How loud is too loud? Using LDL measures for hearing aid fitting and verification CONTINUED!

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I do recall we also talked about this:

- A large percent of people using hearing aids are not satisfied with how the hearing aids handle loud sounds.
- Neither audiologists or HIS's are very interested in conducting LDL measures, or using these measures when fitting hearing aids.

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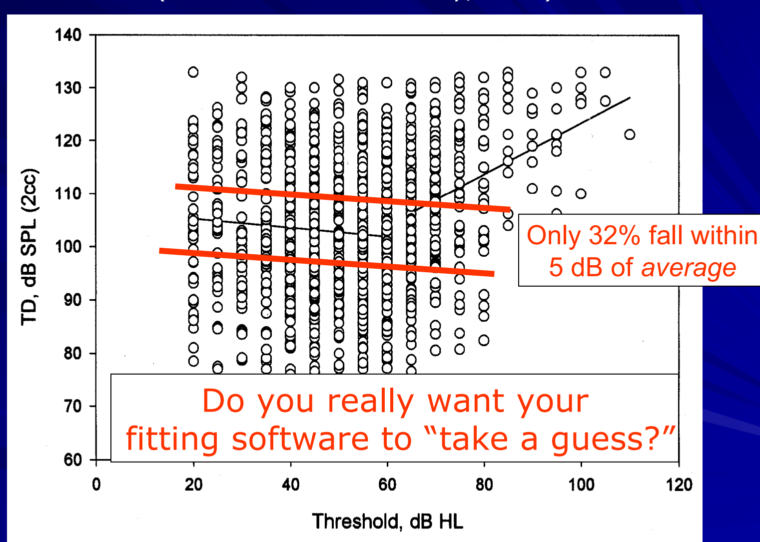
- Neither audiologists or HIS's are very int… , or usi… ring aid…

What we don't really *know*, but logic certainly would suggest it is true: If dispensers put more effort into getting the output "right", hearing aid users would be happier (and the world would be a better place!)

LDL variance as a function of hearing loss

(From Bentler and Cooley, 2001)

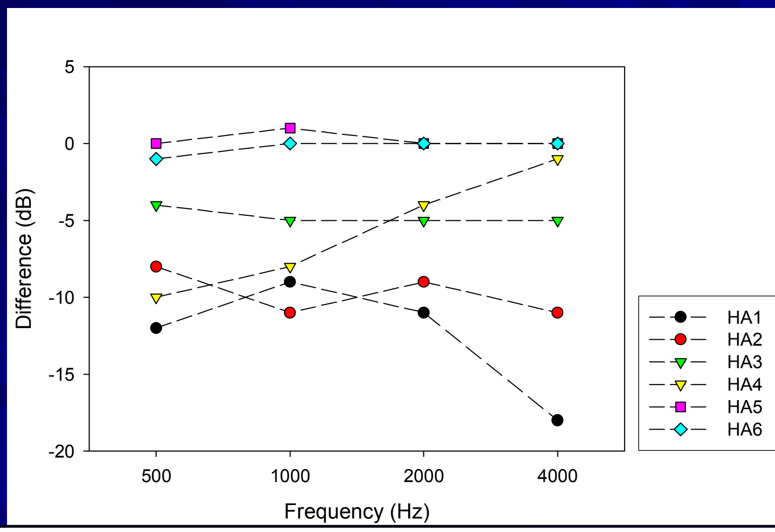


Do you really want your computer software to do your thinking for you?

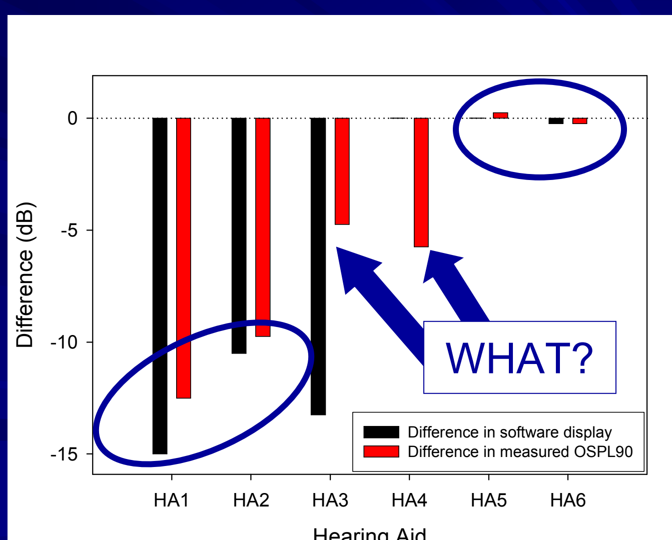
- Mueller et al (2008) examined differences among the "manufacturer's" maximum output settings for 6 popular hearing aids, all fitted to the same hearing loss.
- Maximum output levels were measured for when LDLs were not entered, and also when they were.
- Actual measured output values were compared to values shown on the fitting screen

Maximum output selected by fitting software for 50 dB loss when no LDLs were entered

Change in maximum output when 90 dB LDLs were entered



Change in measured versus software when 90 dB LDLs were entered



A “must read” article from the November 2008 *Hearing Journal*

A comparison of manufacturer-specific prescriptive procedures for infants

By Richard Seewald, Jillian Mills, Marlene Bagatto, Susan Scollie, and Sheila Moodie

Early hearing detection and communication development (EHDCD) programs enable us to identify hearing loss in early infancy, making intervention by 6 months of age a reasonable goal. For infants and children fitted with hearing instruments, it is critical that the devices be adjusted appropriately so that the pre-lingual listener has full and

a function of frequency. Prescriptive algorithms provide the foundation on which the hearing instrument performance characteristics are selected for the infant or child to be fitted. Recent survey data indicate that most audiologists fitting hearing aids to infants and young children use a published hearing aid prescriptive procedure.[6,9] At pre-

verification stages and that includes the measurement of hearing aid output lim-

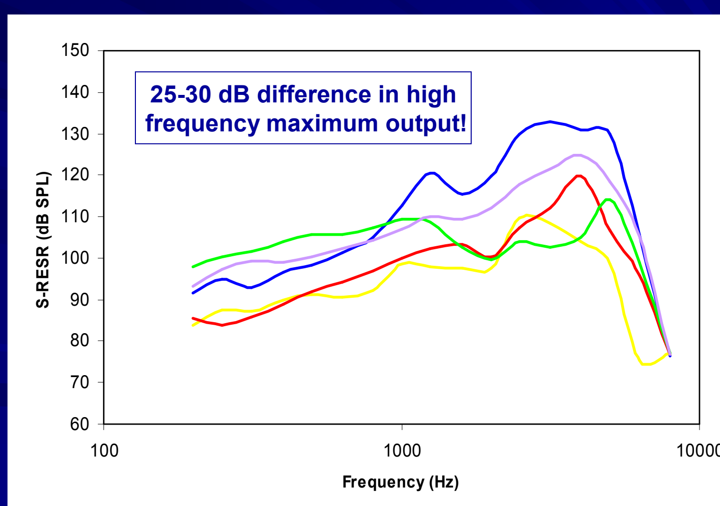
“…an infant can end up with

algorithms makes it difficult for the audiologist to make an informed choice

These authors compared software differences for a young child, but you’ll see similar differences for adults

Measured S-RESR output for five different manufactures

(Gently sloping moderate hearing loss)



So . . . It seems like we really need to do some testing, which could be:

- Pre-testing of LDLs to assist in getting the maximum output set correctly, or
- Verification of real ear output at time of the fitting using probe-mic measures, or
- Verification of real ear output at time of the fitting using aided behavioral measures, or
- Verification of real ear output following the fitting using questionnaires about real-world experiences, or

YOU COULD DO ALL FOUR!

What we're going to talk about today

- How to use the HL LDL to make software hearing aid output adjustments
- How to use both AGCi (WDRC) and AGCo compression to "get the output right".
- How to verify the output using probe-mic REAR and RESR measures
- How to verify the output using aided behavioral measures
- How to verify the output using self-assessment questionnaires

To get started—let's talk about earphone LDL testing: Recall that we covered all these topics in Part I

- When do I do the testing?
- What stimuli do I use?
- What psychophysical procedure do I use?
- How do I define the point of "uncomfortable?"
- What instructions do I use?
- What frequencies should I test?

Loudness Chart from Cox Contour Test

- #7 Uncomfortably Loud
- #6 Loud, But Okay
- #5 Comfortable, But Slightly Loud
- #4 Comfortable
- #3 Comfortable, But Slightly Soft
- #2 Soft
- #1 Very Soft
- #0 Cannot Hear

A reminder on terminology:

- RETSPL: The difference between the output of an audiometer in HL and its output in a 2-cc or 6-cc coupler. Because we're working with hearing aids, we'll talk insert earphones which are calibrated in a 2-cc coupler (Just Like Hearing Aids!)
- REDD (Real Ear Dial Difference): The difference between the HL (e.g., in this case the patient's LDL) and the earcanal SPL for the same dial setting.

