



A Makeover for an Old Friend: Introducing an Evidence-based Familiar Sounds Audiogram

EHDI Conference 2025

Andrea Dunn, AuD, PhD, CCC-A



Disclosures

Andrea Dunn

Vice President of Programs, Oberkotter Foundation

No honorarium is being accepted for this presentation

Agenda

- Understanding the audiogram
- The “speech banana”?
- Purpose of familiar sounds?
- Quick Poll
- Common Issues and Flaws
- Revamped FSA revealed
- Q & A



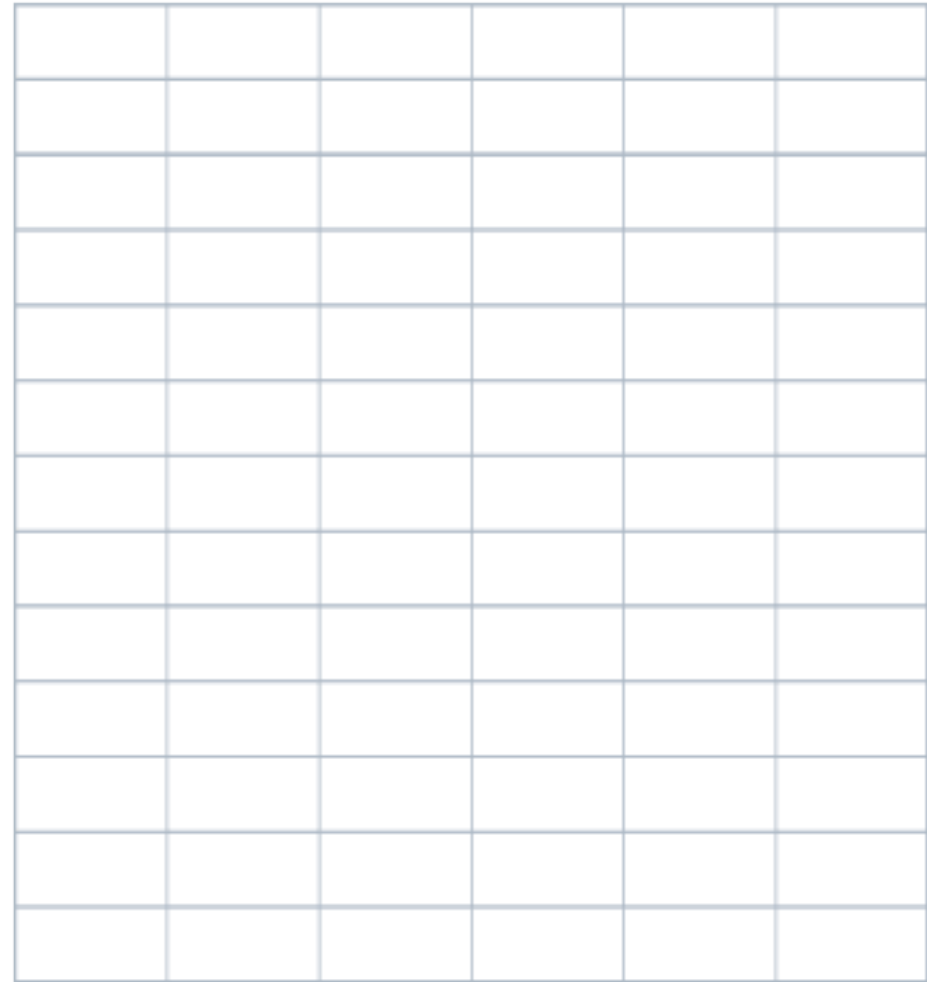
Oberkötter
Foundation



HEARING FIRST
Powering Potential












What is the audiogram?

- Graph or map of hearing
- Shows "thresholds" or the lowest level at which someone can detect different sounds
- Loudness (up and down)
- Pitch (side-to-side; low to high)



