"Assessing outcomes of hearing aids in adults"

Mark Laureyns
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CRS - Amplifon Centre for Research & Studies – Milan – Italy
European Association of Hearing Aid Professionals – Brussels - Belgium

IFOS WORLD COURSE ON
HEARING REHABILITATION

What do most assess?

Audibility

Sp in Quiet

TEST

What are the issues?

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DOI: 10.1055/s-0033-1341343

Preface

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Individual Variability in Aided Outcomes

This issue of *Seminars in Hearing* shares a collection of articles that will prepare readers for analysis and interpretation of individual differences that may occur during the evaluation of different hearing aid treatments or outcome measures. The consequent improved understanding of individual differences should help better customize treatment to the individual and their needs.

Individual Variability in Unaided and Aided Measurement of the Acceptable Noise Level

David A. Eddins, Ph.D.,[1,2] Michelle Arnold, Au.D.,[1] Alexandra Klein, B.A.,[1] and John Ellison, M.S.[3]

Individual Variability in Recognition of Frequency-Lowered Speech

Joshua M. Alexander, Ph.D.[1]

Will My Patient Benefit from Audiologic Rehabilitation? The Role of Individual Differences in Outcomes

Harvey B. Abrams, Ph.D.,[1] and Theresa Hnath Chisolm, Ph.D., CCC-A[2]

Individual Differences Research and Hearing Aid Outcomes

Larry E. Humes, Ph.D., CCC-A[1]

Individual Variability in Benefit from Fixed and Adaptive Directional Microphones

Jason A. Galster, Ph.D.,[1] and Krishna S. Rodemerk, Au.D.[1]

Individual Variability of Hearing-Impaired Consonant Perception

Andrea Trevino, MSEE,[1] and Jont B. Allen, Ph.D.[1]

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What should we assess?

Audibility

Sp in Quiet

Sp in Noise

360°

Noise Tol.

