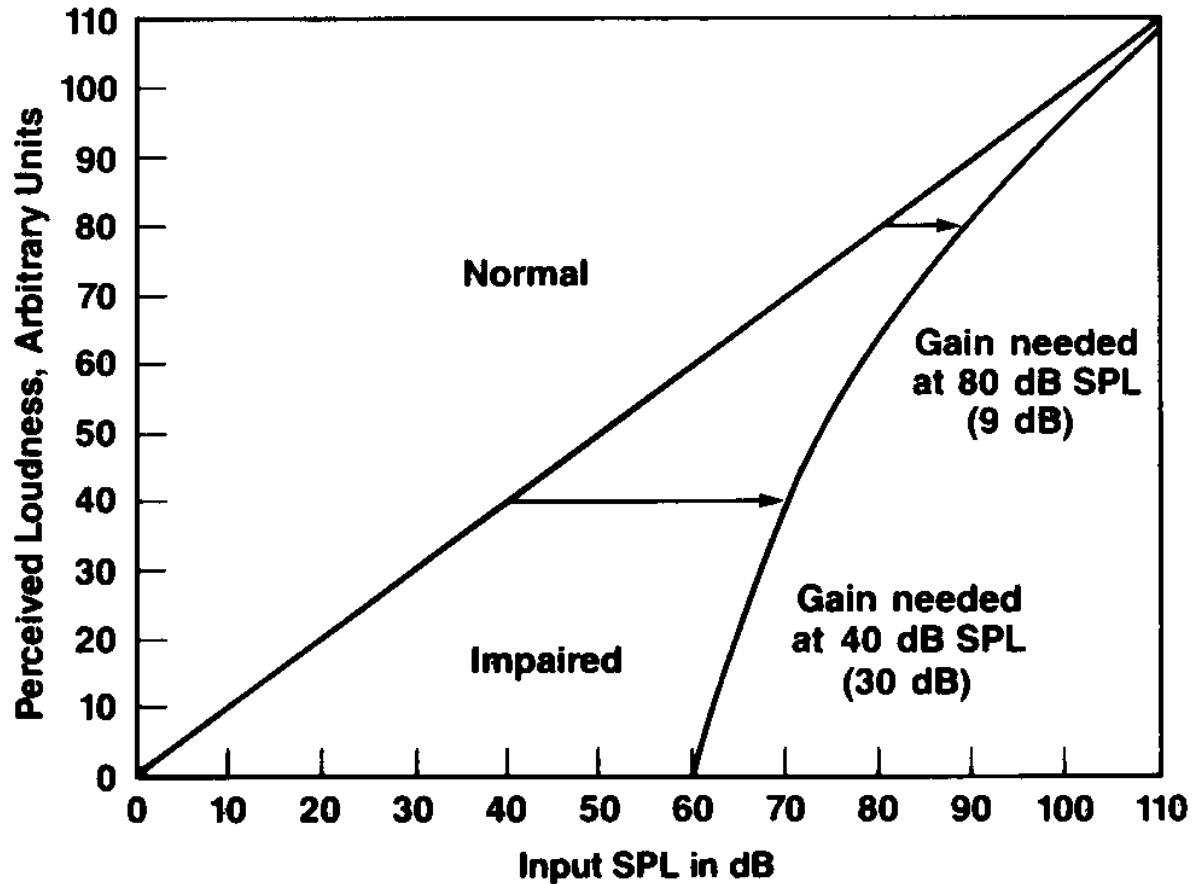# Audiogram+:
GN Resound proprietary fitting rule

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# Loudness normalization - Principle

Background for Audiogram+

- **Audiogram+ is a loudness normalization rule adapted to the 14 band compression system in Canta based on clinical trials.**
  - *Allen J.B., Hall J.L., Jeng P.S. (1990)*

- **Audiogram+ calculates gain targets at the 11 audiometric frequencies for 50 and 80 dB SPL inputs based on air conduction thresholds and a number of additional factors.**