Audiogram Symbols 101

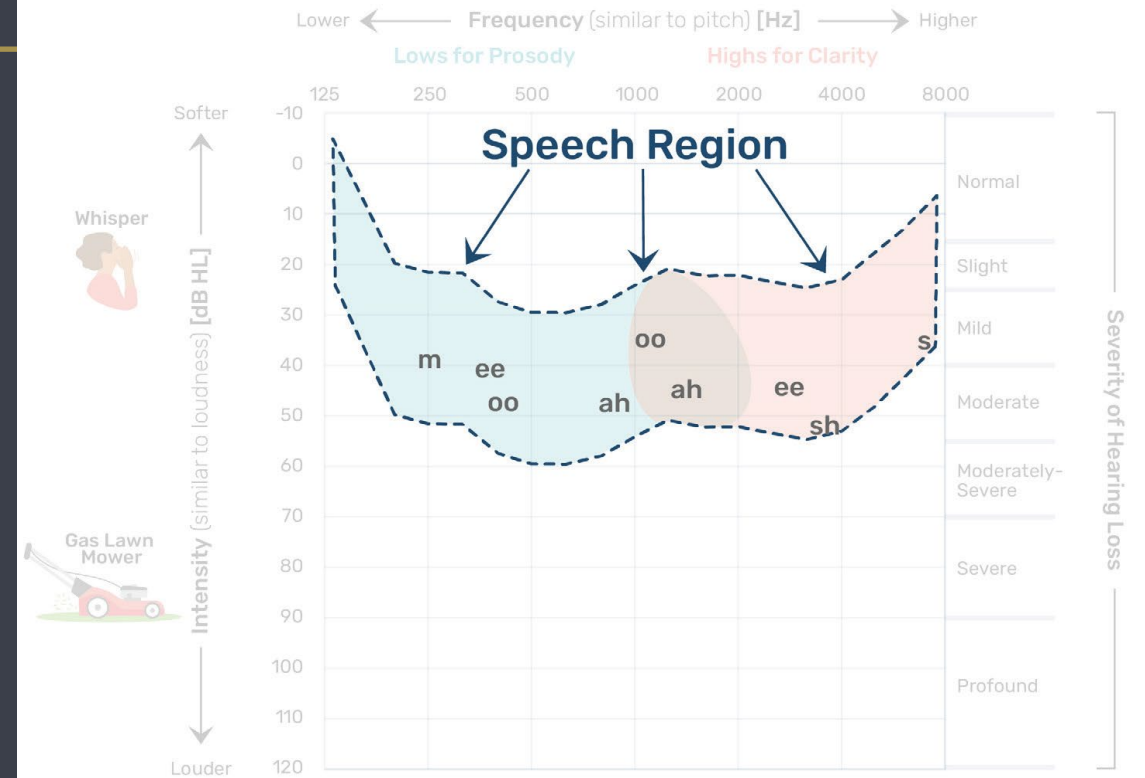
- Thresholds Air Conduction Rt, Lt
- Bone Conduction Rt, Lt
- Soundfield
- Other possible symbols:
 - Masking
 - No Response (NR)

		
	The softest sound your child can hear WITHOUT hearing technology using earphones	
	The softest sound your child can hear with bone conduction testing	
	An arrow pointing down, on any symbol, indicates no response at that frequency (pitch) and intensity (loudness)	
	The softest sound your child can hear with sound-field testing (both ears together)	
	The softest sound your child can hear WITH their cochlear implant(s)	

What is the speech region (banana)?

The “Speech Banana”

- Reflects the broad area or region on the graph where many speech sounds (i.e., the sounds associated with letters in words) fall
- The Ling sounds are a set 6 phonemes (/m/, /oo/, /ah/, /ee/, /sh/, /s/) falling within different parts (i.e., low, medium, high) of the speech region
 - They contain 1 or 2 dominant frequencies