Localisation

Focus

TEST

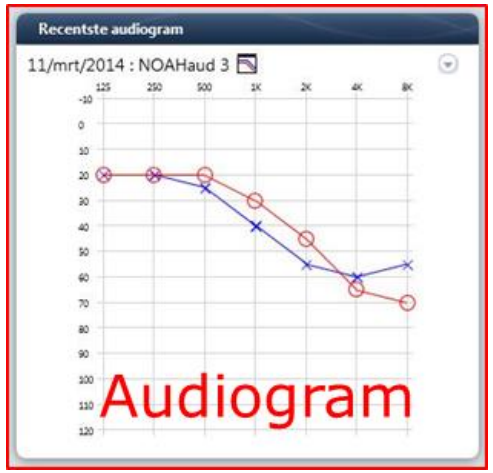
QUESTION

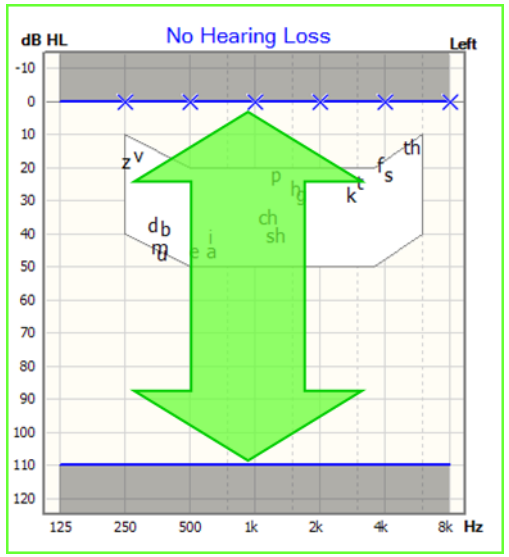
COSI

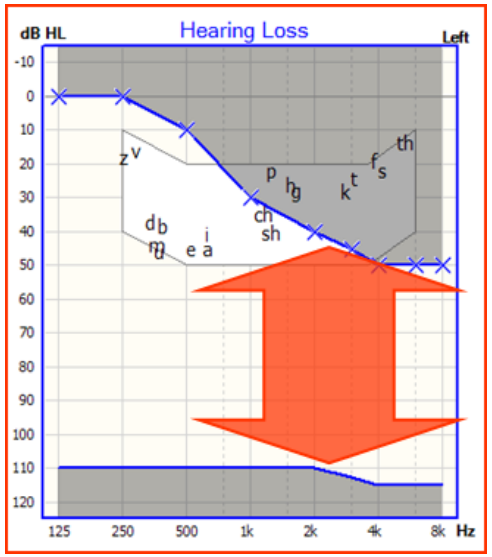
GOALS

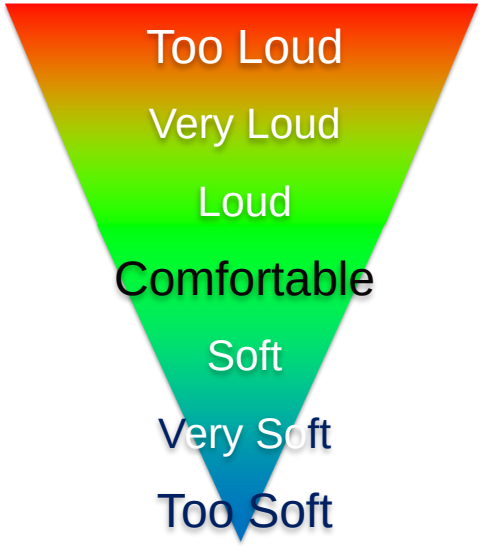
SATISFACTION

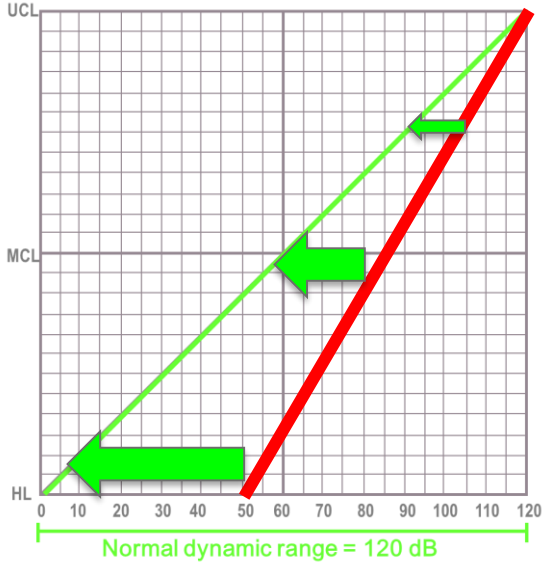
Audibility

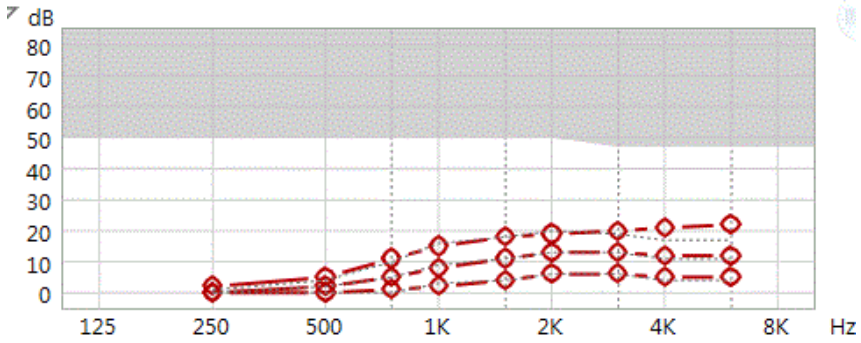












All	250	500	750	1K	1.5K	2K	3K	4K	6K
50	2	5	11	15	18	19	20	21	22
65	0	2	5	8	11	13	13	12	12
80	0	0	1	2	4	6	6	5	5
CR	1.0	1.2	1.5	1.8	1.9	1.9	1.8	2.4	2.4
MPO	96	101	103	107	110	113	114	117	116