- **Gain targets provide an optimal trade-off between speech perception and listening comfort**
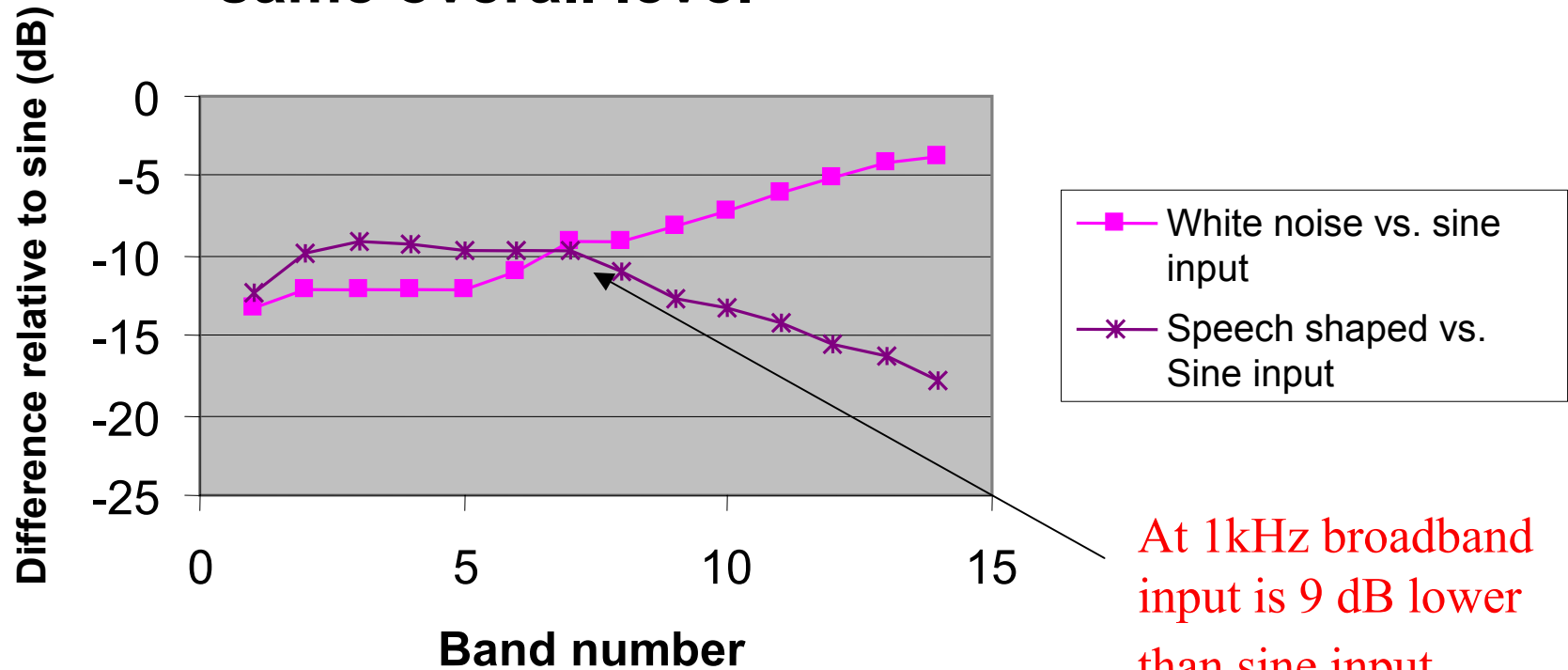
Speech perception with Audiogram+
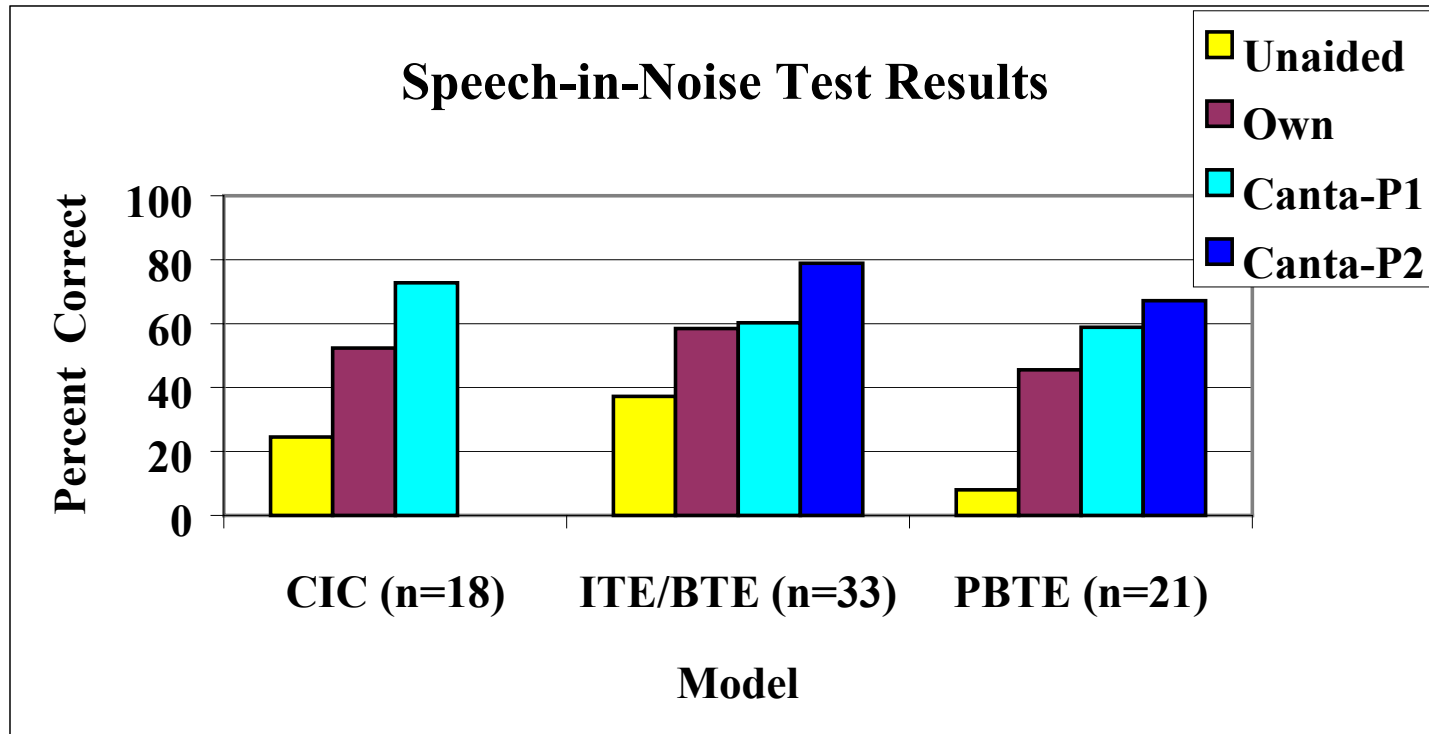
"Own" aids are a selection of digital and programmable instruments

