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Incorporating Principles of Motor Learning in Therapy for SSD with Speech Motor Chaining

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JPO

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Speech Production Lab

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Author Disclosures

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- Financial
  - Salary received from Syracuse University.
  - Grant funding received from the National Institutes of Health (since 2013)
- Non-Financial
  - Dr. Preston developed and continues to research treatments for speech sound disorders, including Speech Motor Chaining and biofeedback
  - Member of the Apraxia Kids Professional Advisory Council
  - Lab members receive no royalties or additional compensation from the Speech Motor Chaining website.

Author Disclosures

Nina R. Benway, PhD CCC-SLP
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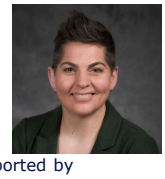
- Financial
  - Stipend through NIH T32 to UMD (Goupell and Carr, PIs)
  - Research supported through NIH Grants
- Non-Financial
  - Developer for Speech Motor Chaining and Creator/Developer for ChainingAI
  - Lab members receive no royalties or additional compensation from the Speech Motor Chaining website

Author Disclosures



Megan C. Leece
Research SLP

- Financial
  - Salary paid by Syracuse University fully supported by NIH/NIDCD/NHMRC grant funding
- Non-Financial
  - Co-author on multiple articles investigating efficacy of Speech Motor Chaining
  - Lab members receive no royalties or additional compensation from the Speech Motor Chaining website

Speech Motor Chaining

A framework for implementing structured practice on speech sounds.

Assumes the SYLLABLE is a core movement in speech planning

Bridges acquisition & motor learning

Adaptive, within a session

School-age clients and adults with persisting speech errors

Preston, Leece & Storto (2019)

What is Speech Motor Chaining?

Built around stabilizing core syllables

Generalization

Stimulability

"ray"

*"It was **a** **rainy** **day** in November"*

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Practice Schedule	Blocked then random
Practice Variability	Prosodic cues built in
Feedback Frequency	Specified; fades at higher linguistic levels
Feedback Type	Trials assigned as: KP/KR, KR, or no feedback
Target Complexity	More complex items built around previously practiced movements
Target Complexity	Changes every 6 trials

Speech Motor Chaining

- Practice Schedule: Unspecified
- Practice Variability: Unspecified
- Feedback Frequency: Unspecified
- Feedback Type: Unspecified
- Target Selection: No relationship between simple/complex items
- Target Complexity: Changes *between* sessions

"Traditional" Articulation Therapy

Candidacy

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In Research...

Persisting Speech Sound Errors: can introduce new speech sounds such as /ɹ/, /s/, or /tʃ/	**Childhood Apraxia of Speech:** can stabilize production of sounds in multisyllabic words	**Broad applicability:** prior research has been published with people ages 7-23	**Modality:** has been studied both in-person and via teletherapy

Clinically...

- **Children younger than age 7 (as young as 5)**
- **Group therapy contexts**
- **Adults with AOS**

Target Selection

Target Sound and Position	Variant 1	Variant 2	Variant 3	Variant 4
/ɹ/ onset	/ɹe/	/ɹɑ/	/ɹi/	/tɹʌ/
/tʃ/ coda	/ɚtʃ/	/ɪtʃ/	/ɛtʃ/	/ʌtʃ/

