

1

Disclosures

- Honorarium for this presentation
- Salary from UNC-CH
- Royalties from MedBridge
- Board member for Aphasia Access
- Grant support from the National Institutes of Health (Speech Profiles and Cue Responsiveness after Left Hemisphere Stroke NIDCD018569)

2

OUTLINE OF THE AFTERNOON

<ul style="list-style-type: none"> ■ 12:45 – 1:00 Definitions and Overview ■ 1:00 – 2:00 Features and assessments ■ 2:00 – 2:15 Break ■ 2:15 – 3:15 Making the diagnosis ■ 3:15 – 3:45 The treatment evidence ■ 3:45 – 4:00 Break ■ 4:00 – 4:45 Holistic treatment planning ■ 4:45 – 5:00 Conclusions

3

MOTOR SPEECH DISORDERS
DARLEY • ARONSON • BROWN

"Apraxia of speech is a distinct motor speech disorder distinguishable from the dysarthrias...and aphasia"

"Apraxia of speech is a disorder of motor speech programming manifested primarily by errors in articulation and secondarily by compensatory alterations of prosody"

(Darley et al., 1975, p. 267)

4

"In diagnostic applications, apraxia of speech is simply defined as a syndrome—a collection of signs and symptoms that occur together and form an identifiable pattern." p. 369

Jacks A. & Haley K. L. (2021). Apraxia of Speech. In J. S. Damico, N. Müller, & M. J. Ball (Eds). The Handbook of Language and Speech Disorders (2nd Edition). Wiley Blackwell. Pp. 368-390c

5

"The thought comes instantly ...that's the same...The issue is getting the sounds out."

Person with AOS

6

Which is different from the rest?

- **Apraxia of Speech (AOS):** A neurologic *speech disorder* that interferes with the motor planning/programming of speech production. Almost always coexists with aphasia—a language disorder
- **Dysarthria:** A neurologic *speech disorder* that reduces the strength, speed, range, steadiness, or accuracy of speech movements.
- **Phonemic paraphasias:** A *phenomenon* where speech sounds sound as if they are substituted, added, omitted, or rearranged.
- **Aphasia with phonemic paraphasias (APP):** A neurologic *language disorder* that affects language processing in spoken and written modalities, where phonemic paraphasias is part of the presentation.

7

The differential diagnosis:

- **Apraxia of Speech (AOS):** A neurologic *speech disorder* that interferes with the motor planning/programming of speech production. Almost always coexists with aphasia—a language disorder
- **Dysarthria:** A neurologic *speech disorder* that reduces the strength, speed, range, steadiness, or accuracy of speech movements.
- **Aphasia with phonemic paraphasias (APP):** A neurologic language disorder that affects language processing in spoken and written modalities, where phonemic paraphasias is part of the presentation.

8

We don't always agree about who has AOS and who has APP

From conceptual definition
to behavioral definition

9

FEATURES AND ASSESSMENTS

10

Traps to avoid in assessment

- Not using a motor speech evaluation
- Relying on speech features that don't differentiate
- Assuming that making sound errors = AOS
- Diagnosing severe aphasia as AOS
- Listening for something that is only vaguely defined

11

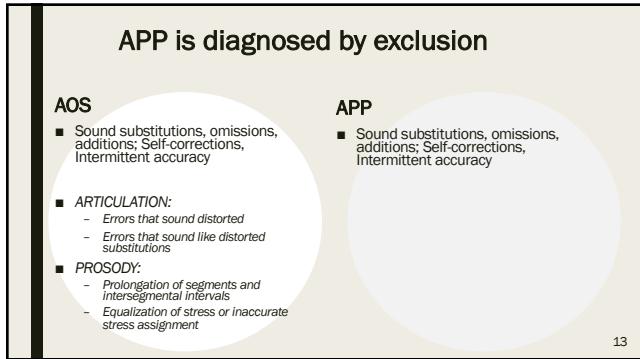
Diagnostic criteria for AOS:

1. Slow speech (long segments, long pauses)
2. Altered prosody (equalized stress; separated syllables)
3. Speech sound distortions
4. Combined sound distortions and sound substitutions/additions

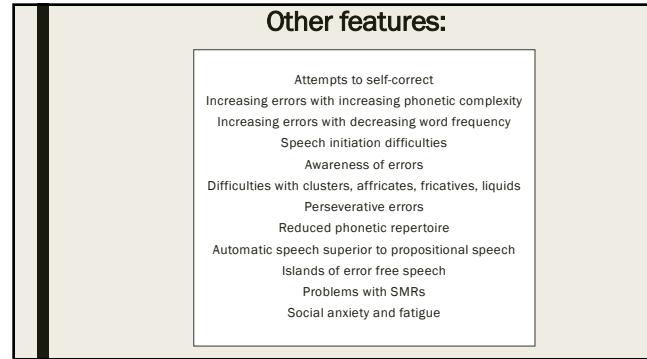
ROOM FOR INTERPRETATION

Ballard, K. J., Wambaugh, J. L., Duffy, J. R., Layfield, C., Maas, E., Mauszycki, S., & McNeil, M. R. (2015). Treatment for acquired apraxia of speech: A systematic review of intervention research between 2004 and 2012. *American Journal of Speech - Language Pathology*, 24(2), 316-337

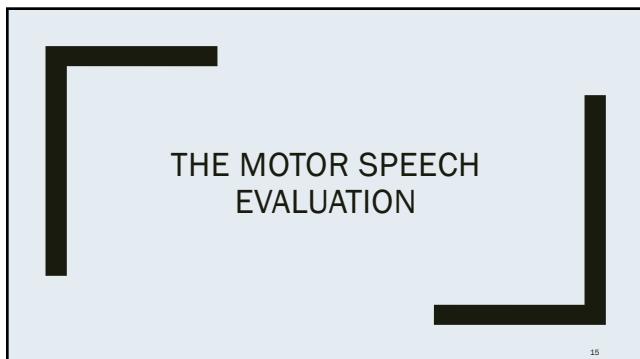
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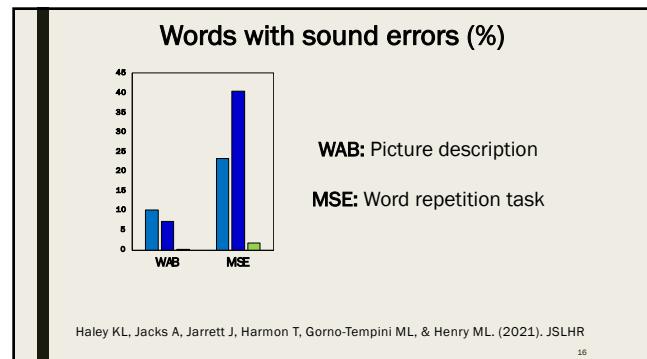
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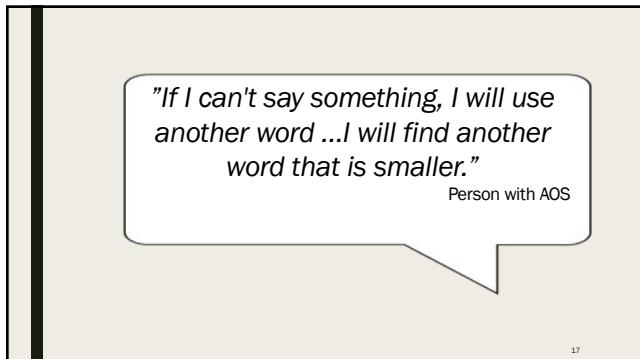
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16



17

The speech sample matters

Connected speech	Motor speech evaluation
<ul style="list-style-type: none"> Speaker decides what to say Several potential lexical and syntactic complications <i>Lower</i> sensitivity to sound production errors. Prosodic abnormality <i>less specific</i> to speech production. 	<ul style="list-style-type: none"> Examiner/protocol determines what is to be said Few lexical and syntactic complications <i>Higher</i> sensitivity to sound production errors. Prosodic abnormality <i>more specific</i> to speech production.