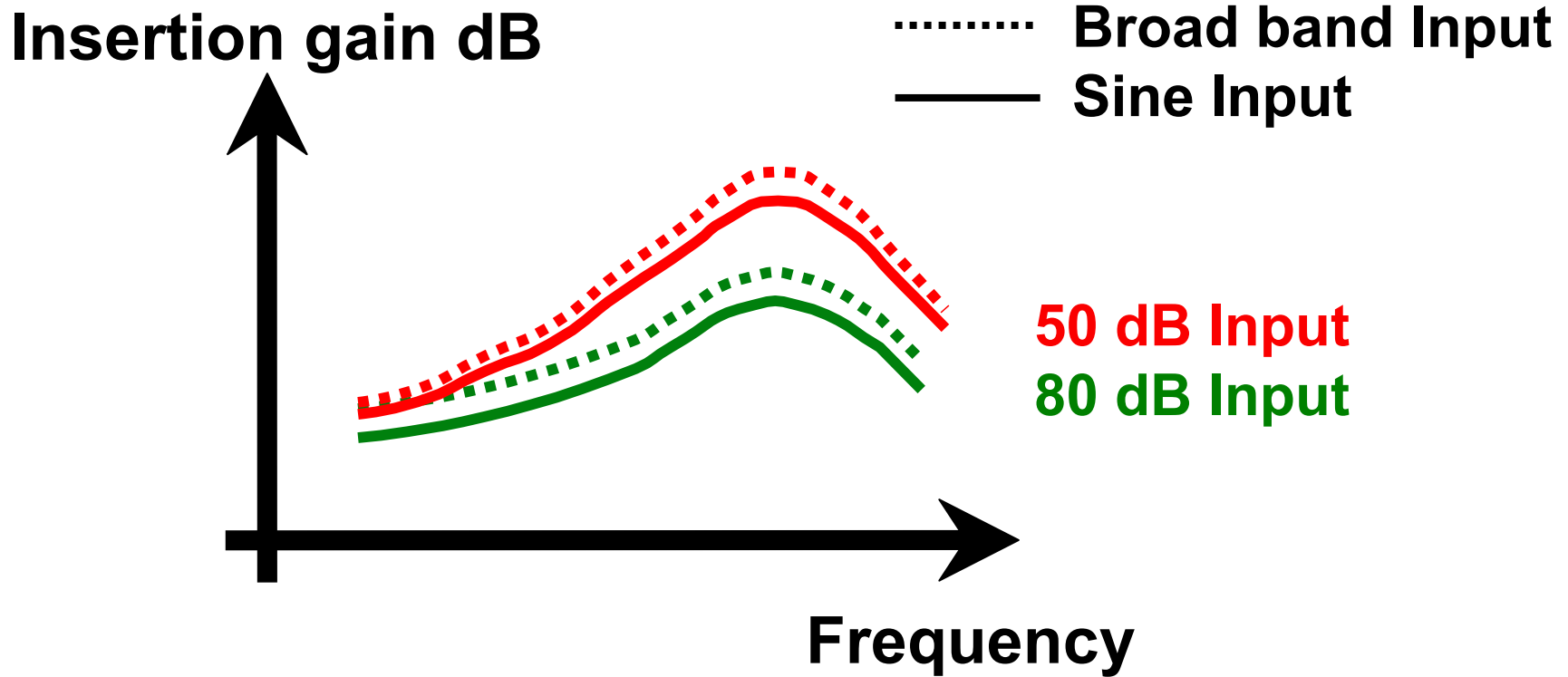# 14 Band Compression system
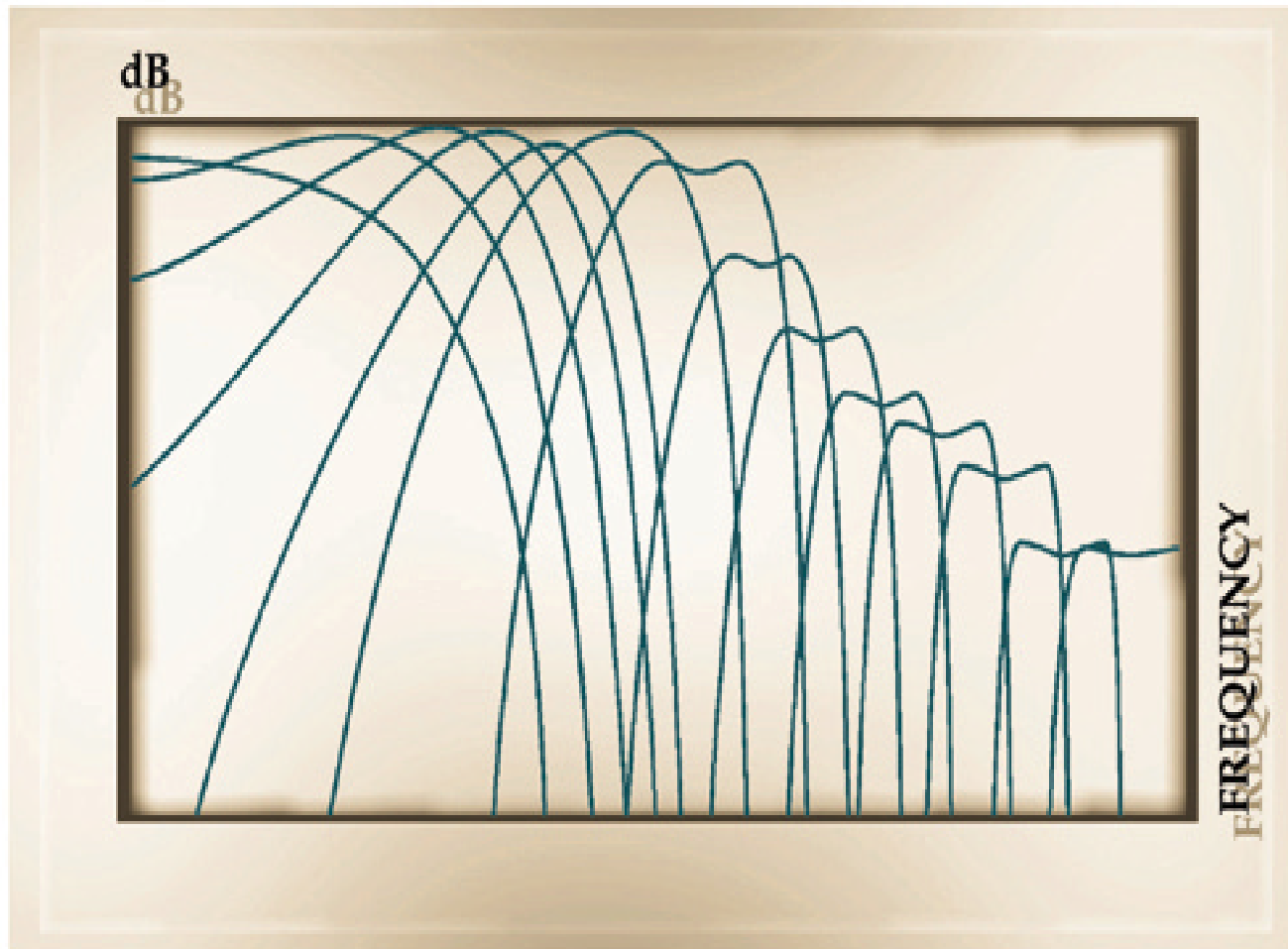
Effect of input signal for 14 band system

