ReSound Sound Shaper

Understanding, fitting and verifying for 2016 and beyond

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Today's Agenda

Introduction to frequency compression
Description of Sound Shaper
Update on current research
Candidacy for Sound Shaper
Fitting and verifying Sound Shaper
Case studies
Q & A

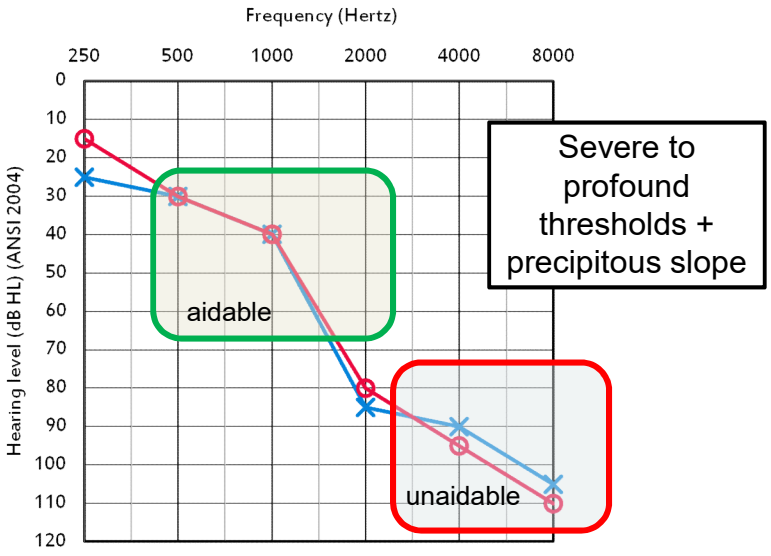
Learning Objectives

After this course learners will be able to describe how the Sound Shaper feature works.

After this course learners will be able to define candidacy criteria for fitting Sound Shaper.

After this course learners will be able to explain how to apply tips, current research and case studies in this presentation to fit and verify Sound Shaper.

Starts with a problem



Introduction to frequency compression

Audibility of high frequency sounds cannot be adequately restored with conventional amplification

Consonants- high frequency and/or softer intensity

More difficulties in background noise

Environmental sounds and localization cues

Speech production

Introduction to frequency compression

Dead regions

Areas of dead inner cells in cochlea

Amplifying these frequencies can decrease speech understanding

Listeners with dead regions may still benefit from wider bandwidth amplification

Issues with physical/acoustic limitations

High-powered receivers

Must have tight seal to ensure high frequency amplification is reaching TM and to prevent feedback

The Solution: ReSound Sound Shaper

Provide audibility for high frequency sounds not aidable via conventional amplification

High frequency sounds are moved to a lower frequency region where there is aidable hearing

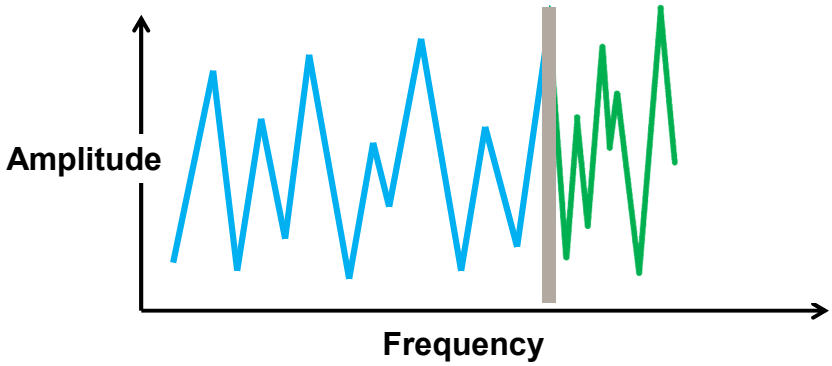
Preserve sound quality

Attempts to minimize perceptual distortion by using linear (proportional) frequency compression