18

36-item Motor Speech Evaluation (MSE)
(Wertz et al., 1984)

mom judge peep bib nine tote dad shush coke gag fife sis zoos church lull	gingerbread snowman television thick thicker thickening jab jabber jabbering zip zipper zippering flat flatter flattering	artillery x 5 impossibility x 5 catastrophe x 5 microscopic x 5 reconstruction x 5 segregation x 5
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Arthur was an oozy oily sneak
In the summer they sell vegetables
The valuable watch was missing
The shipwreck washed up on the shore
Please put the groceries in the refrigerator

19

19

The Mayo Clinic motor speech evaluation

- **Sounds**
 - Vowels, stops, fricatives
- **Monosyllabic symmetric words**
 - Mom, bob, peep, kick, fife, sis, church, shush, lull, roar
- **Words of Increasing length**
 - Cat, catapult, catastrophe, thick, thicker, thickening
- **Repeated multisyllabic (x3)**
 - Animal, snowman, artillery, stethoscope, rhinoceros, volcano, harmonica, specific, statistics, aluminum
- **Sentences**
 - We saw several wild animals, My physician wrote out a prescription, The municipal judge sentenced the criminal
- **AMR; SMR**
 - papapa, tatata, kakaka; pataka
- **Automatic speech**
 - Counting, days of the week, singing

Duffy, J. R. (2013). *Motor speech disorders: Substrates, differential diagnosis, and management* (3rd ed). St Louis, MO: Elsevier Mosby

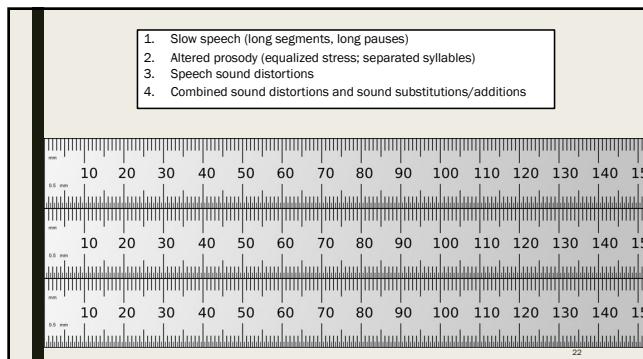
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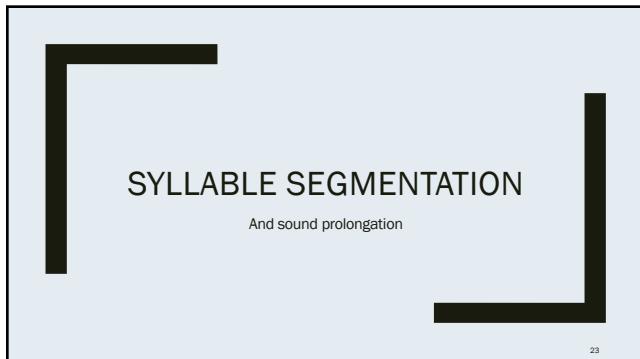
What if there was a test that was both sensitive and specific to apraxia of speech?

What if I could measure the behavior instead of just relying on my own impression?

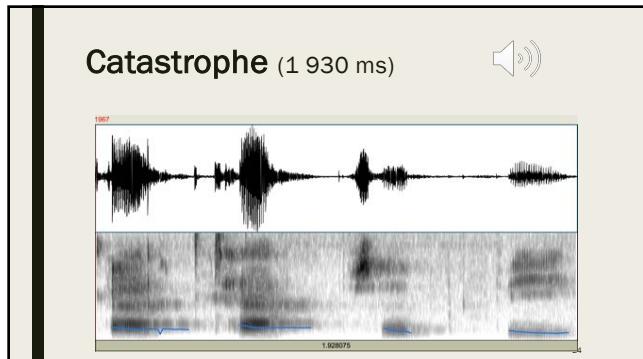
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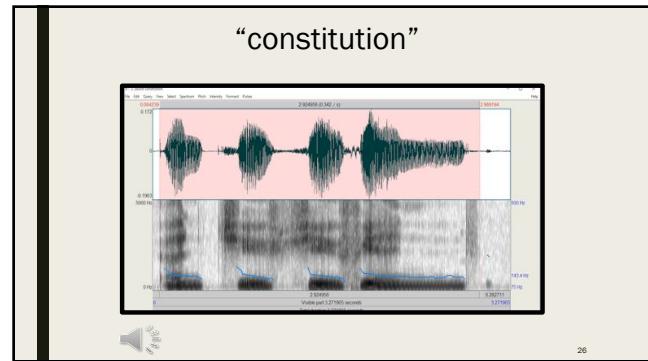


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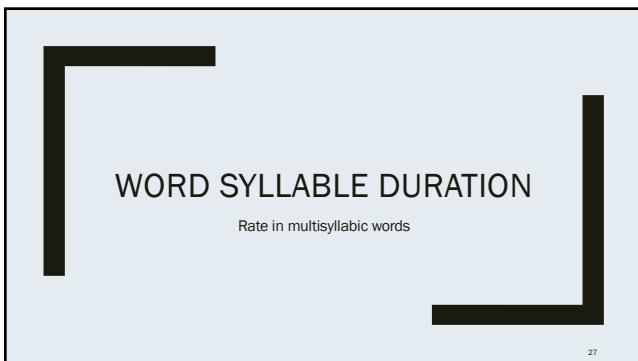
Segment prolongation and inter-syllabic pauses

- E.g. mean pause duration, mean vowel duration
- Syllables with pauses longer than 150 s

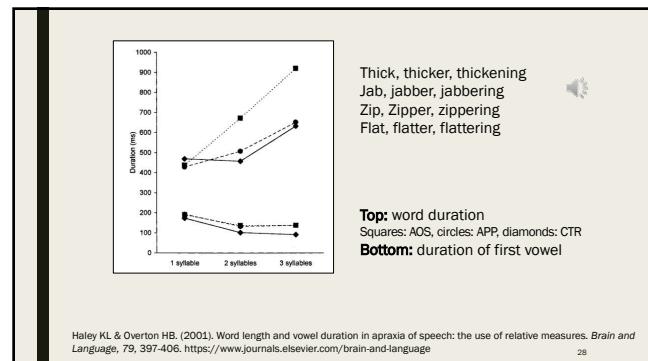
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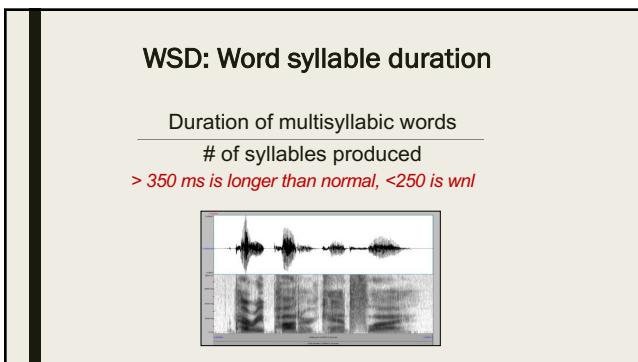


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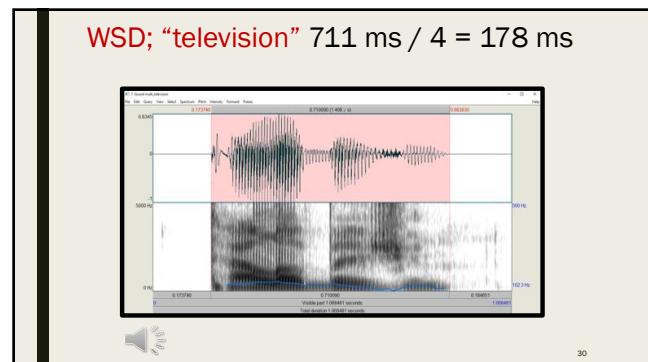


