

Frequency lowering hearing aids: Procedures for assessing candidacy and fine tuning

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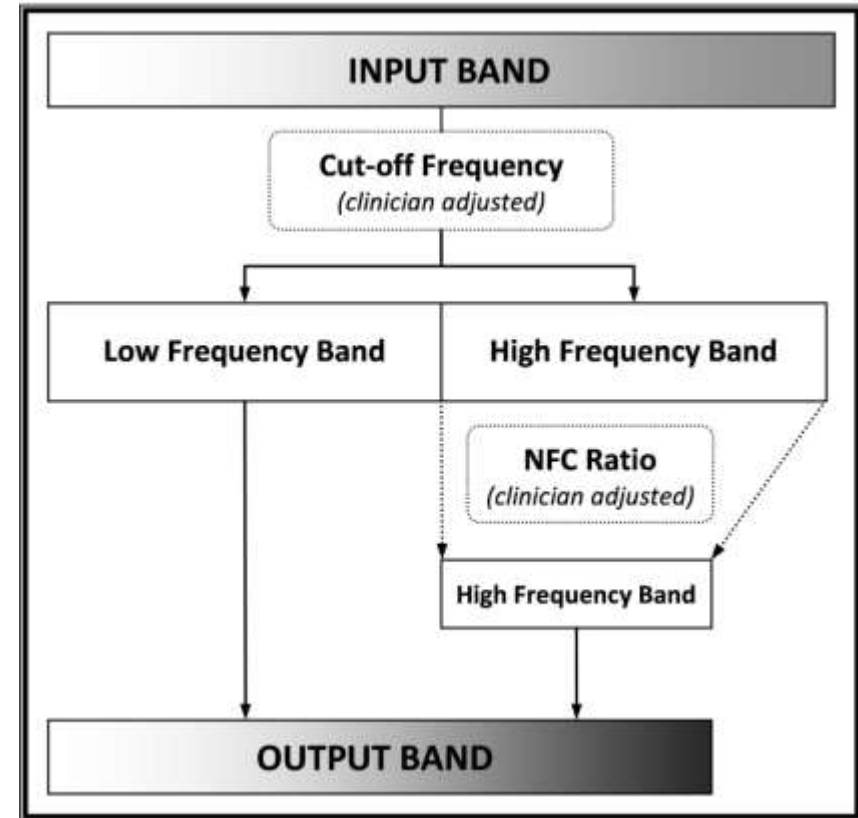
Frances Richert, M.Cl.Sc.



Western
National Centre
for Audiology

Frequency Lowering

- SoundRecover is one form (shown)
- First described in 2005:
 - Simpson et al., 2005; 2006.
- Studies in kids: Bohnert et al (2010); Glista et al. (2009; 2012a,b); Wolfe et al (2010; 2011); Parsa et al (2013)
- AAA Guideline (2013):
Fit if needed, monitor outcomes.



Glista, Scollie, Polonenko and Sulkers (2009),
Hearing Review

Verification & candidacy: overview

- 1) Start by **optimizing the basic fitting**. Measure & tune aided speech & maximum output to target without frequency lowering. Achieve the best possible fitting first.
- 2) **Candidacy** perspective from AAA (2013):
“Frequency lowering should not be prescribed until electroacoustic verification has revealed that high-frequency speech audibility cannot be restored through conventional means.” [Clinical Practice Guidelines: Pediatric Amplification]
- 3) Test **audibility & location of high frequency** speech sounds. Several options exist:
 - Filtered bands of speech
 - Live or prerecorded phonemes such as “s” and “sh”

Specific steps: (these are in the handout)

1. Verify the shape and gain of the fitting without frequency lowering
 - ✓ To ensure best audible bandwidth of speech from gain & WDRC alone
2. Verify the maximum power output (MPO):
 - ✓ To ensure that high level sounds are limited appropriately
 - ✓ MPO measurements are not valid above cutoff frequency
 - ✓ Disable SoundRecover to measure MPO at all frequencies
3. Start with the default frequency lowering setting (**Candidacy**)
 - ✓ Assess the need for frequency lowering by estimating high-frequency audibility with and without frequency lowering active
4. Measures of frequency-specific speech bands or phonemes can help evaluate:
 - ✓ The amount of lowering that has been applied to the signal
 - ✓ The approximate sensation level of high-frequency speech sounds
 - ✓ The potential for speech sound confusions
5. Perform a listening check:
 - ✓ Consider sound quality judgments from the listener as well as the clinician
6. Repeat steps to **fine tune** as needed.

[adapted from Glista & Scollie (2009) AudiologyOnline]

Properties of SR fittings:

- **Candidacy:**

- The basic fitting has been done, but does not provide a full bandwidth of audibility. How much is enough?
 - Enough to provide access to female “s” and “sh”... this requires audibility for inputs above 4000 Hz.
 - Full audibility requires audibility up to and including 9000 Hz. Lowering these frequencies may be necessary.