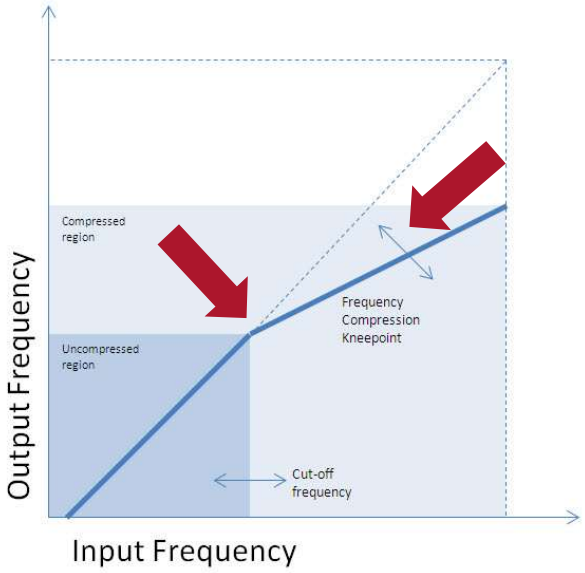
Frequencies below cutoff are not altered

Implementation of Sound Shaper has been simplified

Frequency compression



Introduction to Sound Shaper



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Introduction to Sound Shaper

Nonlinear (non-proportional) frequency compression

Most common type used in today's hearing aids

Frequencies closer to start frequency are shifted less than frequencies at the higher range of the source region

When activated, it is always operating

Proportional frequency compression

Frequencies that are lowered maintain a "constant" relationship with target frequencies

*Source frequency * constant = target frequency*

*6000 Hz * 0.6 = 3600 Hz*

*5000 Hz * 0.6 = 3000 Hz*

*4000 Hz * 0.6 = 2400 Hz*

Harmonic relationships are maintained

When activated, algorithm only lowers signal when speech is detected

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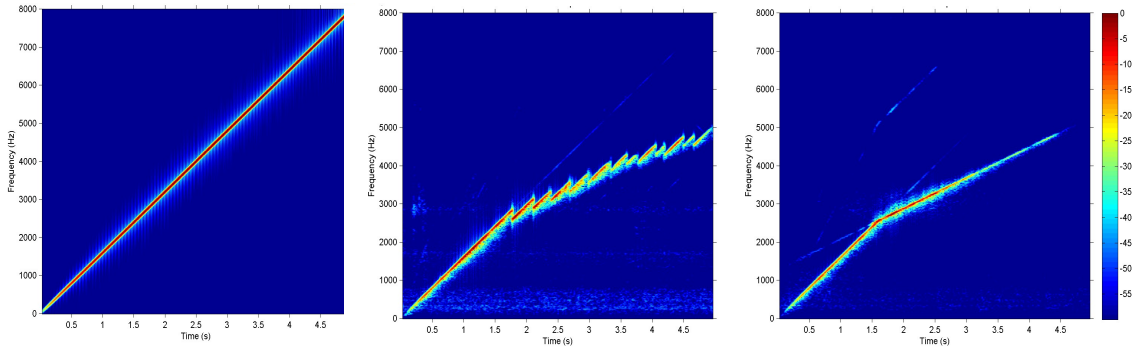

