, and cognitive cues)
  - Carefully consider the conditions of practice (e.g., mass vs distributed practice; random vs. blocked practice of targets)
  - Provide appropriate types and schedules of feedback regarding performance

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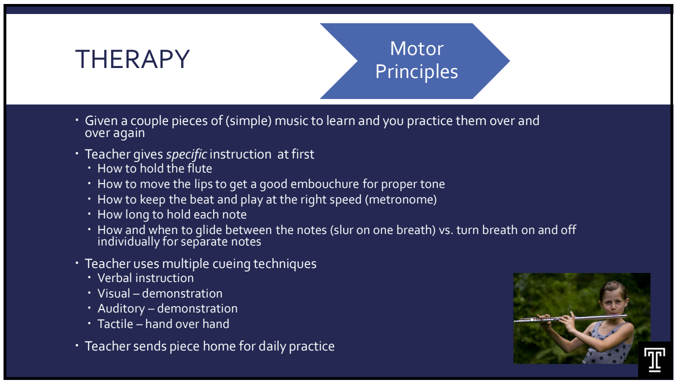
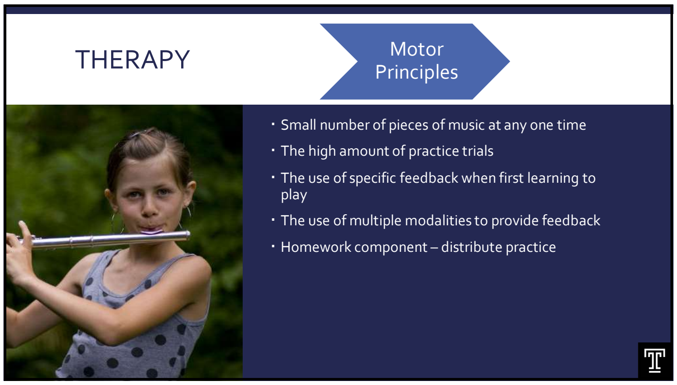


THERAPY

Motor Principles

- Given a couple pieces of (simple) music to learn and you practice them over and over again
- Teacher gives *specific* instruction at first
  - How to hold the flute
  - How to move the lips to get a good embouchure for proper tone
  - How to keep the beat and play at the right speed (metronome)
  - How long to hold each note
  - How and when to glide between the notes (slur on one breath) vs. turn breath on and off individually for separate notes
- Teacher uses multiple cueing techniques
  - Verbal instruction
  - Visual – demonstration
  - Auditory – demonstration
  - Tactile – hand over hand
- Teacher sends piece home for daily practice



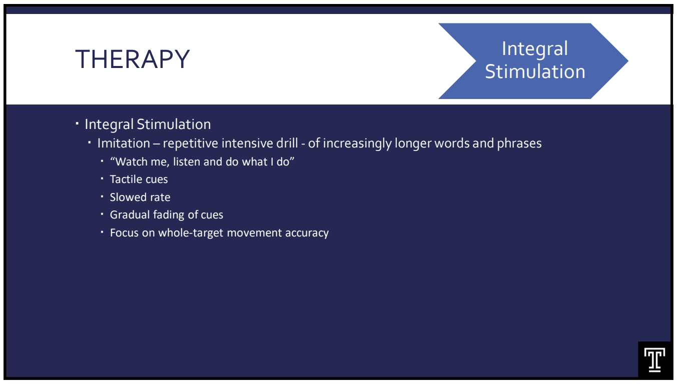
THERAPY

- Small number of pieces of music at any one time
- The high amount of practice trials
- The use of specific feedback when first learning to play
- The use of multiple modalities to provide feedback
- Homework component – distribute practice