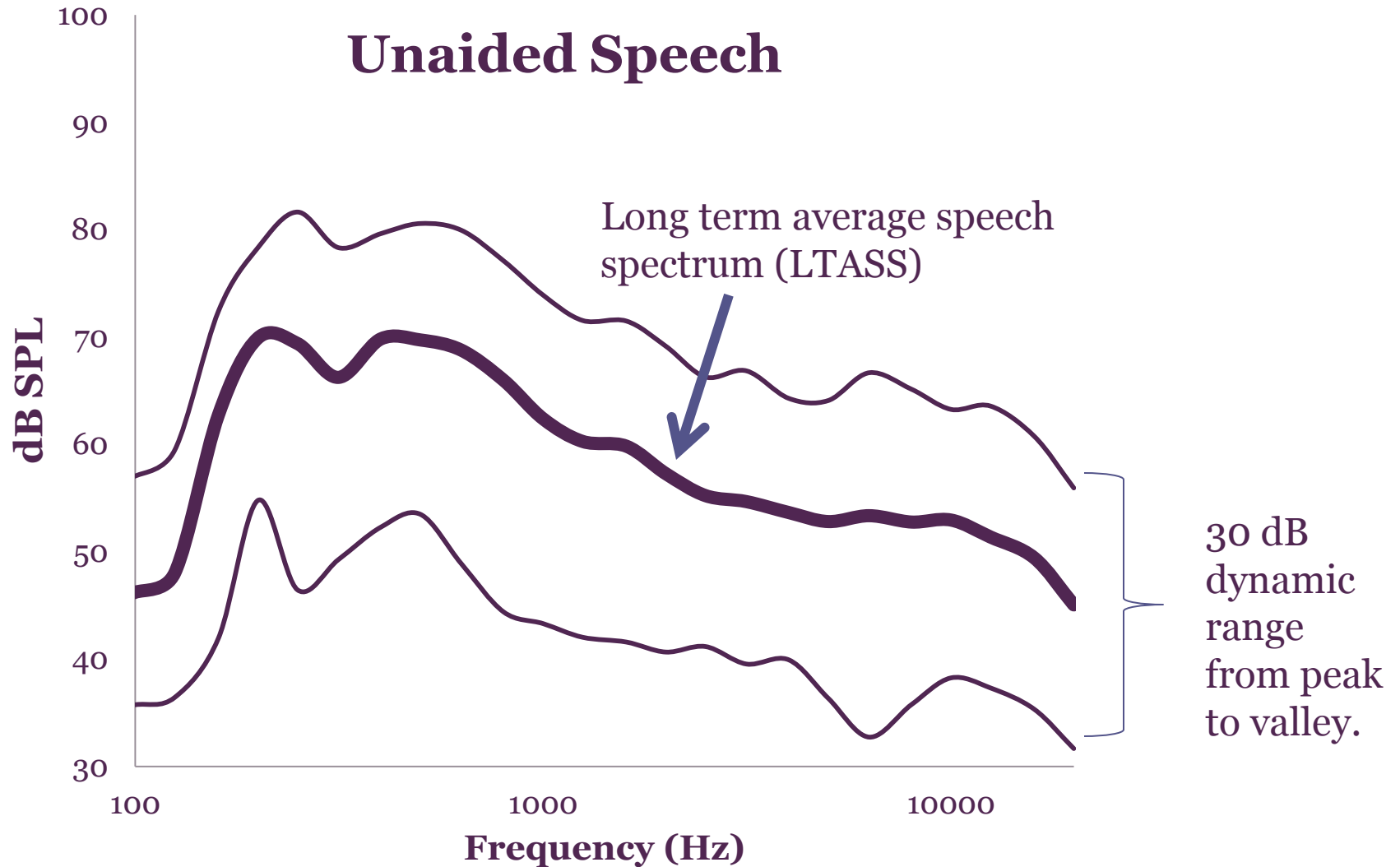
- **Once fitted and fine tuned for the individual:**

- Provides **access** to female “s” and “sh”. The “s” and “sh” sounds are **not overlapping** in frequency.
- We choose the **weakest possible setting** that provides this outcome.