Lower ← Frequency (similar to pitch) [Hz] → Higher

Lows for Prosody

Highs for Clarity

125 250 500 1000 2000 4000 8000

Softer

Whisper

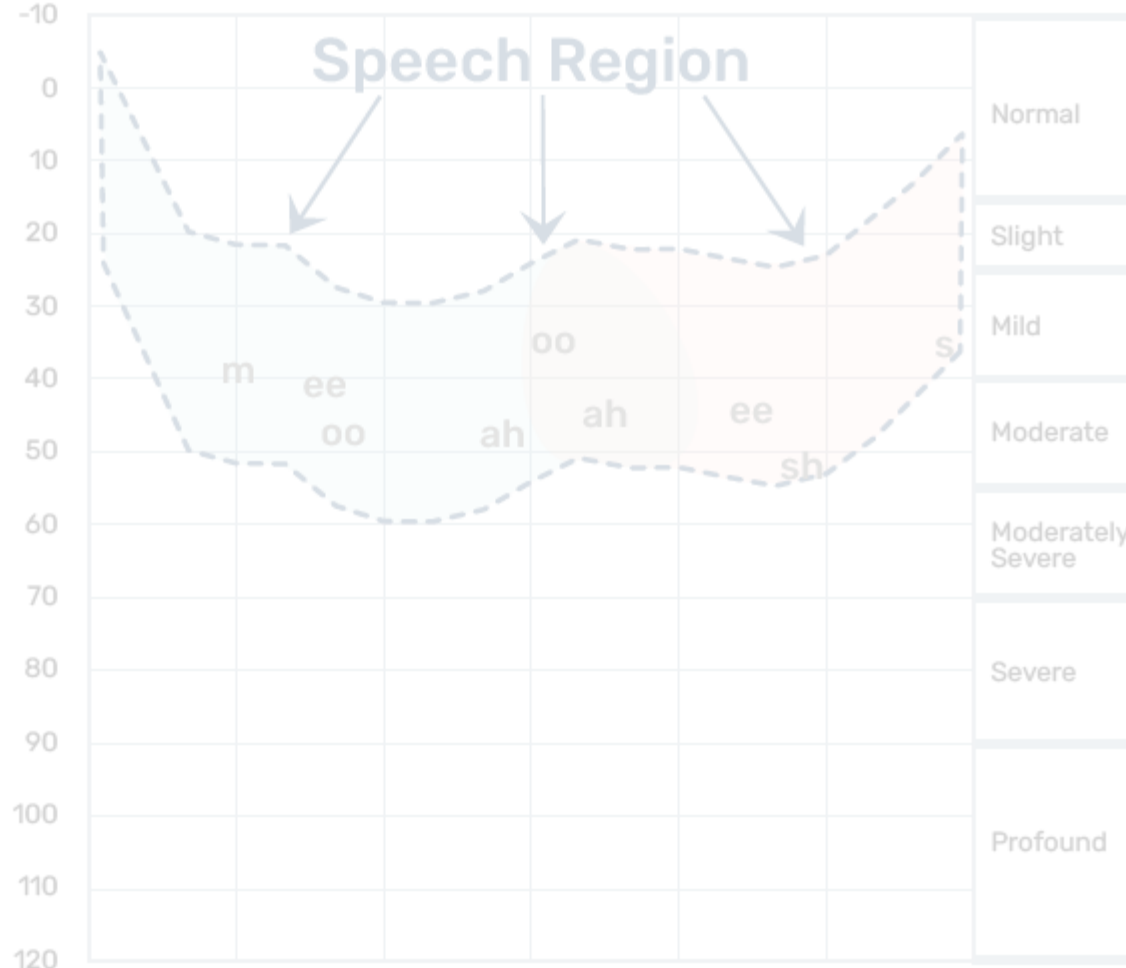


Intensity (similar to loudness) [dB HL]

Louder



Gas Lawn Mower



Familiar Sounds

- Familiar Sounds (i.e., "whisper" versus "gas lawn mower") can be used as visual anchors to show what may or may not be heard based on a person's thresholds
- Similarly, the Ling 6 speech sounds help convey what can or can't be detected based on a person's configuration (i.e., shape) and degree (i.e., level) of hearing differences

How is this used?

- Translate the audiogram into more meaningful real-world understanding
- Bridge gap between “test results” and everyday experiences
- Provide insight into access to key speech sounds for considerations like device recommendations

Let's Take a Quick Poll!

How many FSAs do you think are currently available?

- a) 5 – 10
- b) 11 – 30
- c) 31 – 45
- d) ≥ 46

Common problems with available FSAs

Common Sounds Audiograms: Quantitative Analyses and Recommendations

Cory L. Hillis, Au.D.,¹ Rosalie M. Uchanski, Ph.D.,^{1,2} and Lisa S. Davidson, Ph.D.^{1,2,3}

ABSTRACT

A counseling tool routinely used by pediatric audiologists and early intervention specialists is the often-named “common sounds audiogram” (CSA). Typically, a child’s hearing detection thresholds are plotted on the CSA to indicate that child’s audibility of speech and environmental sounds. Importantly, the CSA may be the first item that parents see when their child’s hearing loss is explained. Thus, the accuracy of the CSA and its associated counseling information are integral to the parents’ understanding of what their child can hear and to the parents’ role in the child’s future hearing care and interventions. Currently available CSAs were collected from professional societies, early intervention providers, device manufacturers, etc., and analyzed ($n = 36$). Analysis included quantification of sound elements, presence of counseling information, attribution of acoustic measurements, and errors. The analyses show that currently-available CSAs are wildly inconsistent as a group, not scientifically justified, and omit important information for counseling and interpretation. Variations found among currently available CSAs can lead to very different parental interpretations of the impact of a child’s hearing loss on his/her access to sounds, especially spoken language. Such variations, presumably, could also lead to different recommendations regarding intervention and hearing devices. Recommendations are outlined for the development of a new, standard CSA.