THERAPY

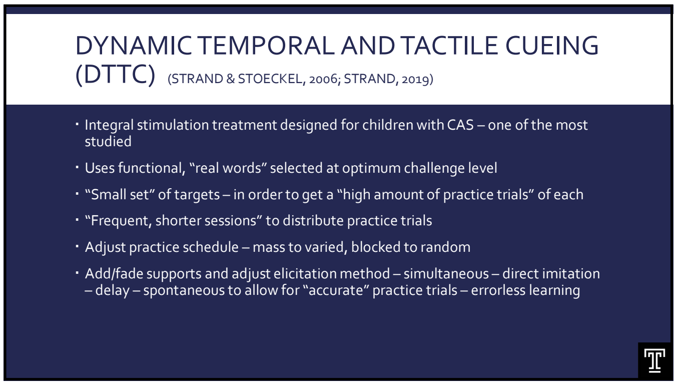
Integral Stimulation

- Integral stimulation approaches are motor-based therapies that have among the strongest evidence to date
  - 8 studies, with several from independent research groups, show increases in speech accuracy in children with CAS
    - Baas, Strand, Elmer, & Barbarsi, 2008; Edeal & Gildersleeve-Neumann, 2011; Gildersleeve-Neumann & Goldstein, 2015; Maas et al., 2012; Maas & Farinella, 2012; Maas et al., 2019; Strand & Debertine, 2000; Strand, et al, 2006
  - 23 children



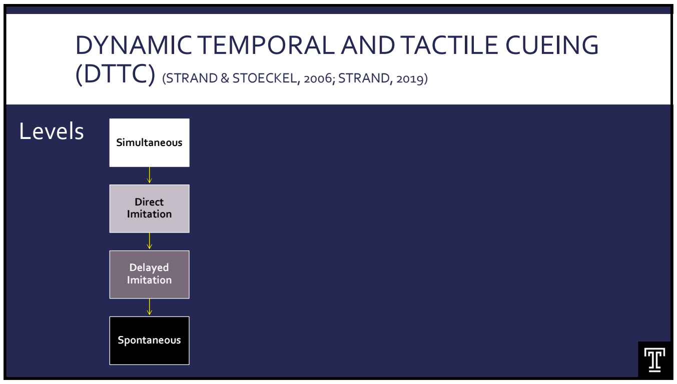
THERAPY

- Integral Stimulation
  - Imitation – repetitive intensive drill - of increasingly longer words and phrases
    - “Watch me, listen and do what I do”
    - Tactile cues
    - Slowed rate
    - Gradual fading of cues
    - Focus on whole-target movement accuracy



DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

- Integral stimulation treatment designed for children with CAS – one of the most studied
- Uses functional, "real words" selected at optimum challenge level
- "Small set" of targets – in order to get a "high amount of practice trials" of each
- "Frequent, shorter sessions" to distribute practice trials
- Adjust practice schedule – mass to varied, blocked to random
- Add/fade supports and adjust elicitation method – simultaneous – direct imitation – delay – spontaneous to allow for "accurate" practice trials – errorless learning



DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

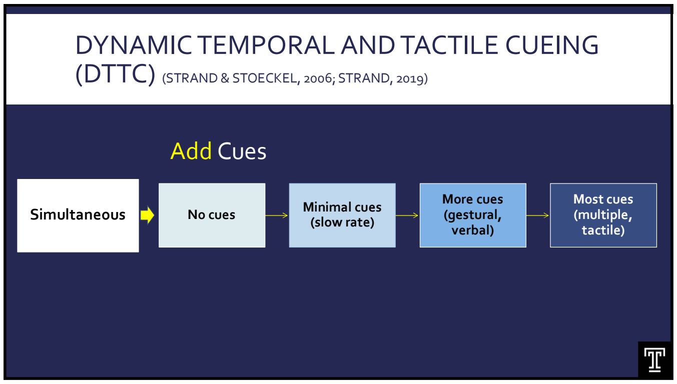
Levels

Simultaneous

Direct Imitation

Delayed Imitation

Spontaneous



DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

Add Cues

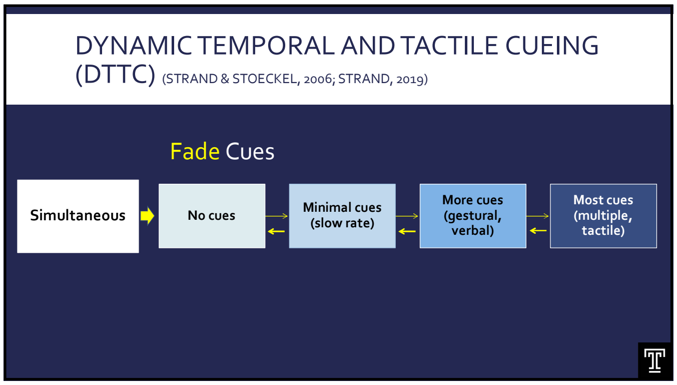
Simultaneous

No cues

Minimal cues (slow rate)

