A Deep-Dive into "S"

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The Anatomy of an /s/ Production

The /s/ production seems so simple.

But when it goes wrong, it's a multi-faceted muddle. There's

- The omitted /s/.
- The /t/ for /s/ substitution.
- The /ʃ/ ("sh") for /s/ substitution.
- The interdental (tongue against front teeth) /s/.
- The frontal /s/ (the tongue protrudes anteriorly), and
- The lateral /s/ (the tongue elevates and blocks the centralized airflow).

Sometimes the tongue is too narrow, or too fat, or foo flat, or it's flaccid. And, about that airflow--instead of flowing centrally, it streams laterally and scoots either around one side of the tongue or escape around both. Then there's my "favorite," the hot-dog tongue that angles off to one side taking the jaw with it. And I haven't even mentioned the infamous nasal snort "s"—the air flows through the nose just on the /s/ sound. That one deserves an article unto itself.

We label the /s/ sound with familiar terms: It's a lingua-alveolar sound, it's a fricative, it's a sibilant, it's voiceless, it has centralized, continuous airflow. But, how do these labels help me in therapy? They're good descriptors, but, honestly, not real valuable to my therapy-kids and me.

Let's pick-apart the /s/ production and come up with information and ideas that we can apply in therapy.

Let's begin with a deep dive into the /s/ production itself and analyze the production elements imbedded within. This will give us clues as to what my speech kids must be capable of to generate the sound.

After you read this paragraph, close your eyes and do the following:

- First, determine where your lips, tongue, and jaw rest when you are not using them. Chances are, your lips are closed, your tongue is up, and your jaw is gently parted.
- Now, move into your /s/ placement and say a sustained /s/. Notice your tongue's stabilization and mobilization. What parts are touching and holding, and what parts are moving?
- And finally, move from your resting posture to /s/ and back again a couple times to get an accurate read as to what's moving and what isn't.

While not everyone's oral resting postures or /s/ productions are the same, there are some standard commonalities. We'll focus on those for right now. (The "differences" typically occur when there are oral structural and/or oral soft tissue issues, or habits, e.g., narrow dental arch, large tonsils, thumb sucking, etc.)

Bottom line: Speech is movement. Moving from the resting positions (of the lips, tongue and jaw) to the placement of the sound, and back again, simulates a small piece of oral movement during connected speaking, as well as the speech sound placement.

I've done this oral resting-stabilization-mobilization task with most speech sounds, and with many of my kid's productions. It helps me figure out what's moving and what's not moving (for the good sounds and for the ones they're doing).

Let's detail the specific oral stabilization and mobilization characteristics for /s/:

- When you moved from your resting posture into your /s/, did you notice that your jaw moved? Yes, who new, there is jaw involvement in an /s/ production. The jaw lowers and moves ever-so-slightly forward and up. Its purpose is to enable the front top and bottom teeth to come in close proximity. This is important. When we tell kids to put their teeth together, only the front teeth approximate—THE BACK TEETH DO NOT CLOSE. The back teeth remain slightly parted.

- Next, what about the sides of your tongue? Did they anchor to the insides of your top, back teeth (either full side contact, or just on the cusps)? This is called bracing or "lateral margin stabilization." (Gick, 2017). This external lingual stabilization keeps the tongue in place, gives support to the part of the tongue that moves, and channels the air to flow centrally. This is critically important.

- Now, this one is tough to discern. Do another /s/ and notice your mid-tongue. Do you feel a slight dipping in your mid-tongue? You should, that mid-tongue-contraction enables the front-tongue to elevate. This is also the tongue's internal stabilization. With my kids, I refer to this as the "tongue bowl." (Kier, 1985)

- When the mid-tongue contracts, the front-tongue lifts. Did you notice that your front-tongue moved vertically (lowered slightly) from its perch on the alveolar ridge? It moved into place as the air flowed through the small space between the surface of the tongue and the ridge. (Please note: If you do a tongue-tip down /s/, your front-tongue did something a little different. A tongue-tip down /s/ is also considered to be normal; we'll cover that below.)

- And last, but certainly not least, the centralized air flows through the tongue-alveolar ridge constricted space, then continues to flow through the approximated top and bottom front teeth. This teeth position is called "anterior dental approximation." The friction of the air moving through the front teeth generates the "hiss" in the hissy /s/ sound. It's safe to say, if the person has no front teeth, no hiss will occur.

Therefore, in therapy, facilitate tongue-sides to side teeth, a tongue bowl (mid-tongue contraction), front-tongue vertical movement, plus slight jaw rotation to approximate the front teeth. Add airflow, and you have a sweet-sounding /s/!