Broadband vs. sine input for same overall level

At 1kHz broadband input is 9 dB lower than sine input

Broad band vs. sine band input

Audiogram+: Additional factors taken into account

- **Severe Hearing Losses**
- **Ski-slope Hearing losses**
- **First Time Users**
- **Air-Bone Gap**
- **UCL**
- **Age**
- **Previous type of amplification**

Accuracy of Audiogram+

- **Very accurate prediction of average desired amplification for mild, moderate and severe losses**

- **Standard deviation twice as high for severe hearing losses, meaning more fine-tuning is needed for these losses.**

Prescribed versus fine-tuned gain (mild to moderate HL)
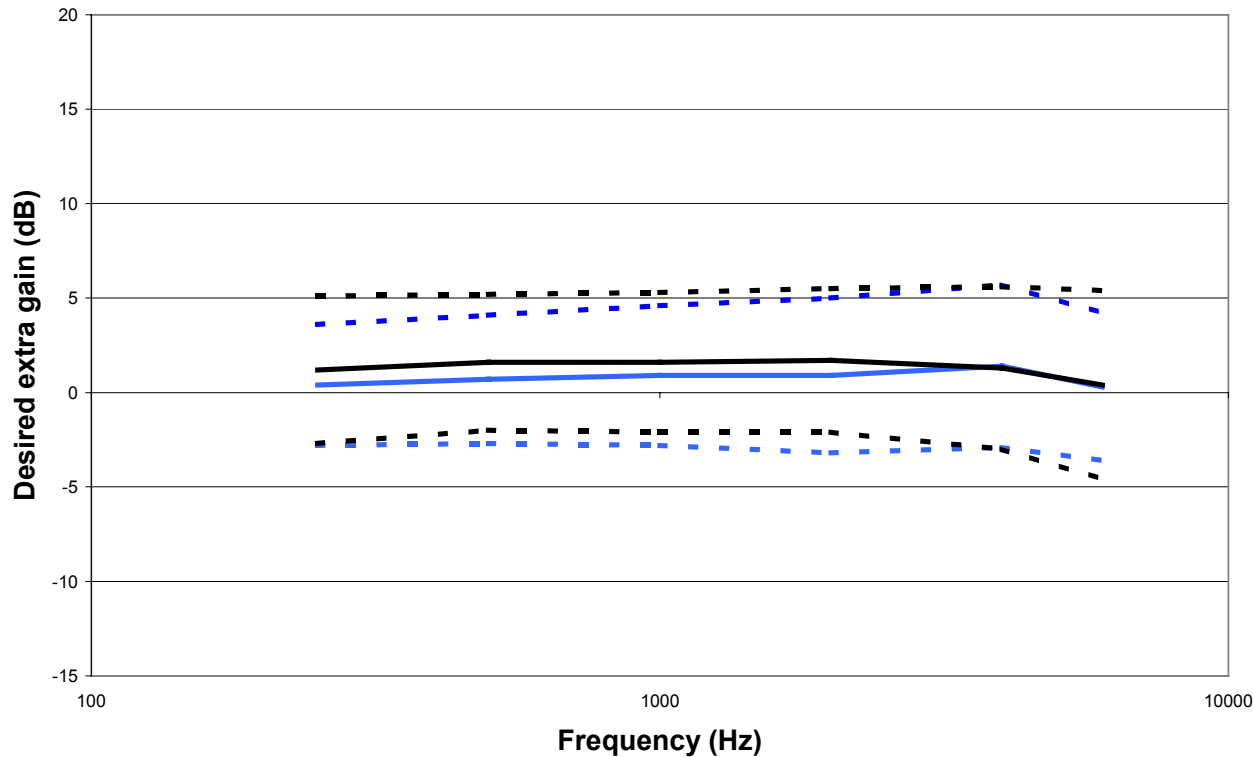
Mean differences and standard deviation (SD) between Audiogram+ prescribed gain targets and the final gain setting preferred by test subjects. Blue line: 80 dB inputs, blue dotted line: corresponding Standard Deviation. Black line: 50 dB inputs, black dotted line: corresponding Standard Deviation.