KEYWORDS: counseling, hearing loss, pediatric, familiar sounds audiogram, speech banana

¹Program in Audiology and Communication Sciences, Washington University School of Medicine, St. Louis, Missouri; ²Department of Otolaryngology, Washington University School of Medicine, St. Louis, Missouri; ³Central Institute for the Deaf, St. Louis, Missouri. Address for correspondence: Lisa S. Davidson, Ph.D., Department of Otolaryngology, Washington University School of Medicine, 4523 Clayton Avenue, Campus Box

8115, St. Louis, MO 63110 (e-mail: davidsonls@wustl.edu).

Tribute to Patricia Stelnachowicz, Guest Editor, Ryan W. McCreery, Ph.D. Semin Hear 2023;44:S49–S63. © 2023, Thieme. All rights reserved. Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA DOI: <https://doi.org/10.1055/s-0043-1764128> ISSN 0734-0451

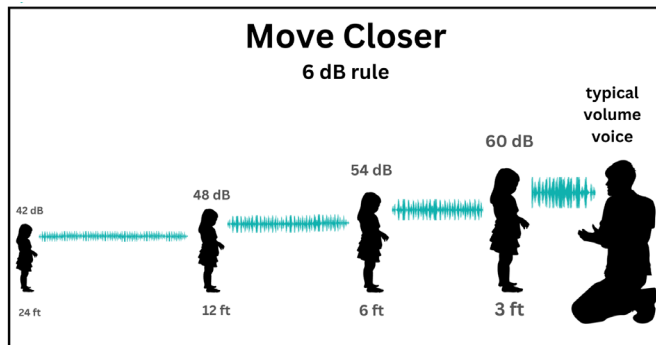
- Searched “Familiar Sounds Audiograms” online and identified **52** different versions; analyzed 36
- Substantial variability in speech and environmental sound placement
 - Differed in frequency and intensity
 - Lacked citations showing basis of measurements
 - Missing critical information or had errors
- What are the implications?
 - These differences change our understanding of what can/ cannot be heard and may or may not align with our everyday experiences.

(Hillis et al., 2023)

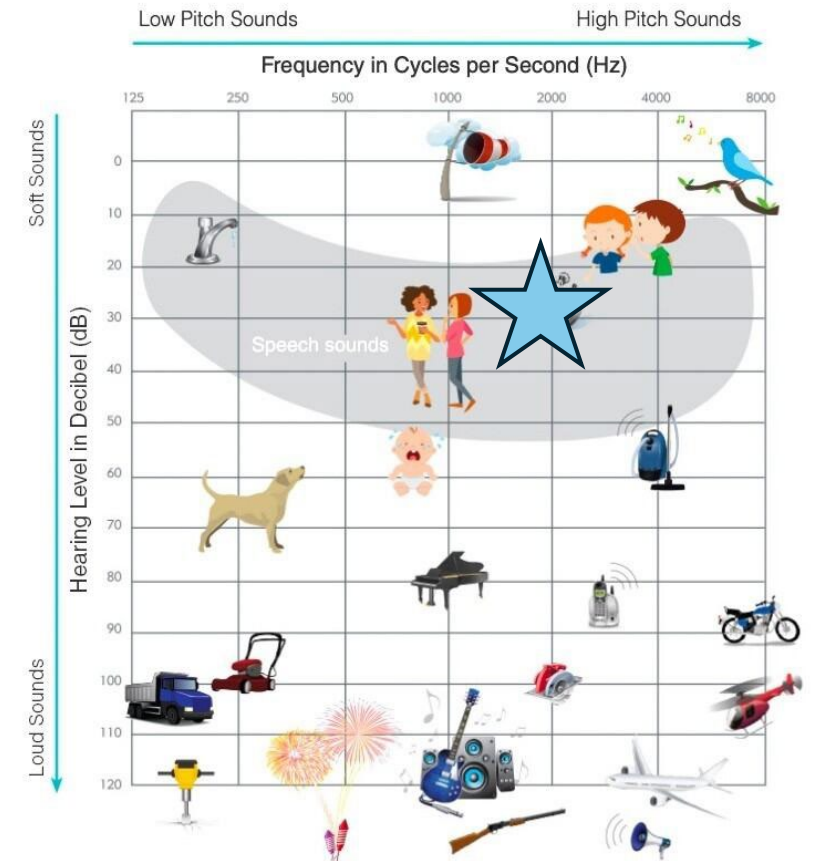
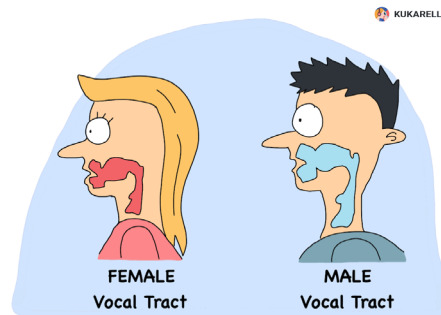
Inconsistencies and absent information (Hillis et al., 2023)

- Size range: 13-32% variation of speech area
- Vertical Position: 25 dB difference across FSAs
- Lacking clarifying information (e.g., distance from source, talker identity)
 - Who's correct?