More on terminology:

- If you want to go from HL to 2-cc coupler:

  HL + RETSPL = 2-cc Coupler
- If you want to go from 2-cc coupler (SPL) to the real ear SPL (RESPL):

  2-cc coupler + RECD = RESPL
- Therefore if you want to go from HL (dial setting) directly to the real ear SPL:

  HL + RETSPL + RECD = RESPL
- The (RETSPL + RECD) is termed the REDD, so:

  HL + REDD = RESPL

Relax, it's all pretty easy—let's put it to practice:

- Your patient has a downward sloping hearing loss going from 35 dB in the lows to 70 dB in the highs. You just finished testing earphone LDLs (insert phones) at two frequencies: 500 Hz and 2000 Hz.
- You used 2-dB steps and found LDLs (#7 rating on Cox Chart) of 102 dB for 500 Hz and 108 dB for 3000 Hz.
- You need to know where to set the AGCo kneepoint, so we need to convert to 2-cc coupler—remember the formula?
- All we need is our RETSPLs and we're ready to go . . .

Let's assume your audiometer is calibrated correctly:

ANSI S3.6 AND ISO 389.2 REFERENCE THRESHOLDS
Sound Pressure Levels in dB re. 20µPa

Frequency (Hz)	Occluded Ear Simulator	HA-2 with Rigid Tube	HA-1
125	28.0 (98.0)	26.0 (96.0)	26.5 (86.5)
250	17.5 (87.5)	14.0 (84.0)	14.5 (84.5)
500	9.5 (79.5)	5.5 (75.5)	6.0 (76.0)
750	6.0 (76.0)	2.0 (72.0)	2.0 (72.0)
1000	5.5 (75.5)	0.0 (70.0)	0.0 (70.0)
1500	9.5 (79.5)	2.0 (72.0)	0.0 (70.0)
2000	11.5 (81.5)	3.0 (73.0)	2.5 (72.5)
3000	13.0 (83.0)	3.5 (73.5)	2.5 (72.5)
4000	15.0 (85.0)	5.5 (75.5)	0.0 (70.0)
6000	16.0 (86.0)	2.0 (72.0)	-2.5 (67.5)
8000	15.5 (85.5)	0.0 (70.0)	-3.5 (66.5)

Table 1

ER-3A INSERT EARPHONE

CALIBRATION IN A 2CC COUPLER

Table 1 shows the Reference Equivalent Threshold Sound Pressure Levels (RETSPLs) measured in three couplers. The couplers are:

1. A[illegible]cluded ear simulator as described in ANSI S3.7 and IEC 711 that closely replicates the acoustic properties of the average ear canal and eardrum. ANSI standard 3.6-1996 calls for the HA-2 sound channel to be substituted for the sound channel in the eartip.
2. An HA-1 2cc coupler with the ER-3 eartip sealed to the top surface of the coupler.
3. An HA-2 2cc coupler with rigid tube. In this case the sound channel of the coupler is substituted for the sound channel in the eartip.

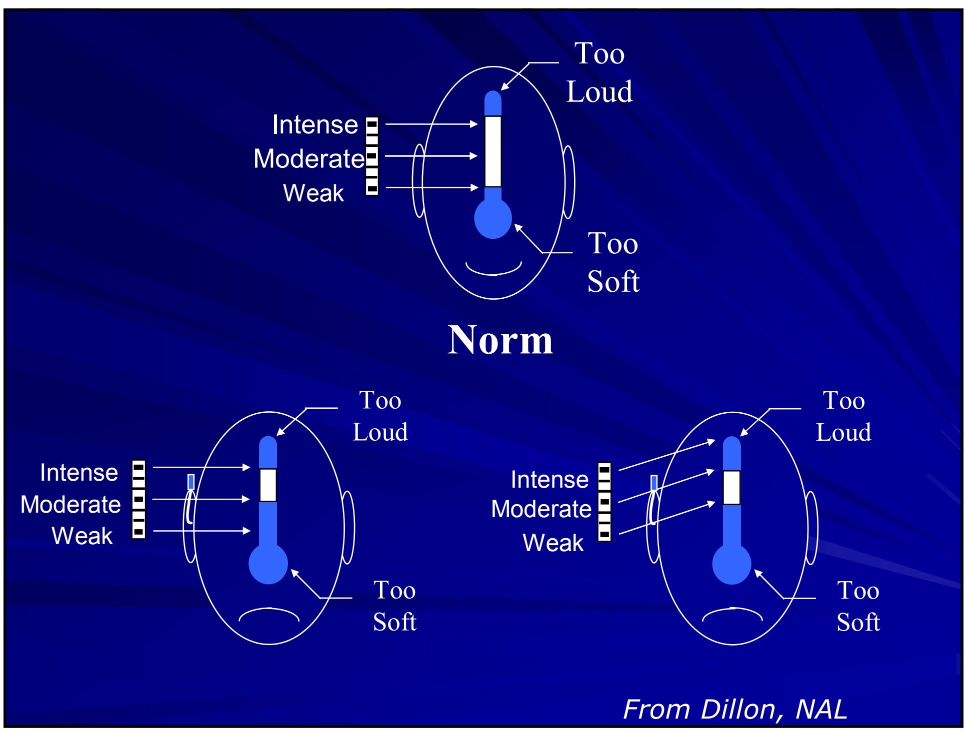
Audiometer calibration is normally performed at a dial setting of 70 dB HL. The calibration targets shown in parentheses next to the RETSPL numbers in Table 1 were obtained by adding 70 dB to each RETSPL number.

So we now know:
RETSPL 500 Hz = 6.0 dB
RETSPL 3000 Hz = 2.5 dB

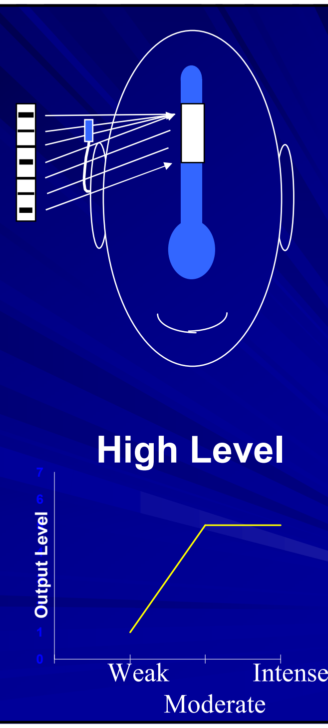
So now we easily can determine our 2-cc coupler settings:

- 500 Hz: 102 dB + 8 dB = 110 dB;
  3000 Hz: 108 dB + 2.5 dB = 110.5 dB
- Now: Some might say these settings could be too high, as we used #7 rather than #6
- On the other hand: Some might say they are too low, as we're basing it on tones, not broad-band signals (narrow-band signals drive the hearing aid to a higher MPO than broad-band signals)

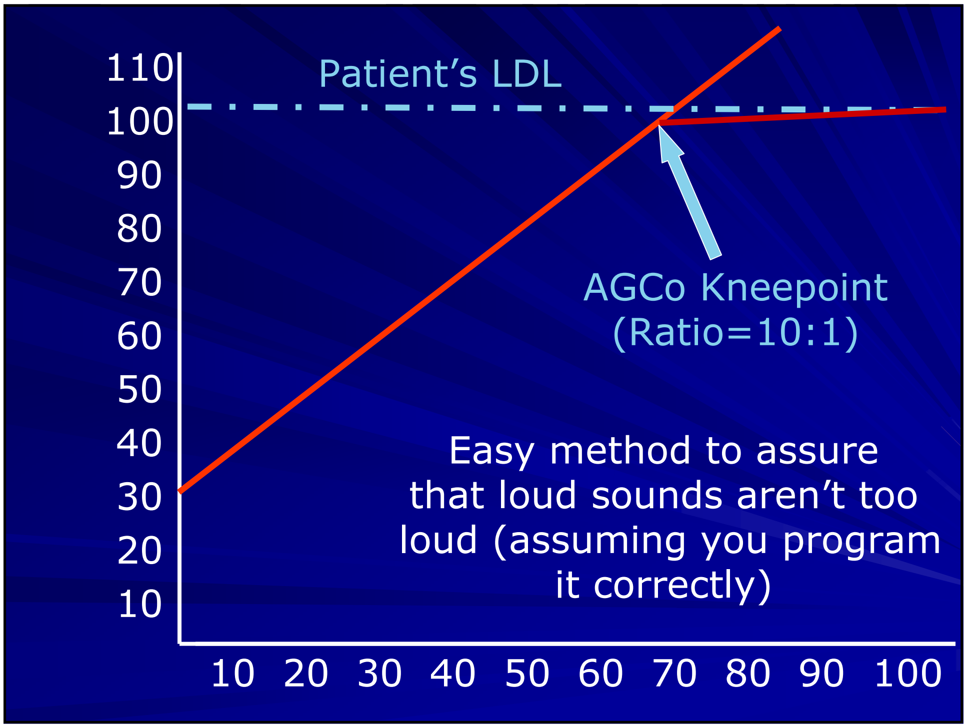
Regardless: We're in a much better place than if we'd just taken a guess!



