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Sound Judgment: Using Effective Speech Therapy Techniques and Motor Learning Principles for Speech Sound Disorders with or without Related Structural Anomalies, presented in partnership with Cincinnati Children's

Presenter: Ann W. Kummer, PhD, CCC-SLP, ASHA Fellow

Moderated by: Amy Hansen, M.A., CCC-SLP, Managing Editor, SpeechPathology.com

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Using effective speech therapy techniques and motor learning principles for speech sound disorders, with or without related structural anomalies, presented in partnership with Cincinnati Children's

Ann W. Kummer, PhD, CCC-SLP, ASHA Fellow

Financial Disclosures

Royalties:

- Kummer, AW. (2014). ***Cleft Palate and Craniofacial Anomalies: The Effects on Speech and Resonance***, 3rd edition from Cengage Learning.
- ***Oral and Nasal Listener*** (ONL) from Super Duper Publications, Inc.
- US Patent on **Nasoscope**, Number: 6656128. Issue date: 12/2/03.

Non Financial Disclosures

- **None**

SOUND JUDGMENT: INTRODUCTION

Objectives

As a result of this course, participants will be able to:

- Describe how to use auditory, visual and tactile-kinesthetic cues to enhance the child's awareness of the misarticulated sound versus the correct sound production.
- Explain how to apply effective speech therapy techniques for typical speech sound errors.
- Explain how to use motor learning and motor memory principles to achieve carryover soon after acquisition of the appropriate placement.

Course Outline

- Anatomical requirements for normal speech
- Effects of abnormal structure on speech sound production
- Enhancing speech sound awareness
- Speech therapy "cookbook"
- Achieving carry-over using motor learning principles
- Summary

ANATOMICAL REQUIREMENTS FOR NORMAL SPEECH SOUND PRODUCTION

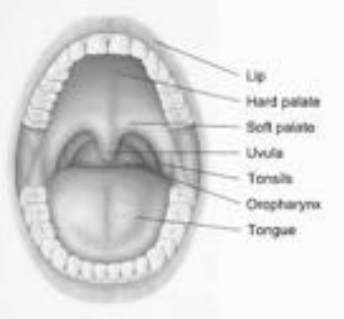
Normal Speech Production

Most speech sounds are produced in the front of the mouth:

- Bilabial sounds- p, b, m, w
- Labiodental sounds- f, v
- Lingual-alveolar sounds- t, d, n, l, s, z
- Palatal sounds- ʃ, ʒ, ʧ, ʤ

Normal Speech Production

- The only speech sounds produced in the back of the mouth are velar sounds (k, g, ŋ)



Normal Speech Production

- The lips should:
  - Approximate at rest without effort
- Bilabial competence is important for production of bilabial and labiodental sounds

Normal Speech Production

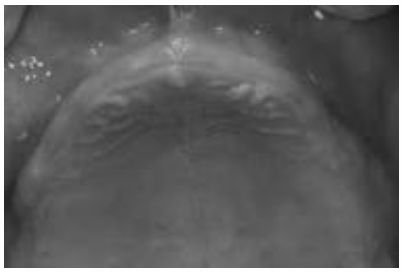
- The tongue tip should:
  - Rest under the alveolar ridge
  - Be able to move up and down, back and forth without interference
- Tongue tip movement is important for production of lingual-alveolar and palatal sounds.

Normal Speech Production

- In an evaluation of speech sound production, the following should always be assessed:
  - Bilabial competence
  - Tongue tip to alveolar ridge relationship

Normal Speech Production

- What about the teeth?
- What if you don't have any?



Normal Speech Production

- Sibilants or the "teeth sounds" (s, z, ʃ, ʒ, ʧ, ʤ) are not actually produced by the teeth
- Teeth are NOT necessary for normal speech production
- Teeth are not necessary for speech, but can actually *interfere* with normal speech production

Science Experiment

- Produce an /s/ sound
- Note the airstream flowing between the tongue tip and alveolar ridge
- Open the jaws and produce an /s/ sound
- Why do we close our teeth to produce /s/?
- Answer: To raise the mandible so the tongue is positioned just under the alveolar ridge

Normal Speech Production

- Sibilants are actually produced by forcing airstream between the tip of the tongue and the alveolar ridge
- Labiodental and interdental sounds can be produced with the lip/tongue and gum ridge

Video 1: Edentulous Speech

EFFECTS OF ABNORMAL STRUCTURE ON SPEECH SOUND PRODUCTION

Structural Abnormalities

Can causing either:

- Obligatory distortions

OR

- Compensatory errors

Obligatory Distortions

- Articulation placement is NORMAL, but the structural abnormality affects sound production
- Corrected by changing structure only
- Cannot be corrected with therapy

Compensatory Errors

- Articulation placement is altered due to structural abnormality
- Corrected by changing structure first… and then by changing function (articulation placement) through speech therapy

Structural Abnormalities that Affect (or Do Not Affect) Speech

- Dental malocclusion
- Ankyloglossia- actually not a cause
- Velopharyngeal insufficiency/incompetence (VPI)

Dental Malocclusion

Dental Malocclusion

- The tongue rests in the mandible
- Wherever the mandible goes, so goes the tongue
- Biggest concern about malocclusion: It affects the position of the tongue tip relative to that alveolar ridge!

Class II Malocclusion

- If the mandible is in a posterior position relative to the maxilla (Class II malocclusion)— the tongue will be posterior to the alveolar ridge

Class II Malocclusion

- Bilabial competence is compromised
- Tongue tip is under the palate instead of the alveolar ridge

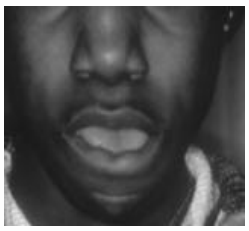
Video 2: Class II Malocclusion

Class III Malocclusion

- If the mandible is in an anterior position relative to the maxilla (Class III malocclusion)— the tongue will be anterior to the alveolar ridge

Class III Malocclusion

- Bottom lip cannot articulate against the top lip or maxillary teeth
- Tongue tip is anterior to the alveolar ridge and maxillary teeth



Video 3: Class III Malocclusion

Video 4: Class III Malocclusion

Anterior Crossbite

- An anterior crossbite is when the maxillary incisors are inside the mandibular incisors
- Can occur with or without a Class III skeletal malocclusion

Video 5: Anterior Crossbite

Video 6: Anterior Crossbite

Ankyloglossia and Speech

Ankyloglossia ("Tongue Tie")

- Ankyloglossia is a congenital condition where the lingual frenulum is either abnormally short or has an anterior attachment near the tongue tip

Ankyloglossia: Functional Characteristics

- Patient cannot touch roof of mouth with tongue tip when the mouth is open

Ankyloglossia: Functional Characteristics

- Patient cannot protrude tongue past the mandibular incisors (or the lower gingiva)

Ankyloglossia and Speech

Common sense approach:

- The sound that requires the most elevation is /l/
- The sounds that requires the most protrusion are /Θ/ and /ð/
- These sounds can be produced with significant tongue tip restriction

Francis D.O., et al. (2015). Treatments for Ankyloglossia and Ankyloglossia With Concomitant Lip-Tie. Comparative Effectiveness Review No. 149. AHRQ, Publication No. 15-EHC011-EF. Rockville, MD: Agency for Healthcare Research and Quality.

Kummer, A. W. (2005, Dec. 27). To clip or not to clip? That's the question. *The ASHA Leader, 10*(17), 6–7, 30.

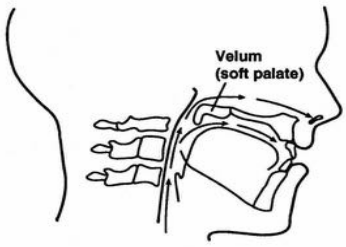
Video 7: Ankyloglossia

Ankyloglossia and Speech

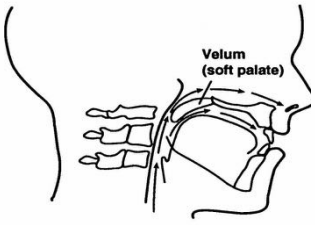
Common sense approach:

- Ankyloglossia is unlikely to affect the production of English sounds
- Ankyloglossia may affect the lingual trill sounds (i.e., the Spanish /r/)

Velopharyngeal Insufficiency (VPI) and Velopharyngeal Incompetence (VPI)



Velopharyngeal Insufficiency



Velopharyngeal Incompetence

Effects of VPI on Resonance

- VPI causes hypernasality, which is a resonance disorder
- Hypernasality affects the quality of vowels and voiced consonants
- It does not affect articulation and therefore, hypernasality cannot be corrected with speech therapy