Talker Distance (Level)



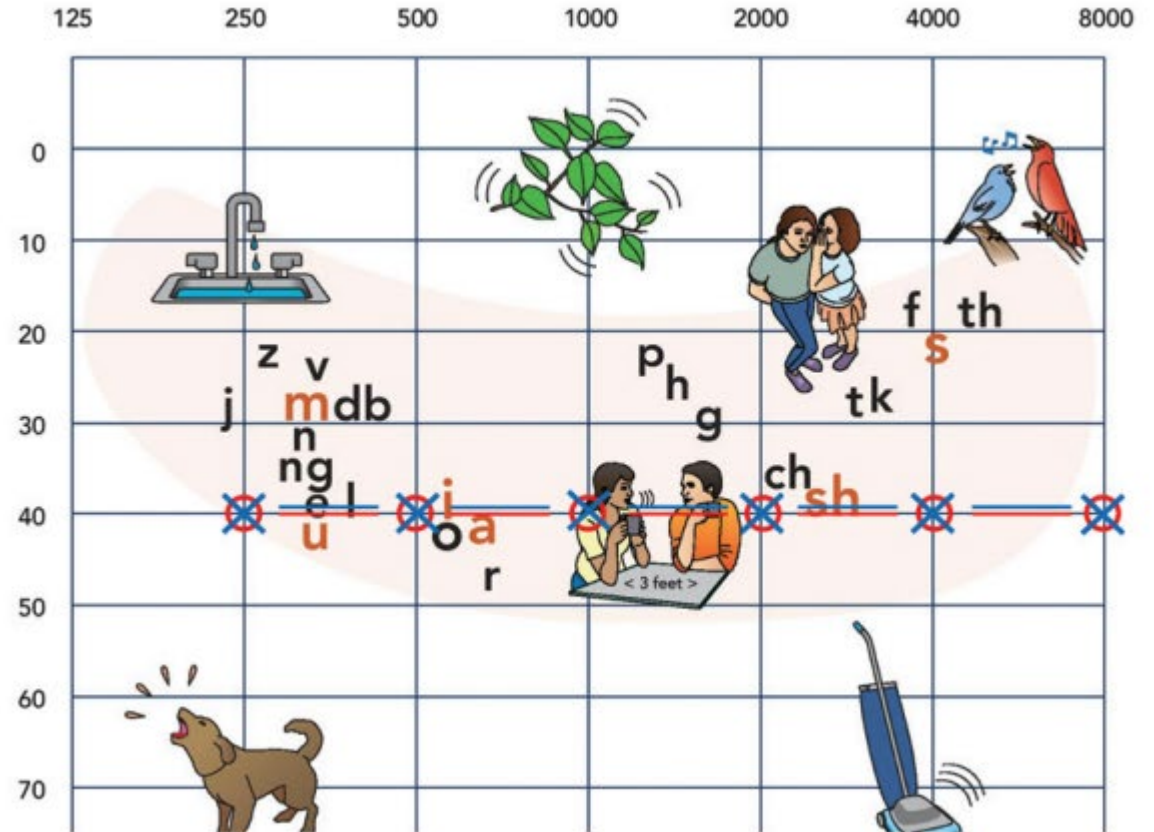
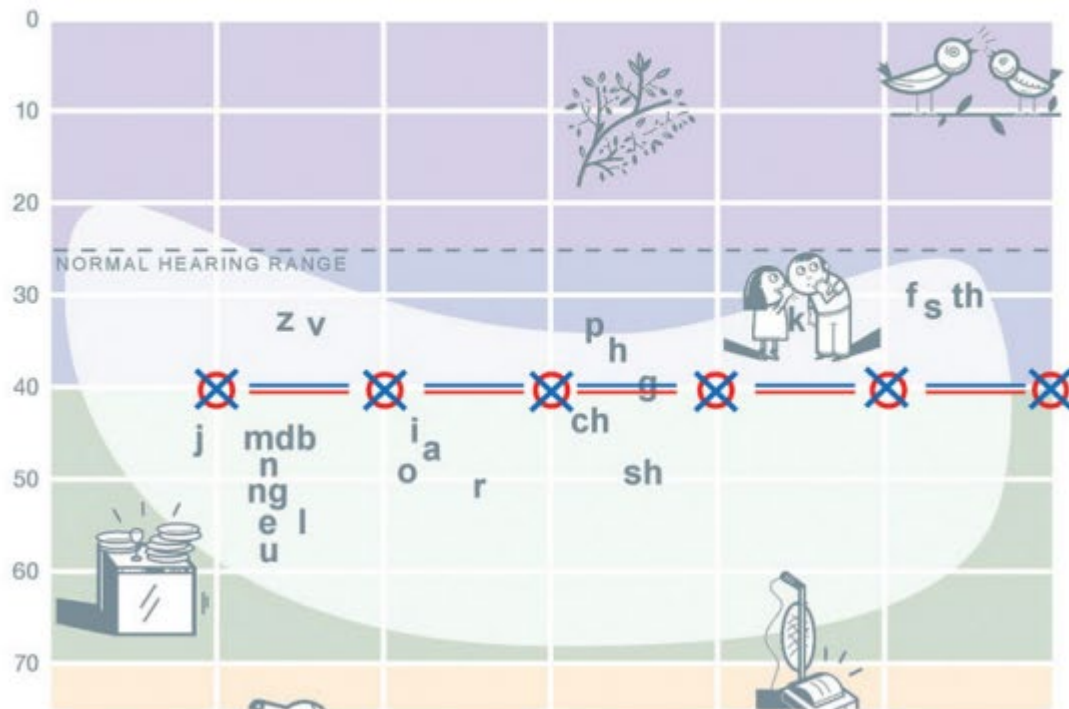
Talker Identity (Pitch)