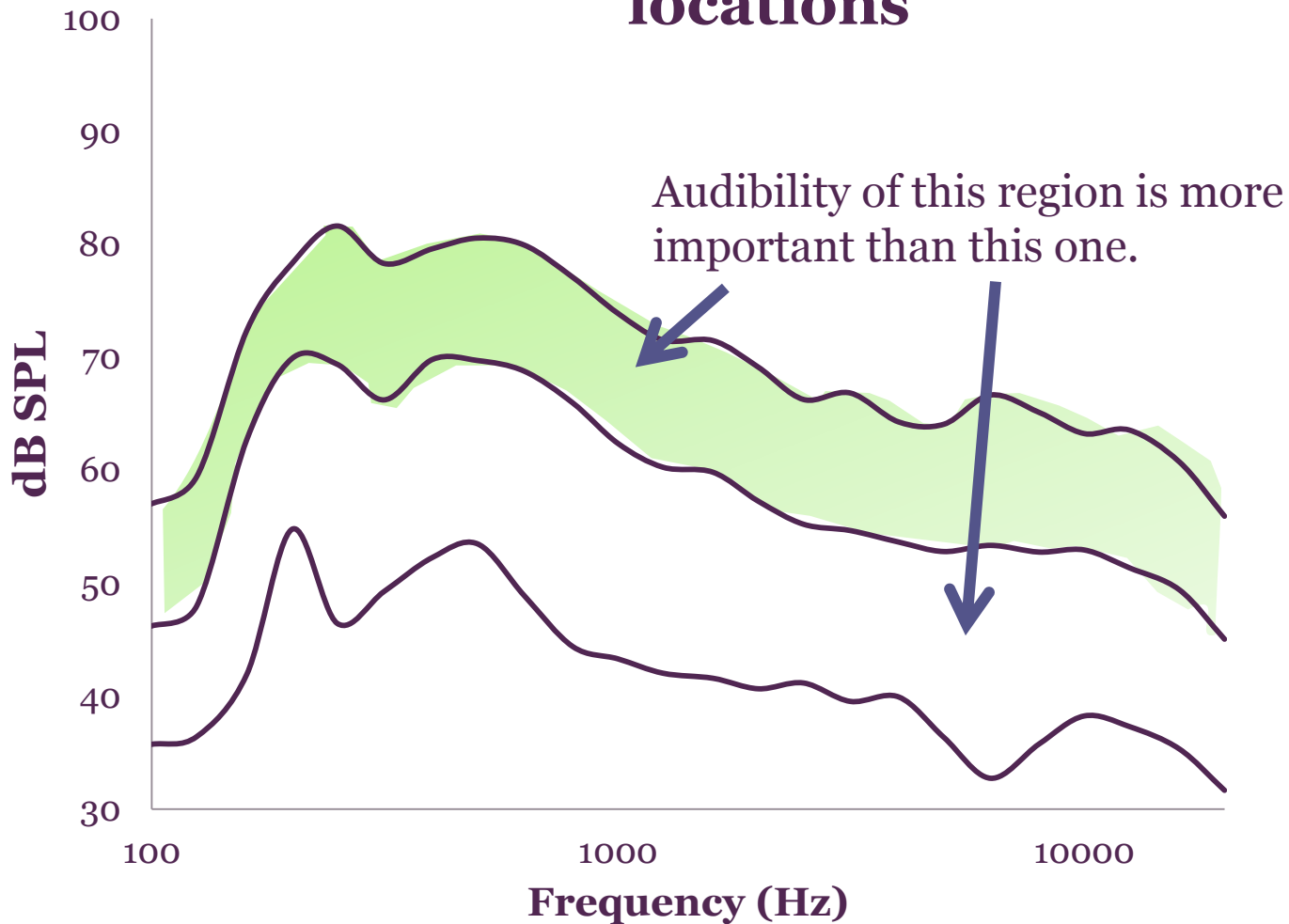
Stimuli

AAA 2013: “The impact of hearing aid signal processing and features such as ... frequency lowering on audibility should be verified... the impact of these features on audibility of speech should be evaluated.”

