Thoughts on Verification Your Professor May Not Have Mentioned

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Siemens Expert Series
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Outline

- Introduction to the use of REM by audiologists
- Example of first-fit versus programmed
- Factors to be discussed:
  - REIG using average versus measured REUG
  - Correcting for bilateral fit
  - Correcting for the number of channels of signal processing
  - Average versus measured REDD and impact on REAR measures

Kirkwood Hear J (2010)

"How often do you do REM?

	0%	Occasionally	<50%	50%	Most of Time	Almost Always
Audiologist	29.9	19.5	13.2	7.1	11.5	19.2
HIS	27.0	21.1	8.9	8.9	13.0	21.1

Mueller and Picou Hear J (2010)

"How often do you do REM?

		Seldom or Never	Sometimes	50%	Usually	Almost Always
Audiologist and HIS		34%	18%	6%	12%	30%

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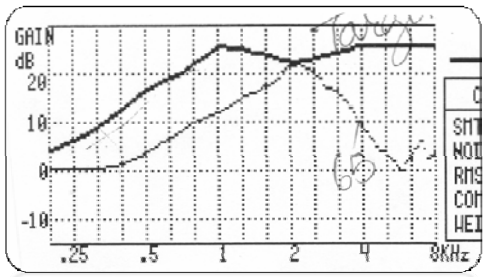
Typical First-Fit



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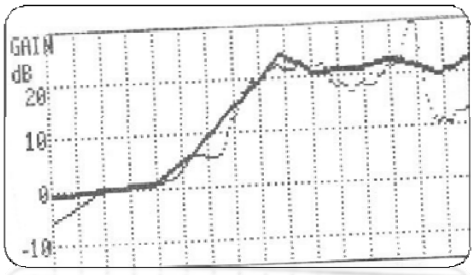
REIG With Verification



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Aazh et al 2012
"The Accuracy of Matching Target Insertion Gain with Open-Fit Hearing Aids"

- N = 51 fittings
- 71% of initial fits failed to be within 10 dB of NAL-NL1 at one or more 7 discrete frequencies between 250-4000 Hz.
- 10 dB is a rather liberal margin for a "acceptable" fit.
- After modification and verification using REM, 18% failed to be within 10 dB of target in one or more frequencies between 250-4000 Hz.
- Several studies (Swan and Gatehouse, 1995; Harrowven, 1998; Norman and James, 2000; Hawkins and Cook, 2003; Aarts and Caffee, 2005; Aazh and Moore, 2007) reported similar findings.
- However, the results from these and other studies as well as two national guidelines (ASHA, 1998; AAA, 2006) have failed to convince most audiologists to routinely use REM to verify the fitting of hearing aids.

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But, for the 20-30% who routinely perform REM's, you might not be aware of…..

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Mueller and Picou (2010)
Hear J 63(5)27-28,30,32

78% use REAR; 22% use REIG, while some use both.

91% of audiologists using REIG use measured REUG

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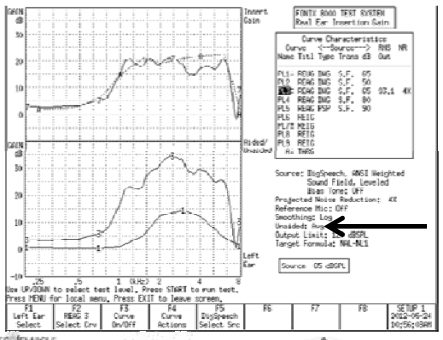
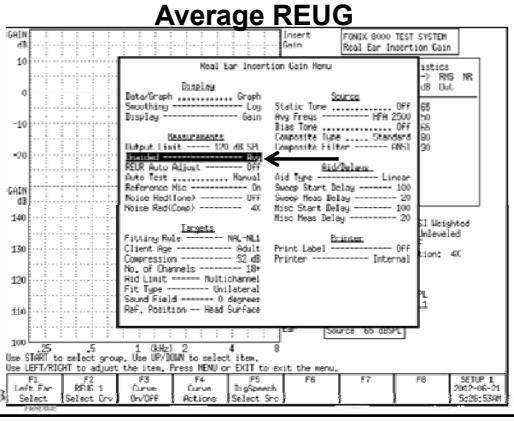
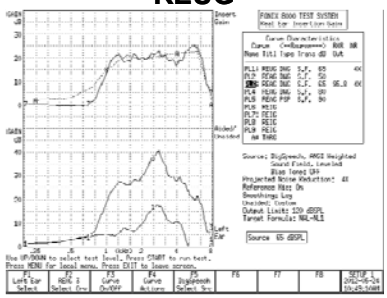
REIG Using Average REUG