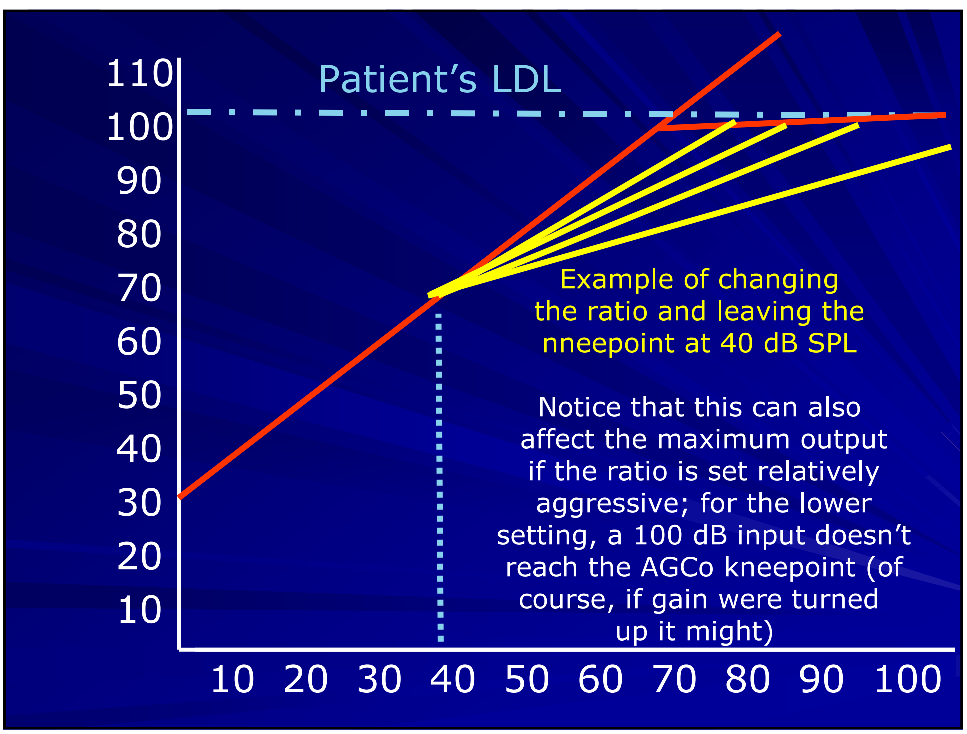
- High level compression works to limit loud sounds, but usually average-to-loud inputs are "stacked" at the top. Can make the world "muffled" and less dynamic and exciting.



- WDRC can be used to effectively "repackage" sounds of all inputs into the user's residual dynamic range.

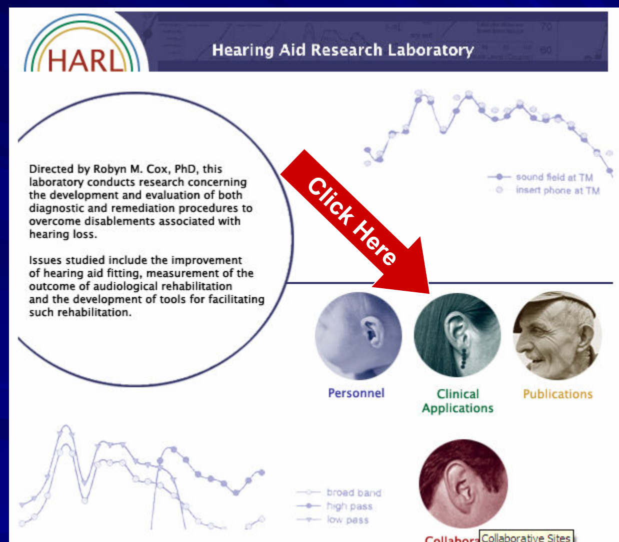


110
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90 100
Patient’s LDL
AGCo Kneepoint
(Ratio=10:1)
Easy method to assure
that loud sounds aren’t too
loud (assuming you program
it correctly)

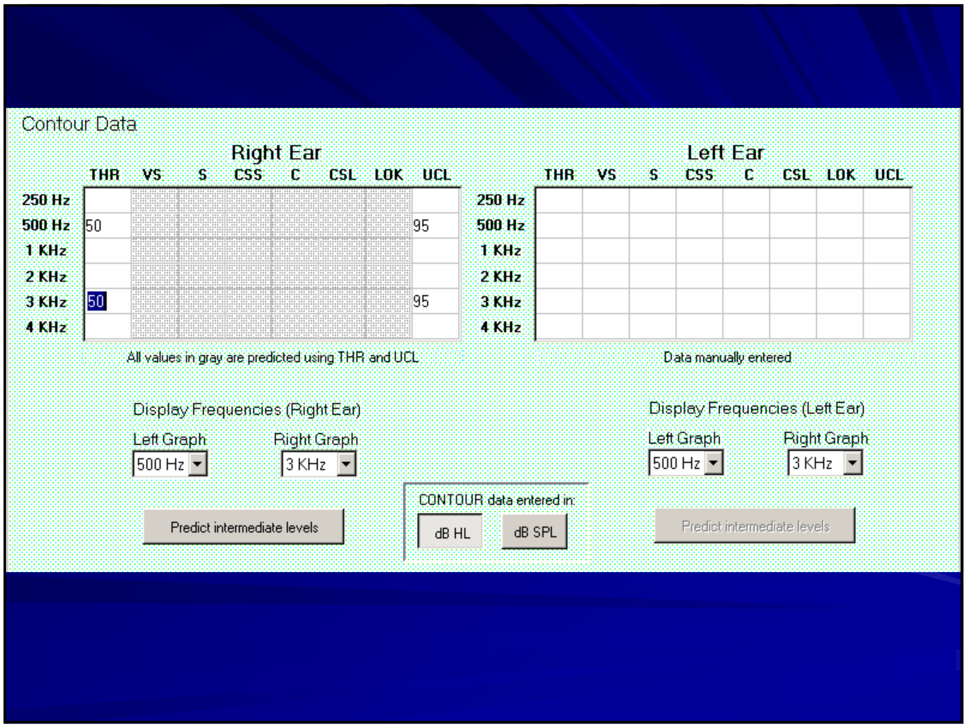


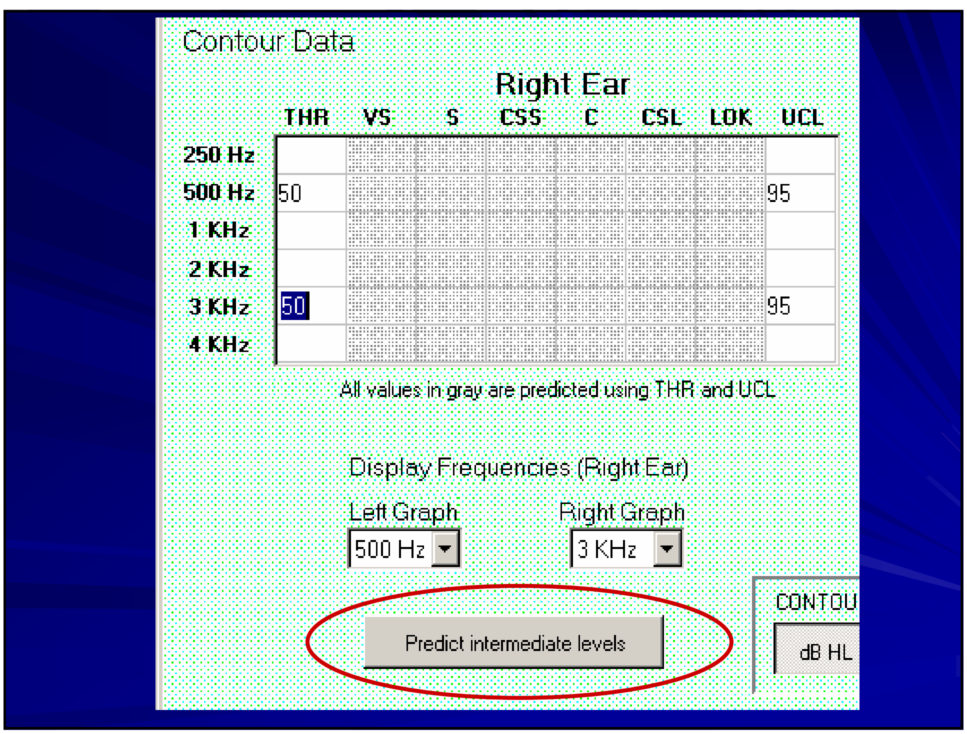
110
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90 100
Patient’s LDL
Example of changing
the ratio and leaving the
nneepoint at 40 dB SPL
Notice that this can also
affect the maximum output
if the ratio is set relatively
aggressive; for the lower
setting, a 100 dB input doesn’t
reach the AGCo kneepoint (of
course, if gain were turned
up it might)