Effects of VPI on Speech

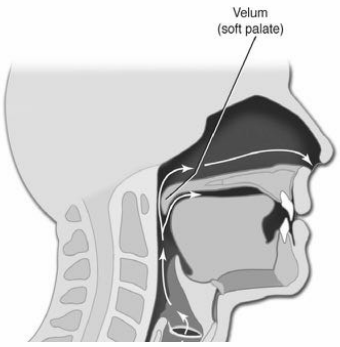
- VPI causes nasal emission on pressure sounds, which can affect production of plosives, fricatives, and affricates
- Due to the lack of oral airflow, the child may develop compensatory articulation substitutions

Compensatory Errors Due to VPI

- Most common compensatory articulation productions for VPI are:
  - Glottal stops substituted for plosives
  - Pharyngeal fricatives substituted for fricatives/affricates

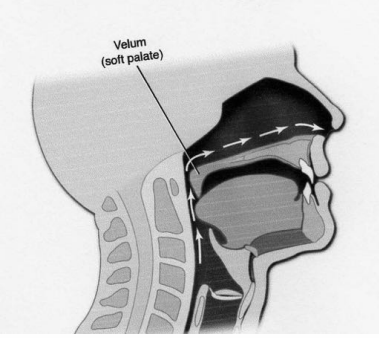
Glottal Stop

- Produced by closing the vocal cords and then opening suddenly
- Can be co-articulated with oral placement
- Often used as place markers for "omissions"



Pharyngeal Fricative

- Air is forced through a narrow opening between the tongue base and/or velum and the pharyngeal wall
- Will result in phoneme-specific nasal emission (PSNE)
- May seem like there is VPI, but it is an articulation disorder instead



Speech Therapy and VPI

- Speech therapy IS appropriate for correction of compensatory articulation errors, preferably AFTER correction of the structure
- Pharyngeal fricative will cause nasal emission, even after VPI surgery
- Work on correction placement… NOT on airflow

Speech Therapy and VPI

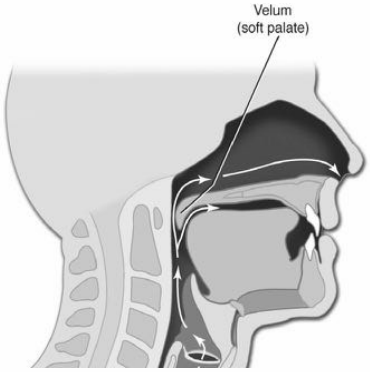
- Speech therapy is NEVER appropriate for obligatory distortions (which occur with normal placement), including:
  - Distortion due to interference of the teeth
  - Hypernasality and/or nasal emission due to VPI but normal placement

ENHANCING SPEECH SOUND AWARENESS

Enhancing Awareness

- Use sensory cues to contrast the difference between the error sound and the correct sound
  - Visual cues
  - Tactile-kinesthetic cues
  - Auditory cues

Enhancing Awareness: Glottal Stops Example



Enhancing Awareness: Glottal Stops

Visual cues:

- Have the child watch your neck during correct and incorrect production
- Have the child watch his own neck in a mirror when:
  - producing syllables in which he does not use a glottal stop (i.e., ma)
  - producing syllables in which he does use a glottal stop (i.e., ba)

Enhancing Awareness: Glottal Stops

Tactile-kinesthetic cues

- Have the child feel your neck during correct and incorrect production
- Have the child feel his own neck in a mirror when:
  - producing syllables in which he does not use a glottal stop (i.e., ma)
  - producing syllables in which he does not use a glottal stop (i.e., ba)

Enhancing Awareness: Glottal Stops

Auditory cues

- Have the child listen to your productions of the correct and incorrect productions.
- Reverse roles: Have the child be the "teacher" and you be the "kid"

Auditory Awareness: Oral & Nasal Listener*

*** Super Duper Publications- 2007**

Auditory Awareness: Oral & Nasal Listener*

SPEECH THERAPY "COOKBOOK"

Therapy for Placement Errors

- Glottal stop
- /l/
- /k/ and /g/)
- /ɚ/ and /r/
- Affricates: /ʧ/ and /ʤ/
- Lateral lisp
- Pharyngeal fricative
- Blends

Kummer, A. W. (2011). Speech therapy for errors secondary to cleft palate and velopharyngeal dysfunction. *Seminars in Speech and Language, 32*(2), pp.191–199.

Kummer, A. W. (2014). Speech therapy. In A.W. Kummer, *Cleft Palate and Craniofacial Anomalies: The Effects on Speech and Resonance*, Clifton Park, NY: Cengage Learning.