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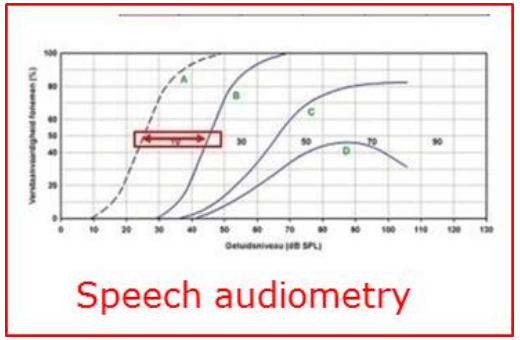
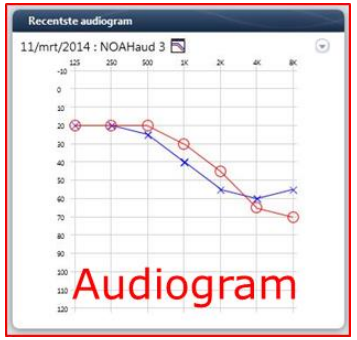
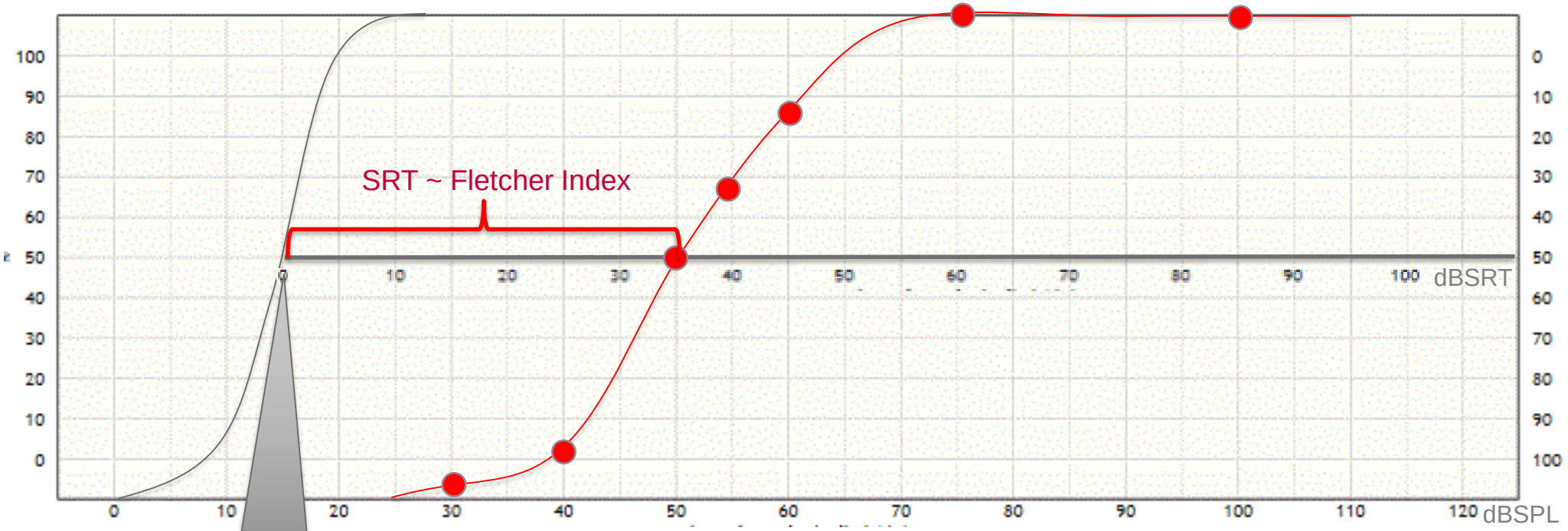
Speech in Quiet

SRT=
Speech Reception Threshold
(50%)







