

**Ultrasound Imaging in Treatment of SSDs:
An Interprofessional Collaboration**


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Introductions


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Learning Objectives

- 1) Identify team members and equipment needed to implement ultrasound visual feedback
- 2) Interpret the visual feedback of lingual movement provided by ultrasound imaging
- 3) Evaluate the success of ultrasound visual feedback as compared to traditional articulation therapy for persistent speech sound disorders

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Disclosures

- All team members work for the University of Oklahoma Health Campus.
- Team members are not receiving a stipend or other financial incentives for this presentation.
- All SLP Faculty are members of ASHA and OSHA.
- Robin White is a member and volunteer for SDMS



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Why is speech production so challenging?

- Complex, dynamic and multi-level integration across cognitive, linguistic, motor and sensory systems.
- High neurological demand
- Articulatory precision
- Speech requires coarticulatory flexibility
- /r/ focus



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The Puzzle of Speech Motor Performance

Actuators
~100 muscles
Many degrees of freedom

Complexity
Moving articulators vary widely in size, physical composition, & flexibility
Fluid-structure interactions



Speed
Produce up to 6-9 syllables/sec

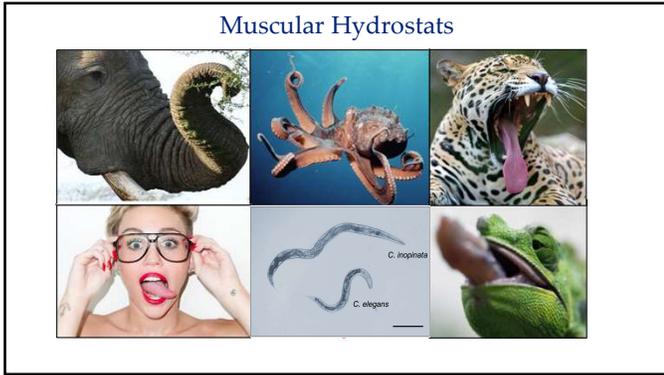
Auditory feedback loop delay
> 100 ms
Predictive control 'internal models'

How is this possible?



Video source: Fast real-time MRI imaging at Max Planck Institute of Biophysical Chemistry

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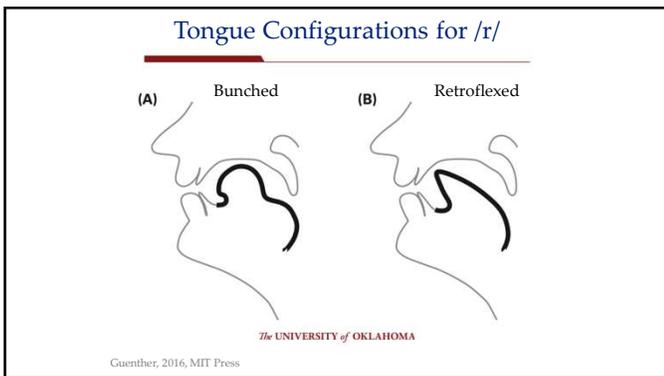
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Traditional Articulation Approach

- Bunched or Retroflex
- Simple cuing "one size fits most"
- Hierarchy
- High articulatory complexity
- Other phonemes have stability

The University of Oklahoma Health logo is located at the bottom left of the slide.

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The Reality of /r/ Production



Image credit to Suzanne Boyce PhD, University of Cincinnati.

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"R" Remediation

- Difficult to teach and hard to self-monitor
- Requires reliance on internal proprioceptive awareness
- Traditional articulation intervention relies on auditory and visual cues, which may not be sufficient for clients with persistent speech sound errors.

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Persistent "R" errors

- So how do we help our "lifer" speech clients?
- Contemporary research and clinical practice have encouraged us to integrate **motor-based principles**, **individualized articulatory modeling**, and **biofeedback** into traditional frameworks
- **Principles of motor learning:** Blocked vs. random practice, massed vs. distributed, knowledge of performance vs. knowledge of results.
- **Facilitative contexts:** Structure of the word facilitates correct production

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Biofeedback for speech intervention

- Making the motor movements visible—one of the optimal ways of providing feedback
- Spectrogram: For visualization of acoustic production
- Ultrasound Imaging: Allows for real-time visualization of tongue motion during ongoing speech, offering an additional modality for biofeedback



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Ultra Sound Collaboration at OU

Our journey to applying Ultrasound as tool in treating SSD began as many collaborations do, with a personal connection.