Haley KL & Overton HB. (2001). Word length and vowel duration in apraxia of speech: the use of relative measures. *Brain and Language*, 79, 397-406. <https://www.journals.elsevier.com/brain-and-language>

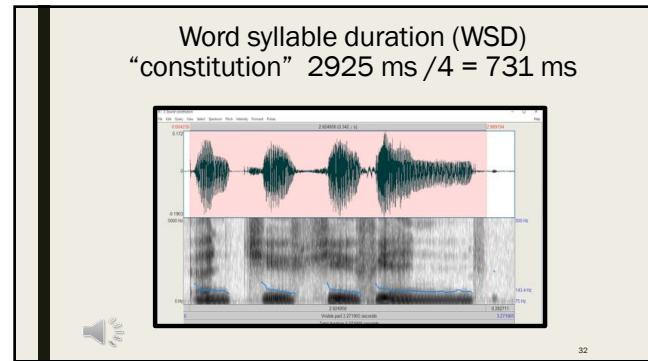
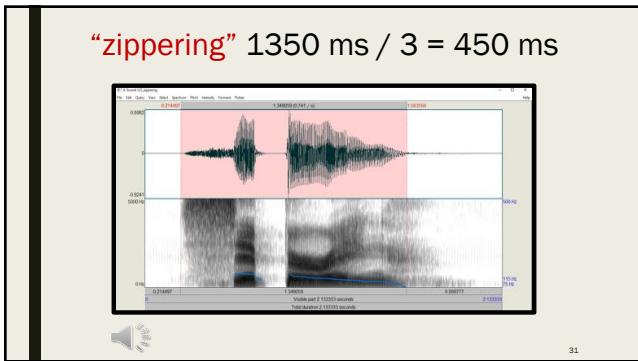
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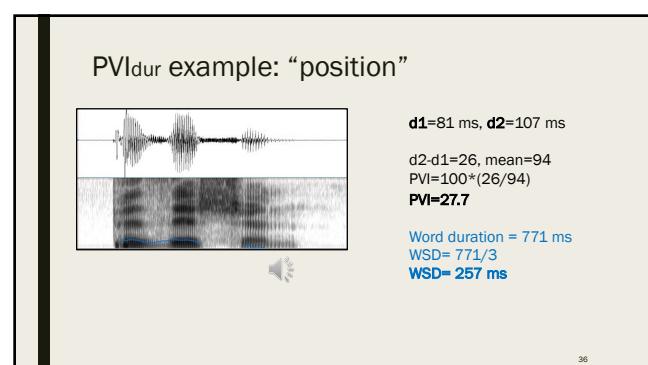
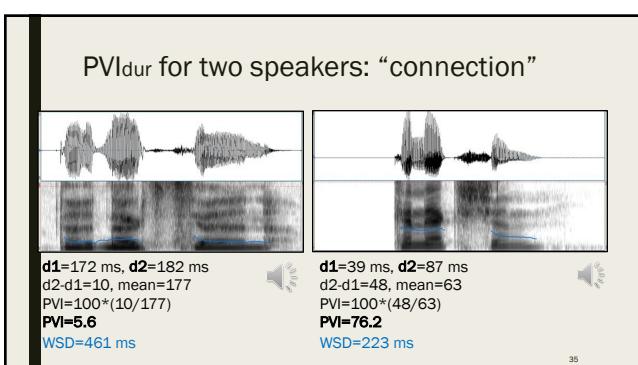
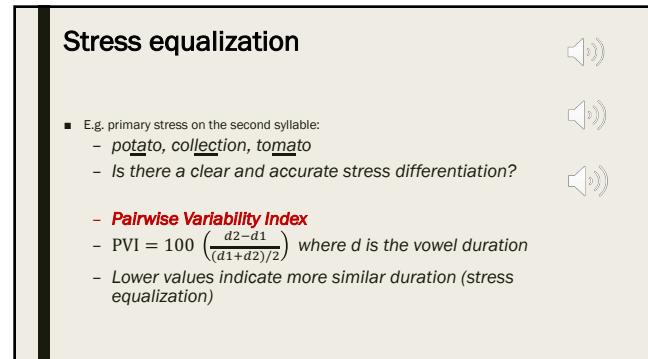
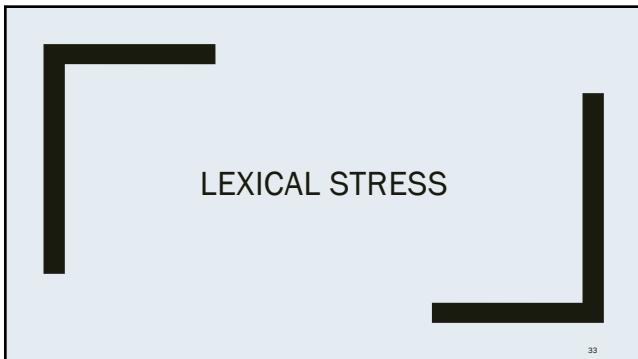


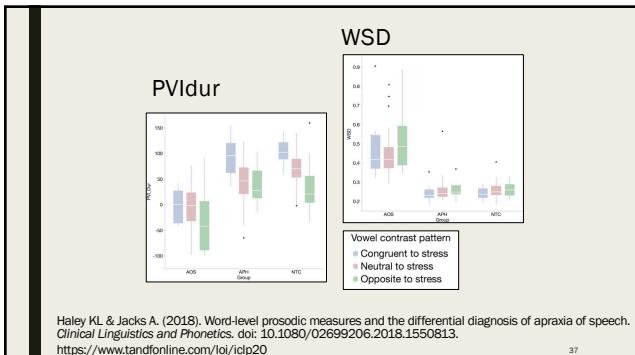
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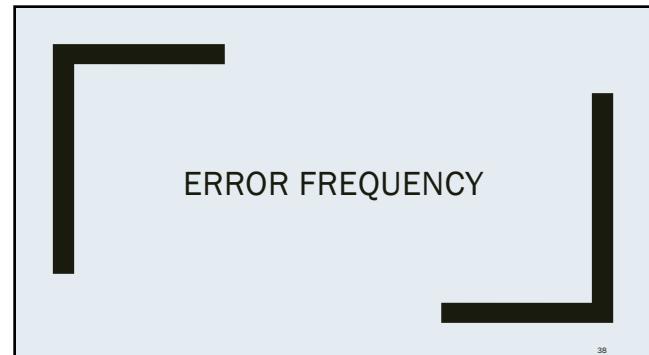
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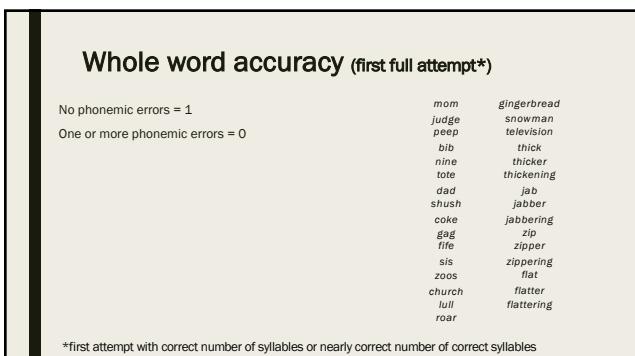