More cues (gestural, verbal)

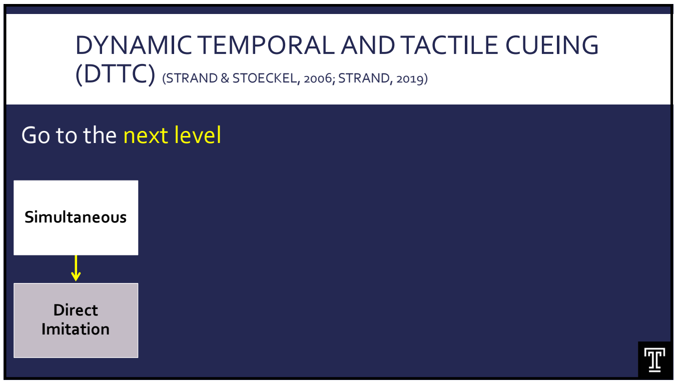
Most cues (multiple, tactile)



DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

Fade Cues

Simultaneous → No cues ⇄ Minimal cues (slow rate) ⇄ More cues (gestural, verbal) ⇄ Most cues (multiple, tactile)



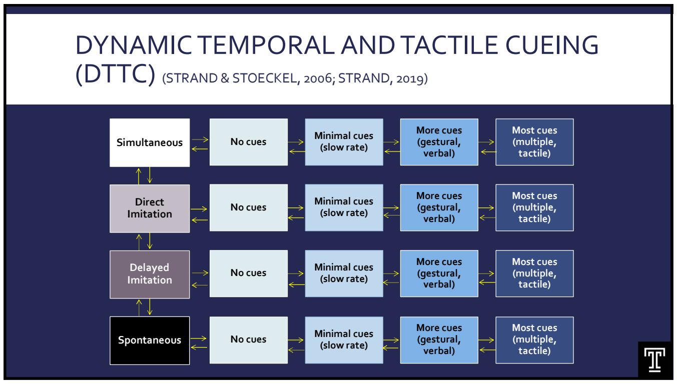
DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

Go to the next level

Simultaneous

↓

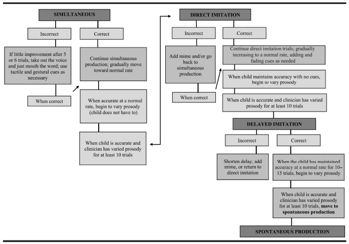
Direct Imitation



DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

Simultaneous	No cues	Minimal cues (slow rate)	More cues (gestural, verbal)	Most cues (multiple, tactile)
Direct Imitation	No cues	Minimal cues (slow rate)	More cues (gestural, verbal)	Most cues (multiple, tactile)
Delayed Imitation	No cues	Minimal cues (slow rate)	More cues (gestural, verbal)	Most cues (multiple, tactile)
Spontaneous	No cues	Minimal cues (slow rate)	More cues (gestural, verbal)	Most cues (multiple, tactile)

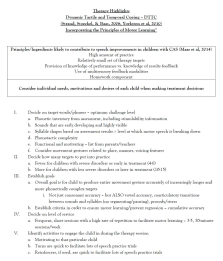
DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)