Prescribed versus fine-tuned gain (severe HL)
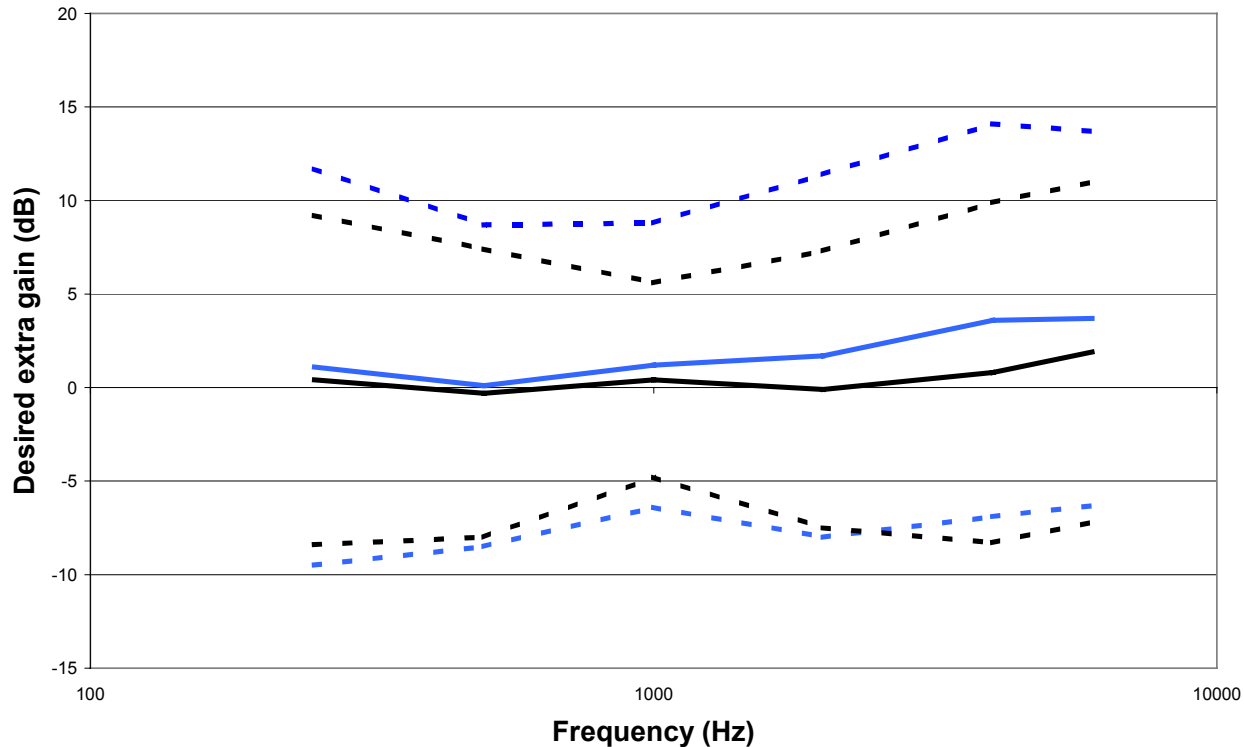
Mean differences and standard deviation (SD) between Audiogram+ prescribed gain targets and the final gain setting preferred by test subjects. Blue line: 80 dB inputs, blue dotted line: corresponding Standard Deviation. Black line: 50 dB inputs, black dotted line: corresponding Standard Deviation.

# Can prescription accuracy be increased for severe and profound losses?

Design

- **Fitting data from several test sites were divided in two groups according to previous use of linear amplification or fast acting WDRC**

- **Target prescriptions calculated by the original Audiogram+ algorithm were compared with the gain preferred by the users**