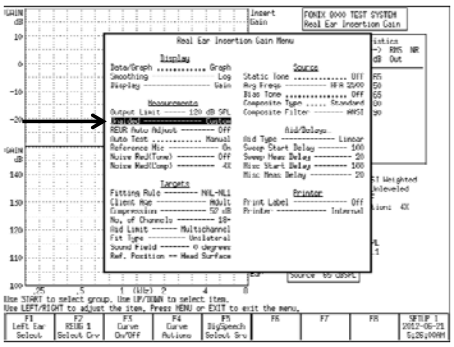
Average REUG



REIG Using Measured REUG



Individual REUG



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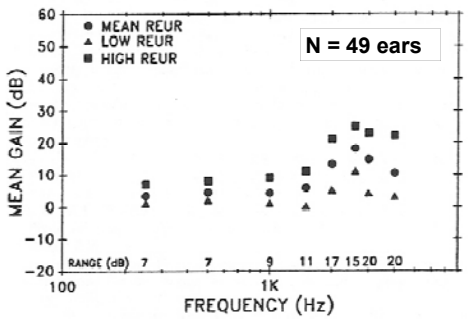
Valente et al 1991



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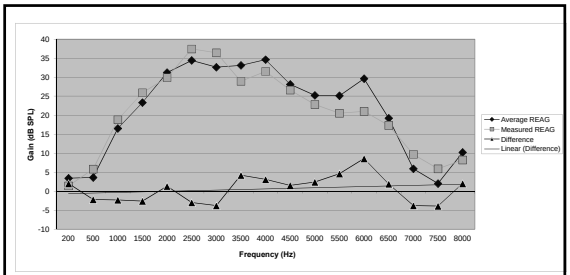

If measured REUG @ any Hz is > than average REUG then > REAG is required to reach target REIG.
If measured REUG @ any Hz is < than average REUG, then < REAG is required to reach target REIG.

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…..the Profession is shifting to REAR

1. Audiology is shifting from REIG to REAR because of the popularity of Verifit and Live Speech Mapping (LSM). Also, REAR measures intuitively make great sense.

2. REAR measures can be SPL-O-Gram or LSM "formats."

3. In my opinion, SPL-O-Gram is a verification tool; LSM is a counseling tool (no standardized signal or input level; no validated target of measured SL).

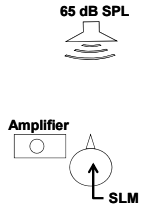
4. SPL-O-Gram uses DSL v5 or NAL-NL1(2) targets for single (linear) or multiple (nonlinear) input levels.

5. Both methods use the DR (in dB SPL) as the target. The DR, however, in both methods is typically predicted based on average transformations after entering the audiogram.

6. Whether one uses REIG or REAR there are errors many may not be aware of.

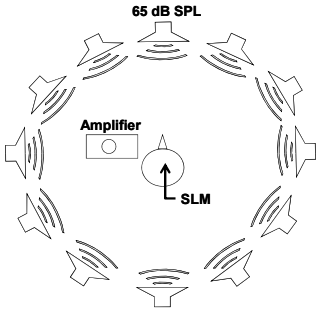
…..failure to correct for bilateral and channel summation

An Analogy to Help Explain Channel Summation

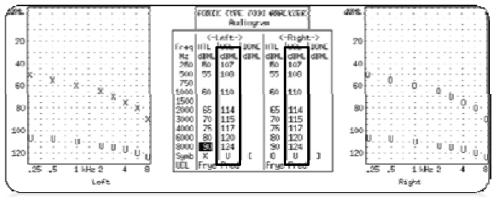


Now, add 11 loudspeakers and keep the input level to each loudspeaker equal

An Analogy to Help Explain Channel Summation

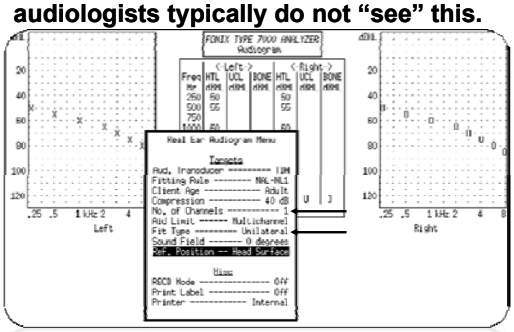


Entered audiogram for fitting bilateral hearing aids with 20 channels of signal processing.