Unprocessed
Pure tone sweep

Non-proportional

Proportional

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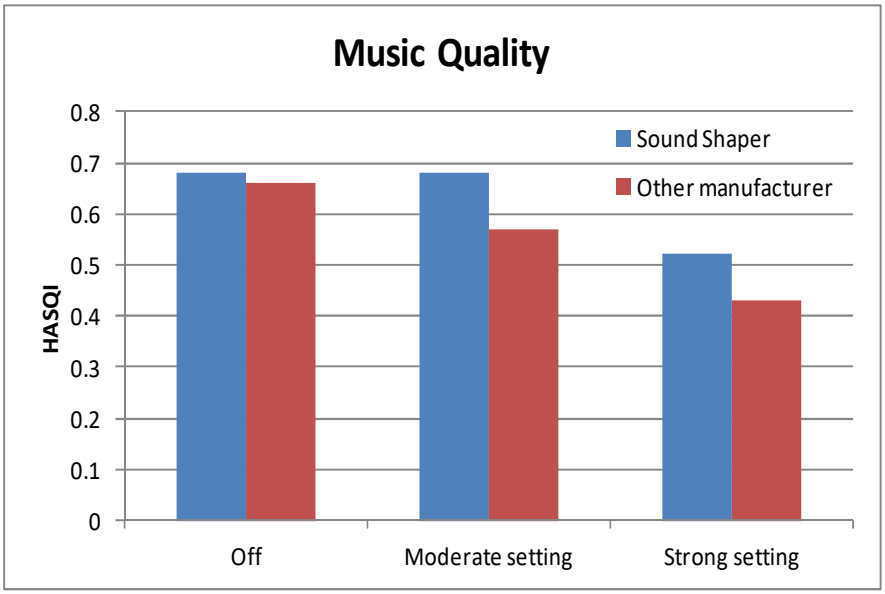
Introduction to Sound Shaper



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What outcomes do we see with frequency compression?

Data reviews from:

Simpson (2009) 4 studies

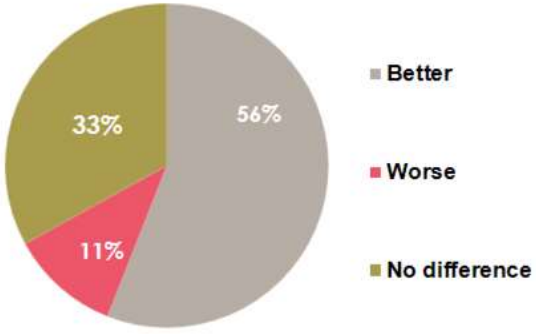
Alexander (2013) 5 studies

Adult hearing impaired listeners

Using simulated and commercially-available frequency compression techniques

Speech in quiet

When using frequency compression over conventional amplification, is speech understanding:



What other outcomes have been measured?

Speech understanding in noise

Benefit from FC in noise (McCreery et al, 2014)

No benefit from FC in noise (Ellis & Munro, 2013; Millet et al, 2016)

Some benefit in spatially-separated noise for those with poor SNR abilities (Shehorn et al, 2013)

Sound quality

Cutoff frequency and CR affect sound quality for HI listeners (Souza et al, 2013; Parsa et al, 2013; Johnson & Light, 2015)

Sound quality is poorer than conventional, even at low CF/CR for speech and music (Souza et al, 2013; Mussoi & Bentler, 2015)

A balance between audibility and sound quality can often be reached (Johnson & Light, 2015)

Binaural cues

FC could reduce perception of binaural cues (Brown et al, 2016)

What's the conclusion on frequency lowering?

It depends!

What are your goals?

Who is your patient?

How are you setting the feature?

Research can also guide our decisions on candidacy and choosing settings…

What factors may affect candidacy?

Hearing loss

Still the most powerful predictor of frequency compression benefit (Souza et al, 2013; Ellis & Munro, 2015)

Age

Older listeners may benefit more from FC than younger listeners (Kokx-Ryan et al, 2015)

Cognitive abilities

Reduced FC benefit seen in listeners with poorer working memory (Arehart et al, 2013)

WM + hearing loss appears to interact (Souza et al, 2015)

Impact of cognitive status may be minimized by using conservative settings that are individualized for patients (Ellis & Munro, 2015)

Sound Shaper Candidacy

Which patients are candidates for frequency compression?