Therapy for Glottal Stop

- Produce an isolated voiceless plosive (i.e., /p/)
- Produce the voiceless plosive and then the vowel, preceded by an /h/ (i.e., /p… ha/
- Produce the voiced plosive cognate (i.e., /b/) with a "whisper" and slowly transition to the /h/ and then the vowel (i.e., /b…ha/
- Do the same for the other voiceless/voiced plosives

Therapy /l/

- w/l is easy
- Place hands on the face an tell the child not to move the face during production to eliminate the lip movement

Therapy /l/

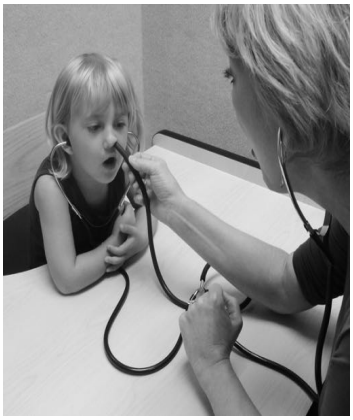
- ŋ/l is hard
- The child can co-articulate the alveolar (tongue tip) and velar placements, so it looks like placement is correct when it's not

Therapy /l/

- Begin with a big yawn to raise the velum up and bring the back of the tongue down
- Make the child aware of the open stretch in the back of the mouth
- Co-articulate the /l/with a big yawn
- Gradually decrease the size of the yawn

Therapy /l/

- For feedback, use a listening tube or the ONL with the tube in the nose
- If sound is heard through the tube, the /ŋ/ (nasal sound) is still there



Video 8:
Yawn Technique for /l/

Therapy for /k/ and /g/

- Have the child produce and hold /ŋ/ to feel placement
- Work on the up and down movement by achieving position and then dropping the tongue

Therapy for /k/ and /g/

If the child can't produce an /ŋ/…

- Put a tongue blade on the middle of the tongue and push down and back

OR

- Firmly press your thumb under the base of the child's chin to push the back of the tongue up

Therapy for /k/ and /g/

- Have child take a breath, place his tongue in an /ŋ/ position, and drop the tongue to produce a /g/
- If necessary, pinch his nose closed and then have him drop the tongue
  - This will turn it into a /g/ with normal oral airflow
- Have the child whisper the /g/ sound to achieve the /k/

Video 9:
Therapy for /k/ and /g/

Therapy for /ɚ/ and /r/

Science Experiment

- Prolong an /ɚ/ and feel where your tongue articulates under your molars on each side
- While prolonging an /ɚ/, move your tongue tip up and down
- **Conclusion:** /ɚ/ is produced in the **back** of the mouth; the tongue tip placement doesn't matter
- Posterior sides of back of tongue articulate under maxillary molars

Therapy for /ɚ/ and /r/

- /ɚ/ is a continuant
- /r/ is a movement sound that begins with /ɚ/
- Slowly produce the syllable /ra/
- Therefore, always start with /ɚ/

Video 10:
Therapy for /ɚ/

Therapy for /ɚ/

- With a tongue blade, stimulate both sides of the back of the tongue and then the upper gum ridge under the molars

Therapy for /ɚ/

- Show the child how the tongue forms the shape of a “boat”
- Ask the child to make a wide smile while “backing up the boat”

Therapy for /ɚ/

- To help elevate the back of the tongue, push up against the base of the chin with your finger
- Make sure it feels loose so you can push

Therapy for /ɚ/

- Assist placement by squeezing the cheeks with your thumb and forefinger to get lip rounding
- Use your middle finger to push up the back of the tongue

Video 11: Therapy for /ɚ/

Video 12: Therapy for /ɚ/

Therapy for /ɚ/

- Once final /ɚ/ is achieved, work on initial /r/ by showing the forward movement of the tongue with your hand
- If the child goes to a /w/, have him hold his hands on his face and tell him not to allow the face to move while going from /ɚ/ to /r/

Therapy for Affricates: /ʧ/ and /ʤ/

- Reminder: Affricates are a combination of a plosive and a fricative:
  - ʧ = t + ʃ
  - ʤ = d + ʒ

Therapy for Affricates: /ʧ/ and /ʤ/

- Make sure the child can produce the individual components of the affricates first:
  - Plosives: t/d
  - Affricates: ʃ/ʒ
- Have the child produce the plosive component with the teeth closed and lips rounded, which will result in the affricate