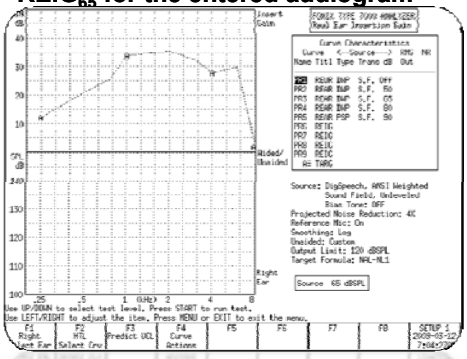


As a sidebar....notice the predicted LDL's <u>in dB HL</u>.
A bit high wouldn't you say?

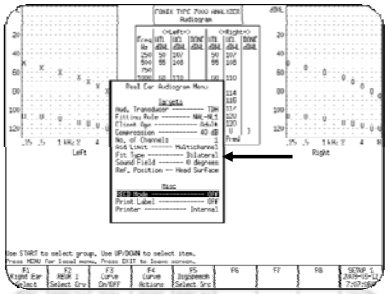
REM default is <u>monaural</u> and <u>1 channel,</u> but audiologists typically do not "see" this.



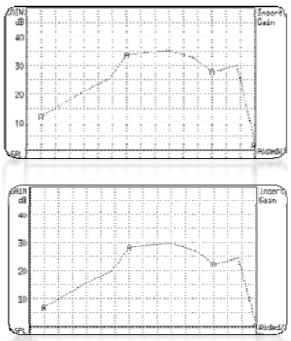
$REIG_{65}$ for the entered audiogram



Now…I'm going to correct for bilateral summation



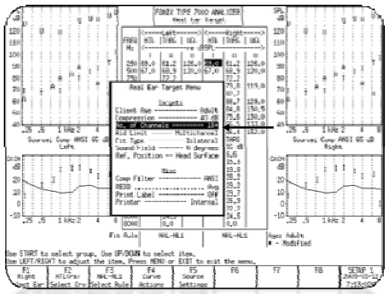
Resulting REIG for bilateral summation



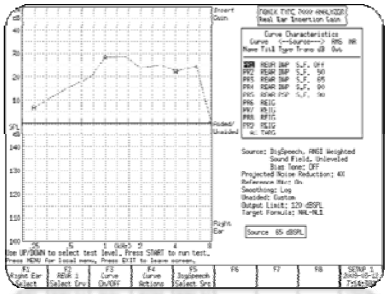
Default

Corrected

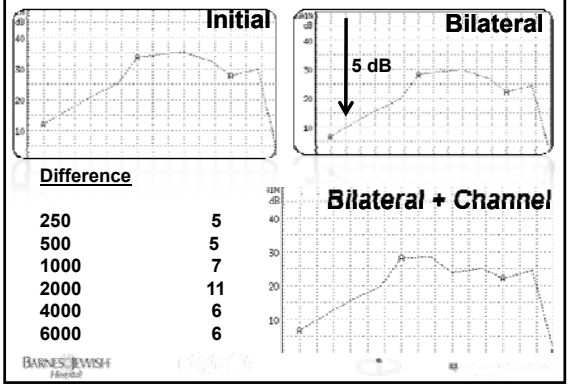
Now…we're going to correct for the number of channels



Resulting REIG for binaural and channel summation



Want to see that again?



Difference

250	5
500	5
1000	7
2000	11
4000	6
6000	6

…..third error when doing REAR Measures

Real Ear to Dial Difference (REDD)

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When completing REAR measures you may not be aware….