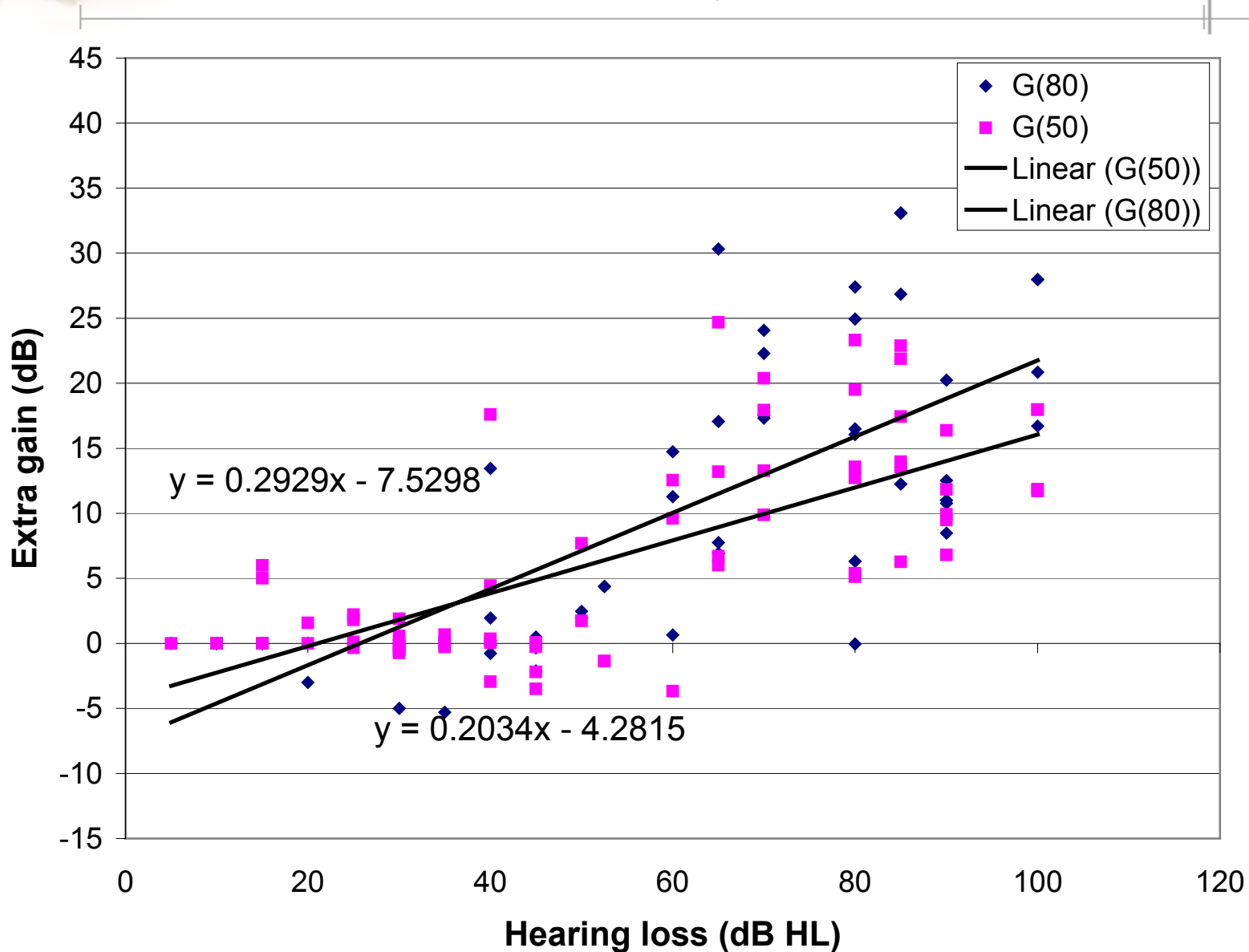- **Comparison was carried out at 0.25, 0.5, 1, 2, 4 and 6 kHz.**

Test subjects

- **59 users of fast acting WRDC**
- **36 users of linear hearing aids**
- **All users binaurally fitted**
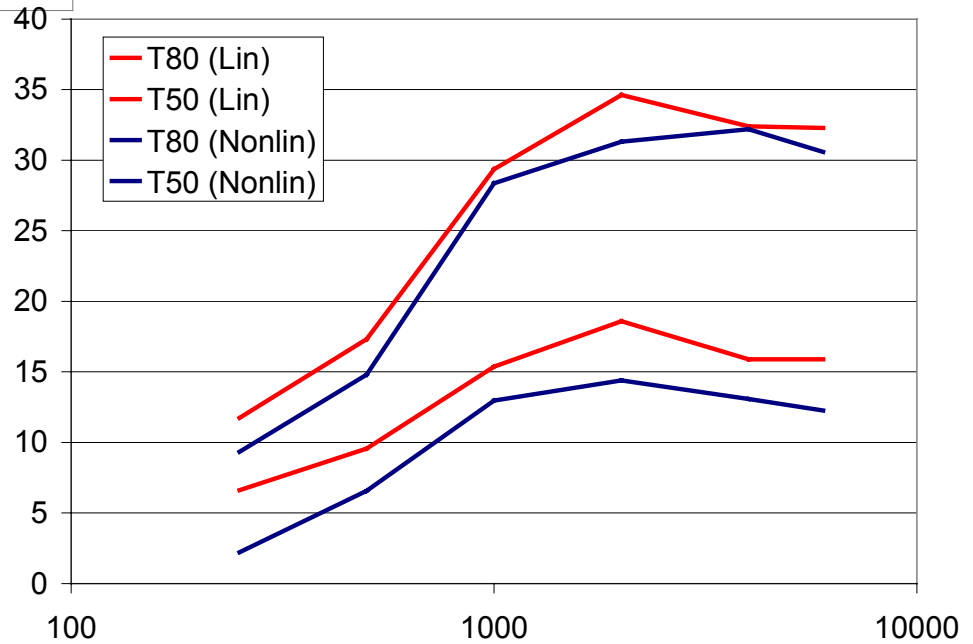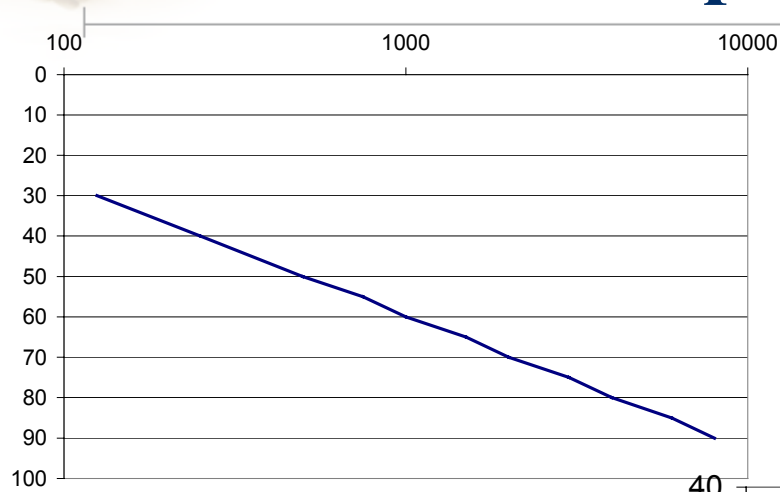- **All experienced users of hearing aids**