Now *these* are components I can address in therapy.

- External tongue stabilization (lingual lateral margin stabilization/bracing).
- Internal tongue stabilization
- Front-tongue vertical movement and sustaining position
- Anterior dental approximation (generated by slight jaw movement + centralized air flow)

The Tongue-Tip Down /s/

Customarily, as we have discussed, the front-tongue interacts with the alveolar ridge, and the sides anchor on the insides of the top, back teeth. This production style is typically referred to as a tongue-tip up /s/ (noting that the tongue is not really UP, it's just not DOWN). There are those, however, who produce a tongue-tip down /s/.

Instead of the front-tongue elevating slightly and interacting with the alveolar ridge, the whole tongue moves slightly forward and the front-tongue lowers and interacts with the back of the front, bottom teeth. the tongue blade creates the fricative interactive space in concert with the alveolar ridge and (in some cases) the back of the top incisors. 'Normal" speakers frequently use this tongue placement for /s/.

Stabilization for this tongue-tip down style occurs more on the insides of the bicuspids than the molars. The typical tongue-tip down /s/ user usually has a corresponding, similarly placed tongue-tip down resting posture. It is not unusual for these individuals to have (or had at one time) large tonsils that displaced the tongue anteriorly.

Both the tongue-tip up /s/ and the tongue-tip down production styles are considered to be normal and, elicit a similar, and very natural sounding /s/.

External Lingual Stabilization

As a therapist, keep this in mind:

To generate refined, small movements (of which speech is small),
you must stabilize near the moving part.
Lips, tongue, and jaw movements must be small
to accommodate co-articulated speech.

Appropriate stabilization enables appropriate mobilization.

Refined front-tongue vertical movements and posturing, as in the /s/, necessitate support. Without it, the front-tongue is unable to differentiate the small movement adjustments to distinguish between a /t/ and /d/, /s/ and /z/, /ʃ/ (sh) and /ʒ/ (zh), and /tʃ/ (ch), and /dʒ/ (j).

No matter if working with a child with one artic-error or multiple errors, an essential goal is to generate refined lingual movements. To do so, the child must learn to first, *place* the tongue appropriately for external stabilization on the side-teeth, then *use* the appropriate lingual stabilization during speaking.

Following are therapy-techniques to generate external lingual stabilization. First, the appropriate placement—and sensory awareness—of side-tongue, side-teeth contact. The tongue-sides (bilaterally) contact the side-teeth and the perimeter (sides) of the hard palate.

Tools: Use a thin speech-therapy tool, such as a small, infant-sized tongue depressor; do not use craft sticks as they have splinters. (I buy mine "unwrapped" at either harmonycr.com or amazon.com). If you want to use an ARK Probe, or NUK Massage Brush, or Z-Vibe, they are

excellent alternatives. Flavored spray to spray on the therapy tool is a plus—kids love it (amazon.com: Toot Tarts Sugar Free Candy Spray).

Number of task-repetitions and sets: All tasks in this article are to be done according to the child's needs and capabilities; they are capability-based. The number of repetitions and sets are based on the fatigue-level of the child. When you see deterioration of the task, STOP; that's indicates your number of repetitions. Pause a second or two, then do another set of repetitions. Do two or three sets. Next therapy session, increase the number of repetitions based on the child's improved capability.

Do the following two activities with your kids to generate awareness of lateral margin, side-tongue to side-teeth placement. We want them to become tactually aware of the feel and the position.

1) Side-Stroke Match: With the therapy tool, stroke each side of the tongue from back to front, then stroke the insides of the top side teeth and the perimeter of the hard palate. Lift the tongue up and match and touch the tongue-sides and the side-teeth together.

2) Bite-Slide: Gently bite on the sides of your tongue; then as you slowly bite your teeth together, slide the sides of your tongue UP, against the top side teeth. The tongue ends up against the roof of your mouth.

In addition, work concurrently toward establishing the child's oral resting posture. The resting positions of the lips, tongue, and jaw influences the implementation of lateral margin stabilization during the /s/ production, and the consistency of the placement during conversation.

A critical positioning piece: "Wherever the lips, tongue, and jaw rest, is where they speak." Where the articulators rest establishes a familiar operating zone for the tongue to interact with the surrounding mouth parts.

The ideal resting positions: The lips are gently closed, the front-tongue surface is nicely nestled on the alveolar ridge, and the tongue-sides contact the side teeth (same place they stabilize).