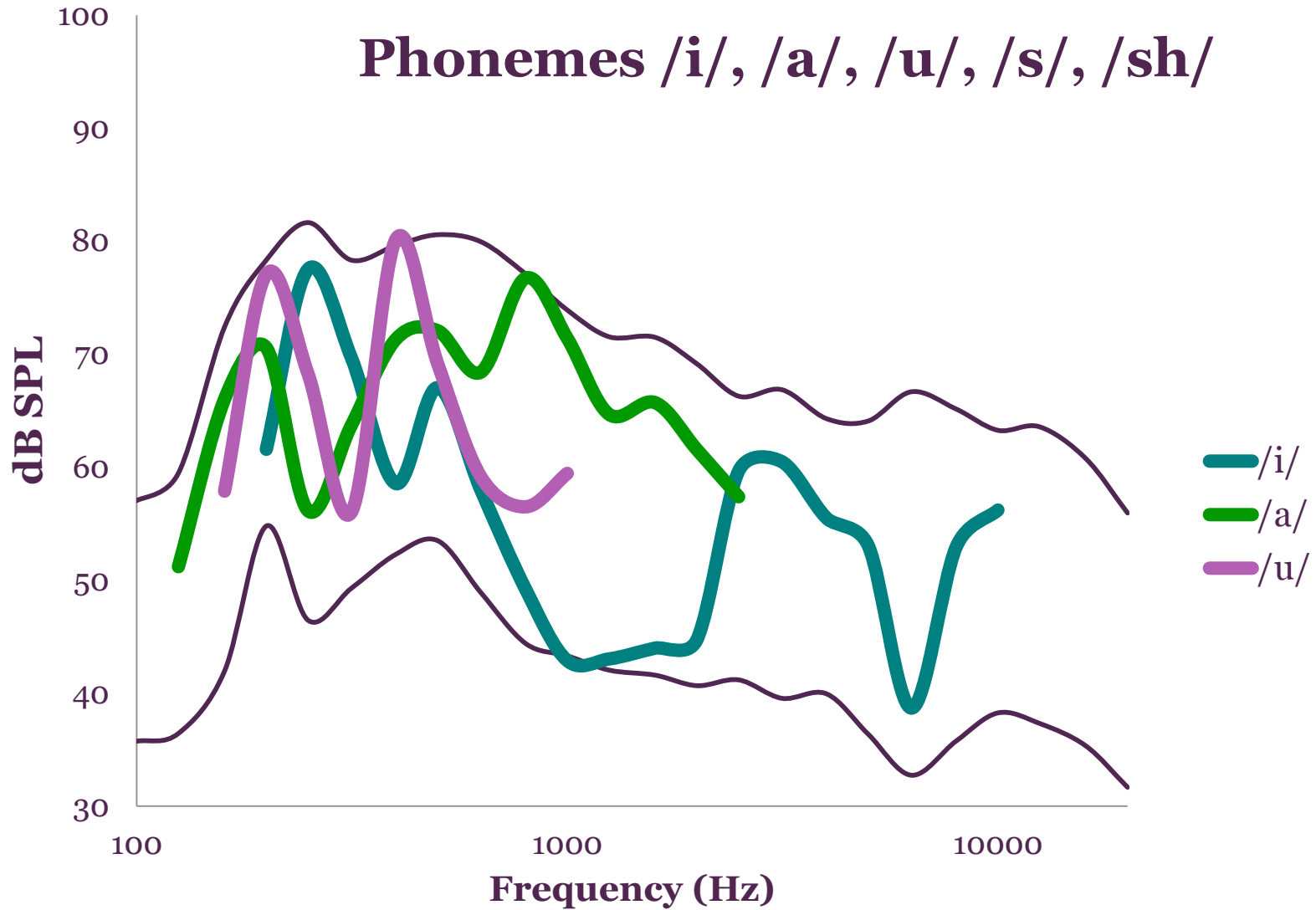
Unaided Speech



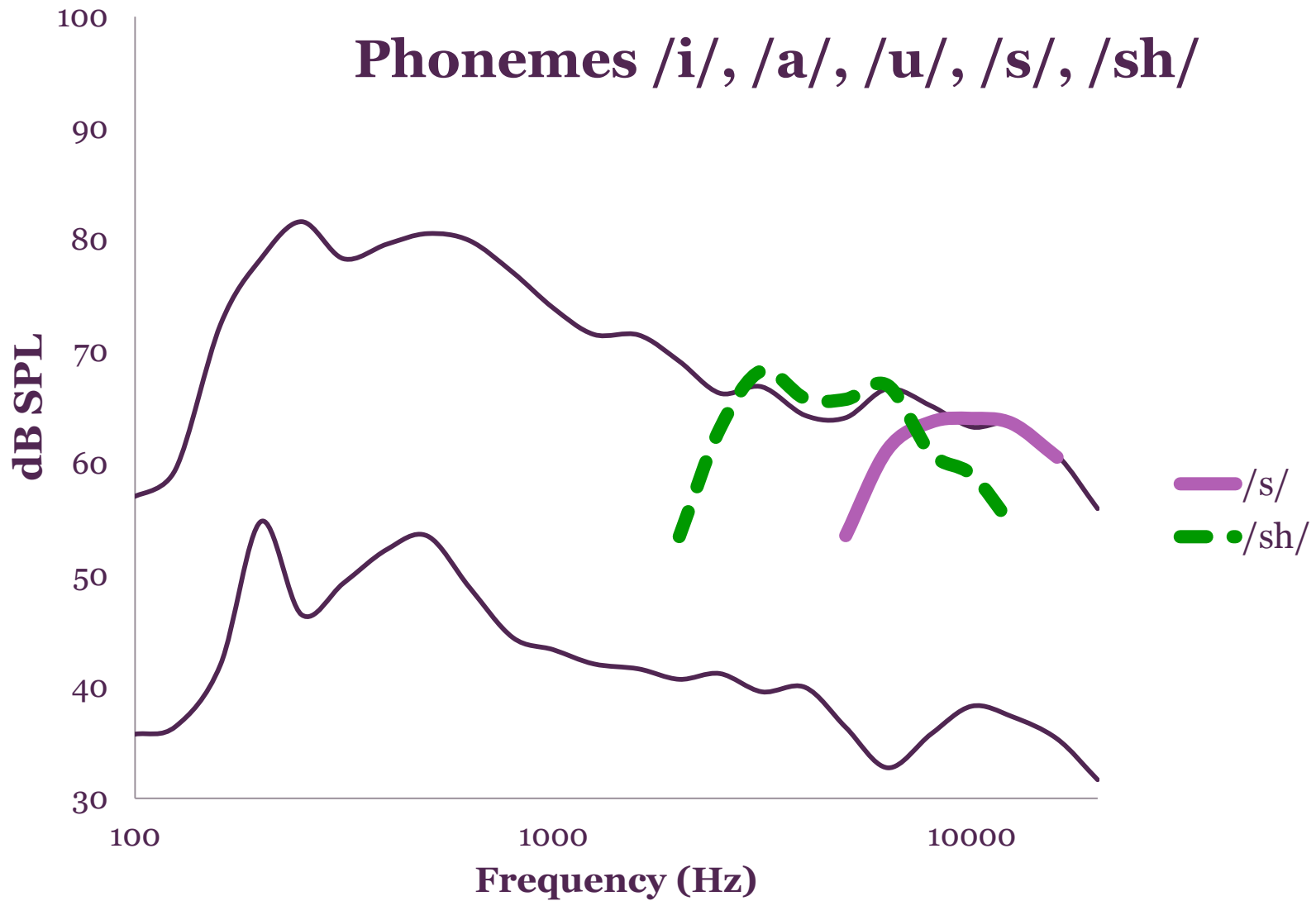
Unaided Speech: Importance & Cue locations



Phonemes /i/, /a/, /u/, /s/, /sh/



Phonemes /i/, /a/, /u/, /s/, /sh/



Using phonemes to help us in assessing candidacy, verification, and fine tuning of frequency lowering. *(a protocol in development)*

Case 1: Tuning to improve benefit.

Case 2: Verification to determine candidacy.

Case 3: Asymmetric frequency compression?