Previous nonlinear users, 0.5 kHz
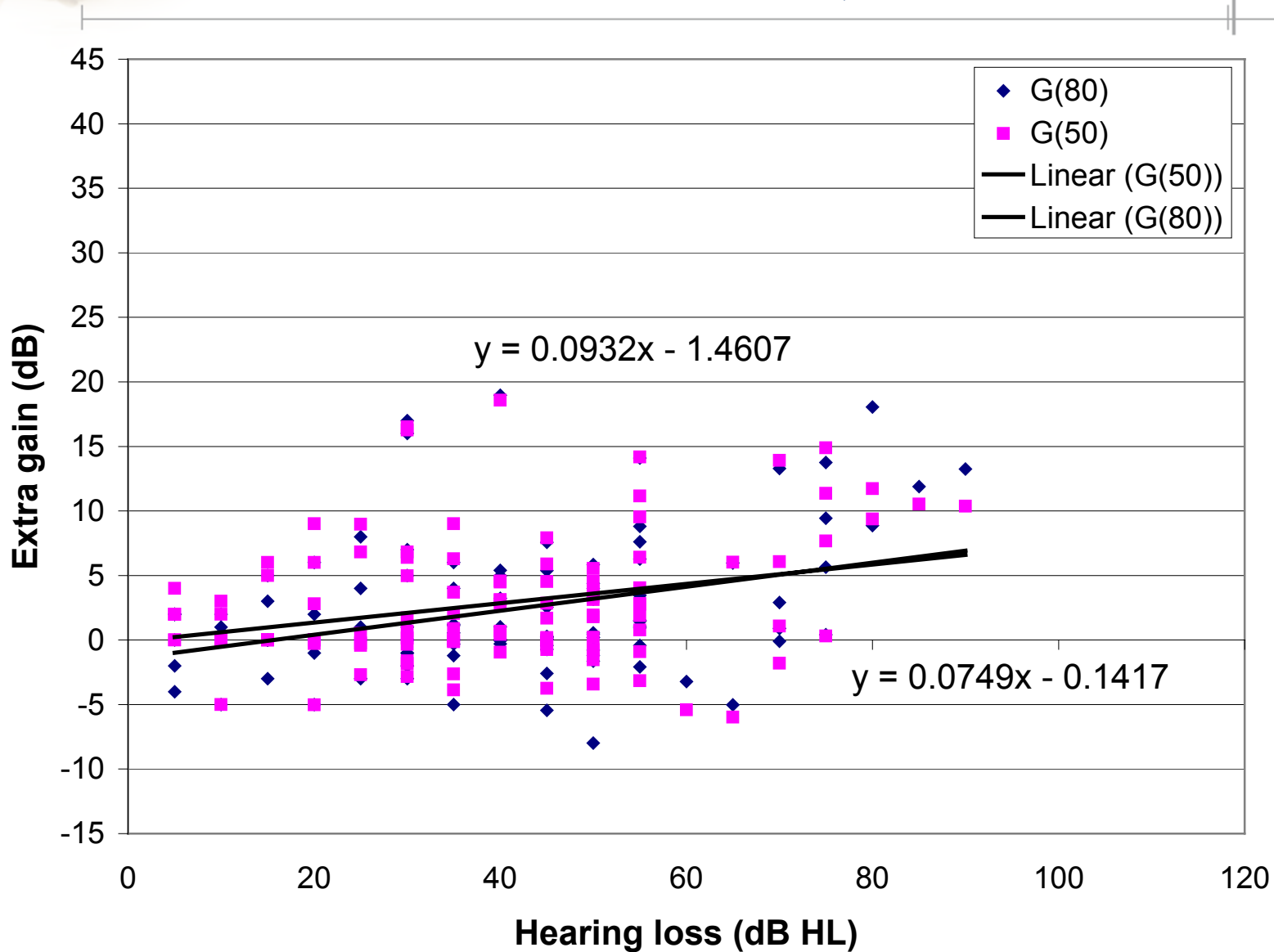
# Previous linear users, 0.5 kHz