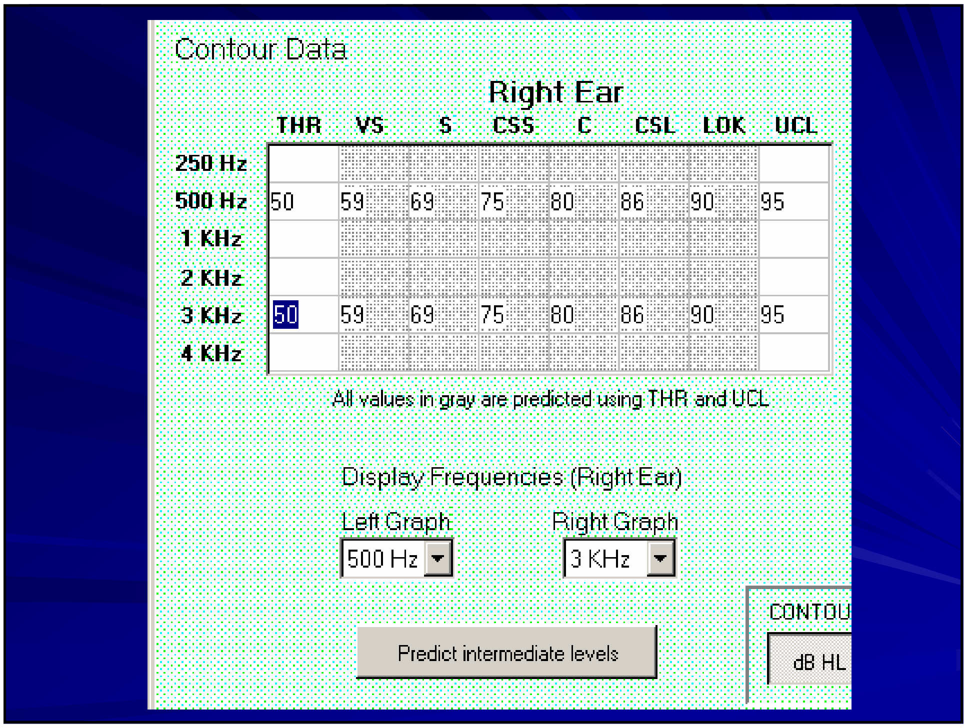
Go to Robyn Cox's lab at:
www.ausp.memphis.edu/harl

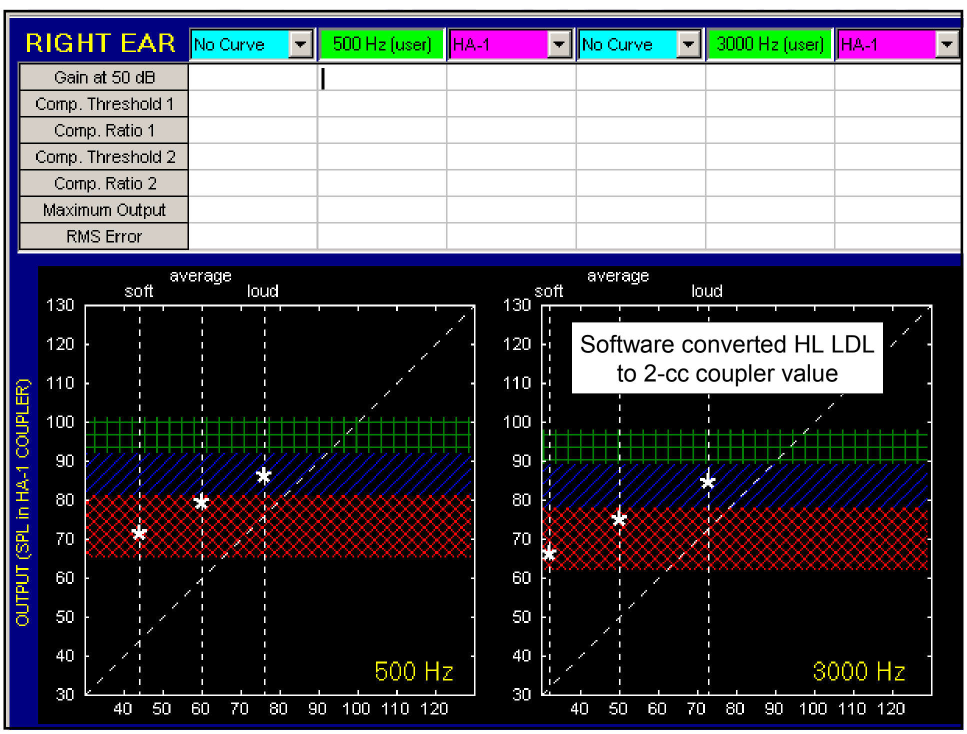


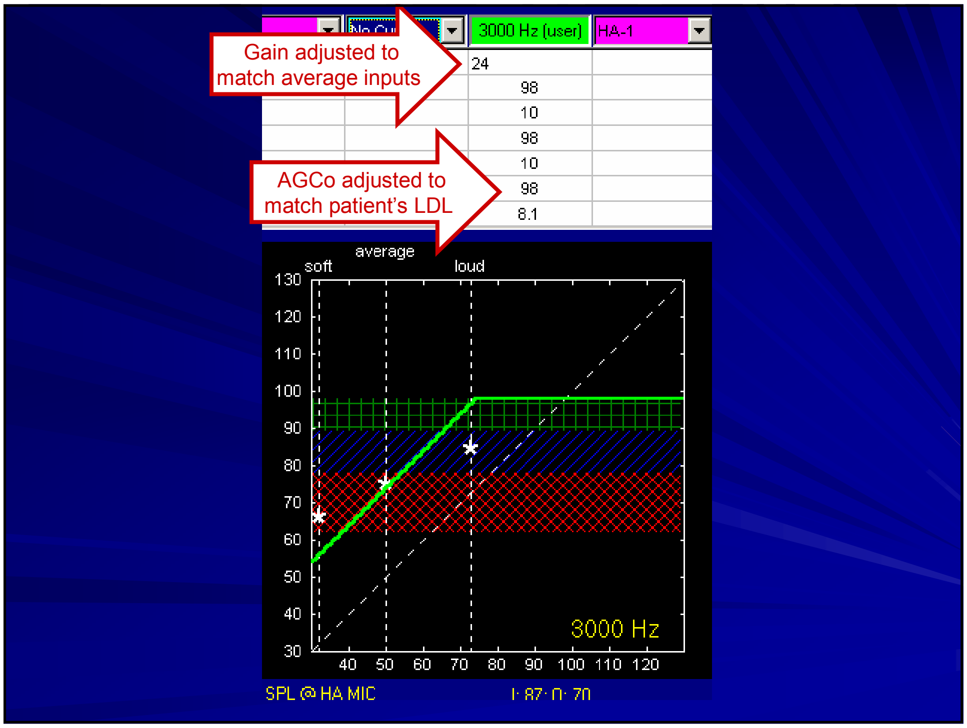
There is a "treasure chest" of useful stuff here, but for now we're going to go to *VIOLA*


Contour Data
Right Ear
THR VS S CSS C CSL LOK UCL
250 Hz
500 Hz 50 95
1 KHz
2 KHz
3 KHz 50 95
4 KHz
All values in gray are predicted using THR and UCL
Left Ear
THR VS S CSS C CSL LOK UCL
250 Hz
500 Hz
1 KHz
2 KHz
3 KHz
4 KHz
Data manually entered
Display Frequencies (Right Ear)
Left Graph
500 Hz
Right Graph
3 KHz
Display Frequencies (Left Ear)
Left Graph
500 Hz
Right Graph
3 KHz
CONTOUR data entered in:
dB HL
dB SPL
Predict intermediate levels
Predict intermediate levels