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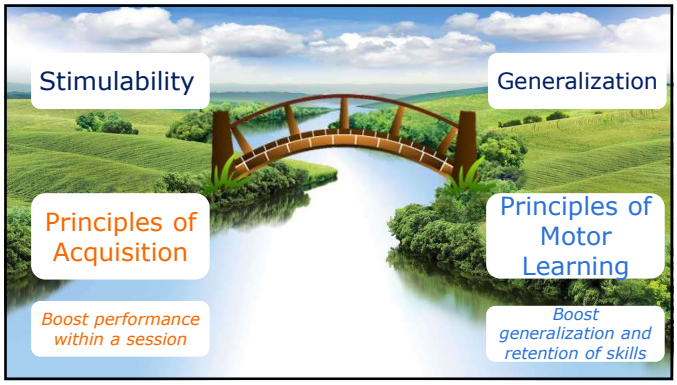
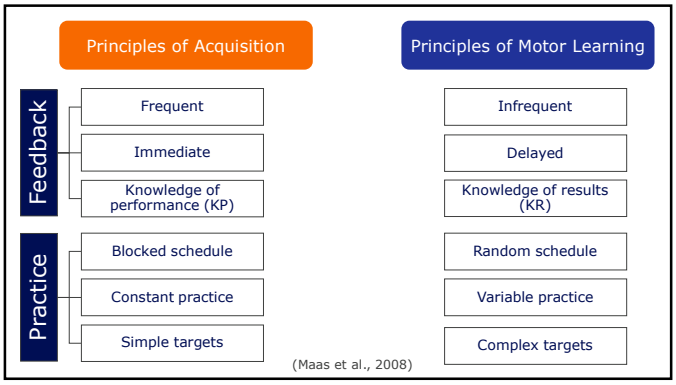
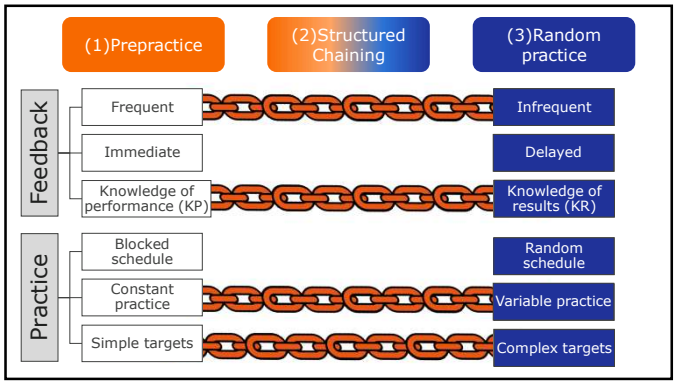
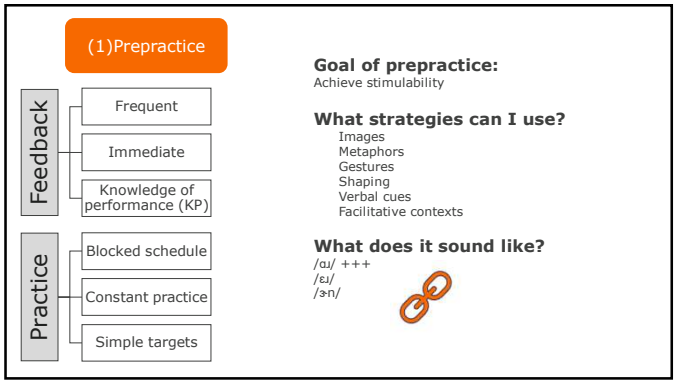
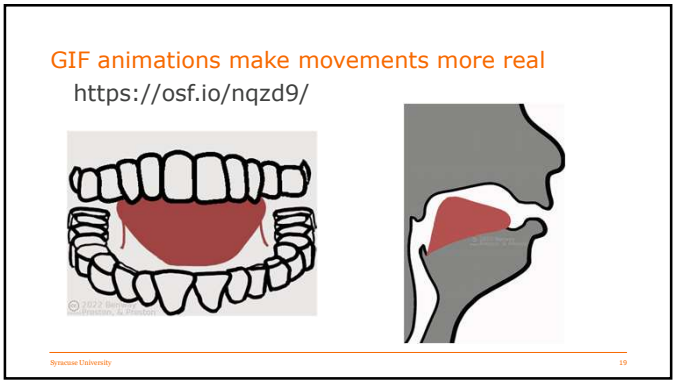

Stimulability
Generalization
Principles of Acquisition
Principles of Motor Learning
Boost performance within a session
Boost generalization and retention of skills


Principles of Acquisition
Principles of Motor Learning
Feedback
Frequent
Immediate
Knowledge of performance (KP)
Infrequent
Delayed
Knowledge of results (KR)
Practice
Blocked schedule
Constant practice
Simple targets
Random schedule
Variable practice
Complex targets
(Maas et al., 2008)