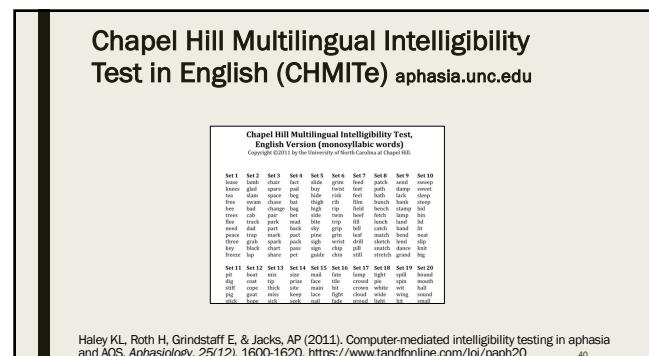
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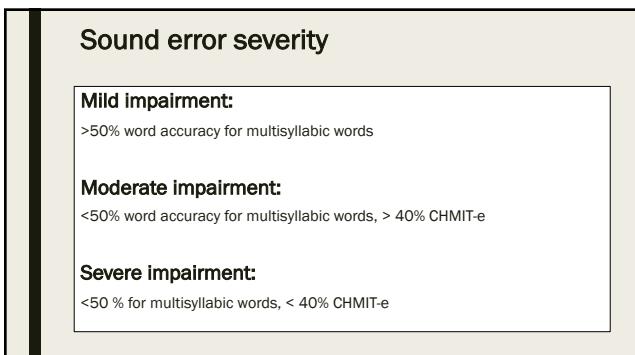
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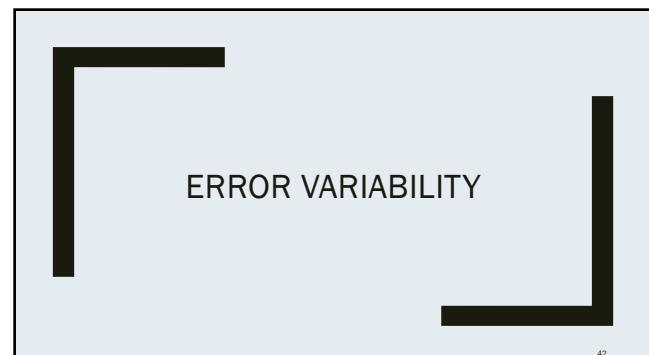
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42

Are sound errors variable or consistent?

- “...articulatory **inconsistency** on repeated productions of the same utterance” (Wertz, LaPointe, & Rosenbek, 1984, p. 81).
- “...relatively **consistent** in terms of type and invariable in terms of location.” (Wambaugh et al., 2006, p. xvii).

The answer depends on how consistency and errors are defined

43

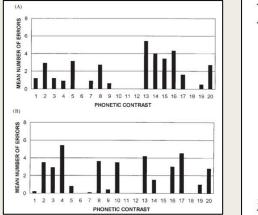
What we do know about error consistency in AOS

- Average error frequencies are consistent
- People have difficulties with certain sounds and sound combinations
- Many tend to favor certain errors
- Phonetic form is inconsistent**

Haley, K. L., Cunningham, K. T., Eaton, C. T., & Jacks, A. (2018). Error Consistency in Acquired Apraxia of Speech With Aphasia: Effects of the Analysis Unit. *Journal of Speech, Language, and Hearing Research*, 61, 210–226. <http://islr.pubs.asha.org>

44

Many tend to favor certain errors (and profiles vary from person to person)



Haley KL, Ohde RN, & Wertz RT. (2000). Single word intelligibility in aphasia and apraxia of speech: a phonetic error analysis. *Aphasiology*, 14, 179-202. <https://www.tandfonline.com/loi/paph20>

45

Phonetic form is inconsistent



“The typical apraxic subject [...] might insert the schwa once (thereby sounding somewhat like a dysarthric subject), unequivocally say /spl/ correctly the second time, repeat and block on it on the third presentation (a stuttering-like response), make a totally unrelated substitution the fourth time, emit a particularly difficult sequence of phonemes (sukptweeing/spleen) the fifth time, make a substitutive simplification the next time (speer or pleen for spleen), and then say it with the precision of a normal speaker”

(Johns and Darley, 1970, p. 780).

46

Do people with AOS simplify their speech?

47

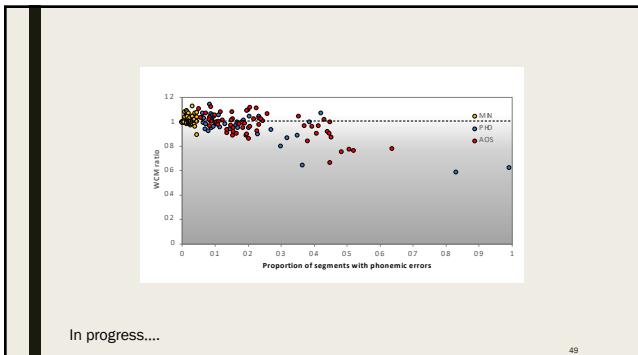
The word complexity measure

Word	IPA	Final C	Cluster	Velar	Liq/Rho V	Fric./Affr.	Vcl Fric/Affr.	Total score
Tot	ʊ							0
Mest	mit	1						1
Say	seɪ							1
Pull	pʊl	1			1			2
Ring	rɪŋ	1			1			3
Van	væn	1		1	1			3
Burst	bɜːst	1	1	1		1	1	4
Text	tɛkst	1	1	1		1		4
Size	sایz	1				2		4
Glass	glæs	1	1	1	1	1		5
Grasp	grasp	1	2	1	1	1		6
Strange	streɪndʒ	1	2	1	2	1		7

IPA = International Phonetic Alphabet; Final C = Final consonant; Velar = Velar consonant; Liqu/Rho V = Liquid or rhotic vowel; Vcl Fric/Affr = Voiced fricative or affricate; and Diphthong

Stoe-Gammon, C. (2010). The word complexity measure: Description and application to developmental phonology and disorders. *Clinical Linguistics and Phonetics*, 24, 271–282.

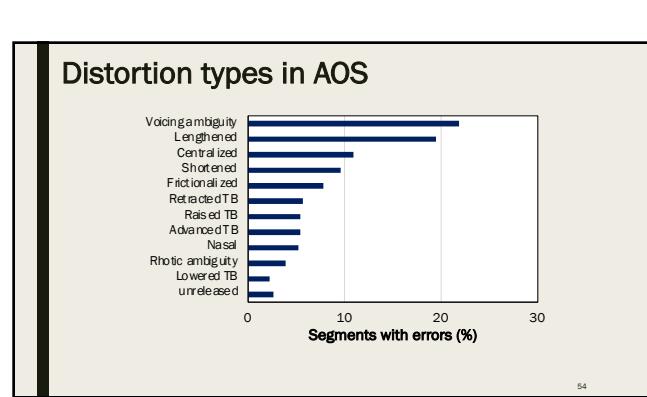
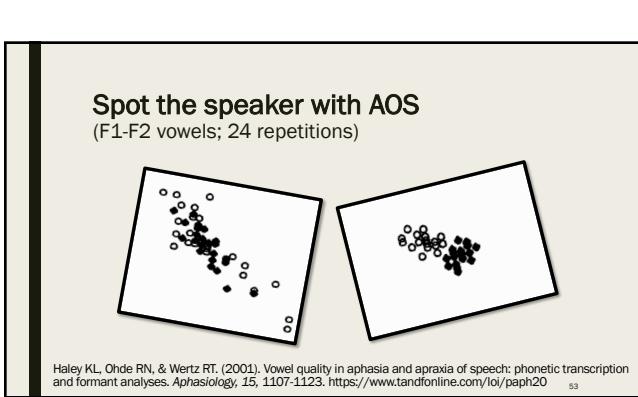
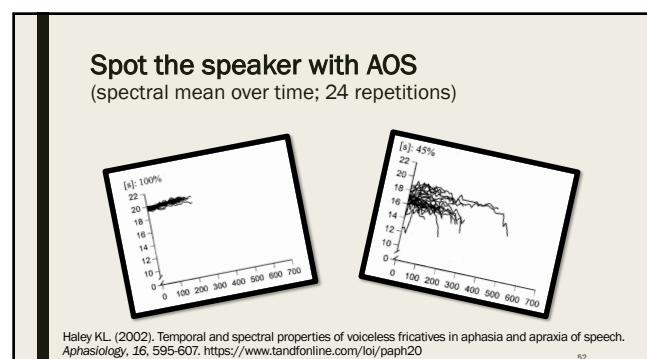
48



SOUND DISTORTION ERRORS

50

- ### What are distortion errors?
- Imprecise articulation
 - Phonetic ambiguity
 - Sound error captured only with narrow phonetic transcription
 - Not co-articulation, dialect, or accent



What is a distorted substitution error?