When you enter the audiogram in dB HL, the REM software will convert the threshold (dB HL) to dB (SPL) by adding the average REDD from ANSI S3.6-1989 to calculate the *predicted* threshold in dB SPL:

250	19	3000	15.5
500	12	4000	13
1000	9	6000	13
2000	15	8000	14

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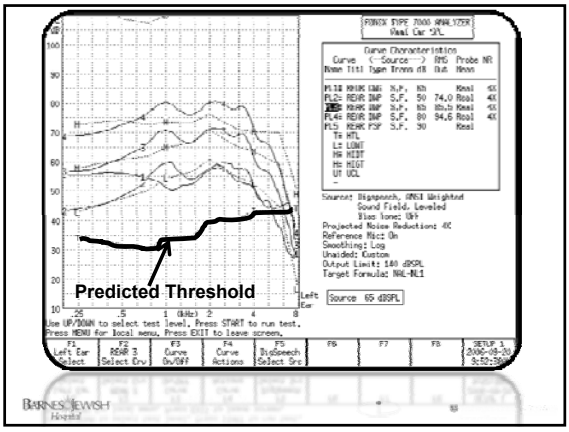

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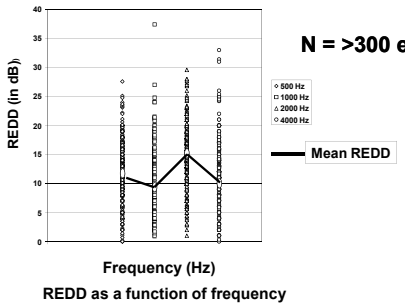
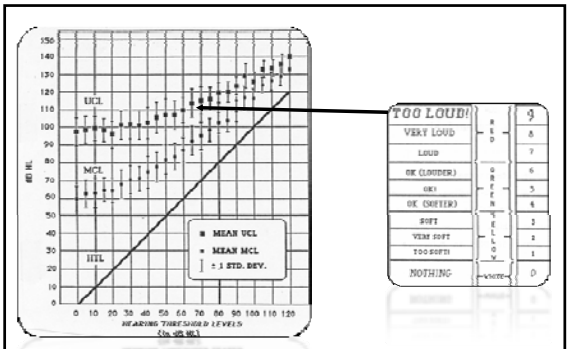
However…Keller and Valente (2006)…



N = >300 ears

REDD as a function of frequency

Next….with the same stroke of the keyboard, the software will *predict* the LDL in dB HL from Pascoe (1988) and add the average REDD to convert the LDL from dB HL to LDL in dB SPL



Frye 6500, 7000 and 8000

REDD

FREQ (Hz)	dB
250	19.0
500	12.0
750	10.5
1000	9.0
1500	12.0
2000	15.0
3000	15.5
4000	13.0
6000	13.0
8000	14.0

LDL

HTL dBHL	UCL HL	HTL dBHL	UCL HL
0	97	65	114
5	99	70	115
10	99	75	117
15	98	80	120
20	97	85	120
25	101	90	124
30	102	95	130
35	101	100	127
40	103	105	133
45	105	110	134
50	107	115	137
55	108	120	140
60	110		

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HL	250	500	1000	1500	2000	3000	4000	6000	8000	Pascoe (1988)
0	116	109	106	109	112	113	110	110	111	97
5	118	111	108	111	114	115	112	112	113	99
10	118	111	108	111	114	115	112	112	113	99
15	117	110	107	110	113	114	111	111	112	98
20	116	109	106	109	112	113	110	110	111	97
25	120	113	110	113	116	117	114	114	115	101
30	121	114	111	114	117	118	115	115	116	102
35	120	113	110	113	116	117	114	114	115	101
40	122	115	112	115	118	119	116	116	117	103
45	124	117	114	117	120	121	118	118	119	105
50	126	119	116	119	122	123	120	120	121	107
55	127	120	117	120	123	124	121	121	122	108
60	129	122	119	122	125	126	123	123	124	110
65	133	126	123	126	129	130	127	127	128	114
70	134	127	124	127	130	131	128	128	129	115
75	136	129	126	129	132	133	130	130	131	117
80	139	132	129	132	135	136	133	133	134	120
85	139	132	129	132	135	136	133	133	134	120
90	143	136	133	136	139	140	137	137	138	124
95	149	142	139	142	145	146	143	143	144	130
100	146	139	136	139	142	143	140	140	141	127
105	152	145	142	145	148	149	146	146	147	133
110	153	146	143	146	149	150	147	147	148	134
115	156	149	146	149	152	153	150	150	151	137
120	159	152	149	152	155	156	153	153	154	140