The timeline: Start with a minimal amount of time (10 seconds), and over several weeks, increase the resting time until comfortable and consistent. The oral resting posture impacts speech-sound placement—especially the /s/--and carryover.

(For additional information see, *The Key to Carryover: Change Oral Postures to Fortify Speech Production*, by Boshart)

To personally sense your *use* of lateral margin stabilization, close your eyes, focus on the sides of your tongue, and count out loud from 1 to 10. Do you feel a slight lateralized pressure of your tongue-sides against your side teeth when you say "six" and "seven"? This is your tongue "bracing" (i.e., holding on; supporting the front-tongue) during the /s/ sound production.

Consequently, until you say the sound, the tongue-sides just *touch* the side teeth. Use occurs when all of the /s/ components occur (the ones you discovered at the beginning of this article): lateral margin stabilization, mid-tongue contraction, front-tongue vertical movement, and airflow.

Continuing our deep-dive analysis of the components, the /s/ (as you know) also requires *internal* lingual stabilization.

Internal Lingual Stabilization

To personally feel your internal tongue-tension do the following: From your oral resting posture, move into your /s/ placement, say /s/, but this time, notice the movements and contractions of your front-tongue and mid-tongue.

Did your front-tongue lowered slightly (on the vertical plane) from the alveolar ridge and sustain itself in space as the centralized air moved?

Let's think about this: To successfully achieve that refined, front-tongue vertical movement, then sustain itself in space, the front-tongue must have help. And it does. The front-tongue has stabilizing support both externally *and internally*. Externally, the sides brace on the top, side, teeth. Internally, *the mid-tongue contracts*. When the mid-tongue contracts, it not only offers support, it generate front-tongue elevation.

Mid-tongue contraction is a critical piece in the production of /s/ as well as all front-tongue speech sounds (/t/, /d/, /n/, /l/, /s/, /z/, /ʃ/ (sh), /ʒ/ (zh), /ʧ/ (ch), /ʤ/ (j).

This was first pointed out in physiology literature. **Lier** states that the tongue is a muscular hydrostat, along with an elephant's trunk and octopus arms, etc. The human tongue, an elephant's trunk and octopus arms all move in the same manner. To move and elevate the front-tongue you MUST contract the mid-tongue; it's impossible to move the front-tongue without tightening the mid-tongue.

The term I use with my kids to represent mid-tongue contraction is "tongue bowl." For an /l/, there is definitely a tongue *bowl*. For an /s/ production, it's not so much a bowl as it is a *saucer*; the concave lingual shape is smaller.

Therefore, when there is greater mid-tongue contraction, the front-tongue curls. When the mid-tongue contraction is less, the front tongue lift is more refined. The production of /l/ and a retroflex /r/ requires the most mid-tongue contraction. The /t/, less. The /s/ requires some mid-tongue tension, but not as much as a /ʃ/ "sh."

In addition, mid-tongue contraction variation is dependent of "good" lingual muscle tone. There is discussion and frankly, some confusion, about lingual tonicity. Low lingual tonicity impacts the ability of the tongue to contract appropriately (to generate mid-tongue contraction), and therefore, successfully maneuver front-tongue vertical movement. Therefore, as a means to compensate, the tongue moves horizontally (for frontal and inter-dental contacts) rather than vertically.

Also, if a person has maintained a lowered (or lowered and forward) tongue resting position for years—for whatever reason—chances are that lingual tone will be impacted. This is not a given for everyone, but certainly something to consider when working with your cases.

Following are two tasks to generate mid-tongue contraction. If there is adequate tone, the following tasks will localize mid-tongue contraction. Keep in mind, once the child is able to do a tongue bowl, practice it, at least for a week.

1) Tongue Tapping: To make the mid-portion of the tongue contract into a "bowl", tap the mid- tongue with the end of a small, infant-sized tongue depressor. Tap repeatedly in a firm press-release motion. Keep the tongue inside behind the bottom teeth and make the mid-tongue scoop. When the mid-tongue tightens the front (and sometimes the sides) lift. Do at least 3 times in a row (one set); stop for a couple seconds to rest, then do two more sets (resting briefly in between each set).

   The child must learn (do) to isolate the mid part of their tongue and do so intentionally with a basic level of control and repetition.

2) Tongue Bowl Variations (big, medium, small): Using a spray bottle filled part-way with water, spray a large amount water on the top mid-tongue. The tongue contracts into a larger tongue bowl to hold the water; hold then swallow. Spray little less water; ask the child to make their tongue-bowl smaller to hold the lesser amount of water. Finally, spray a very small amount of water onto their mid-tongue, and ask the child to create a small tongue-bowl to hold the water. Emphasize the feel of the levels of tension. Practice this for at least a week to generate capability and familiarity.