Lateral Lisp

- A lateral lisp is caused by interference of the anterior airflow during sibilant production
- Interference can be caused by:
  - Abnormal position of the teeth (obligatory distortion)
  - Abnormal placement of the tongue tip or dorsum of the tongue (articulation error)

Science Experiment

- Hold your tongue on your alveolar ridge while you prolong an /s/ sound
- Produce a /t/ sound but don't drop your tongue during the airflow release
- Both of these will cause a lateral lisp

Lateral Lisp

- To determine if the airflow is central or lateral, put a straw in front of the teeth and then to the sides during the production of the /s/

Lateral Lisp

- If normal, air through straw will be heard when it is in front of the central incisors
- If lateral, air through straw will be heard somewhere on the side of the dental arch

Pharyngeal Fricative

- Pharyngeal fricative is a common compensatory production for kids with VPI
- This placement will persist after surgical correction.
- A pharyngeal fricative substitution can also be found in children with NO history of cleft or VPI

Pharyngeal Fricative

- Because the pharyngeal fricative uses airflow in the pharynx, it causes phoneme-specific nasal emission (PSNE)
- It sounds like VPI but it's not.

Therapy for a Lateral or Pharyngeal Fricative

- The technique for correction is exactly the same
- The beginning incorrect placement (whether in the pharynx or the oral cavity) is irrelevant
- The goal of therapy for both is to achieve normal placement and anterior airflow in the oral cavity

Therapy for a Lateral or Pharyngeal Fricative

- Have the child produce a /t/ sound
- Provide auditory and tactile feedback of the anterior airflow:
  - Have the child put his hand in front of his mouth and feel the airstream during production
  - Have the child put a straw in front of his teeth and push the air into the straw during production

Therapy for a Lateral or Pharyngeal Fricative

- Have produce the /t/ with the teeth closed
- Have the child prolong the production until it becomes /tssss/ with air going through the straw
- Transition to the syllable by inserting an /h/ between the /s/ and vowel
- Use this technique for /ʃ/ if needed
- Note: /h/ is a good transition sound between corrected sounds and the vowel

Video 13: Therapy for a Lateral or Pharyngeal Fricative

Video 14: Therapy for a Lateral or Pharyngeal Fricative

- Insertion of /h/ for transition from consonant to the vowel

Video 15: Therapy for a Lateral or Pharyngeal Fricative

Video 16: Therapy for a Lateral or Pharyngeal Fricative

- Feedback using a straw

Video 17: Therapy for a Lateral or Pharyngeal Fricative

- Feedback using a straw or a listening tube

Video 18: Therapy for a Lateral or Pharyngeal Fricative

- Correcting placement eliminates the phoneme-specific nasal emission (PSNE)

Blends

- It's important to divide the consonants into individual components and then blend them together slowly

/l/ Blends

- Plosives + /l/: Add the /ah/ vowel as a transition
  - Play = pa… lay
  - Blue = ba… lu
  - Clay = ca… lay
  - Clue = ca… lue

/l/ Blends

- Fricative + /l/: Prolong the fricative and then produce the /l/ with the rest of the word
  - flew = fff… lu
  - slay = sss… lay

/s/ Blends

- When /s/ is followed by the letters “p,” “t,” or “k,” these sounds are actually voiced.
- Therefore, /s/ blends with a plosive should be divided as follows:
  - spell = s… bell
  - stop = s… dop
  - skate = s… gate

/r/ Blends

- Have the child produce the sound before the “r” in a syllable with the vocalic /ɚ/
  - Tree = ter… ee
  - Fry = fer… y

General Principles of Speech Therapy

Priorities

Considerations in determining phoneme priorities:

- Stimulability
- Intelligibility
- Continuants
- Placement of production
- Word position

Stimulability

- Determine the sound(s) with good stimulability
- Start out with the easiest sounds for quick success

Intelligibility

- Choose the sound(s) which will have the greatest impact on intelligibility (i.e., /s/ before /f/)

Continuants

- When working on placement, always start with a continuant (which you can hold), if possible
- Examples include:
  - Bilabials: /m/
  - Lingual-alveolars: /n/
  - Velars: /ŋ/

Place of Production

- Start with anterior sounds before posterior sounds
- Examples: bilabials and lingual-alveolars before velars

Word Position

- Start with CV productions, and then the initial position before the medial or final position
- The exception is "r"
  - Final /ɚ/ should be corrected before the initial or medial /r/)

Oral-Motor Exercises

- "Exercises" do not work!!!
- There is NO evidence that exercises help with speech sound disorders
- Strengthening muscles doesn't even make sense

Lof, G. L. (2008). Controversies surrounding nonspeech oral motor exercises for childhood speech disorders. *Seminars in Speech and Language, 29*(4), 253–255.