With new leadership in The College of Allied Health, interprofessional projects and teaming are supported

Interprofessional Sonography Lab

Dr. Matt Masapallo joined the faculty in Fall 2024 Implemented the Speech Motor Lab



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Collaboration-cont

- Clinical educators gathered information for using US for treating persistent SSD.
- We were fortunate to receive grant money to purchase a portable device for the CSD department
- Professor Robin White provided real-time training for faculty in the new Interprofessional Sonography Lab and an orientation for SLP graduate students

Although UVB is an effective intervention strategy, appropriate training as a clinical tool for remediating speech sound errors is not commonly provided in graduate-level speech-language pathology programs due to the lack of trained instructors (e.g., faculty members or clinical supervisors) with knowledge of UVB. - Campos, LSHSS Vol. 53 July 2022



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Ultrasound Value

For Students

- Students will have the opportunity to use ultrasound imaging to visualize articulatory movements, particularly of the tongue, during speech
- Students will have hands on training and the interprofessional experience of working with MIRS students and faculty
- Students will learn to integrate ultrasound biofeedback with other speech therapy strategies to create a comprehensive therapy plan for articulation disorders.

For Providers

- Ultrasound has emerged as a visual biofeedback tool to add to a clinician's "toolbox" for treating persistent speech sound disorders.
- Our SLP Clinical educators have access to the equipment and more importantly the knowledge for using Ultrasound
- Can be used as a clinical and a research tool
- Can provide direct quantitative assessment of patient motor performance
- See better patient outcomes



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Ultrasound Value

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Getting to the "How(s)"

- OU experience
 - Higher Education/Training Setting
 - Initial client session
 - Casual and Formal discussions
 - Practice sessions in the ultrasound lab
 - Purchasing equipment for the SLP program
 - Future potential training for students



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"How" You Can Do This

- Finding your team members if this is something you wish to pursue in your practice
 - Local resources
 - Networking
 - Literature and Video resources
- Things to consider:
 - Which clients do you intend to utilize this with?
 - Types of equipment
 - Cost of equipment
 - Storage of equipment and supplies
 - How will you learn to use the equipment? Who can you call if you have a problem?



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"How" to Benefit

- | | |
|--|--|
| <p>Directly</p> <ul style="list-style-type: none"> • Interprofessional collaboration • Add new tools to your toolbox • Potential success with a difficult case | <p>Indirectly</p> <ul style="list-style-type: none"> • Add new tools to your toolbox • Awareness of when clients might benefit from ultrasound biofeedback • Potential success with a difficult case |
|--|--|



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"How" t

- Demonst
- Real-time



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Conclusion

- Future Directions
- Summer Camp, IPE Collaboration, Teletherapy for rural communities
- Research Opportunities
- Student instruction-Speech Sound Disorders



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Resources

- Cabbage, K. L., & Hitchcock, E. (2022). Clinical considerations for speech perception in school-age children with speech sound disorders: A review of the current literature. *Language, Speech, and Hearing Services in the Schools*, 53(5), 768-785. https://doi.org/10.1044/2022_LSHSS-21-00120
- Dugan, et al. (2023) A qualitative analysis of clinician perspectives of ultrasound biofeedback for speech sound disorders. *American Journal of Speech-Language Pathology*, 32 (2), 1252-1274. https://doi.org/10.1044/2023_AJSLP-22-00194
- Lee, S. & Sanclibrion, S. (2015). How to get started with ultrasound technology for treatment of speech sound disorders. *Perspectives of Speech Science and Orofacial Disorders*, 25, 64-69.
- McAllister Byan, T. (2017). Efficacy of visual-acoustic biofeedback intervention for residual rhotic errors: A single-subject randomization study. *Journal of Speech, Language, and Hearing Research*, 60(5), 1175
- Preston, J. L., Brick, N., & Landi, N. (2013). Ultrasound biofeedback treatment for persisting childhood apraxia of speech. *American Journal of Speech-Language Pathology*, 22(4), 627-643. [https://doi.org/10.1044/1058-0360\(2013\)12-0139](https://doi.org/10.1044/1058-0360(2013)12-0139)



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