1. Pascoe (1988) dB HL to LDL (last column to right)

2. HL to SPL conversion (ANSI S3.6-1989 Table G-1) in each cell)

250	19
500	12
1000	9
1500	12
2000	15
3000	15.5
4000	13
6000	13
8000	14

Predicted $RESR_{90}$ (Dillon, 2012)

HTL	250	500	1k	2k	4k
0	85	90	90	90	87
5	86	91	91	92	89
10	87	92	93	93	90
15	89	94	94	94	91
20	90	95	95	96	92
25	91	96	97	97	93
30	92	98	98	99	95
35	94	99	100	100	96
40	95	101	101	101	97
45	96	102	103	103	98
50	97	103	104	104	99
55	99	105	106	105	101
60	100	106	108	107	102
65	103	110	110	109	105
70	107	113	113	113	108
	133	**126**	**123**	**129**	**127**
85	118	123	121	120	116
90	121	126	123	122	117
95	125	130	128	125	120
100	128	133	129	127	122
105	132	136	131	130	125
110	135	140	134	133	127
115	139	143	136	135	130
120	143	146	139	138	133

Frye Values

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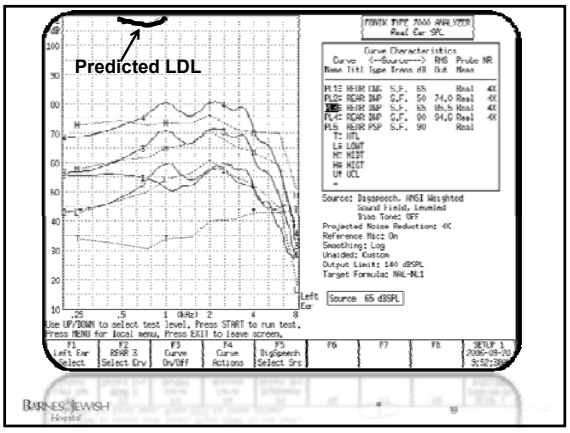
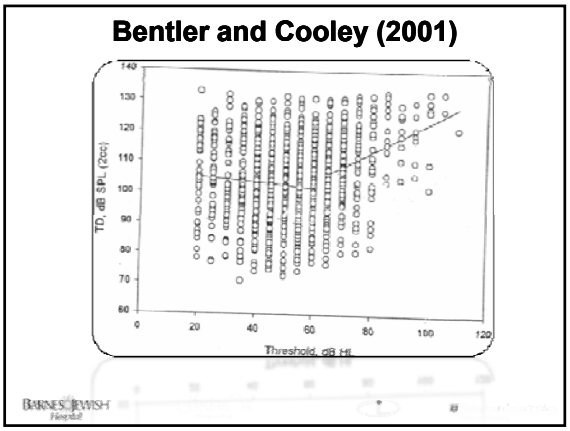
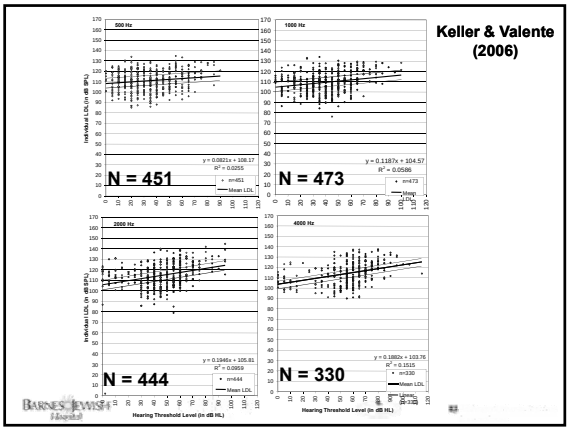


Bentler and Cooley (2001)





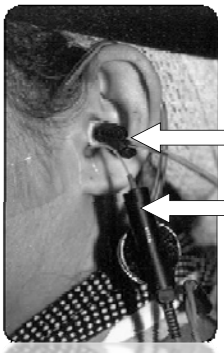
Keller & Valente (2006)

How can one measure the individual REDD?