Does variety matter?

Same hearing thresholds, different plots, different counseling,
different interpretations

Figure 1. Hillis et al., 2023

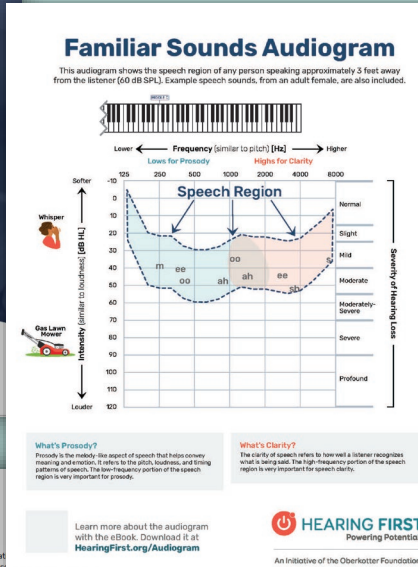


Revising the FSA

- Specific source information for sounds and speech
- Consistent methods applied
 - Female speech
 - Recording distance ~ 3 ft
 - Formulas for conversions (SPL to HL)
- Clear labels and legends
- Accessible language
- Error checking
- Free resource

Additional resources

- Ebook:
 - A free guide for families and professionals on interpreting the audiogram.
 - Explains connection between hearing, brain development, and the implications on speech and language.
- Technical addendum:
 - Rationale and citations for sound selection.
 - Details on frequency and level placement and conversion methods.



Technical Addendum to the Sounds Audiogram (FSA)

Uchanski & Davidson; December 5, 2024

This document provides technical details and references to explain the rationale, shape, size and placement of the speech region; 2) the placement of the other sounds; and 3) the placement of other familiar sounds along the outside of published studies offer background information on speech areas within audiograms, including their historical development (e.g., Tyler, 1979, as cited in Humes, 1991). Significant variations in how speech regions are depicted have been noted, largely due to differences in the chosen average speech level (Dusen, Hawkins & Van Tasel, 1987). More recent research highlights substantial inaccuracies and variability in familiar sounds audiograms currently in circulation, calling for revision and standardization (Hillis, Uchanski & Davidson, 2023).