- Combination of a phoneme substitution (or addition) and a distortion

e.g. for "dad"

[dʒ:ãd]

55

"Really hard word and I need to think about words and I need to think how tongue is thinking about"

Person with AOS

56

Case Study mild/moderate to mild AOS

To document recovery with AOS quantitatively
....and based on the lived experience

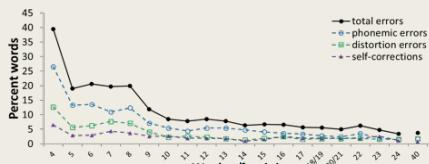
Haley, K. L., Shafer, J., Harmon, T., & Jacks, A. (2016). Recovering with Acquired Apraxia of Speech: The First Two Years. *American Journal of Speech-Language Pathology*, 25 (45), S687-S696. <http://jsh.sagepub.com>

57

Motor speech evaluation

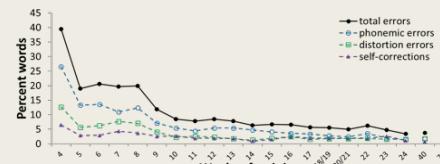
Measure	9 weeks	79 weeks
Speech sound production		
CHM1-e single word intelligibility (%)	87.0	94.0
MSE monosyllabic accuracy (%)	80.0	100.0
MSE di- and multisyllabic accuracy (%)	48.6	92.3
	"mild-moderate"	"mild"
Speaking rate for multisyllabic words		
Syllable duration (ms)	418.2	275.0
	"slow"	"WNL"

58



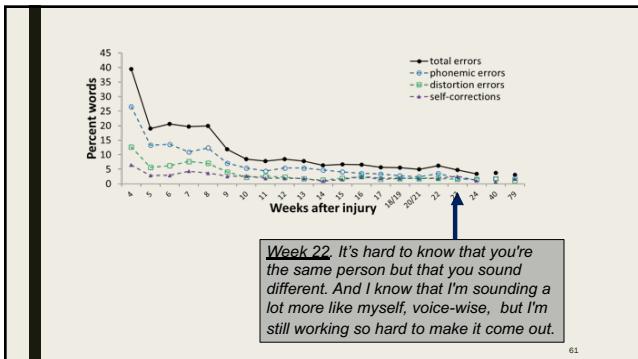
Week 14: "I know that you guys are going to say —Well you sound great... You've made so much progress. It's true and I'm so grateful but if I'm being honest again it's still hard to know that you're still not all the way back to what you were before."

59

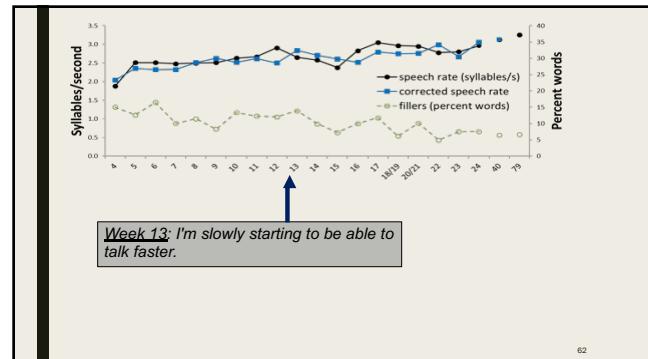


Week 18/19: Overall, it's getting easier and taking less focus. I still have to think but I.. it requires less complete focus than it used to.

60



61



62

*"Sometimes I feel that speaking is a great accomplishment.
Don't hold it against me."*
Person with AOS

63

63

MAKING THE DIAGNOSIS

64

Option A: Clinical impression

65

Running speech, multisyllabic word repetition

Sample 1: Aphasia with phonemic paraphasia (Wernicke), sentence repetition, "catastrophe"

Sample 2: Aphasia with phonemic paraphasia (Conduction), WAB picture, "catastrophe"

Sample 3: Apraxia of Speech (Broca), WAB picture, "catastrophe"

Sample 4: Apraxia of Speech (Global), WAB picture, "gingerbread"

66

Examples of sound errors in APP (i.e. no AOS)

"constitution" "stethoscope"

"volcano" "stethoscope"

"harmonica" "spaghetti"

"flat" "spaghetti"

67

People with AOS also produce sound errors that sound "phonemic" to listeners

Substitution errors "pink, "zip"

Omission errors "flatter," "flattering"

Addition errors "nine," "sport"

68

68

Sound distortions are more common in AOS than in APP. Examples:

"stethoscope" "tote"

"stethoscope" "poor"

"spaghetti" "bib"

69

Self-corrections occur in APP (especially in classic conduction aphasia)

"church" "stethoscope"

"gingerbread" "The shipwreck washed up on the shore"

*They are often referred as *conduit d'approche*

70

70

Self-corrections also occur in AOS*

"harmonica" "thickening"

"shade" "fox"

*Sometimes part of audible articulatory groping

71

Sound and pause prolongations are common in AOS

"thicker" "gingerbread"

"shush" "catastrophe"

"thick" "The shipwreck washed up on the shore"

72

72

Syllable segmentation sounds like:

Audible pause between syllables
Equalized stress across syllables



73

Multisyllabic words in AOS: Slow rate and syllable segmentation

“stethoscope”		“constitution”	
“harmonica”		“harmonica”	
“gingerbread”		“spaghetti”	

74

74

Speech is both consistent and inconsistent in AOS

“spaghetti”		“artillery”	
“constitution”		“rhinoceros”	
“harmonica”		“catastrophe”	

75

75

75

Speech is both consistent and inconsistent in APP

“rhinoceros”		
“catastrophe”		

76

76

When diagnosing coexisting dysarthria, listen/watch for:

- **Similar quality across speech tasks**
 - *Propositional/automatic, repetition/discourse, phonetically easy/complex*
- **Phonatory signs**
 - *harsh, strained, breathy, monopitch, monoloudness, short phrases, low pitch*
- **Resonatory signs**
 - *continuous hypernasality*
- **Confirmatory signs**
 - *facial, lingual, or palatal weakness*
 - *dysphagia*

77

77

Why differential diagnosis is difficult

1. The “Checklist Approach,” is problematic because:
 - Checklists vary
 - Interpretation of behaviors vary
 - Weighting of criteria vary
 - Attention and priorities vary
2. Speech production is complex and clinical populations are heterogeneous
 - *The AOS – APP dichotomy is too simplistic*
 - *Some profiles are easy to recognize; others are not*
 - *Recognizing the disorder “when you hear it” is not justifiable*

78

Option B: Data analysis

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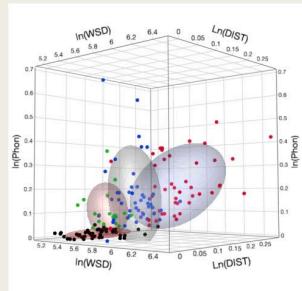
Case examples, quantitative metrics

Speech quality	Case A Severe AOS	Case B Moderate AOS	Case C Moderate APP	Case D Mild APP	Case E No Impairment
Intelligibility Test (%)	32	52	58	92	98
Multisyllabic Word Accuracy (%)	0	27	49	82	97
Distortions (% segments)	33	16	5	2	3
Distorted substitutions (%)	10	8	1	0	0
Phonemic complexity ratio	0.75	1.1	1.0	1.05	1.0
Word syllable duration (ms)	520	446	210	197	225
Pause duration (ms)	443	310	87	82	96
Pairwise Variability Index	11	25	77	89	98

80

Feature Constellations

AOS (N=45),
APP (N=10)
Minimal (N=52)
Borderline (N=46)



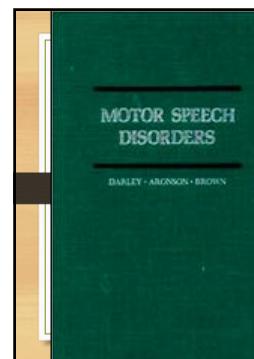
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What if there was a way to get pertinent measurements automatically.... Then base diagnosis on evidence-based interpretation?