SIMULTANEOUS
Incorrect
Correct
If little improvement after 5 or 6 trials, take out the voice and just mouth the word; use tactile and gestural cues as necessary
When correct
Continue simultaneous production; gradually move toward normal rate
When accurate at a normal rate, begin to vary prosody (child does not have to)
When child is accurate and clinician has varied prosody for at least 10 trials
DIRECT IMITATION
Incorrect
Correct
Add mime and/or go back to simultaneous production
When correct
Continue direct imitation trials; gradually increasing to a normal rate, adding and fading cues as needed
When child maintains accuracy with no cues, begin to vary prosody
When child is accurate and clinician has varied prosody for at least 10 trials
DELAYED IMITATION
Incorrect
Correct
Shorten delay, add mime, or return to direct imitation
When the child has maintained accuracy at a normal rate for 10–15 trials, begin to vary prosody
When child is accurate and clinician has varied prosody for at least 10 trials, move to spontaneous production
SPONTANEOUS PRODUCTION

DYNAMIC TEMPORAL AND TACTILE CUEING (DTTC) (STRAND & STOECKEL, 2006; STRAND, 2019)

- What level of the DTTC hierarchy am I working at
  - Simultaneous
  - Direct Imitation
  - Delayed Imitation
  - Spontaneous
- What "movement" based cues do I use?

DTTC HIGHLIGHTS – HANDOUT 4

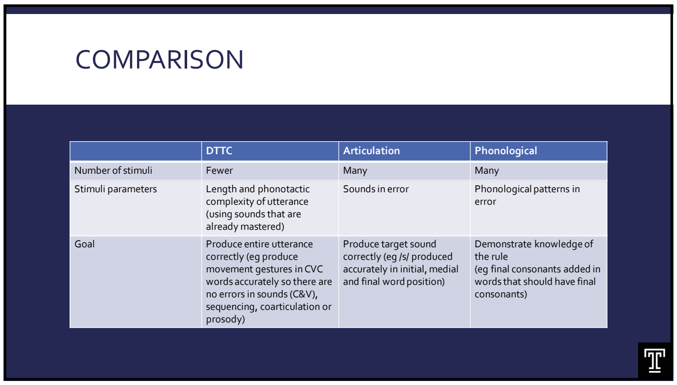


Therapy Highlights
Dynamic Tactile and Temporal Cueing – DTTC
(Strand, Stoeckel, & Baas, 2006, Yorkston et al, 2010)
Incorporating the Principles of Motor Learning*

Principles/Ingredients likely to contribute to speech improvements in children with CAS (Maas et al, 2014)
High amount of practice
Relatively small set of therapy targets
Provision of knowledge of performance vs. knowledge of results feedback
Use of multisensory feedback modalities
Homework component

Consider individual needs, motivations and desires of each child when making treatment decisions

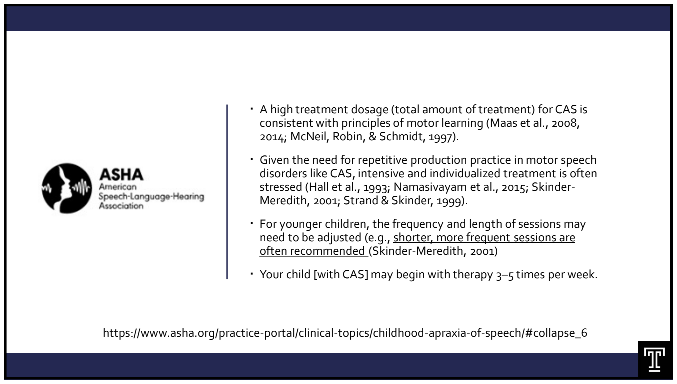
I. Decide on target words/phrases – optimum challenge level
   a. Phonetic inventory from assessment, including stimulability information
   b. Sounds that are early developing and highly visible
   c. Syllable shapes based on assessment results – level at which motor speech is breaking down
   d. Phonotactic complexity
   e. Functional and motivating – list from parents/teachers
   f. Consider movement gestures related to place, manner, voicing features
II. Decide how many targets to put into practice
   a. Fewer for children with severe disorders or early in treatment (4-6)
   b. More for children with less severe disorders or later in treatment (10-15)
III. Establish goals
   a. Overall goal is for child to produce entire movement gesture accurately of increasingly longer and more phonetically complex targets
      i. Not just consonant accuracy – but ALSO vowel accuracy, coarticulatory transitions between sounds and syllables (no segmenting/pausing), prosody/stress
   b. Establish criteria in order to ensure motor learning/prevent regression – cumulative accuracy
IV. Decide on level of service
   a. Frequent, short sessions with a high rate of repetition to facilitate motor learning – 3-5, 30-minute sessions/week
V. Identify activities to engage the child in during the therapy session
   a. Motivating to that particular child
   b. Turns are quick to facilitate lots of speech practice trials
   c. Reinforcers, if used, are quick to facilitate lots of speech practice trials