SRT reference=
Speech Reception Threshold
(50%)

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HEARING REHABILITATION

Speech in Quiet

SRT=
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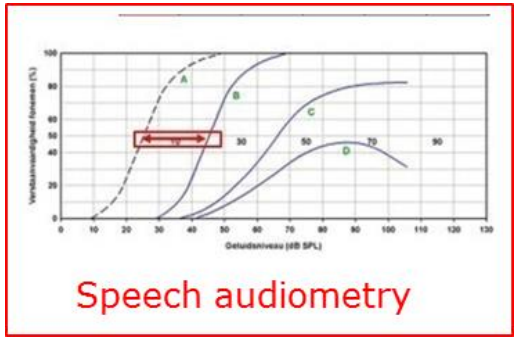
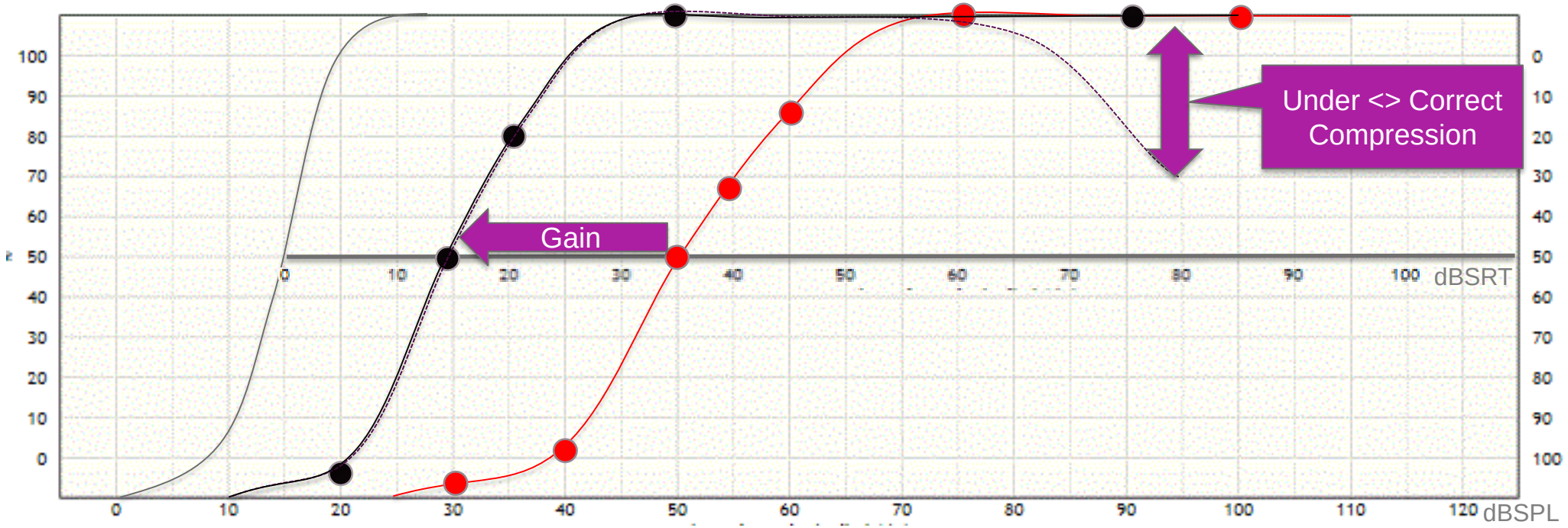


All	250	500	750	1K	1.5K	2K	3K	4K	6K
50	2	5	11	15	18	19	20	21	22
65	0	2	5	8	11	13	13	12	12
80	0	0	1	2	4	6	6	5	5
CR	1.0	1.2	1.5	1.8	1.9	1.9	1.8	2.4	2.4
MPO	96	101	103	107	110	113	114	117	116

Audibility | Sp in Quiet | Sp in Noise | 360° | Noise Tol. | Localisation | Focus