Lof, G. L. (2011). Science-based practice and the speech-language pathologist. *International Journal of Speech-Language Pathology*, *13*(3), 189–196.

Lof, G. L., & Watson, M. M. (2008). A nationwide survey of nonspeech oral motor exercise use: Implications for evidence-based practice. *Language Speech Hearing Services Schools, 39*(3), 392–407.

MOTOR LEARNING & MOTOR MEMORY FOR CARRYOVER

Motor Learning & Motor Memory

- Speech requires motor movement that is *fast*, *complex*, *automatic* and *effortless*
- This is accomplished by ***motor learning*** and ***motor memory***

Schmidt, R. A., & Lee, T. D. (2011). *Motor control and learning: A behavioral emphasis,* (5th ed.). Champaign, IL: Human Kinetics.

Motor Learning

Motor learning: Acquisition of new motor skills in order to execute complex motor movements and sequences

Motor learning is dependent on:

- Instructions
- Trial and error
- Feedback

Motor Learning

- Results in the development, change or refinement of a motor program (i.e., change in production of a speech sound)
- This is what occurs in speech therapy when the SLP teaches placement and provides feedback

Motor Memory

- **Motor memory:** Develops automaticity of the newly learned motor movement
- Is dependent on constant repetition (e.g., **PRACTICE!**)

Practice

- Results in brain reorganization due to neural plasticity
- Allows movement to be done without conscious thought
- Results in "carry-over" into connected speech

Practice

- Practice is necessary for all types of motor learning
- Examples:
  - Ballroom dancing
  - Sports
  - Playing a musical instrument
  - Speech

Ruscello, D. & Vallino, L. The Application of Motor Learning Concepts to the Treatment of Children with Compensatory Speech Sound Errors, ***SIG 5 Perspectives on Speech Science and Orofacial Disorders***, October 2014, Vol. 24, 39-47. doi:10.1044/ssod24.2.39

Practice Dose

- ***Dose:*** Number of correct responses in a practice session (in therapy or at home)
- Higher dose per practice session is directly related to the rate of progress

Baker, E. Optimal intervention intensity in speech-language pathology: discoveries, challenges, and unchartered territories, *International Journal of Speech Language Pathology*, 14 (5), 478-85.

Practice in Therapy

- Use tokens and work quickly
- DRILL to increase the dose

Practice in Therapy

Procedure

- Hold the token by the side of your mouth
  - This brings the child's attention to your face
- Have the child imitate a sound or word
- Put the token in the container quickly and say "Good talking" or something similar
- Work fast to get as many tokens as possible

Practice Distribution

- Distributed practice (practice throughout the week) facilitates both short-term performance and long-term learning
- Home practice is ESSENTIAL!

Practice at Home

- Speech therapy is like taking piano lessons—if you don't practice at home, you don't learn to play the piano!

Practice at Home

- Need to train the parents/family members to work with the patient at home

Practice at Home

- Frequent short practice sessions throughout the day and week are better than a few long sessions
- A 30 second practice session counts

Practice at Home

- Practice throughout the day (i.e., while doing daily chores, just before dinner, during a bath)
- Have practice material in the car and on the iPad.
- Have the child sing with favorite songs using the target sound and a vowel.
- Incorporate practice into homework. Have the child read out loud.

Practice at Home

Child's Name: _____Practice Log Start Date: _____

Practice between sessions will greatly increase your child's success in speech therapy. It is better to practice several times each a day, than to practice a long time once a day. A practice session can be as short as 30 seconds.

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total
# of times								
	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total
# of times								
	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total
# of times								
	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total
# of times								

SUMMARY

Summary: What to Do

- Increase sensory awareness of correct versus incorrect sound production
- Use appropriate placement techniques
- Incorporate daily practice and drill work for motor memory and carry-over

Summary: What NOT to do

- Do not work on obligatory distortions due to abnormal structure
- Do not use oral-motor "exercises" or blowing and sucking

Goal of Treatment

- Normal speech production in connected speech

Handouts

www.cincinnatichildrens.org/speech

For Healthcare Professionals

Lecture Notes

Expand your Expertise with "Speech Tools"

"Speech Tools" will be delivered to you monthly from the speech-language pathology experts at Cincinnati Children's.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