Measuring REDD

Audiometer dial is 70 dB HL

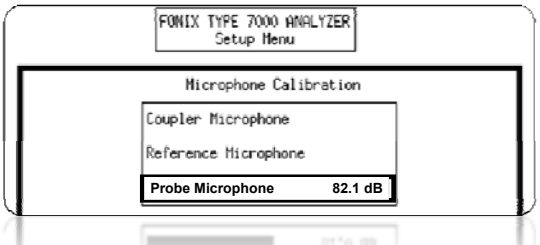
Probe



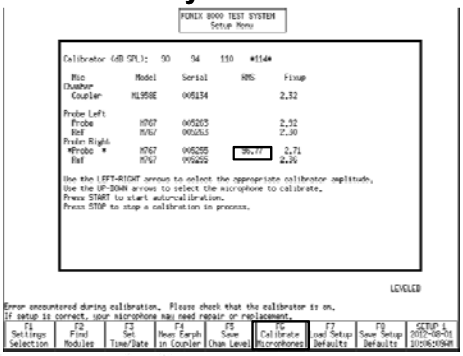
Insert Earphone from Audiometer

Probe Microphone

Frye 7000



Frye 8000



Verifit

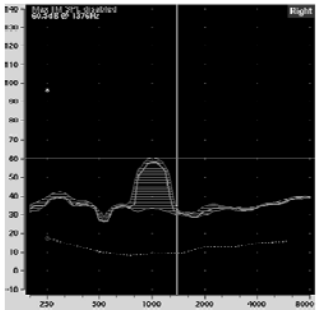


Table used to document REDD in SPL (We'll Come Back to This a Little Later)

	RT HL	RT SPL	RT REDD	LT HL	LT SPL	LT REDD
500	70	78	8			
1000	70	82	12			
2000	70	87	17			
3000	70	80	10			
4000	70	76	6			

Add REDD to audio threshold to convert to dB SPL @ TM.

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Using the Dynamic Range of the Patient as the *Target*

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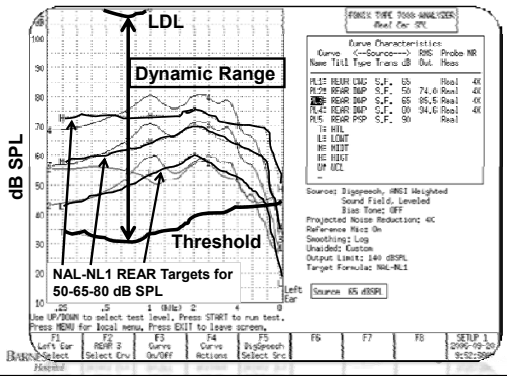
SPL-O-GRAM



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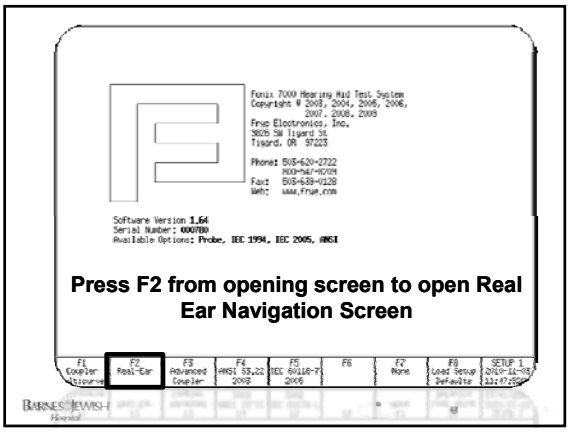
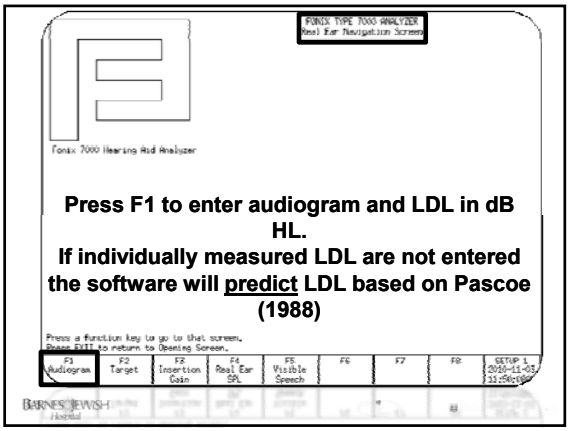
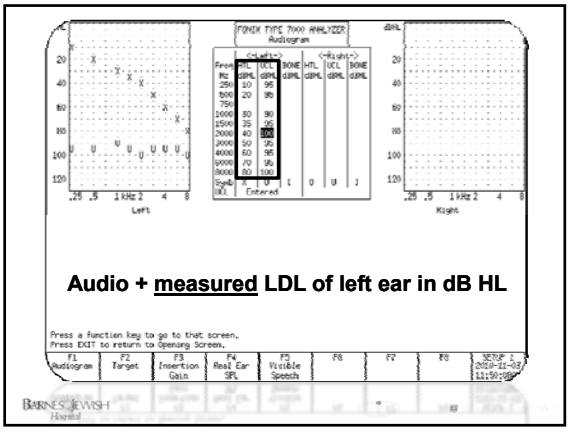