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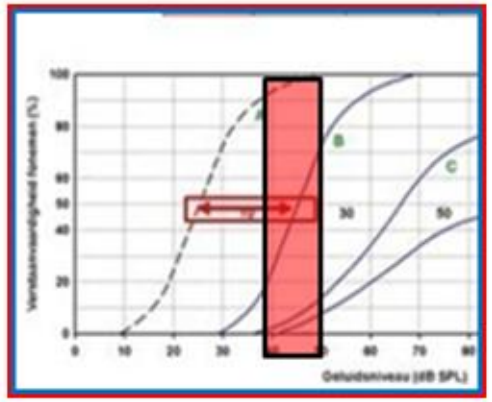
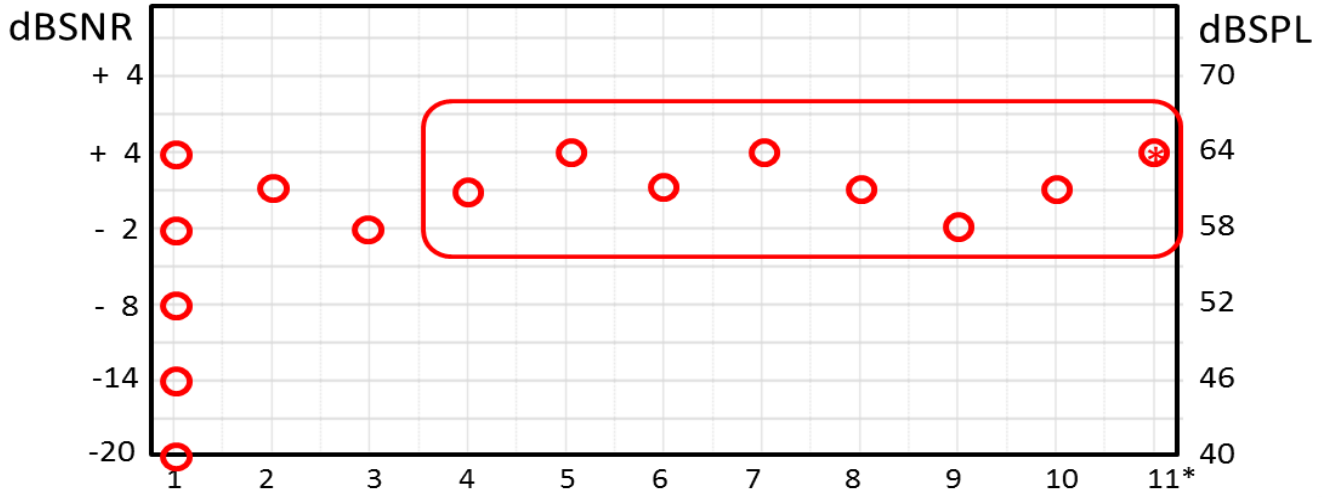
Speech in Noise

A speech in noise test is much closer to the real experienced problems … so much better call to action! “hearWHO” self-test





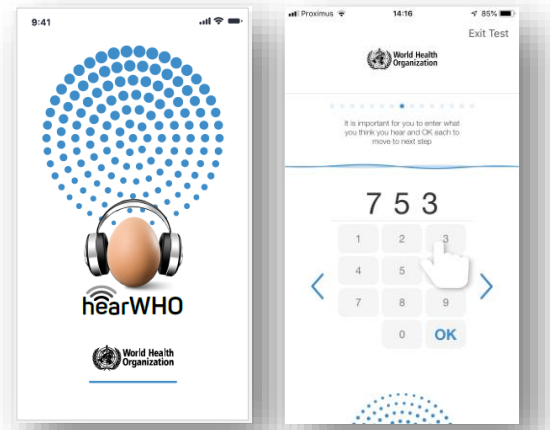
Audibility | Sp in Quiet | Sp in Noise | 360° | Noise Tol. | Localisation | Focus

hearWHO

An app to check your hearing.