COMPARISON

	DTTC	Articulation	Phonological
Number of stimuli	Fewer	Many	Many
Stimuli parameters	Length and phonotactic complexity of utterance (using sounds that are already mastered)	Sounds in error	Phonological patterns in error
Goal	Produce entire utterance correctly (eg produce movement gestures in CVC words accurately so there are no errors in sounds (C&V), sequencing, coarticulation or prosody)	Produce target sound correctly (eg /s/ produced accurately in initial, medial and final word position)	Demonstrate knowledge of the rule (eg final consonants added in words that should have final consonants)

SERVICE LEVELS



- A high treatment dosage (total amount of treatment) for CAS is consistent with principles of motor learning (Maas et al., 2008, 2014; McNeil, Robin, & Schmidt, 1997).
- Given the need for repetitive production practice in motor speech disorders like CAS, intensive and individualized treatment is often stressed (Hall et al., 1993; Namasivayam et al., 2015; Skinder-Meredith, 2001; Strand & Skinder, 1999).
- For younger children, the frequency and length of sessions may need to be adjusted (e.g., shorter, more frequent sessions are often recommended (Skinder-Meredith, 2001)
- Your child [with CAS] may begin with therapy 3–5 times per week.

https://www.asha.org/practice-portal/clinical-topics/childhood-apraxia-of-speech/#collapse_6

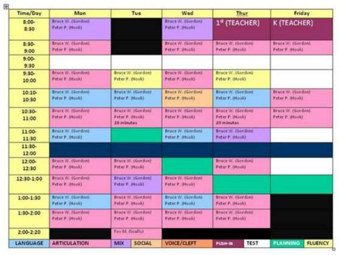
SERVICE LEVEL

- The more frequently the child receives appropriate therapy, the better his/her long term prognosis

https://www.apraxia-kids.org/apraxia_kids_library/prognosis-for-apraxia-what-does-the-future-hold/

CONSIDER. . .

HOW COULD YOU DISTRIBUTE SESSIONS FOR A CHILD WITH CAS IN YOUR SCHOOL?

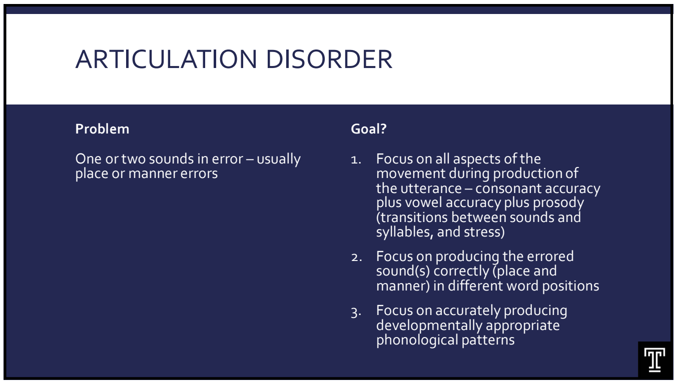


Time/Day	Mon	Tue	Wed	Thur	Friday
8:00-8:30	Bruce W. (Gordon) Peter P. (Hook)		Bruce W. (Gordon) Peter P. (Hook)	1st (TEACHER)	K (TEACHER)
8:30-9:00	Bruce W. (Gordon) Peter P. (Hook)		Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)
9:00-9:30					
9:30-10:00	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	
10:10-10:30	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)
10:30-11:00	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook) 20 minutes	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook) 20 minutes	Bruce W. (Gordon) Peter P. (Hook)
11:00-11:30	Bruce W. (Gordon) Peter P. (Hook)		Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	
11:30-12:00					
12:00-12:30	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)		Bruce W. (Gordon) Peter P. (Hook)	
12:30-1:00	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)		
1:00-1:30	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	
1:30-2:00	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	Bruce W. (Gordon) Peter P. (Hook)	
2:00-2:20		Fox M. (Scully)			
LANGUAGE	ARTICULATION	MIX SOCIAL	VOICE/CLEFT	PUSH-IN TEST	PLANNING FLUENCY