82

THE TREATMENT EVIDENCE

83



"The goal of therapy is to help the apraxic patient regain voluntary accurate control in programming the position of his articulators to produce phonemes and phoneme sequences"

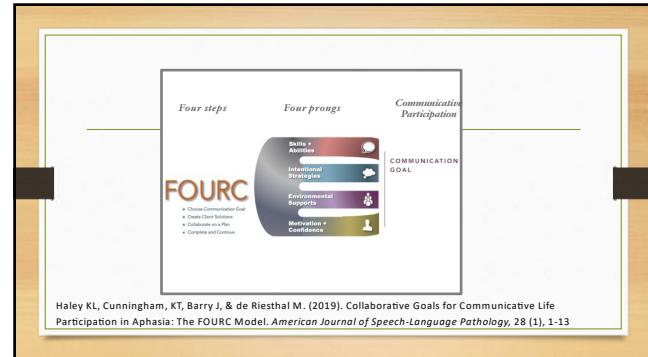
(Darley et al., 1975, p. 279)

84

“The first priority in treatment is to ensure that people with communication disorders have functional means to communicate. Communication access in AOS and CAS is usually most efficiently enhanced by making the communication environment supportive and providing training for clients, partners, and parents to use effective listening, multimodal communication, and adequate time for the interaction. Communication strategies should be considered early on, and not as a last resort.”

Jacks A. & Haley K. L. (2021). Apraxia of Speech. In J. S. Damico, N. Müller, & M. J. Ball (Eds.). The Handbook of Language and Speech Disorders (2nd Edition). Wiley Blackwell. Pp. 368-390c

85



86

“There is no evidence from randomized trials to support or refute the effectiveness of therapeutic interventions for apraxia of speech.”

“There is a need for high quality randomized trials to be undertaken in this area.”

West. C., Hesketh, A., Vail, A., & Bowen, A. (2005). Interventions for apraxia of speech following stroke. Cochrane Database Syst Rev. 2005 Oct 19;(4):CD004298.

87

Treatment of AOS: Systematic reviews

- First review: 59 publications from 1951 to 2003, total n=146, 78% male, MCA stroke majority
- Second review: 26 articles from 2003 to 2012, N=107, 59% male. MCA stroke majority
- Articulatory kinematic approaches - “probably effective”
- Rate/rhythm control approaches - “possibly effective”

Wambaugh, J.L., Duffy, J.R., McNeil, M.R., Robin, D.A., & Rogers, M. (2006). Treatment guidelines for acquired apraxia of speech: A synthesis and evaluation of the evidence. *Journal of Medical Speech-Language Pathology*, 14(2), xv-xxiii.

Ballard, K.J., Wambaugh, J.L., Duffy, J.R., Layfield, C., Maas, E., Mauszycki, S., & McNeil, M. (2015). Treatment for acquired apraxia of speech: A systematic review of intervention research. *American Journal of Speech-Language Pathology*, 24, 316-337.

88

Articulatory kinematic (AK) approaches: “recommended” for moderate to severe AOS

- “Recommendations” should usually be followed by clinicians, but clinicians should be responsive to patient preferences and should be watchful for new evidence concerning the approach

Wambaugh, J.L., Duffy, J.R., McNeil, M.R., Robin, D.A., & Rogers, M. (2006). Treatment guidelines for acquired apraxia of speech: A synthesis and evaluation of the evidence. *Journal of Medical Speech-Language Pathology*, 14(2), xv-xxiii.

89

“Really hard word and I need to think about words and I need to think how tongue is thinking about”

Person with AOS

90

**Rate/rhythm control (RRC) approaches:
Options to consider for AOS**

Clinicians should be aware of such treatments as potentially viable approaches, but clinician and patient preference should have a considerable role in the decision making process; clinicians should be attentive to new literature pertaining to the treatment option

Wambaugh, J.L., Duffy, J.R., McNeil, M.R., Robin, D.A., & Rogers, M. (2006). Treatment guidelines for acquired apraxia of speech: A synthesis and evaluation of the evidence. *Journal of Medical Speech Language Pathology*, 14(2), xv-xxiii.

91

"Slowing down makes it easier to get the words right."

Person with AOS

92

What is the treatment goal?

- Reproduction of stimuli?
 - Acquisition of behavior
- Reorganization of the organism?
 - Maintenance and generalization
 - Retention and transfer

93

Principles for learning generalization

- Response generalization
 - Emergence of untrained responses
- Stimulus generalization
 - Transfer of behavior to conditions or situations that are different from those in which training occurred

Thompson, C. K. (1989). Generalization in the treatment of aphasia. In L.E. McReynolds and J.E. Spradlin (Eds.), *Generalization strategies in the treatment of communication disorders* (pp. 82-115). Philadelphia: BC Decker.

94

“unison/choral speech”....aka “integral stimulation”.... aka “speech entrainment,” etc...

Rosenbek JC, Lemme ML, Ahern, MB, Harris EH, & Wertz, RT (1973). A treatment for apraxia of speech in adults. *Journal of Speech and Hearing Disorders*, 38, 462-472

Fridriksson, J., Hubbard, H.I., Hudspeth, S.G., Holland, A.L., Bonilha, L., Fromm, D., & Rorden, C. (2012). Speech entrainment enables patients with Broca's aphasia to produce fluent speech. *Brain*, 135 (12), 3815-2629.

95

“Watch me, listen to me, say it with me”

96

The classic eight-step continuum (AK)
more → less support

Targets: Functional words and phrases
Methods: Maximal support, gradually faded and replaced by self-generated response and volitional control; repeated practice; role playing
Outcome: Ability to generate targets in staged dialogue
Evidence: Case studies

Rosenbek JC, Lemme ML, Ahern MB, Harris EH, & Wertz RT (1973). A treatment for apraxia of speech in adults. *Journal of Speech and Hearing Disorders*, 38, 462-472

97

Sound production treatment (SPT; AK)
less → more support

- Targets:** Consonants that are particularly difficult, typically in 8-10 treated items
- Methods:** response-contingent hierarchy with integral stimulation, graphemic cues, articulatory placement, and external feedback.
- Outcome:** Accuracy (%) of target sounds in repetition probes. Improvements for both treated and untreated (phonemically similar) targets—response generalization
- Generalization:** Good response generalization, limited stimulus generalization (better for high levels of acquisition for long treatment period).
- Evidence:** Series of single case experimental designs

98

Treatment hierarchy for SPT
less → more support (Wambaugh et al., 1998)

Step 1: Modeling/Imitation

- “Say chair...tear” “Say chair”....”Say tear”

Step 2: Modeling + Visual cue/Imitation

- “chair...tear” while pointing to written word

Step 3: Integral Stimulation

- “Watch me, listen to me, and say it with me....chair”

Step 4: Modeling with Silent Juncture/Imitation*

- “Say the word like this, ch.....air”

Step 5: Articulatory Placement/Modeling

- “Your tongue was not raised”

* This step was omitted in subsequent investigations

99

Sound Production Treatment modified
less → more support

- Step 1 – Modeling/repetition of target word**
 - If correct, 5 additional repetitions
 - If incorrect, modeling/repetition of contrast word (Feedback and integral stimulation if needed)
- Step 2 – Written letter cue + modeling/repetition**
- Step 3 – Integral stimulation – up to 3 attempts**
- Step 4 – Articulatory placement cues and integral stimulation**

Wambaugh, J. L., & Nessler, C. (2004). Modification of sound production treatment for apraxia of speech: Acquisition and generalisation effects. *Aphasiology*, 18, 407-427.