(1)Prepractice
(2)Structured Chaining
(3)Random practice
Feedback
Frequent
Immediate
Knowledge of performance (KP)
Infrequent
Delayed
Knowledge of results (KR)
Practice
Blocked schedule
Constant practice
Simple targets
Random schedule
Variable practice
Complex targets


Pre-practice
/ɑ/
/i/


(1)Prepractice
Feedback
Frequent
Immediate
Knowledge of performance (KP)
Practice
Blocked schedule
Constant practice
Simple targets
Goal of prepractice:
Achieve stimulability
What strategies can I use?
Images
Metaphors
Gestures
Shaping
Verbal cues
Facilitative contexts
What does it sound like?
/ɑɹ/ +++
/ɛɹ/
/ɝn/


GIF animations make movements more real
https://osf.io/nqzd9/
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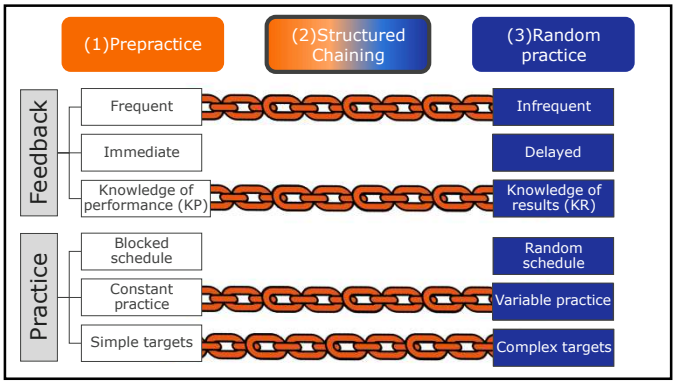
Structured Chaining



Core sound sequences are gradually expanded.

Speech Motor Chaining

Five levels of complexity

1. Syllable — ray
2. Monosyllabic word — race
3. Multisyllabic word — erasing
4. Phrase — erasing the answer
5. Sentence — [make up a sentence with erasing]

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Preston, Leece & Storto (2019)

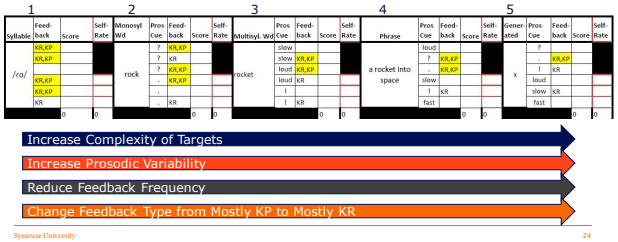
But…

Speech Motor Chaining isn't just building linguistic complexity.

How do I adapt complexity, variability, feedback type, feedback frequency… in the same session?

What is Speech Motor Chaining?

- Freely available resources: https://osf.io/5jmf9/



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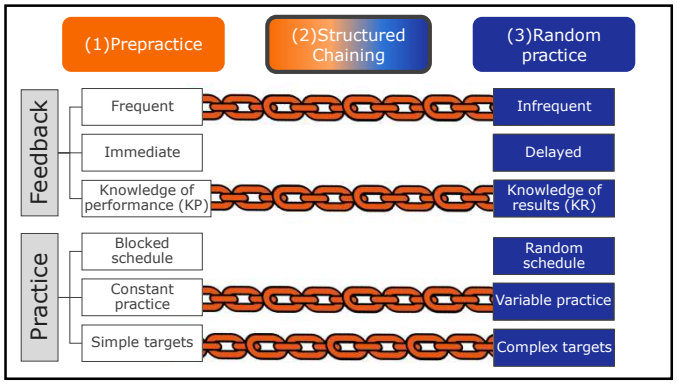
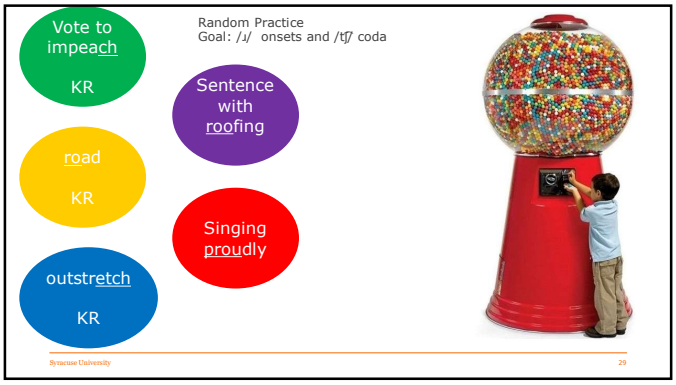
Random Practice