Case 1: Age 7

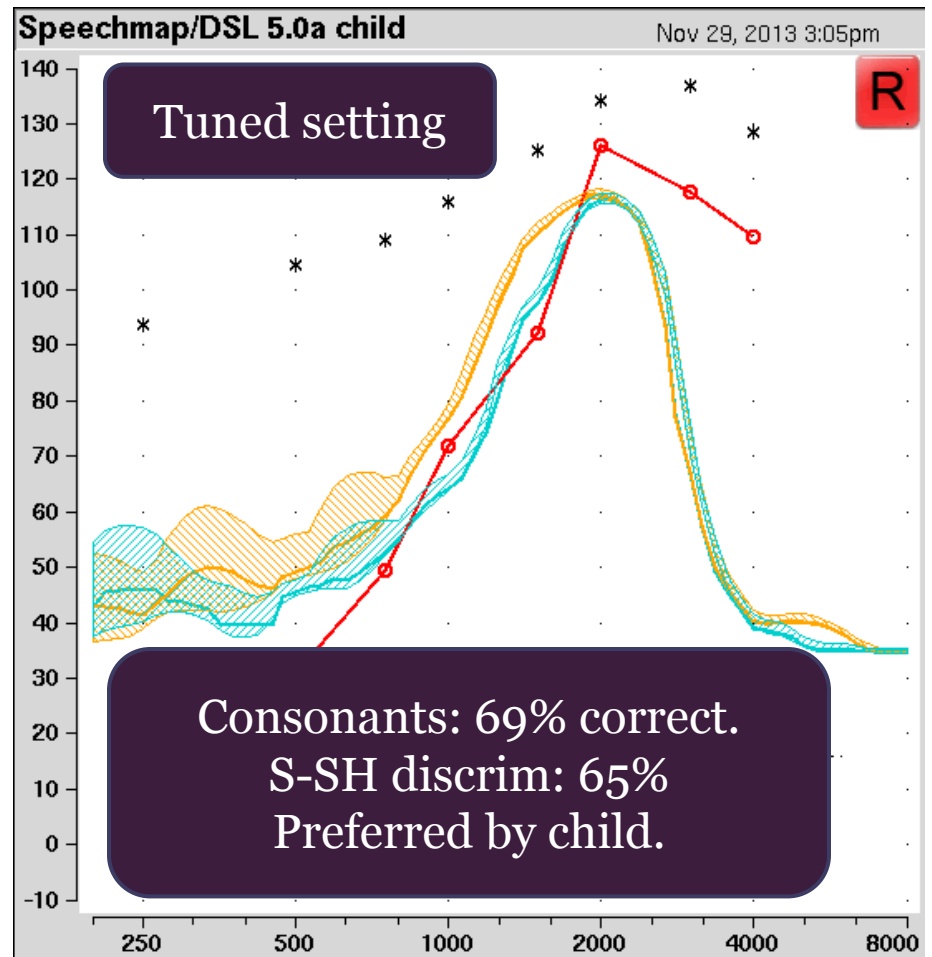
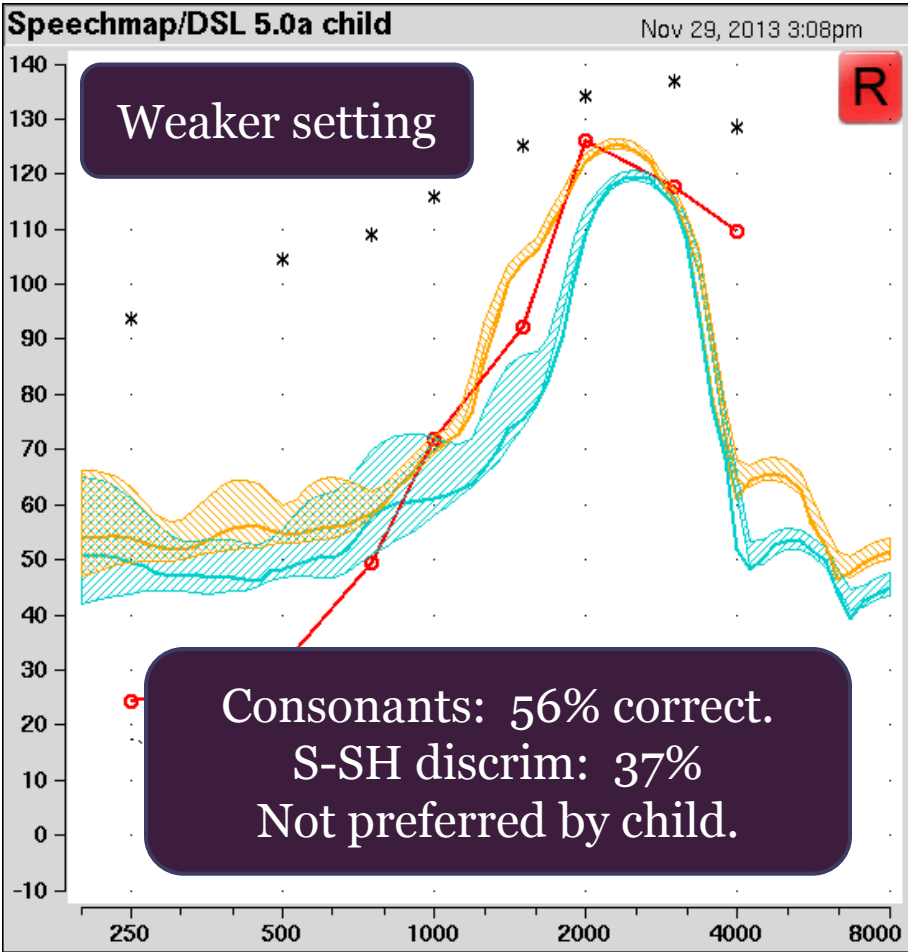
- Asphyxia at birth, normal hearing in the low frequencies, steeply sloping to profound at 2000 Hz.
- Likely **dead regions** in the cochlea **above 2000 Hz**.
 - Definitive results not available, but some threshold shift observed at maximum masking levels.
- **Successful user of frequency compression** signal processing (SoundRecover). Fine tuning affects his outcomes: at weaker settings, he loses the benefit.

Scollie, S. & Glista, D. (2011). Digital Signal Processing for Access to High Frequency Sounds: implications for children who use hearing aids. *ENT & Audiology News*, 20(5), 83-87.

Case 1: fitting, candidacy, tuning



Case 1: Outcomes



Case 1: Summary

- A clear candidate for this technology.
- Clear benefit, but not at every setting. Adjustments were necessary.
- Verification of aided phonemes can illustrate important changes.

Using phonemes to help us in assessing candidacy, verification, and fine tuning of frequency lowering.

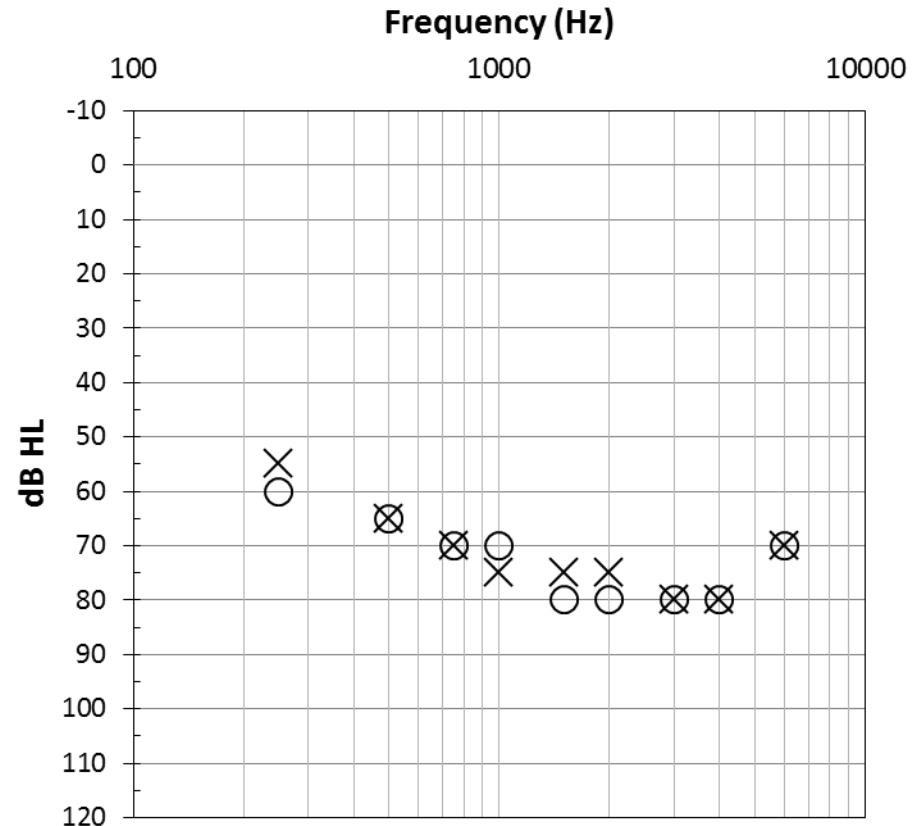
Case 1: Tuning to improve benefit.