100

Motor Learning Guided treatment (MLG; AK)

- Targets:** Meaningful words and phrases (in chunks of five)
- Condition:** Face-to-face, independent home practice, telehealth
- Methods:** Written word plus clinician model (SGD), client repeats, clinician repeats gives knowledge of result (e.g. “the third one was the closest”); repeat each chunk; varied order; varied pausing.
- Outcomes:** Accurate oral reading accuracy for target words and phrases.
- Evidence:** Case studies

101

Script training (combined tx)
more → less support

Targets: Monologues or dialogues
Methods: integral stimulation, repetition, independent production
Outcomes: Production of script words and phrases, increased speech rate and fluency, improved morphosyntax
Generalization: Stimulus generalization
Evidence: Small group studies and single case experimental design

Youmans, G. L., Youmans, S. R., & Hancock, A. B. (2011a). Script training treatment for adults with apraxia of speech. *American Journal of Speech-Language Pathology*, 20, 23–37.
Goldberg S, Haley KL, & Jacks, AP (2012). Script Training and Generalization for People with Aphasia. *American Journal of Speech-Language Pathology*, 21, 222-238.

102

I had a stroke.
Speaking is hard.
But I can understand you.

Youmans, G. L., Youmans, S. R., & Hancock, A. B. (2011a). Script training treatment for adults with apraxia of speech. *American Journal of Speech-Language Pathology*, 20, 23 – 37.

LE's Scripts

Script 1

Clinician: Hello, how may I help you?
IE: I want to make an appointment.
C: Okay.
IE: I had a stroke and do not speak well, but I understand everything. Numbers are hard for me. Please slow down and repeat them.
C: No problem. What is your name?
IE: I need my 1 year check-up.
C: What doctor do you see?
IE: Dr. Who?
C: Okay. When are you available?
IE: I can come Tuesday, Wednesday, or Thursday mornings.
C: How about this Tuesday at 8 am?
IE: No, I live two hours away. I need time to drive there and after I have to pick-up my children at two thirty.
C: How about Wednesday morning?
IE: Can you repeat that?
C: Ten o'clock or eleven o'clock?
IE: I have an appointment at 11 o'clock.
C: Can you repeat that?
IE: Yes, that's fine. Thank you.
C: You're welcome. Goodbye.

Goldberg S, Haley KL, & Jacks A. (2012). Script training and generalization for people with aphasia. *American Journal of Speech-Language Pathology*, 21, 222-238

103

Response Elaboration Training (RET) modified for persons with AOS (combined tx)

- Step 1: Elicitation of a response “Tell me as much as you can about this picture or anything that it reminds you of.”
- Step 2: Reinforcement
- Step 3: Request elaboration
- Step 4: Reinforcement and combination
- Step 5: Model and request repetition
- Step 6: Elicit with picture after (>5 second) delay

Steps 1-6: Request repetition and give integral stimulation as needed

Wambough JL, Wright S & Nessler C (2012) Modified Response Elaboration Training: A systematic extension with replications. *Aphasiology*, 26:12, 1407-1439

104

M-RET: evidence

- Single case experimental design (MBD across behaviors)
- Expected outcome: Increased correct information units CIU
- Response generalization to new picture sets

Wambough, J. L., Fleszar, M. M., West, J. E. and Doyle, P. J. 1998a, Effects of treatment for sound errors in apraxia of speech and aphasia. *Journal of Speech, Language, and Hearing Research*, 41, 725-743.

105

Combined aphasia and apraxia of speech treatment, CAAST steps 1-2

Step 1:

- Therapist—Presents action picture and says, “Tell me anything about this picture; what does it remind you of?; what’s happening?”
Participant—No response.
- Therapist—“You could say something like man spills ... or ... drops a cup.”
Participant—“Spill.”

Step 2:

- Therapist—“Spill, great.” Referring to a sentence frame, asks participant to indicate where to write “spill.”

Wambough, J. L., Wright S, Nessler C, & Mauszycki S C. 2014, Combined Aphasia and Apraxia of Speech Treatment (CAAST): Effects of a Novel Therapy. *Journal of Speech, Language, and Hearing Research*, 57, 2191 – 2207

106

CAAST, steps 3-4

Step 3:

- Therapist—“What does the man spill?” Participant—“Milk.”

Step 4:

- Therapist—“Milk, good, spill milk.” Referring to the sentence frame, asks the participant where to write “milk.”

Wambough, J. L., Wright S, Nessler C, & Mauszycki S C. 2014, Combined Aphasia and Apraxia of Speech Treatment (CAAST): Effects of a Novel Therapy. *Journal of Speech, Language, and Hearing Research*, 57, 2191 – 2207

107

CAAST, step 5

Step 5A

- Therapist—“Repeat after me . . . spill milk.” Participant—“Pill milk.”

Step 5B:

- Therapist—“Good try, but not quite correct. Let’s concentrate on this sound (underlines the “s” on the sentence frame) and try again . . . spill milk.”
Participant—“Spill milk.”
- Therapist—“That’s right. Now, let’s say it three more times.”

Wambough, J. L., Wright S, Nessler C, & Mauszycki S C. 2014, Combined Aphasia and Apraxia of Speech Treatment (CAAST): Effects of a Novel Therapy. *Journal of Speech, Language, and Hearing Research*, 57, 2191 – 2207

108

CAAST, step 6

Step 6:

- Therapist—Removes the picture and imposes a 5-s delay (e.g., “Wait and then I’m going to ask you to say it again”).
Participant—“Milk.”
- Therapist—“Good try, but not quite. Watch me and try it with me . . . spill milk.”

Wambough, J. L., Wright S., Newster C., & Mawryck S. C.: 2014, Combined Aphasia and Apraxia of Speech Treatment (CAAST): Effects of a Novel Therapy. *Journal of Speech, Language, and Hearing Research*, 57, 2191 – 2207

109

CAAST: evidence

- Single case experimental design (MBD across behaviors)
- Expected outcome: Increased correct information units CIU
- Response generalization to new picture sets

Wambough, J. L., Wright S., Newster C., & Mawryck S. C.: 2014, Combined Aphasia and Apraxia of Speech Treatment (CAAST): Effects of a Novel Therapy. *Journal of Speech, Language, and Hearing Research*, 57, 2191 – 2207

110

How are these treatments similar?

111

What if there was a way to customize treatment to the patient’s specific behavioral profile?

What if it was possible to count on treatment effects in daily life and have those treatments also include psychological wellbeing?

112

HOLISTIC TREATMENT PLANNING

113

Principles of adult learning

- Adults must want to learn
- Adults will learn only what they feel they need to learn
- Adults learn by doing
- Adult learning focuses on problem solving
- Experience affects adult learning
- Adults learn best in an informal situation
- Adults want guidance and consideration as equal partners in the process

Knowles, Malcolm (1980). *The modern practice of adult education: From pedagogy to andragogy*. Wilton, Connecticut: Association Press.

114

Principles of motor learning

<p>1. Stages of learning</p> <ul style="list-style-type: none"> a) Cognitive stage b) Associative stage c) Autonomous stage <p>2. Pre-practice considerations</p> <ul style="list-style-type: none"> a) Motivation and goal setting b) Instructions c) Perceptual pre-training d) Modeling 	<p>3. Practice</p> <ul style="list-style-type: none"> a) Amount b) Schedule c) Variability d) Whole and Part <p>4. Augmented feedback</p> <ul style="list-style-type: none"> a) Structure b) Timing
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115

Motor learning defined

A set of processes associated with practice or experience leading to relatively permanent changes in the capability for skilled movement.