Uchanski & Davidson, 2024

1. **DESIGN OF SPEECH REGION ON AN AUDIOGRAM:** Depiction of a speech region on an audiogram requires knowledge of the mean spectrum of speech, the overall level of the speech, and the dynamic range of speech, as well as a conversion from dB SPL to dB HL.
 - a. **Mean Spectrum of Speech, or Long-term Average Speech Spectrum (LTASS):** The mean spectrum measurement shows the average intensity levels of speech, from a long recording, at different frequencies. The mean spectrum levels for this Familiar Sounds Audiogram's (FSA) speech region (which correspond to an approximate vertical midpoint of the speech region, prior to dB HL conversion) are based on the Long-Term Average Speech Spectrum (LTASS) for adult female speech from the study of Byrne et al. (Table II, 1994). By design, this same female LTASS is used to create the ISTS test signal (Holube et al., 2010). Additionally, 1/3-octave band analysis shows that 90% of speech energy is concentrated in low frequencies, i.e., at or below 800 Hz.
 - b. **Overall Level of the Speech:** The overall level of conversational speech chosen for the speech region in this FSA is 40 dB SPL. This level corresponds to a typical vocal effort by the talker, and a distance of 1 m (~3-4 ft) between the talker and listener. This overall level is supported by Boothroyd (2019), Olsen (1998), Pearson, Bennett, & Fidell (1977), Cox, Matasich, & Moore (1988, p. 1101), Steinmachowicz, Lewis, Hoover, & Nishi (1993), Cornilleau, Gagné, & Sewald (1991, Table 1, p. 49), Holube, Fredelake, Vraming, & Kolmeier (2010, p. 892), and Skinner, Holden, & Whitford (1997).
 - c. **Dynamic Range of Speech:** The dynamic range of speech, chosen for each 1/3-octave band in the speech region of this FSA, spans from +12 dB to -18 dB about the mean spectrum level. This represents a dynamic range of 30 dB in each 1/3-octave band, which is consistent with the dynamic range of speech used in SII calculations and is supported by the Audioscan Verifit manual (2021, p. 9; +12 dB to -18 dB re: LTASS correspond to L1 [99th-percentile, aka speech peaks] and to L70 [30th-percentile, aka the valleys of speech]).



HEARING FIRST

Powering Potential

Hearing First. (2024). *Familiar Sounds Audiogram eBook*. Hearing First. <https://www.hearingfirst.org/m/resources/7734>

Uchanski, R. M., & Davidson, L. S. (2024). *Technical addendum to the Familiar Sounds Audiogram (FSA)*. Hearing First. <https://www.hearingfirst.org/m/resources/9805>



Oberkötter
Foundation

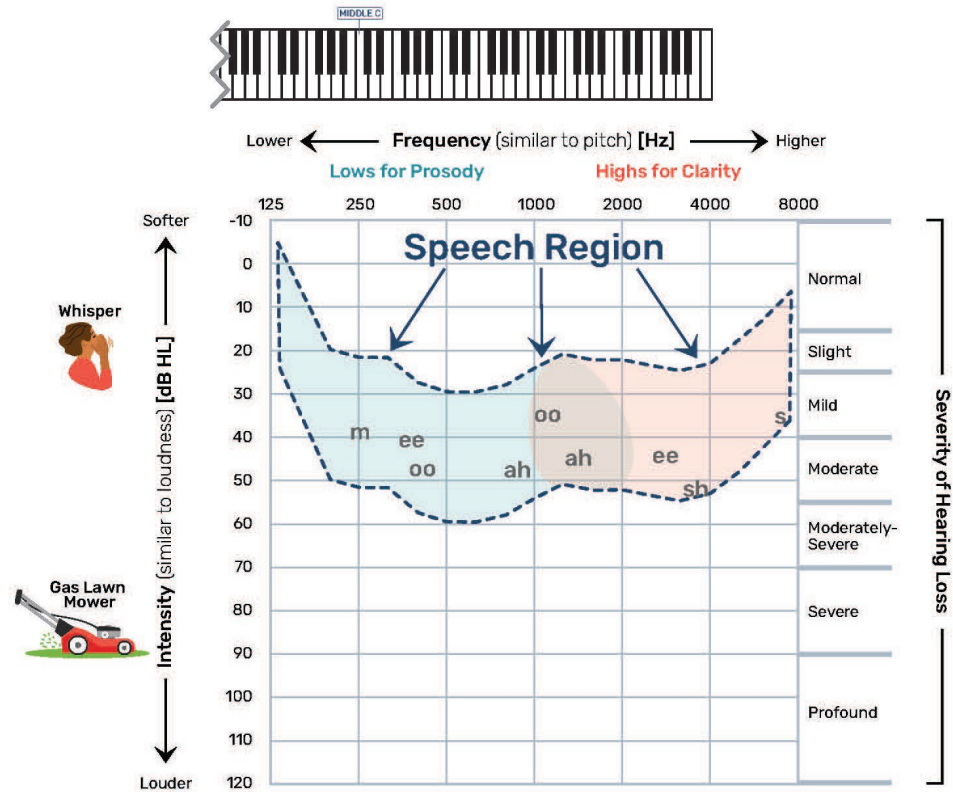


HEARING FIRST
Powering Potential

New FSA

Familiar Sounds Audiogram

This audiogram shows the speech region of any person speaking approximately 3 feet away from the listener (60 dB SPL). Example speech sounds, from an adult female, are also included.