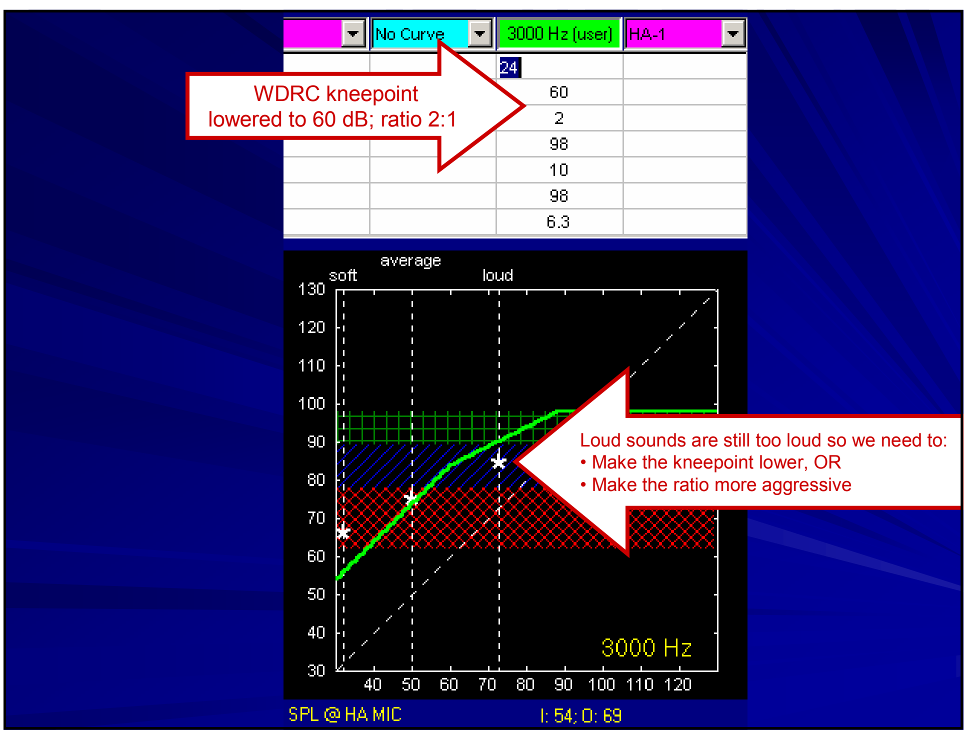

Contour Data
Right Ear
THR VS S CSS C CSL LOK UCL
250 Hz
500 Hz 50 95
1 KHz
2 KHz
3 KHz 50 95
4 KHz
All values in gray are predicted using THR and UCL
Display Frequencies (Right Ear)
Left Graph
500 Hz
Right Graph
3 KHz
CONTOU
dB HL
Predict intermediate levels


Contour Data
Right Ear
THR VS S CSS C CSL LOK UCL
250 Hz
500 Hz 50 59 69 75 80 86 90 95
1 KHz
2 KHz
3 KHz 50 59 69 75 80 86 90 95
4 KHz
All values in gray are predicted using THR and UCL
Display Frequencies (Right Ear)
Left Graph
500 Hz
Right Graph
3 KHz
Predict intermediate levels
CONTOU
dB HL

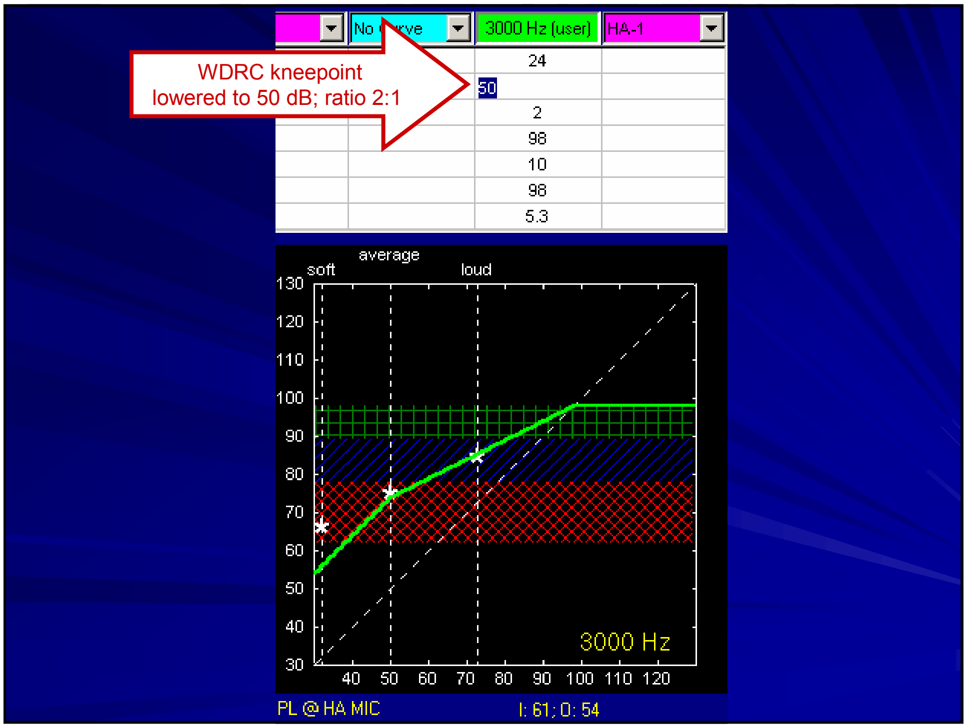

RIGHT EAR
No Curve
500 Hz (user)
HA-1
No Curve
3000 Hz (user)
HA-1
Gain at 50 dB
Comp. Threshold 1
Comp. Ratio 1
Comp. Threshold 2
Comp. Ratio 2
Maximum Output
RMS Error
OUTPUT (SPL in HA-1 COUPLER)
soft
average
loud
500 Hz
3000 Hz
Software converted HL LDL to 2-cc coupler value

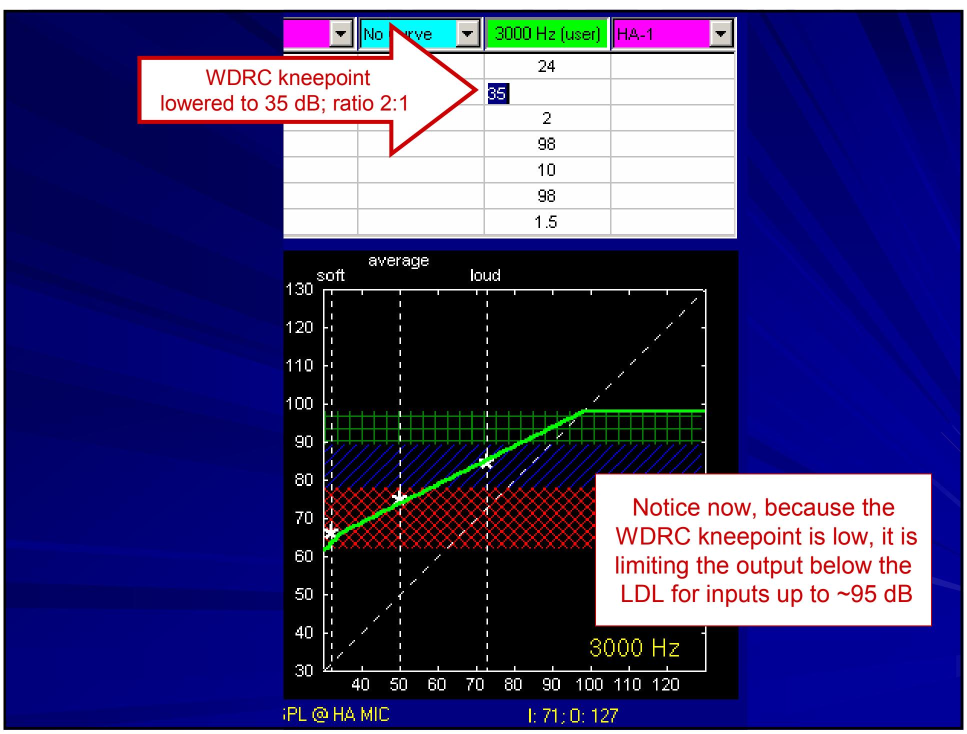


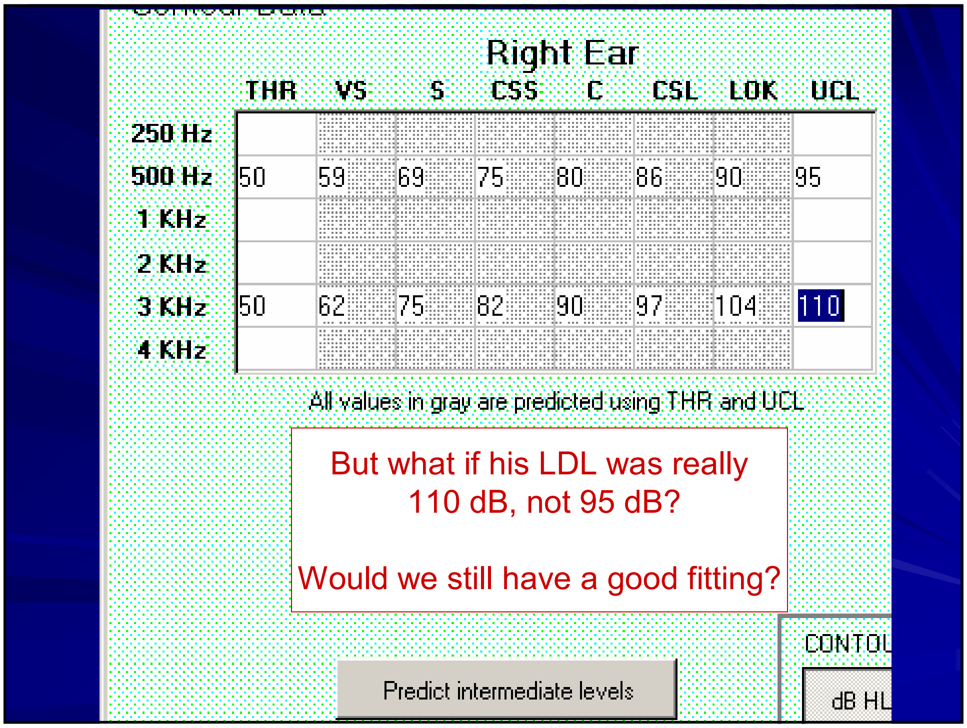
Gain adjusted to match average inputs
AGCo adjusted to match patient's LDL
3000 Hz (user)
HA-1
24
98
10
98
10
98
8.1
average
soft
loud
3000 Hz
SPL @ HA MIC