Press F2 from opening screen to open Real Ear Navigation Screen

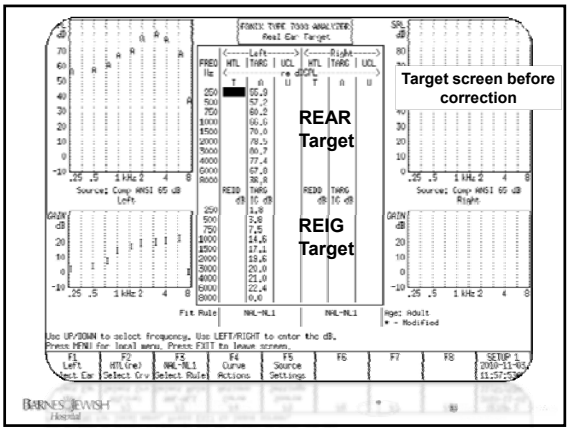


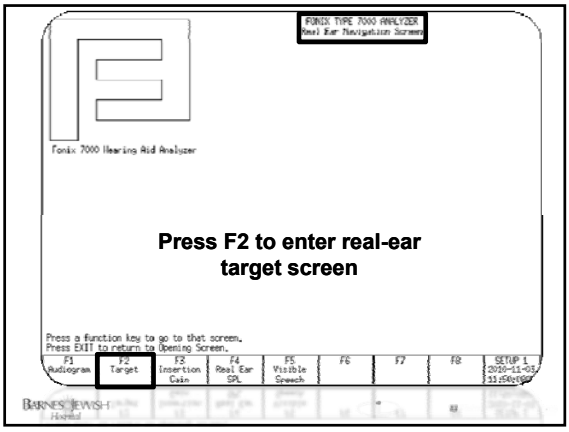
Press F1 to enter audiogram and LDL in dB HL.
If individually measured LDL are not entered the software will <u>predict</u> LDL based on Pascoe (1988)



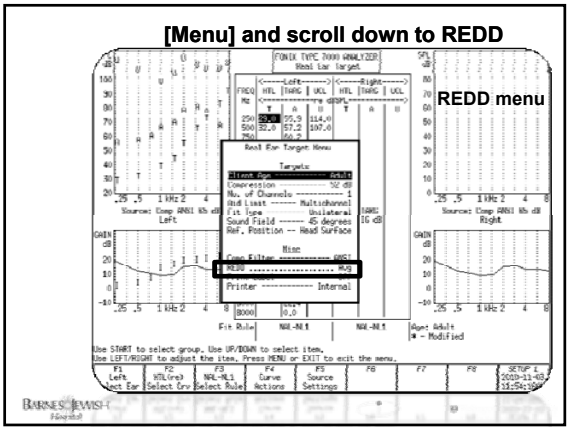
Audio + <u>measured</u> LDL of left ear in dB HL

Hz	dB HL	ANSI- S3.6 1989	Predicted Threshold (SPL)	My REDD	Diff	Measured Threshold (dB SPL)	Change SL of REAR
250	10	19	29	13	-6	23	+6
500	20	12	32	15	+3	35	-3
1000	30	9	39	12	+3	42	-3
2000	40	15	55	16	+1	56	-1
3000	50	15.5		12	-3.5		
4000	60	13	73	2	-11	62	-11
6000	70	13		10	-3		
8000	80	13	93	12	-1	92	+1