Sound Shaper is designed for “typical” patient profile:

Severe to profound high frequency sensorineural hearing loss

Steeply sloping thresholds

Not so “typical” but may still benefit:

Mild-moderate hearing loss

Do see some benefits for high frequency consonant identification for this group (Alexander et al, 2014)

Flat severe to profound hearing loss

If you are concerned about distortion

Consider measure of speech in noise, such as QuickSIN

Unaided QSIN performance best predictor of speech abilities using FC (Kates et al, 2013)

Patients should be evaluated on an individual basis

Sound Shaper Candidacy

Which patients may Sound Shaper NOT be recommend for?

Recommended fitting software setting is Off

Patient has known cognitive issues, especially if they are elderly

Sound Shaper Candidacy

If you suspect a patient is not or will not receive audibility of high frequency sounds, measure it!

Fitting Sound Shaper

If you feel your patient would benefit from Sound Shaper, how do you determine settings?

Activate most conservative setting that provides high frequency audibility your patient is missing with conventional amplification

As FC settings become more aggressive, speech intelligibility performance can decrease (e.g., Souza et al, 2013)

Fitting Sound Shaper

Three settings for Sound Shaper in fitting software:

Mild (4 kHz)

Moderate (3.5 kHz)

Strong (2.5 kHz)

Note that the default setting is Off

Sound Shaper Setting	FC Knee Point	FC Ratio
Mild	4000 Hz	1.33:1
Moderate	3500 Hz	2:1
Strong	2500 Hz	2:1

Fitting Sound Shaper

“Mild”

Recommended if the audiogram has a slope ≥ 10 dB per octave frequency, and the slope begins ≥ 4000 Hz

“Moderate”

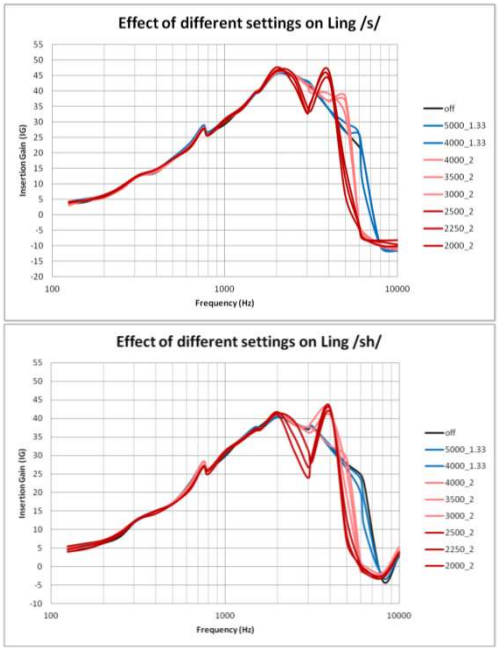
Recommended if the audiogram has a slope ≥ 10 dB per octave frequency, and the slope begins at 2000 Hz

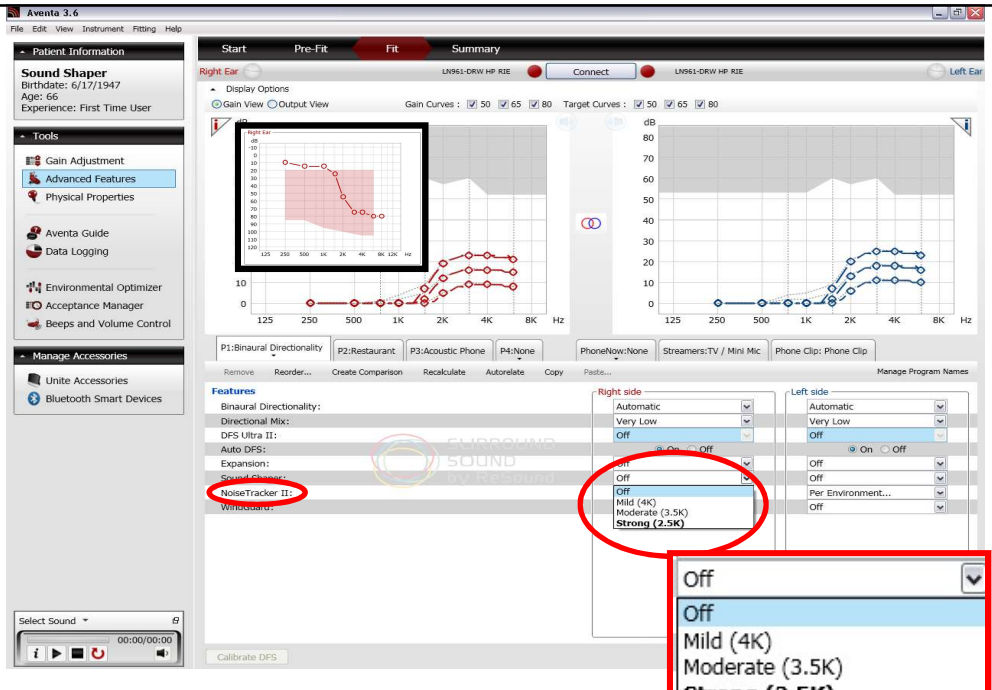
“Strong”