IDEAS

- Collaborate with Reading teacher
  - Send them mastered targets for distributed practice
- Drive-by – grab kids when you can
  - AM while other kids are taking off boots, getting settled
- "Speech" centers when the kids divide up into centers in the classroom
- Teletherapy
  - More frequent sessions easier
  - Shorter sessions easier
- Education to administrators
  - Address needs now may reduce needs later on
  - Not a large percentage of kids who have CAS

GOALS



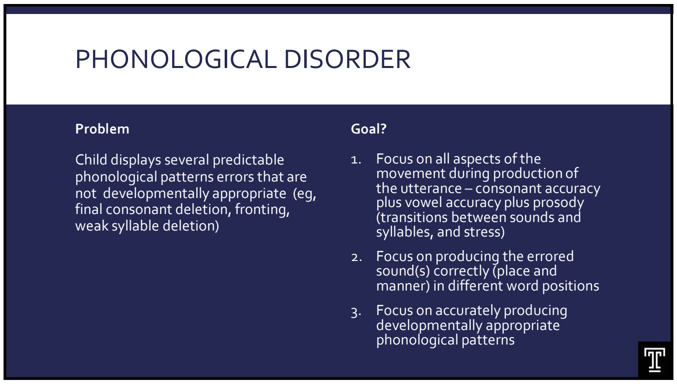
ARTICULATION DISORDER

Problem

One or two sounds in error – usually place or manner errors

Goal?

1. Focus on all aspects of the movement during production of the utterance – consonant accuracy plus vowel accuracy plus prosody (transitions between sounds and syllables, and stress)
2. Focus on producing the errored sound(s) correctly (place and manner) in different word positions
3. Focus on accurately producing developmentally appropriate phonological patterns



PHONOLOGICAL DISORDER

Problem

Child displays several predictable phonological patterns errors that are not developmentally appropriate (eg, final consonant deletion, fronting, weak syllable deletion)

Goal?

1. Focus on all aspects of the movement during production of the utterance – consonant accuracy plus vowel accuracy plus prosody (transitions between sounds and syllables, and stress)
2. Focus on producing the errored sound(s) correctly (place and manner) in different word positions
3. Focus on accurately producing developmentally appropriate phonological patterns

CHILDHOOD APRAXIA OF SPEECH

Problem

Difficulty planning and programming speech movements resulting in segmental (vowels and consonants) and suprasegmental (transitions between sounds and syllables, and stress) errors throughout the entire utterance

Goal?

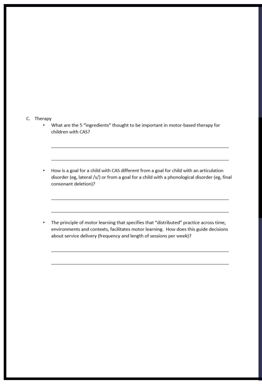
1. Focus on all aspects of the movement during production of the utterance – consonant accuracy plus vowel accuracy plus prosody (transitions between sounds and syllables, and stress)
2. Focus on producing the errored sound(s) correctly (place and manner) in different word positions
3. Focus on accurately producing developmentally appropriate phonological patterns

CAS GOAL

- Caleb will produce the CVC word "home," at the word level in delayed imitation with a total score of 4/6 or higher across three trials, across three consecutive weekly probes.
- Probe scoring
  - 2 = no errors
  - 1 = 1-2 errors
  - 0 = more than 3 errors
- Accuracy is judged on all of the following:
  - Consonant accuracy
  - Vowel accuracy
  - Stress
  - Fluent movements between sounds and syllables (no segmentation)