Speech Motor Chaining - Summary

(1)Prepractice

Maximum clinician cueing & feedback

Syllable level

4 target variants

(2)Structured Chaining

Small blocks

5 linguistic levels

Introduce prosodic variation

Change feedback

(3)Random Practice

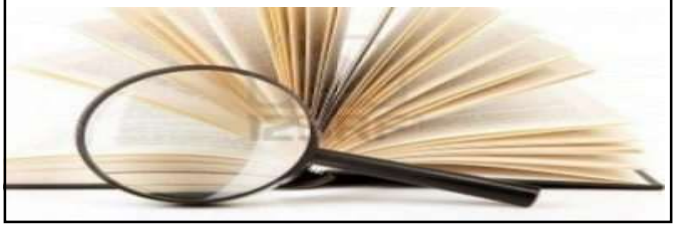
Random order

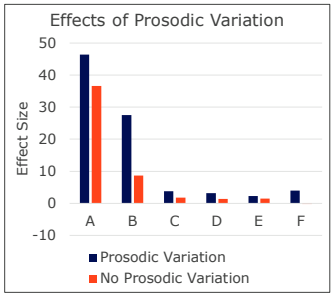
Delayed, KR feedback (50%)

Highest level of complexity child can handle

Include prosodic variation

Evidence Base





Prosodic variation may help with learning

Preston, Leece, McNamara, & Maas (2017).

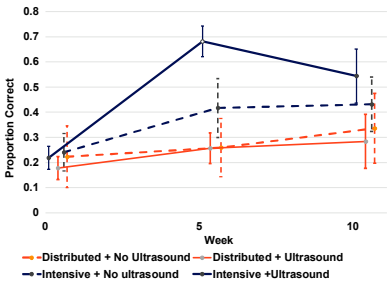
Service Delivery

- Speech Motor Chaining has been shown to facilitate improved speech sound production in face-to-face treatment as well as teletherapy
- Evidence of effectiveness in:
  - 10 min sessions, daily (Herbst et al., in press)
  - 2 x 60 min sessions per week (Preston et al., 2017)
  - "Bootcamp" approach beginning with a week of intensive treatment (Preston et al., 2023)

Also studied with school-age children with CAS

Think about treatment distribution (& biofeedback)

Preston et al. (2023)



Website: Session Summary

Accuracy for each sound target, at each level of linguistic complexity attempted.

Session Summary - Default

Session Info | Chains | Session Summary | Session Results

Session Time: 01/27/2021 10:45 AM - 12:56 PM (183011 minutes)

iChain Research Template

Sound Target 1: /r/onset

Variant 1: /ri/
Variant 2: /ru/
Variant 3: /ra/
Variant 4: /ro/

Syllables Attempted	13
Syllables Correct	8
Syllable Percent Correct	61.5%
Monosyllable Words Attempted	6
Monosyllable Words Correct	6
Monosyllable Words Percent Correct	100.0%
Multisyllable Words Attempted	6
Multisyllable Words Correct	3
Multisyllable Words Percent Correct	50.0%

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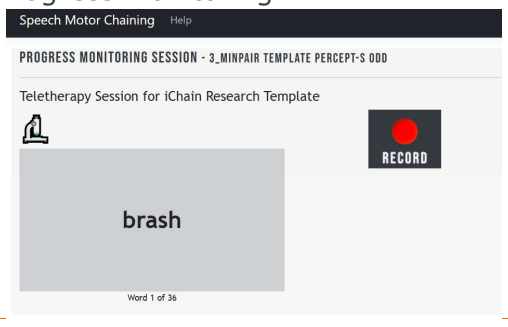
(4)Progress Monitoring



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Progress Monitoring Summary

Accuracy for each sound target, for different phonological contexts.