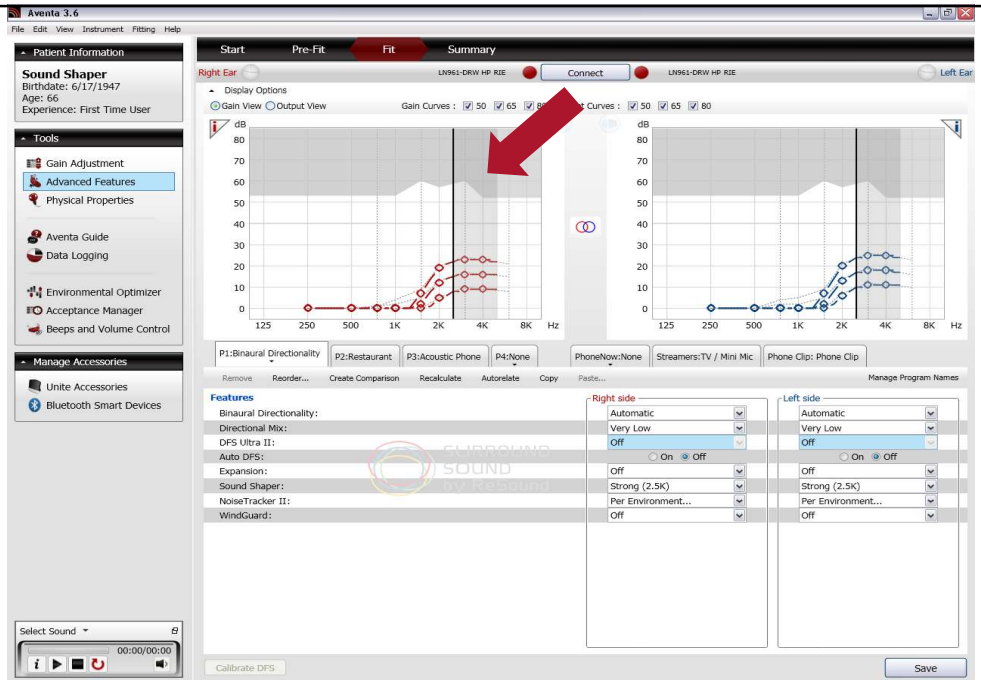
Recommended if the audiogram has a slope ≥ 10 dB per octave frequency, and the slope ends ≥ 2000 Hz

Sound Shaper settings

Setting ID	*Cut-off [Hz]*	*CR*
"Off"	*n/a*	*n/a*
1 (weakest)	5000	*1.33*
2	4000	*1.33*
3	4000	*2*
4	3500	*2*
5	3000	*2*
6	2500	*2*
7	2250	*2*
8 (strongest)	2000	*2*