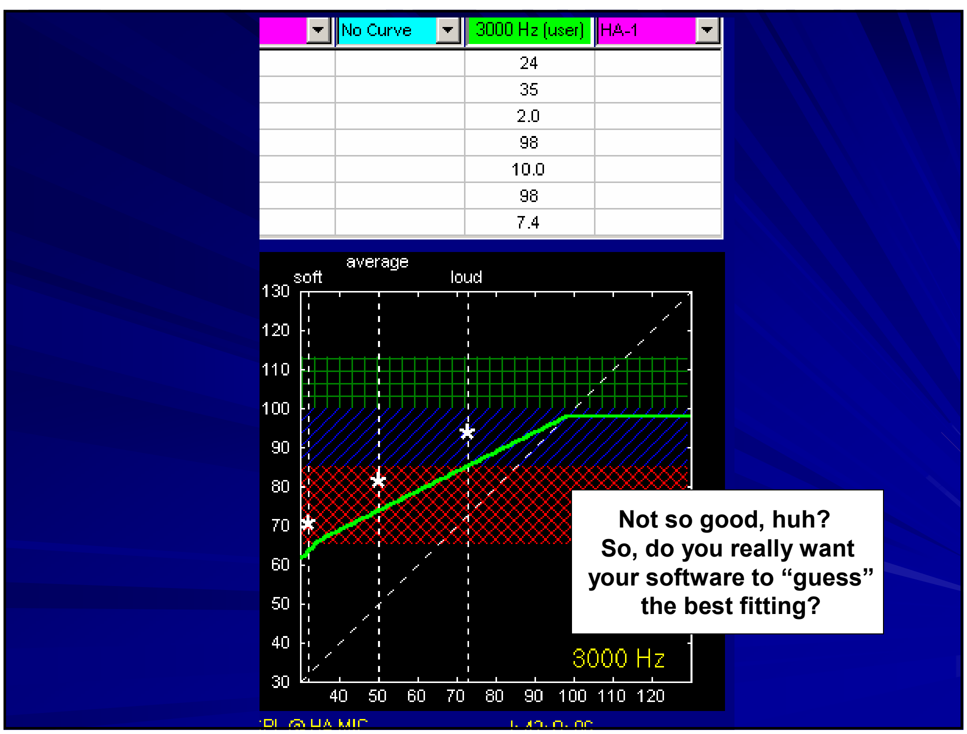


No Curve
3000 Hz (user)
HA-1
WDRC kneepoint lowered to 60 dB; ratio 2:1
24
60
2
98
10
98
6.3
average
soft
loud
Loud sounds are still too loud so we need to:
• Make the kneepoint lower, OR
• Make the ratio more aggressive
3000 Hz
SPL @ HA MIC
I: 54; O: 69


WDRC kneepoint
lowered to 50 dB; ratio 2:1
3000 Hz (user)
HA-1
24
50
2
98
10
98
5.3
average
soft
loud
3000 Hz
PL @ HA MIC
I: 61; O: 54


WDRC kneepoint
lowered to 35 dB; ratio 2:1
3000 Hz (user)
HA-1
24
35
2
98
10
98
1.5
average
soft
loud
Notice now, because the WDRC kneepoint is low, it is limiting the output below the LDL for inputs up to ~95 dB
3000 Hz
PL @ HA MIC
I: 71; O: 127


Right Ear
THR VS S CSS C CSL LOK UCL
250 Hz
500 Hz 50 59 69 75 80 86 90 95
1 KHz
2 KHz
3 KHz 50 62 75 82 90 97 104 110
4 KHz
All values in gray are predicted using THR and UCL
But what if his LDL was really 110 dB, not 95 dB?
Would we still have a good fitting?
Predict intermediate levels
CONTOU
dB HL


No Curve
3000 Hz (user)
HA-1
24
35
2.0
98
10.0
98
7.4
soft
average
loud
130
120
110
100
90
80
70
60
50
40
30
40 50 60 70 80 90 100 110 120
3000 Hz
Not so good, huh?
So, do you really want your software to "guess" the best fitting?

Regarding the "treatment" for "things are too loud"

- If soft and average sounds are also too loud, simply turning down overall gain may solve the problem (although this does not lower the MPO, only reduces the likelihood it will be reached).
- If loud environmental sounds are too loud (e.g., "uncomfortably loud"), then turning down the AGCo kneepoint is recommended.
- If loud environmental sounds are "loud, but okay," but loud speech is too loud, then adjusting WDRC is recommended:
  - Make the compression ratio more aggressive
  - Make the compression kneepoint lower

Remember this slide from earlier?

- If you want to go from HL to 2-cc coupler:

  HL + RETSPL = 2-cc Coupler
- If you want to go from 2-cc coupler (SPL) to the real ear SPL (RESPL):

  2-cc coupler + RECD = RESPL
- Therefore if you want to go from HL (dial setting) directly to the real ear SPL:

  HL + RETSPL + RECD = RESPL
- The (RETSPL + RECD) is termed the REDD, so:

  HL + REDD = RESPL

Just for fun, let's do some math!

- Let's say that you just tested your Monday morning patient, and learned that his HL LDL is 100 dB (we'll keep it easy; round numbers and only do one frequency).
- Therefore, using our RESPL formula:

100 + RETSPL + RECD = RESPL LDL

Let's assume our audiometer is calibrated, and that we used insert earphones: Here is the RETSPL table that you saw before

ANSI S3.6 AND ISO 389.2 REFERENCE THRESHOLDS
Sound Pressure Levels in dB re. 20µPa

Frequency (Hz)	Occluded Ear Simulator	HA-2 with Rigid Tube	HA-1
125	28.0 (98.0)	26.0 (96.0)	26.5 (86.5)
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500	9.5 (79.5)	5.5 (7[illegible]	6.0 (76.0)
750	6.0 (76.0)	[illegible]	2.0 (72.0)
1000	[illegible]	0.0 (70.0)	0.0 (70.0)
1500	[illegible] (79.5)	2.0 (72.0)	0.0 (70.0)
2000	[illegible]1.5 (81.5)	3.0 (73.0)	2.5 (72.5)
3000	13.0 (83.0)	3.5 (73.5)	2.5 (72.5)
4000	15.0 (85.0)	5.5 (75.5)	0.0 (70.0)
6000	16.0 (86.0)	2.0 (72.0)	-2.5 (67.5)
8000	15.5 (85.5)	0.0 (70.0)	-3.5 (66.5)

Table 1

RETSPL for 2KHz is 2.5 dB

Just for fun, let's do some math!

- Let's say that you just tested your Monday morning patient, and learned that his HL LDL is 100 dB (we'll keep it easy; round numbers and only do one frequency).
- Therefore, using our RESPL formula:

100 + 2.5 + RECD = RESPL LDL

Since we're not going to measure the RECD, we'll just look at a table of average values

Age/Freq	250	500	750	1000	1500	2000	3000	40[illegible]	[illegible]000
1 month	3	8	9	12	15	15	16	[illegible]	23
12 months	3	6	8	10	10	11	11	[illegible]	17
24 months	3	5	7	9	9	10	[illegible]	14	15
36 months	3	5	7	9	8	9	[illegible]	13	14
60 months	3	5	7	9	7	8	8	13	13
8 yrs - Adult	3	4	6	8	7	7	8	13	13

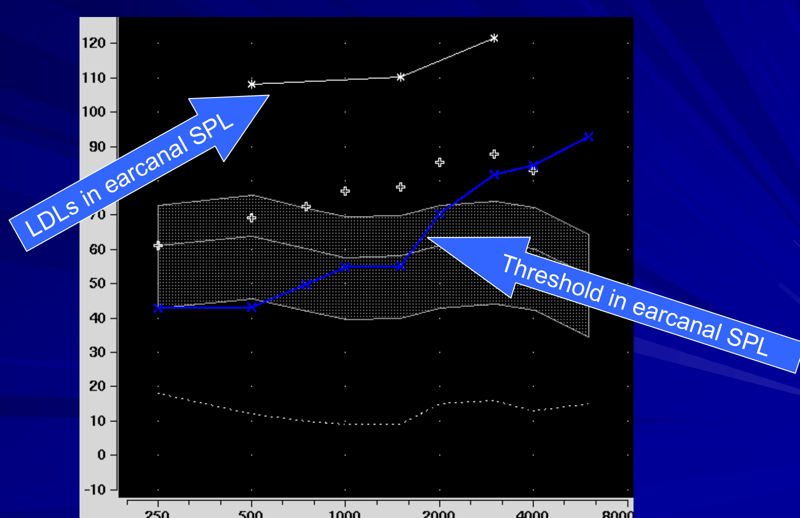
RECD (average) for 2KHz is 7 dB

Just for fun, let's do some math!