Front-Tongue Mobilization

As we just learned, front-tongue elevation (and all its vertical variations) is contingent on mid-tongue contraction and side-tongue bracing. The following tasks will help the child to feel and replicate the simultaneous result of front-tongue movement and mid-tongue contraction.

1) Front-Tongue Curl: Ask the child to open his/her mouth and allow the tongue to sit lowered, behind their bottom teeth. Place a small straw (coffee stirrer) crosswise on the blade of the tongue (looks like the child has whiskers). Ask them to bite down on the ends of the straw and curl their tongue-tip up and around the straw. Focus and feel the mid-tongue tighten and the front-tongue lift and curl simultaneously.

   This is excellent for curled /l/ productions and retroflex /r/s, but we must refine the front-tongue curl into a front-tongue "lift" for /s/ and other front-tongue speech sounds.

2) Front-Tongue Squeeze-Up: The child opens his/her mouth and places a **Toothette** on the front-tongue (on the tip and blade). Bite down carefully on the stick; do not let their jaw, or tongue, move forward. Remain biting throughout the activity. Now while biting, lift the front-tongue up and squeeze the sponge. Lift and lower the front-tongue, using mid-tongue contraction. Train the tongue to just move UP–not forward.

   To give the child a purpose and motivation to squeeze up, use flavored spray on the sponge of the Toothette. Yummy flavoring emerges when they squeeze the sponge.

   Practice each one for at least a week or two to build awareness, control, and capability to apply to speech sound production.

Combining the /s/ Components

Let's review the stabilization and mobilization of the almost simultaneous /s/ components as they move into position from the desirable oral resting posture:

- The jaw lower slightly and moves the front top and bottom teeth into close proximity,
- The tongue-sides brace against the top, side teeth,
- The mid-tongue contracts, and enables
- The front-tongue to lower and sustain itself in space as
- Air flows centrally between the narrowed space created by the front-tongue and alveolar ridge, and
- The air continues to flow through the approximated front teeth to create the hissy, narrow-sounding /s/.

The following tasks incrementally progresses the child into utilization of the /s/ production components. Again, practice them, and encourage the child to close his/her eyes and focus and feel the maneuvers.

1) Small Tongue-Tip Lifts WITHOUT Sound: If necessary to keep the jaw still, stabilized and to just emphasize front-tongue vertical movement, bite on a small tongue depressor, or small straw. Anchor/brace the tongue-sides against the top side teeth. Now slightly tighten the mid-tongue to generate small, up-down front-tongue movement. Do several times, over three sets.

2) Small Tongue-Tip Lifts WITH Sound: Basically, do the tasks in #1 (anchor tongue-sides, contract the mid-tongue while simultaneously moving the front-tongue up and down, ever-so-slightly), but this time, add plosiveness; make very tiny /t/s. We're adding another layer, i.e., air flow. Make sure that only the front-tongue moves vertically; no flat tongue horizontal movements.

For a complete /s/ production, add continuous airflow and anterior dental approximation to the stabilization-mobilization procedures.

3) Small Tongue-Tip Lifts with CONTINUOUS AIRFLOW: Keep the sides of your tongue on the top side teeth, now lower the front-tongue a little bit and force a continuous flow of air through the space, and out the front.

4) Small Tongue-Tip Lifts with CONTINUOUS AIRFLOW and ANTERIOR DENTAL APPROXIMATION: Keep the sides of your tongue on the top side teeth, lower the front-tongue and force a continuous flow of air through the space, and gently move your top and bottom front teeth in close proximity (not closed), and keep the air flowing out between your front teeth.

During the /s/ production:

- Call attention to the components. Have him/her close his/her eyes and focus and feel the stabilization, mobilization, contraction, and air flow components.
- The side-tongue/side-teeth position and anchoring is the core position. Each time they say /s/, have them double check their tongue-teeth position.

- Use the tongue on top resting position to initially get the tongue in its placement up within the dental arch (not smashed up to the top, just up within the dentition).
- Make note that the tongue postures and stays still while the air moves and flows through.
- The friction of the air as it flows through the approximated front teeth is what generates the “hiss” in the hissy /s/ sound. It’s safe to say, no front teeth, no hiss.
- Take your time and take it one step at a time. Feel free to generate oral capability over time, using the /s/ components as your guide.

Practice the new /s/ with its new components for a few weeks. Make sure they have established familiarity and are able to easily replicate it at this basic level before you move into CV and VC and words.

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