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Fitting Sound Shaper

Asymmetric hearing loss

Sound Shaper can be set differently for each ear in the fitting software

Consider choosing one Sound Shaper setting and using it on both sides

May want to use more conservative setting in both ears

Different Sound Shaper settings may be warranted in some cases

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Verifying Sound Shaper

Number one goal is to ensure there is audibility using real ear measurements

Sound Shaper is providing adequate audibility of high frequencies

Also, that there is not audibility without Sound Shaper (if you are not sure)

Real ear verification will not be able to establish possible speech understanding improvements

Nonsense syllable/phoneme comparison tests are best for showing benefits from FC algorithm

Verifying Sound Shaper

Recommended real ear stimuli

Long term average speech spectrum (LTASS) at various input levels

Ling /s/ in Aurical FreeFit

Filtered speech in Audioscan Verifit

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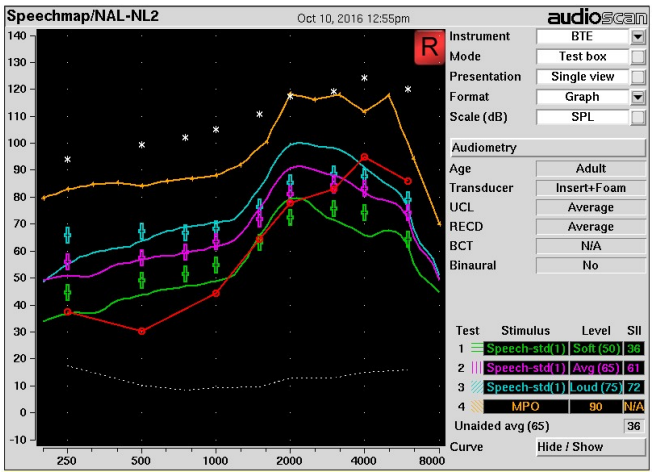
Verifying Sound Shaper

1) Measure LTASS at various input levels without and with Sound Shaper

Ensure that there is a need for Sound Shaper, and that Sound Shaper does not reduce high-frequency bandwidth



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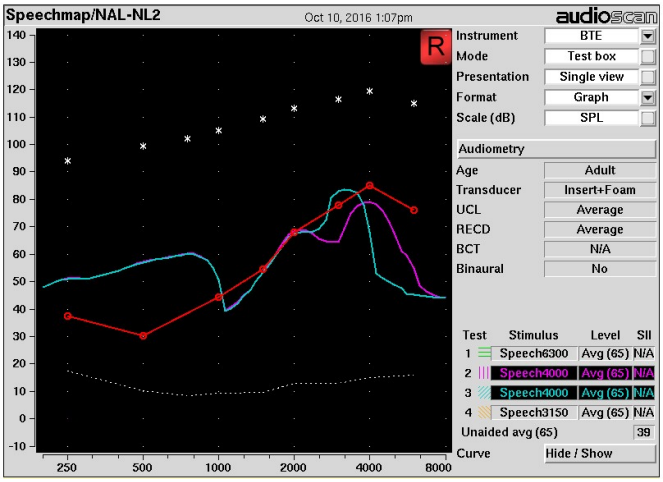
Verifying Sound Shaper

2) Use high-frequency stimuli to verify audibility



Verifit filtered speech

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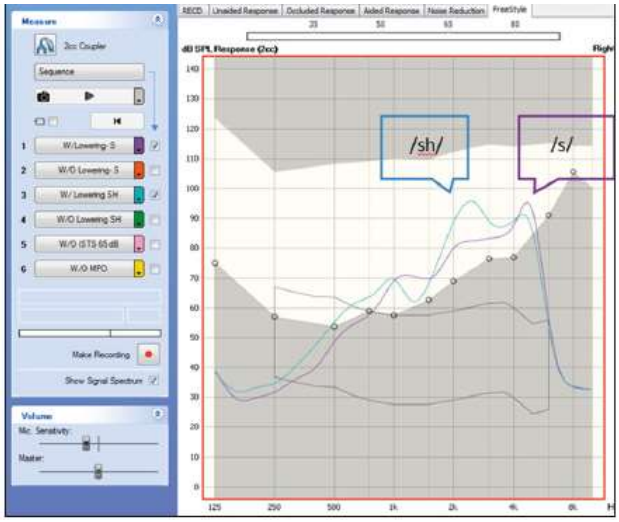
Verifying Sound Shaper