Sound Target: /r/ onset

Clinician Rating

Correct	Total	Percent
20	31	64.52%

Linguistic Complexity

	Correct	Total	Percent
One-Syllable Words	14	18	77.78%
Two-Syllable Words	5	11	45.45%
Three+ Syllable Words	1	2	50.00%

Vowel Context

	Correct	Total	Percent
Front Vowels	15	20	75.00%
Back Vowels	5	11	45.45%

Consonant Information

	Correct	Total	Percent
Singletons	11	20	55.00%
Clusters	9	11	81.82%

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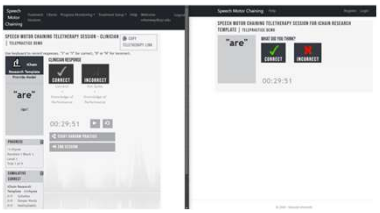
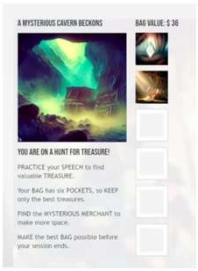
Coming Soon

- **Telepractice**
- Gamification
- AI Clinician



Coming Soon

- Telepractice
- **Gamification**
- AI Clinician



Coming Soon

- Telepractice
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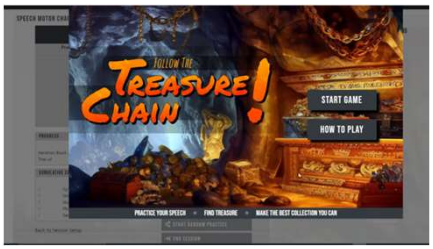
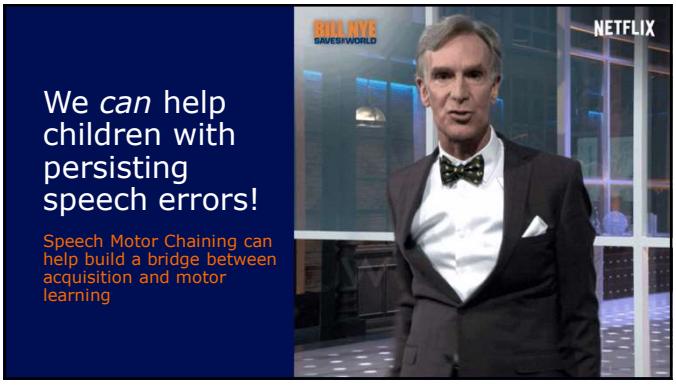


Benway & Preston, 2024

Want more on AI?

Level Up Your Critical Thinking Around Artificial Intelligence for Speech Sound Disorders

- Session 1395 (Invited)
  - Part 1: Intro to AI/Machine Learning
  - Friday 9:30a-10:30a; CC/Arch/Arch-4C-3 (Lvl 4)
- Session 1447 (Invited)
  - Part 2: Evaluating AI Clinician Research
  - Friday 12p-1p; CC/Arch/Arch-4C-3 (Lvl 4)



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https://speechproductionlab.syr.edu/
Research opportunities
Free resources

https://chaining.syr.edu/

We're also on Instagram!
@speechproductionlabsyr

Selected References

Maas, E., Robin, D. A., Austermann Hula, S. N., Freedman, S. E., Wulf, G., Ballard, K. J., & Schmidt, R. A. (2008). Principles of motor learning in treatment of motor speech disorders. *American Journal of Speech-Language Pathology, 17(3), 277-298. doi:10.1044/1058-0360(2008/025)*

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