Learning is inferred from observed changes in behavior.

Capability for skilled movement is reflected in:

- Consistency – achieving the goal most of the time
- Flexibility – adapting to different contexts
- Efficiency – minimum energy required



116

Motivation as Foundation

Self-Determination Theory

Innate Psychological Needs

- Autonomy
- Competence
- Relatedness

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11, 227-268.

117

The OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016)

Motor learning, motivation, and retention are enhanced when learners:

- 1) Expect to perform competently
- 2) Experience autonomy in their own learning
- 3) Focus their attention on external outcomes

Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychonomic Bulletin & Review*, 23(5), 1382-1414.

118

OPTIMAL Principle 1: Expected performance competence

- Expectation of ineffective or modest performance → **rumination**
- **Not addressed** in AOS treatment programs:
 - What do our learners expect of themselves during our treatment programs?
 - How might those expectations affect outcomes?
- **Confidence-strengthening** is integral to the FOURC model (Haley et al., 2019)
- Instead of verbal explanation, we use **video self-modeling**.
- People with aphasia like this (Harmon et al., 2017)

119

OPTIMAL Principle 2: Learner autonomy

- Learners prefer, perform, and retain best under conditions where they can **exert some control** over their environment and learning experiences.
- Even **choices** that are seemingly peripheral to the learning task (e.g. order of practice targets, color of material) enhances learning.
- Collaborative (patient-centered) treatment planning is fantastic, but day-to-day autonomy matters too.
- Customized targets are fairly common in clinical treatment protocols, but **choice of methods is unusual**
 - Some choices in home program, still limited
 - Our clients want more choices and flexibility (Harmon et al, 2017)

120

**OPTIMAL Principle 3:
External attentional focus**

- Movement outcomes are diminished when learners attend to how their bodies move rather than the desired movement effect.
 - Unnecessarily conscious control mode that disrupts automaticity and conscious control
- Internal focus for speech: Where is my tongue?
- External focus for speech: What am I trying to say?
- Internal focus is closely related to sound-based treatments; external focus is closely related to word- and phrase-based treatment

121

**Action for Speech-
Action for Conversation**

Developing a different type of tx for AOS

122

What we learned in a preliminary study:

- People with aphasia want to play a more active role in determining goals and targets
- They do not always feel that practice is effective and feel that motivation depends on seeing progress
- SLPs and clients want flexibility to choose and adapt techniques and strategies
- Everyone wants results in real communication
- People usually don't practice enough

Harmon TG, Hardy L, & Haley KL. (2017). Proactive social validation of methods and procedures used for training speech production in aphasia. *Aphasiology*, 922-943.

123

Action for Speech: Core Features

- Self-selected conversation as target; accuracy and fluency outcomes
- Progression of self-generated cues
- SLP assumes coaching role
- Stimulus generalization is expected
- Conditions are improved for psychological well-being

124

Action for Speech (Overview)

In this program, you will practice **three conversation topics**. The first step is to select the topics you want to work on. The next step is to select **ten things you want to say** about each topic. We will **take photos** to help you remember the 3 conversations and the 10 things you want to say about each one.

You will use a tablet computer to practice at home. We will meet twice per week to keep you on track.

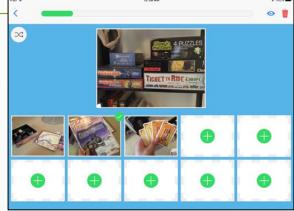
With this program, **you decide** when to practice and what clues you want to use to be successful. We will tell you about choices you have. We will help you make the treatment work for you.

125

Three conversation topics

126

10 phrases for each conversation topic



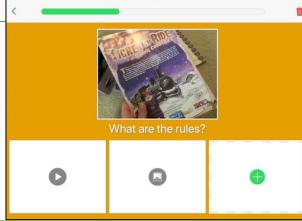
127

Self-modeling → Competence

- The user records 1-3 video practice cues with SLP assistance.
- Whenever possible, the user models what to say**
- Include at least one cue that helps the user be successful more than 85% of the time. Adjust:
 - Length of target (one word, some words, all words)
 - Speaker role (unison, user alone after repetition, SLP alone)
 - Production rate and articulatory clarity
 - Alerts/Isolated practice/Phonetic derivation for problematic sections
 - With increased accuracy, more subtle cues may be introduced

128

Three self-generated practice cues



129

Structure of the ActionSC therapy session

- Review home practice log, share data
- Review phrases and cues (client leads). Clinician gives feedback when requested. New video cues are recorded as needed
- Confirm practice plan for next session

130

Haley KL, Cunningham KT, Shafer J, & Kim I. (2021). Autonomy-supportive treatment for acquired apraxia of speech: feasibility and therapeutic effect. *Aphasiology*. 35 (4), 539-559

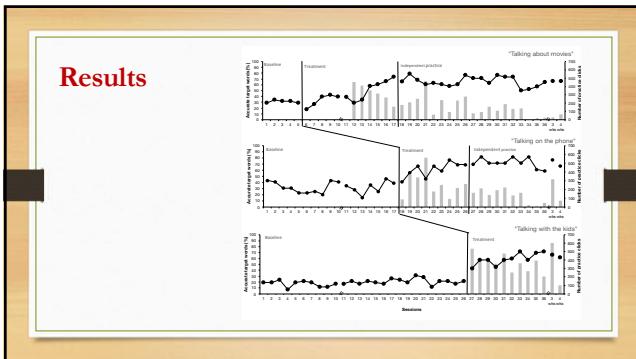
60-year old woman with Broca's aphasia (AQ=52.6)

131

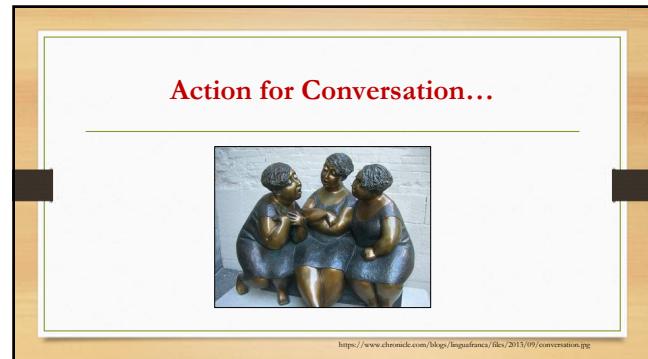
Conversations

I like that movie	How are the kids?	I have a new bill
It wasn't good	NAME, are you working tonight?	Somebody called
What do you want to watch?	Hi, how are you?	Are you taking me to church
Tyler Perry	Do you have a boyfriend?	NAME?
I like comedy	How is your son?	NAME, I need help
I've seen that one	Things are good	Let me call NAME
See any good movies?	Let's talk soon	Hi NAME
Black Panther	NAME, it's NAME calling	Tell me about your girl
Coming over to watch a movie?	It was nice talking	What are you doing today?
What time?	How is your girlfriend?	Are you here?
		Hello NAME

132



133



134

CONCLUSIONS

135

Conclusions:
Assessment and diagnosis

- AOS is best diagnosed through systematic assessment and measurement
- Both AOS and APP involve sound errors; AOS additionally involves sub-phonemic distortions and abnormal prosody
- AOS is a behavioral syndrome that resembles other behavioral syndromes and boundaries among them are fuzzy
- Main features of AOS can be measured, often in clinically feasible way

136

Conclusions: Treatment

- Most AOS treatments are articulatory-kinematic in nature
- Most rely on combinations of repetition, oral reading, and integral stimulation
- Most treatments result in learning
- Response generalization is more common than stimulus generalization
- Most treatments consider the patient a passive recipient
- It is also possible/logical to base treatment on motivational theory

137

LET'S TALK!

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138