2) Use high-frequency stimuli to verify audibility



Aurical FreeFit Ling sounds

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Verifying Sound Shaper

3) Determine other effects Sound Shaper may have on signal

Measure separation of /s/ and /sh/ phonemes

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Case study 1- Mr. L

70 year old male, mild to profound noise-induced sensorineural hearing loss

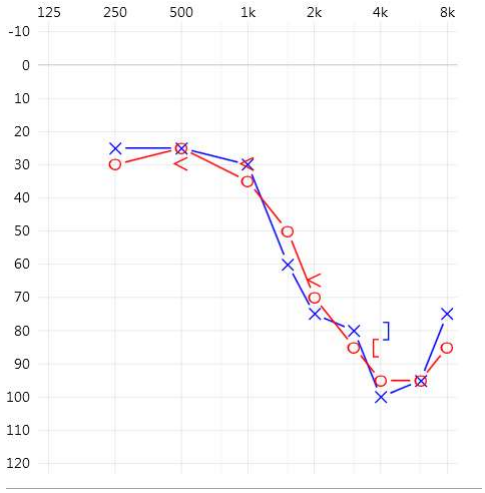
Experienced hearing aid user (10 years)

Reported extreme distortion when listening to speech, that his own hearing aids were not very helpful

Confirmed dead region bilaterally using TEN test (Moore et al, 2000)

Importance of wider bandwidth for amplification

Tested Mr. L using varying degrees of high frequency bandwidth- He performed best with greater high-frequency bandwidth



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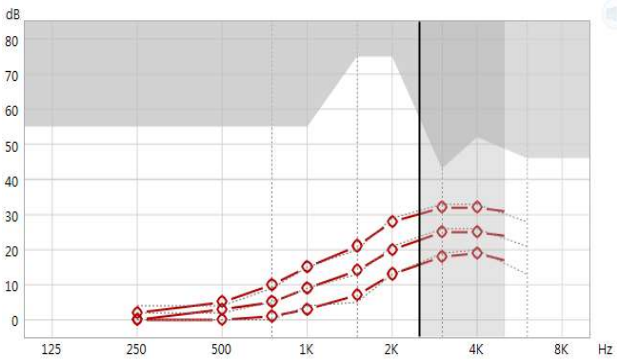
Case study 1- Mr. L



Hearing aid fitting:

RIE with Ultra power receiver

High frequency gain was maximized before activating Sound Shaper, but ran into feedback issues

Sound Shaper = Strong (2.5k) bilaterally

Mr. L's experience:

Mr. L required several weeks of wear time with Sound Shaper to begin demonstrating benefits for phoneme perception

Benefits were still small, even after experience with Sound Shaper. But there was improvement compared to own hearing aids

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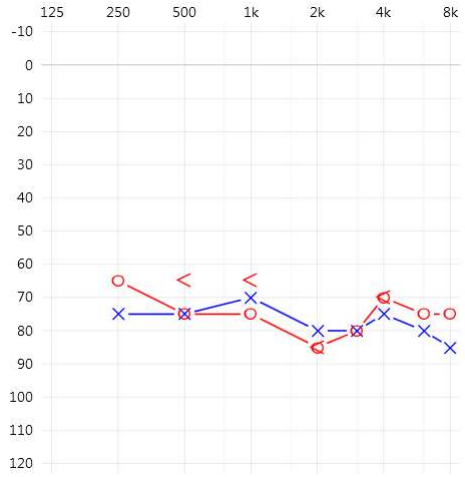
Case study 2- Mr. J