Case 2: Verification to determine candidacy.

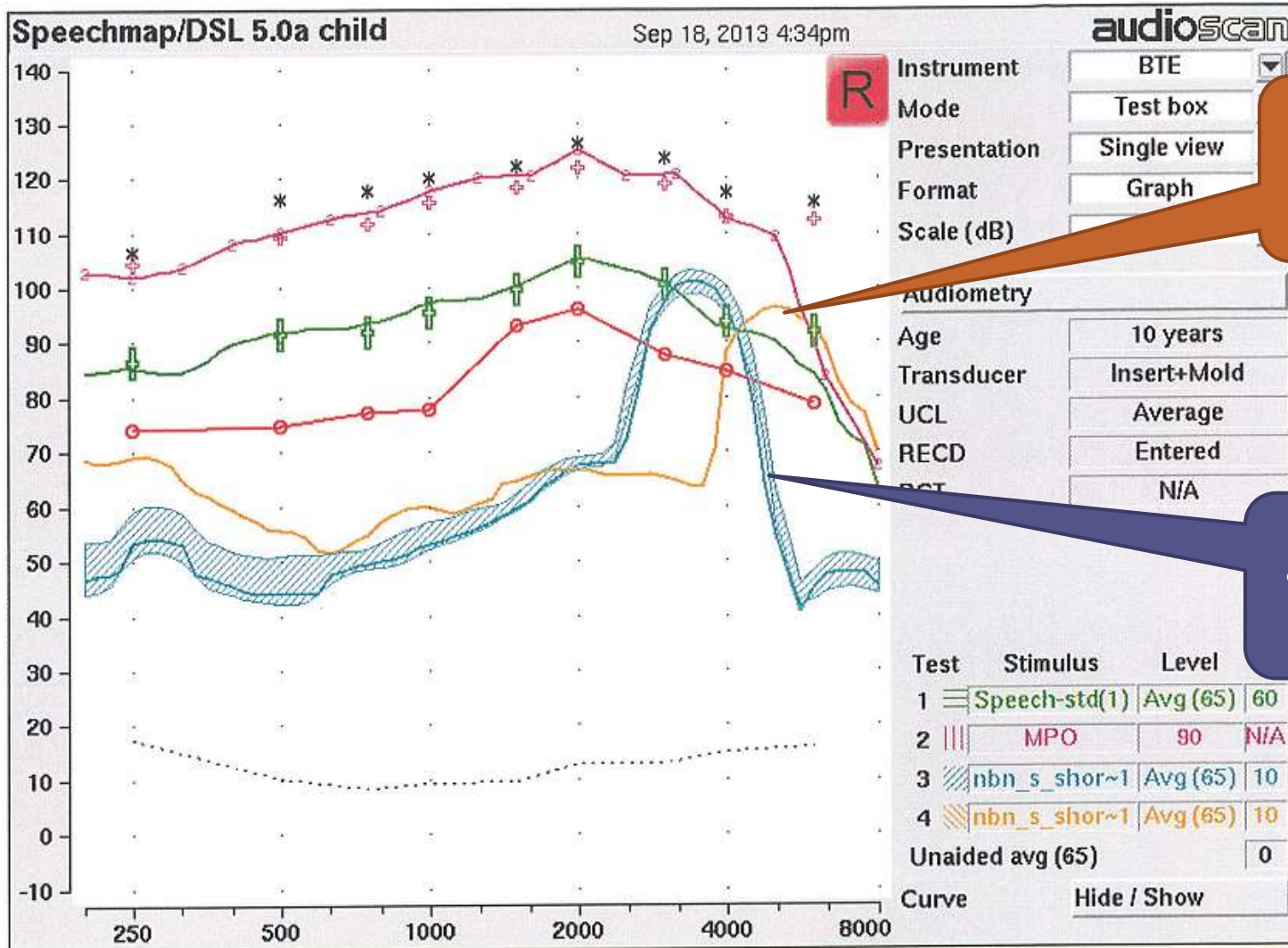
Case 3: Asymmetric frequency compression?

Case 2: 10 year old boy

- History of frequency compression use in his hearing aids with good benefit.
- Recent refitting (new aids).
- New hearing aids provide more high frequency audibility than was possible with the old aids.
- Impact on SoundRecover candidacy & tuning?



Case 2: New aid, right ear



“S” with SR off

“S” with SR on

Case 2: fitting & outcomes

- Tested **detection** with SR off and on:
 - Aided Ling6(HL) thresholds:
No difference and good results (<30 dB HL) with both settings.
 - UWO Plurals:
No difference and good results (83%) with both settings.
- Did a two-memory trial (on, off)
 - No real world preference other than a note that school bell was louder with SR on.
- Conclusions? Next steps? (there's probably more than one way to go...)
 - Enable? (no harm noted)
 - Disable? (no harm noted)
 - An in-between setting? (not trialed)

Case 2: Summary

- Technology changes have improved the bandwidth available from hearing aids.
- In some cases, this adjusts candidacy for SoundRecover in two ways:
 - A weaker setting than previously used may be appropriate.
 - It may be appropriate to disable it for previous users.
- No systematic studies of this issue are available.