CAS GOAL

- Caleb will produce the CVC word "home," at the word level in delayed imitation with a total score of 4/6 or higher across three trials, across three consecutive weekly probes.
- /hum/ =
  - 1
- /h.im/ =
  - 1
- /i.m/ =
  - 0
- TOTAL = 2/6
- Probe scoring
  - 2 = no errors
  - 1 = 1-2 errors
  - 0 = more than 3 errors
- Accuracy is judged on all of the following:
  - Consonant accuracy
  - Vowel accuracy
  - Stress
  - Fluent movements between sounds and syllables (no segmentation)



C. Therapy

- What are the 5 "ingredients" thought to be important in motor-based therapy for children with CAS?
- How is a goal for a child with CAS different from a goal for child with an articulation disorder (eg, lateral /s/) or from a goal for a child with a phonological disorder (eg, final consonant deletion)?
- The principle of motor learning that specifies that "distributed" practice across time, environments and contexts, facilitates motor learning. How does this guide decisions about service delivery (frequency and length of sessions per week)?

REFLECTIONS "C"

RESOURCES

- Continued Education in CAS
  - Apraxia Kids website – apraxia-kids.org
  - Apraxia-Kids Intensive Training (next "boot camp" in 2025)
  - FREE workshops sponsored by the University of Texas at Dallas and the Once Upon a Time (OUAT) Foundation - hosted by Edythe Strand, PhD.
    - https://childapraxiatreatment.org/learning-opportunities/
    - Or you can find it on youtube (no CEU's) by searching for "Edy Strand CAS workshop youtube"
  - FREE in-person 2-day intensive trainings sponsored by OUAT at: https://childapraxiatreatment.org/
    - Next workshop in Boston, MA, July 21-22, 2023 (apply by May 26) – limited to 50 attendees

RESOURCES

- What is CAS
  - ASHA position statement
  - ASHA Practice Portal – childhood apraxia of speech
- Diagnosis
  - McCauley & Strand (2008) – review of motor speech assessments
  - Murray, et al (2020) – systematic review of differential diagnosis of CAS
  - Strand, et al (2013) – motor speech assessment (DEMSS)
- Treatment
  - Maas, et al (2008) – principles of motor learning in CAS
  - Maas, et al (2014) – review of motor-based intervention protocols
  - Strand (2019) – DTTC Tutorial
  - DeThorne, et al (2009) – When "Simon Says" doesn't work: Alternatives to imitation for facilitating early speech development.
  - Stoeckel & Caspari, 2020 – ASHA Perspectives Article on making treatment decisions for CAS

FINAL POLL – HOW DO YOU FEEL ABOUT CAS?

QUESTIONS

REFERENCES

- ASHA Practice Portal on CAS (17 pages without references) https://www.asha.org/practice-portal/clinical-topics/childhood-apraxia-of-speech/#collapse_0
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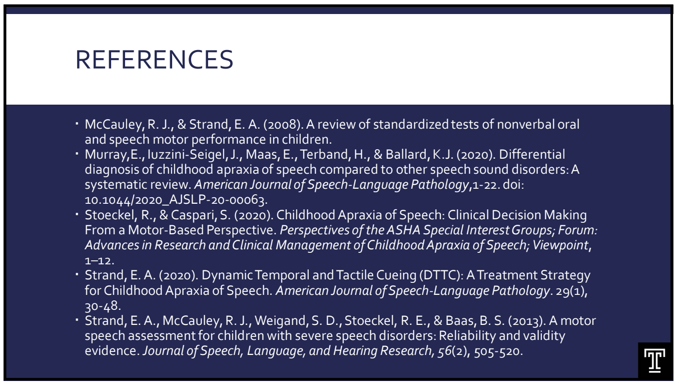

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- Strand, E. A., McCauley, R. J., Weigand, S. D., Stoeckel, R. E., & Baas, B. S. (2013). A motor speech assessment for children with severe speech disorders: Reliability and validity evidence. *Journal of Speech, Language, and Hearing Research*, *56*(2), 505-520.