40 year old male, severe congenital sensorineural hearing loss

Lifelong hearing aid user- first time frequency compression user

Father of two young kids

Avid music lover



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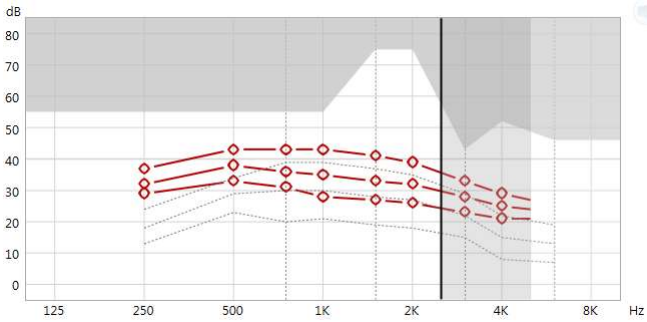
Case study 2- Mr. J



Hearing aid fitting:

RIE with Ultra power receiver

High frequency gain was maximized before activating Sound Shaper

Sound Shaper = Strong (2.5k) bilaterally

It was helpful to give Mr. J 2 take-home programs when fitted: Program 1 used Sound Shaper and Program 2 used conventional amplification

Mr. J's experience:

Better audibility of /s/, though some confusions with /s/ and /sh/

Reported better environmental awareness, noticed audibility of high frequency consonants for the first time in other people's speech

Music was more difficult to accept- He could pick up on changes in pitch with Sound Shaper compared to conventional amplification

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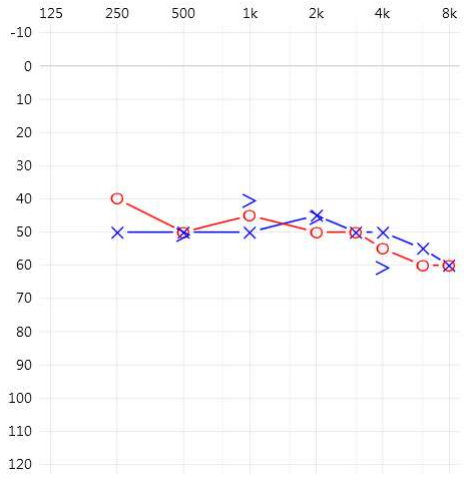
Case study 3- Ms. R

30 year old female, mild to moderate sensorineural hearing loss

Experienced hearing aid user (10 years), desired more benefit

Based on her hearing loss, Ms. R is not a “typical” FC candidate

She was willing to try something novel for more audibility of high frequencies



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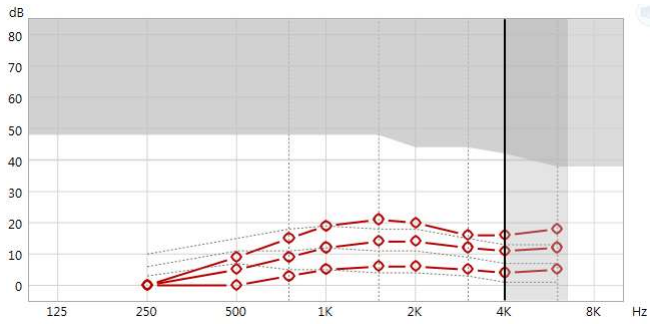
Case study 3- Ms. R



Hearing aid fitting:

Open fit BTE with power dome

High frequency gain was maximized before activating Sound Shaper

Sound Shaper = Mild (4k) bilaterally

Ms. R’s experience:

Subjectively preferred FC over conventional amplification

She appreciated the new stimuli she was hearing

Noticed the change in sound quality- but liked it as it meant she was hearing more high frequency sounds

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Thank you!

Any questions?

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