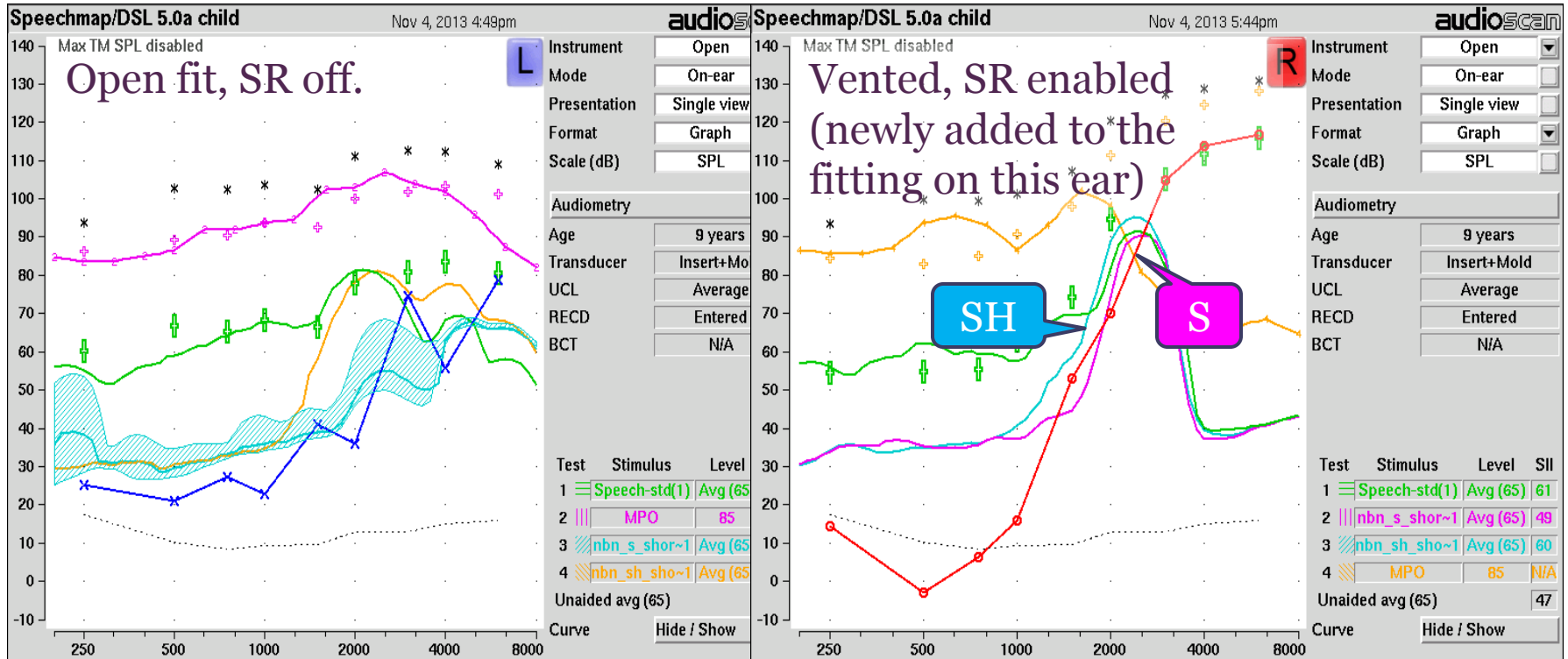
Using phonemes to help us in assessing candidacy, verification, and fine tuning of frequency lowering.

Case 1: Tuning to improve benefit.

Case 2: Verification to determine candidacy.

Case 3: Asymmetric frequency compression?

Case 3: Asymmetrical SR



Connect left on-ear probe microphone. Insert instrument into client's ear. Select one of Test 1 through Test 4.

Connect right on-ear probe microphone. Insert instrument into client's ear. Select one of Test 1 through Test 4.

- Evidence: John et al. ,(2013)
- Outcome: “remarked immediately on improved audibility of sounds following today’s adjustments”

Case 3: Summary

- Default settings (and most research studies) use better ear settings.
- Trials of asymmetrical settings (with monitoring) may be warranted in some cases.

Specific steps: (here they are again)

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[adapted from Glista & Scollie (2009) AudiologyOnline]

Thanks!!

Thanks to Phonak for hosting the conference, inviting me today, and for your ongoing support for this work.

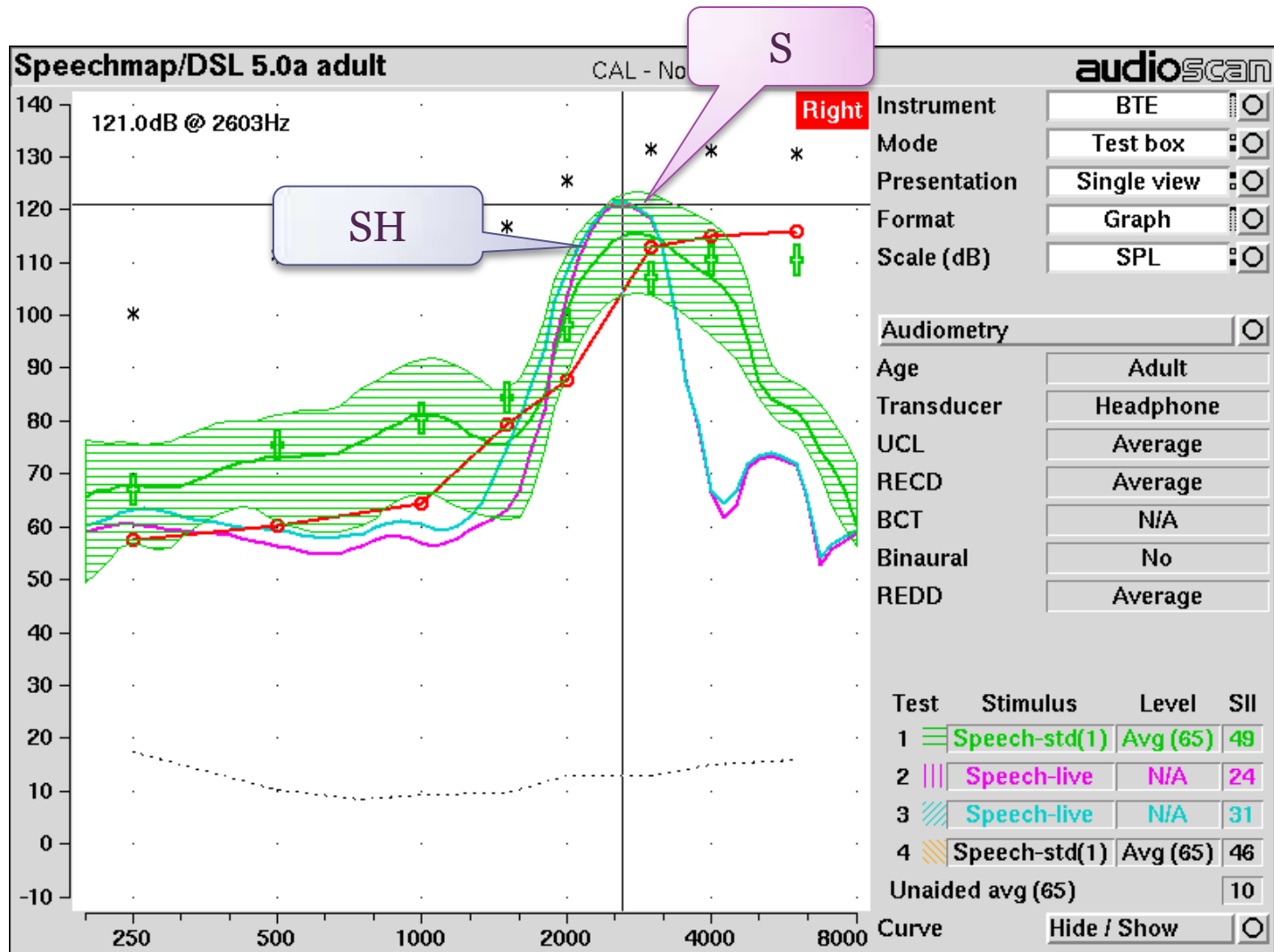
Interested in trying phonemic
verification? Email:
hftb@nca.uwo.ca