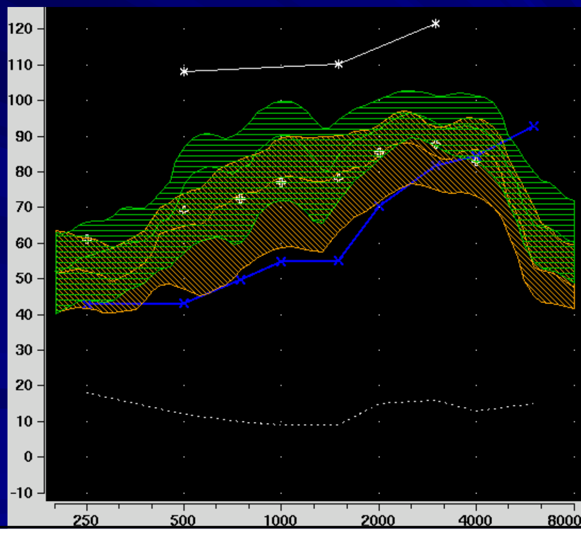
- Let's say that you just tested you Monday morning patient, and learned that his HL LDL is 100 dB (we'll keep it easy; round numbers and only do one frequency).
- Therefore, using our RESPL formula:

$$100 + 2.5 + 7 = 109.5 \text{ (earcanal SPL LDL)}$$

So we now have an REDD to convert both the patient's thresholds and the LDL to earcanal SPL values



Using real speech you would first verify your fitting for soft and average inputs
(That's a talk for another day!)

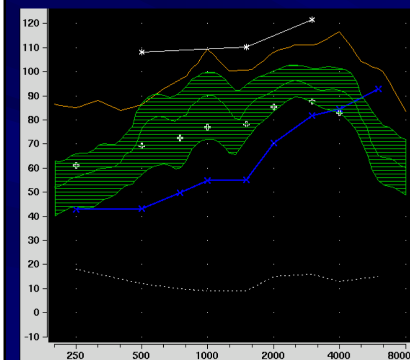


For today, we're interested in:

>Output for speech at 75 dB SPL

>Maximum output for swept tone (RESR)

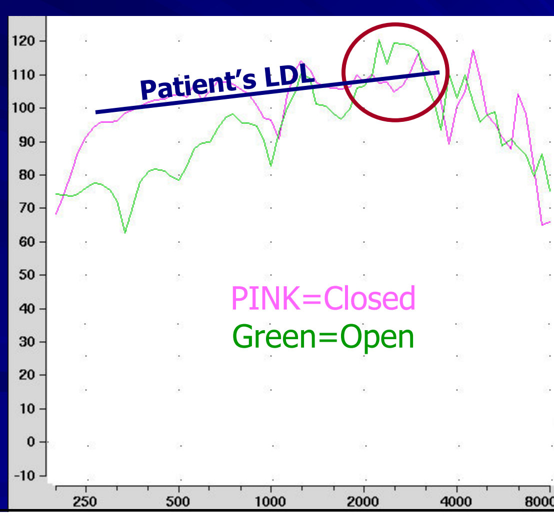
Let's consider the possibilities:



- If we can't get rid of the peak at 100 Hz, then we really can't raise the AGCo kneepoint.
- If we can get rid of the peak, then the AGCo kneepoint could go up by 10 dB or so. Looks like maybe we need more AGCi compression for the 1000 Hz range.
- But . . . It could be the WDRC not the AGCo is limiting the output in the 1500 to 4000 Hz region. Raising the AGCo kneepoint might not change anything.
- If we need that aggressive AGCi compression to match our 75 dB SPL speech inputs, then we probably shouldn't mess with things.

The beauty is: Our repeated probe mic measures will tell us what works and what doesn't!

And, as we discussed in Part I, because of residual earcanal resonance, there are often output issues with OC fittings too. In fact, the MPO for open often is higher than for a closed fitting.



Getting the output right . . .

- If you conduct frequency-specific LDL measures and then set the WDRC parameters and AGCo kneepoints accordingly, and . . .
- Using probe-mic testing you carefully measure the RESR and the output for high level speech inputs (and then adjust the hearing aid's gain and output accordingly) . . .
- Is there any need to conduct aided behavioral testing for loudness verification?

YES . . . And here are the reasons why!

A few reasons why aided behavioral measures are a useful cross-check

- Reason #1: Monaural loudness summation: Much of our testing and hearing aid adjustments are based on pure-tone information. We know that there is summation for broad-band signals (speech) and this is accounted for in our calculations—for the *average* patient.
- Reason #2: There is also channel summation—prescriptive methods attempt to account for this, but it is difficult to predict—a quick tutorial on channel summation and how it could affect loudness:

A simplified version of channel summation, for a four channel WDRC instrument:

- Let's say you delivered a flat 60 dB SPL signal to a single-channel instrument that had a WDRC kneepoint of 50 dB SPL. The WDRC would "see" 60 dB and provide whatever gain you prescribed for this input. We'll say it was 20 dB.
- Now, we'll make this a four-channel hearing aid (equal channels) and deliver the same input signal. That 60 dB is now divided among four channels, so (in theory) you would have 54 dB SPL in each channel: 54 + 54 + 54 + 54 = 60 dB (your second grade math teacher might not have agreed with this, but it's true).

A simplified version of channel summation, for a four channel WDRC instrument:

- The hearing aid now delivers the gain programmed in each channel for a 54 dB SPL signal, not 60 dB. This of course is more than 20 dB (as you know, with WDRC, the lower the input the more the gain).
- The extra gain from these four channels now sums, and the net result is that the overall output is higher. The more the channels, the greater the possibility of summation.

For now, let's just conclude by saying that it happens, and the magnitude is difficult to predict.

Bilateral (binaural) summation

- Much of the “summation research” has been conducted under earphones or soundfield. Is summation using hearing aids the same?
- Probably not, and for this (and other) reason(s) hearing aid bilateral summation research has not all reached the same conclusions.
- What we generally know (or tend to believe):
  - Summation is around 2-3 dB at threshold and becomes greater as the input become higher
  - Bilateral summation varies considerably among patients (~3 to 10 dB or so); average for average-level inputs is considered to be around 3-6 dB
  - Most fitting methods account for this summation effect

General procedures (modeled after 1994 IHAFF protocol):

- Use the 7-point loudness anchors from the Cox Contour test.
- Present continuous discourse “soundfield.” (Could be in test booth, but reverberant room is okay too, and maybe even better).
- Conduct loudness ratings (speech inputs) for soft (~45 dB SPL), average (~60-65 dB SPL) and loud (~80-85 dB SPL)
- Conduct testing with patient aided bilaterally (although if problems exist, you may have to do some individual ear identification).
- Also a good idea to include loudness ratings for “obnoxious noises”—more on that shortly.

Conducting the test: What is okay?

For the 45 dB SPL input . . .

- #7 Uncomfortably Loud
- #6 Loud, But Okay
- #5 Comfortable, But Slightly Loud
- #4 Comfortable
- #3 Comfortable, But Slightly Soft OKAY
- #2 Soft GREAT!
- #1 Very Soft OKAY
- #0 Cannot Hear

Conducting the test: What is okay?

For the 65 dB SPL input . . .

- #7 Uncomfortably Loud
- #6 Loud, But Okay
- #5 Comfortable, But Slightly Loud OKAY
- #4 Comfortable GREAT!
- #3 Comfortable, But Slightly Soft OKAY
- #2 Soft
- #1 Very Soft
- #0 Cannot Hear

Conducting the test: What is okay?

For the 85 dB SPL input . . .

- #7 Uncomfortably Loud ← NOT OKAY
- #6 Loud, But Okay ← GREAT!
- #5 Comfortable, But Slightly Loud ← OKAY
- #4 Comfortable
- #3 Comfortable, But Slightly Soft
- #2 Soft
- #1 Very Soft
- #0 Cannot Hear

Obnoxious noise testing . . .

- The aided obnoxious noise test for loudness has been around for quite a while. Many of you have used:
  - The hand clap
  - The drawer slam
  - The book drop

HARL Hearing Aid Research Laboratory

But now . . . From the lab of Robyn Cox,
we have a test with some science behind it . . .

What's contained in the HONK:

- Metal 12 oz coffee can with plastic cover
  - Contains three ¾ x 1½ hex-head bolts; four 5/8 inch hex nuts
  - Hold horizontally and shake can near the patient
  - Makes flat broad-band noise of about 80 dB SPL with peaks about 100 dB SPL
- Two glass jars (16 oz) with 24 or so marbles
  - Poor the marbles back and forth between jars near the patient
  - Makes high-frequency noise in 5-10K range with a level around 100 dB SPL and peaks up to 115 dB SPL.