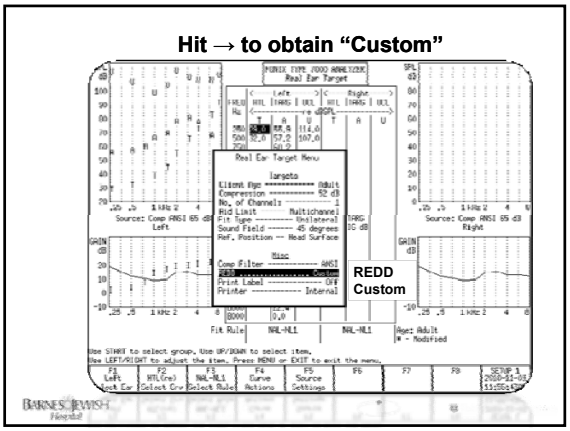


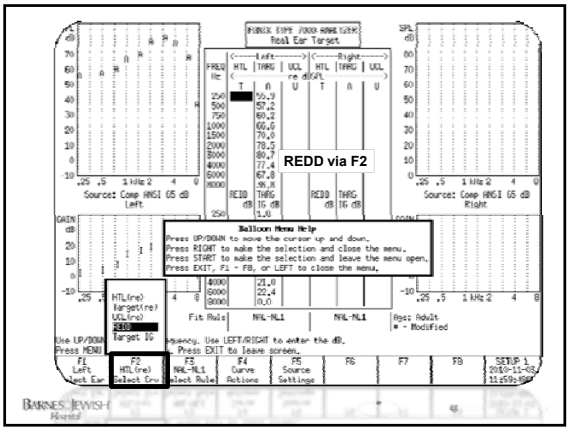


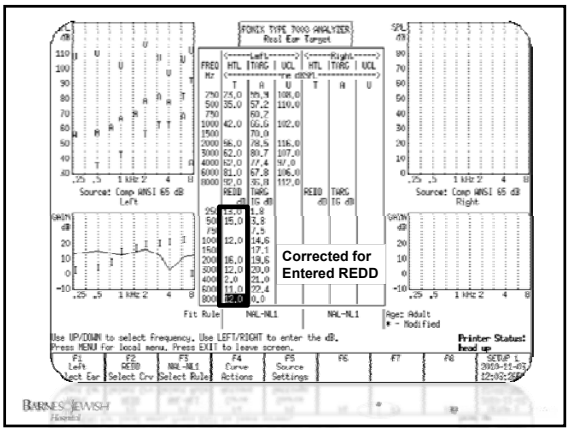
[Menu] and scroll down to REDD



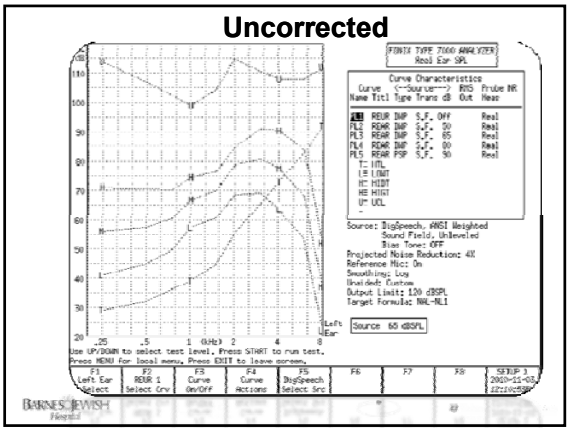
Hit → to obtain "Custom"



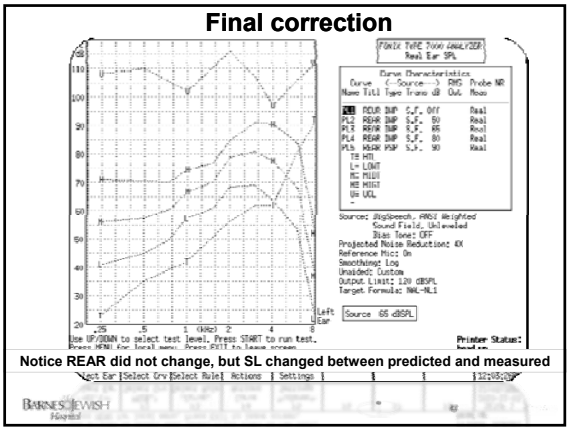




Uncorrected



Final correction



Notice REAR did not change, but SL changed between predicted and measured


"That's all folks!"