New rule: Example

Accuracy of improved fitting rule

Mean difference and SD between preferred fitting and prescription:

	HTL		G(80) 250	500	1	2	4	6	All	G(50) 250	500	1	2	4	6	All
Linear	<65	Diff.	-1	-2	-1	0	1	1	*-1*	-1	-1	-1	0	1	2	*-1*
		SD	6	3	4	4	5	3	*4*	4	4	4	4	5	6	*5*
	>65	Diff.	1	2	0	-1	0	0	*0*	1	1	-2	-2	-1	-2	*-1*
		SD	11	9	7	8	9	9	*9*	11	6	4	5	6	7	*6*
Nonlinear	<65	Diff.	0	0	0	0	1	0	*0*	1	0	0	0	0	-1	*0*
		SD	4	4	4	5	4	3	*4*	4	4	4	5	4	4	*4*
	>65	Diff.	2	1	0	0	1	0	*0*	-1	1	-1	0	0	-1	*0*
		SD	7	6	6	6	6	6	*6*	7	7	5	6	6	6	*6*
Previous combined rue	<65	Diff.	-1	0	0	0	-2	-2	*-1*	-1	0	1	1	-1	-1	*0*
		SD	4	4	4	5	5	4	*4*	5	4	4	4	5	5	*4*
	>65	Diff.	1	0	1	2	4	4	*2*	0	0	0	0	1	2	*1*
		SD	11	9	8	10	10	10	*10*	9	8	5	7	9	9	*8*

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Hearing Innovations for Life

Accuracy of improved fitting rule
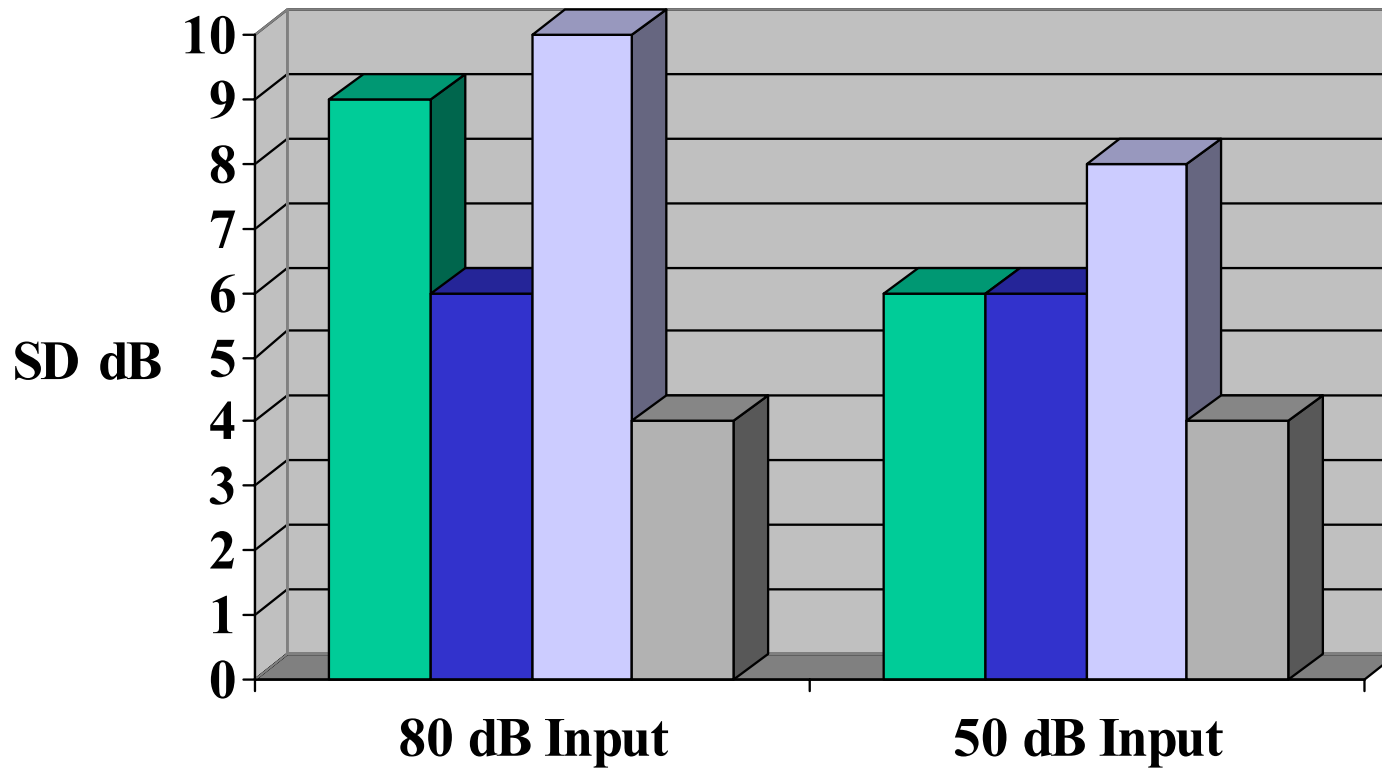
Conclusion

- **Audiogram+ is tailored to the Resound compression system (channels, time constants)**
- **Audiogram+ gives an optimal trade-off between speech perception and listening comfort and a high prescription accuracy.**
- **Tested in a large number of clinical trials**
- **For severe hearing losses use of separate prescriptions for previous users of linear and nonlinear amplification improves the prescription accuracy.**