Use the same anchors and decision making as before:

For either of the noise makers . . .

- #7 Uncomfortably Loud — NOT OKAY
- #6 Loud, But Okay — GREAT!
- #5 Comfortable, But Slightly Loud — OKAY
- #4 Co
- #3 Co
- #2 So
- #1 Very Soft
- #0 Cannot Hear

For details and supporting research, check out Robyn's Page Ten articles in the September and October, 2009 *Hearing Journal*

Getting to know your new "PAL"

PROFILE OF AIDED LOUDNESS

Name: ____________________
Date: ____________________

Status: __ unaided __ previous hearing aids
___ current hearing aids

Instructions: Please rate the following items by both the level of loudness of the sound and by the appropriateness of that loudness level. For example, you might rate a particular sound as "Very Soft." If "Very Soft" is your preferred level for this sound, then you would rate your loudness satisfaction as "Just Right." If, on the other hand, you think the sound should be louder than "Very Soft", then your loudness satisfaction rating might be "Not Too Good" or "Not Good At All." The Loudness Satisfaction rating is not related to how pleasing the sound is to you, but rather, the appropriateness of the loudness. Here is an example:

The hum of a refrigerator motor:

Loudness rating	Satisfaction rating
0 Do not hear	5. Just right
1 Very soft	4. Pretty good
2 Soft	3. Okay
3 Comfortable, but slightly soft	2. Not too good
4 Comfortable	1. Not good at all
5 Comfortable, but slightly loud	
6 Loud, but OK	
7 Uncomfortably loud	

In this example, the hearing aid user rated the loudness level of a refrigerator motor running as "Comfortable, but slightly soft" and rated his loudness satisfaction for this sound as "Just right." This satisfaction rating indicates that the person believes that it is appropriate for a refrigerator motor to sound "Comfortable, but slightly soft."

There are four questions related to loud sounds, which ~75% of normal hearing people rate as #6

10. A barking dog:

Loudness rating	Satisfaction rating
0 Do not hear	5. Just right
1 Very soft	4. Pretty good
2 Soft	3. Okay
3 Comfortable, but slightly soft	2. Not too good
4 Comfortable	1. Not good at all
5 Comfortable, but slightly loud	
6 Loud, but OK	
7 Uncomfortably loud	

Score sheet for the PAL

Aided Performance

Soft sounds	Q3	Q4	Q5	Q8	Category average
Loudness	___	___	___	___	____(target = 2)
Satisfaction	___	___	___	___	____

Average sounds	Q1	Q6	Q7	Q12	Category average
Loudness	___	___	___	___	____(target = 4)
Satisfaction	___	___	___	___	____

Loud sounds	Q2	Q9	Q10	Q11	Category average
Loudness	___	___	___	___	____(target = 6)
Satisfaction	___	___	___	___	____

Possible outcomes for the PAL
"Life is Good"

Loud sounds	Q2	Q9	Q10	Q11	Category average
Loudness	6	5	6	6	5.7 (target = 6)
Satisfaction	5	5	4	5	4.7

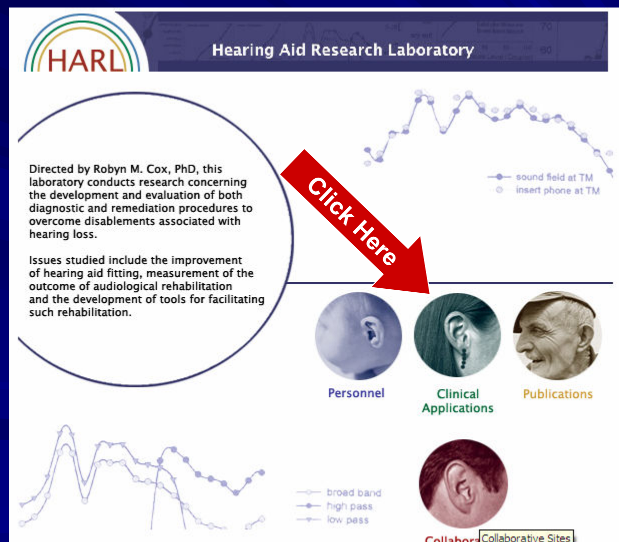
Possible outcomes for the PAL
"Life is a little strange: Need to talk"

Loud sounds	Q2	Q9	Q10	Q11	Category average
Loudness	6	6	6	7	6.2 (target = 6)
Satisfaction	3	3	3	2	2.7

Possible outcomes for the PAL
"Life not good: Time to start over"

Loud sounds	Q2	Q9	Q10	Q11	Category average
Loudness	7	7	7	6	6.7 (target = 6)
Satisfaction	1	2	1	3	1.7

We're going back to visit Robyn Cox: www.ausp.memphis.edu/harl



There is a "treasure chest" of useful stuff here, but for now we're going to go to *APHAB*

Total of 24 questions, 6 questions for four different scales

- EC: Ease of Communication (listening in quiet)
- BN: Listening in Background Noise
- RV: Listening in Reverberation
- AV: Aversiveness (tolerance/annoyance loud sounds)

A

ABBREVIATED PROFILE OF HEARING AID BENEFIT

NAME: ______________________ ☐ Male ☐ Female TODAY'S DATE: ___/___/___

Last *First*

INSTRUCTIONS: Please circle the answers that come closest to your everyday experience. Notice that each choice includes a percentage. You can use this to help you decide on your answer. For example, if a statement is true about 75% of the time, circle "C" for that item. If you have not experienced the situation we describe, try to think of a similar situation that you have been in and respond for that situation. If you have no idea, leave that item blank.

A Always (99%)
B Almost Always (87%)
C Generally (75%)
D Half-the-time (50%)
E Occasionally (25%)
F Seldom (12%)
G Never (1%)

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Sample APHAB questions:

	Without Hearing Aid	With Hearing Aid
1. When I am in a crowded grocery store, talking with the cashier, I can follow the conversation.	A B C D E F G	A B C D E F G
2. I miss a lot of information when I'm listening to a lecture.	A B C D E F G	A B C D E F G
3. Unexpected sounds, like a smoke detector or alarm bell are uncomfortable.	A B C D E F G	A B C D E F G
4. I have difficulty hearing a conversation when I'm with one of my family at home.	A B C D E F G	A B C D E F G
5. I have trouble understanding the dialogue in a movie or at the theater.	A B C D E F G	A B C D E F G
6. When I am listening to the news on the car radio, and family members are talking, I have trouble hearing the news.	A B C D E F G	A B C D E F G
7. When I'm at the dinner table with several people, and am trying to have a conversation with one person, understanding speech is difficult.	A B C D E F G	A B C D E F G
8. Traffic noises are too loud.	A B C D E F G	A B C D E F G
9. When I am talking with someone across a large empty room, I understand the words.	A B C D E F G	A B C D E F G

More sample questions:

A Always (99%)
B Almost Always (87%)
C Generally (75%)
D Half-the-time (50%)
E Occasionally (25%)
F Seldom (12%)
G Never (1%)

	Without Hearing Aids	With Hearing Aids
13. The sounds of running water, such as a toilet or shower, are uncomfortably loud.	A B C D E F G	A B C D E F G
14. When a speaker is addressing a small group, and everyone is listening quietly, I have to strain to understand.	A B C D E F G	A B C D E F G
15. When I'm in a quiet conversation with my doctor in an examination room, it is hard to follow the conversation.	A B C D E F G	A B C D E F G
16. I can understand conversations even when several people are talking.	A B C D E F G	A B C D E F G
17. The sounds of construction work are uncomfortably loud.	A B C D E F G	A B C D E F G
18. It's hard for me to understand what is being said at lectures or church services.	A B C D E F G	A B C D E F G
19. I can communicate with others when we are in a crowd.	A B C D E F G	A B C D E F G

APHAB norms expressed as "percent of problems" (small numbers are *good*)

Users of WDRC capable hearing aids- Unaided				
Percentile	EC	RV	BN	AV
95	99	99	99	70
80	83	87	89	35
65	75	81	81	21
50	63	71	75	14
35	56	65	67	8
20	46	58	58	3
5	26	47	41	1

Users of WDRC capable hearing aids- Aided				
Percentile	EC	RV	BN	AV
95	86	79	82	82
80	39	57	58	64
65	28	46	48	53
50	23	37	40	38
35	17	29	32	23
20	12	21	22	14
5	5	12	14	2

Important things to remember about self-assessment questionnaires on loudness:

- The patient may not have experienced all of the items on the list—you might have to come up with "similar" items on your own.
- It's very likely that the patient will rate loudness "worse" when aided, even when output has been programmed correctly.
- Whenever possible, try to compare patient's ratings with satisfied hearing aid users, or with people with normal hearing.