What's Prosody?

Prosody is the melody-like aspect of speech that helps convey meaning and emotion. It refers to the pitch, loudness, and timing patterns of speech. The low-frequency portion of the speech region is very important for prosody.

What's Clarity?

The clarity of speech refers to how well a listener recognizes what is being said. The high-frequency portion of the speech region is very important for speech clarity.

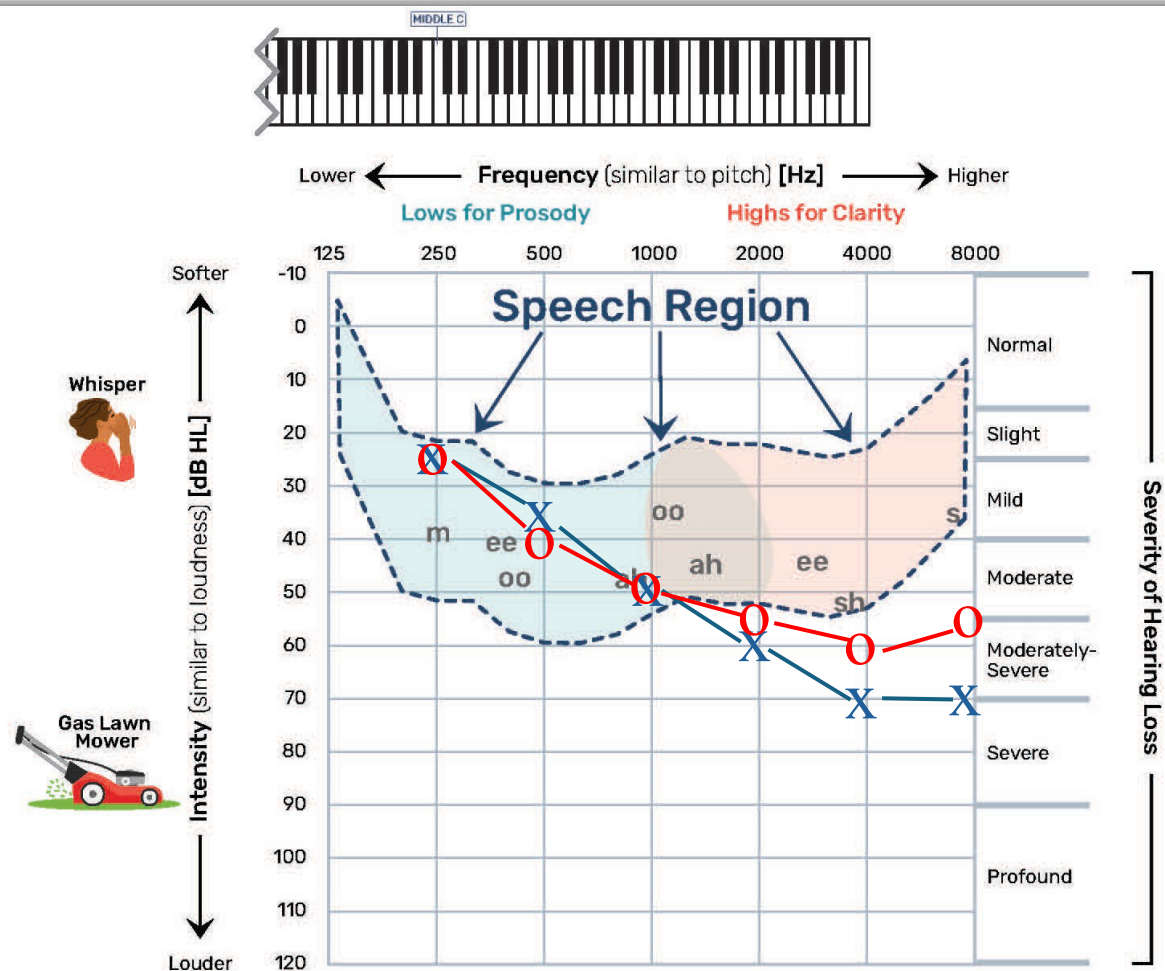
Learn more about the audiogram with the eBook. Download it at HearingFirst.org/Audiogram



An Initiative of the Oberkottter Foundation



New FSA – Sam



YOUR VIRTUAL GOODY BAG AWAITS!



Visit
HearingFirst.org/EHDI



Oberkötter
Foundation



HEARING FIRST
Powering Potential