(High frequency test battery at the National
Centre for Audiology, University of Western
Ontario, Canada)

Selected references:

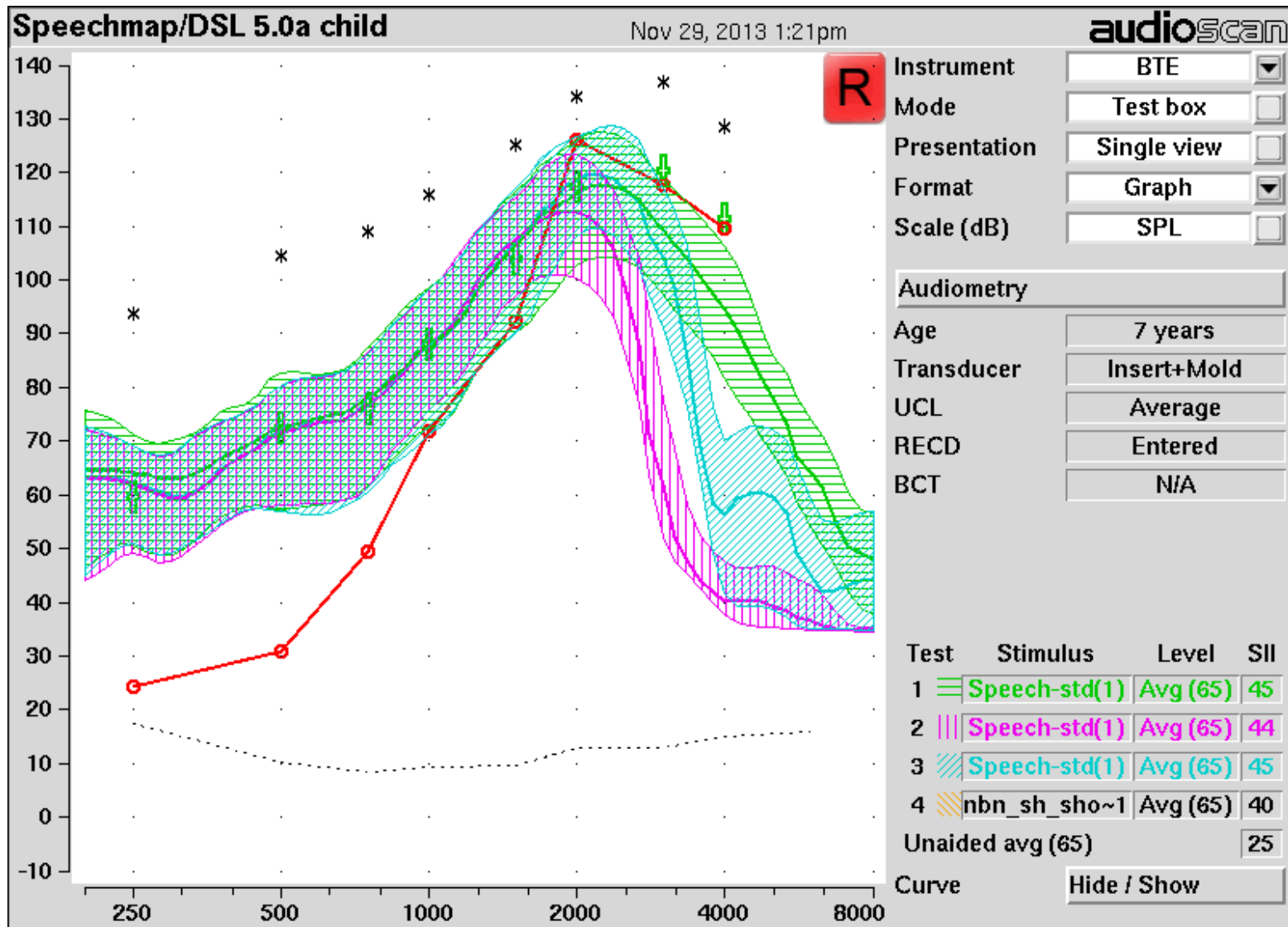
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What does too much overlap look like?



Connect coupler and instrument to coupler microphone. Select one of Test 1 through Test 4.

What about auditory deprivation?



How is this different than how we are verifying now?