Word or Sentence (n°)

First word is repeated until correctly reproduced (increase in 6 dB steps)
Then you go down 3 dB
Every time the word is correctly repeated … reduce 3 dB
Every time the word in not correctly repeated … increase 3 dB
For the 10th word … write down the level at which the 11th would be presented (does not exist … we just need the value)
Take the average of the 8 last values and subtract the noise level … this is the dBSNR voor 50% score.



The adaptive procedure is much faster – has a much better test retest reliability and reduces the learning effect.

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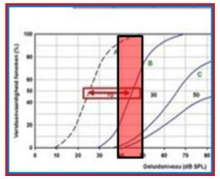
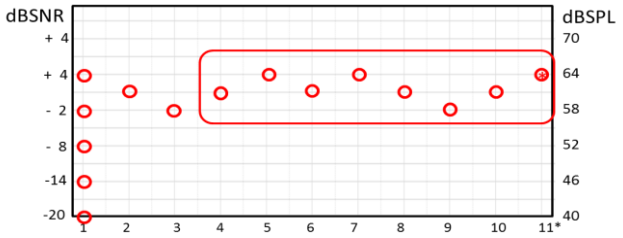
Speech in Noise


Speech Audiometry in Noise



Unaided 3 dB SNR Loss … requirement for refund hearing aids In Belgium (< 65 years)

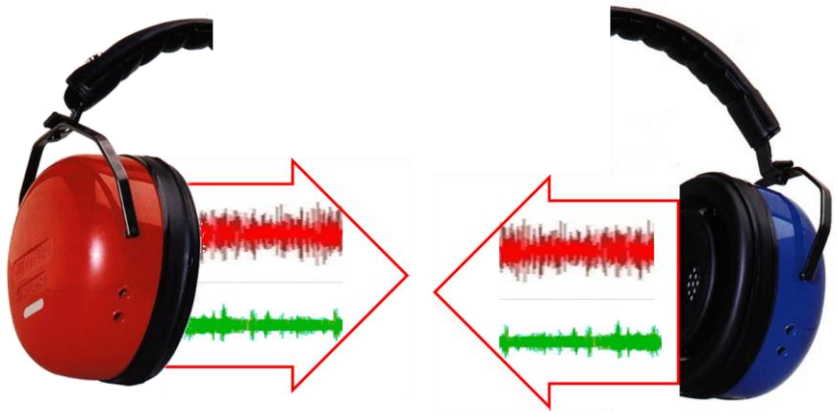
Improved auditory functionality: Aided SNR improvement

	≥ 2 dB SNR deterioration	Little or no difference (difference < 2 dB)	≥2 dB SNR improvement
%	14%	25%	61%

SNR= Signal to noise ratio

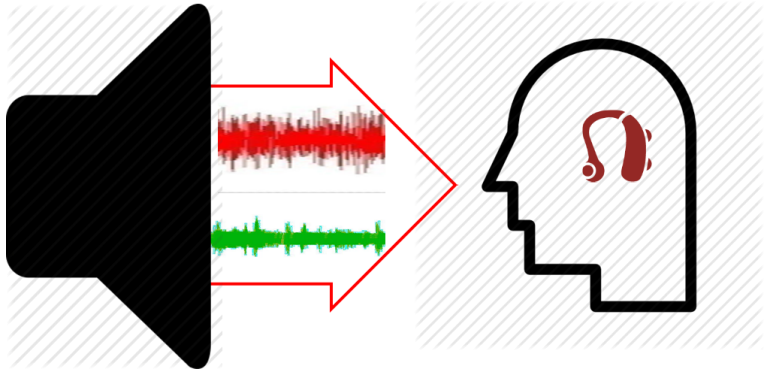
BLU list – Adaptive procedure in free field (speech and noise from the same loudspeaker at 0° and at 1 m distance.)

Aided 2 dB SNR improvement (Speech & Noise same loudspeaker)



High Frequency Gain
Correct Compression

Directionality
Good Binaural Fit
Optimised Localisation



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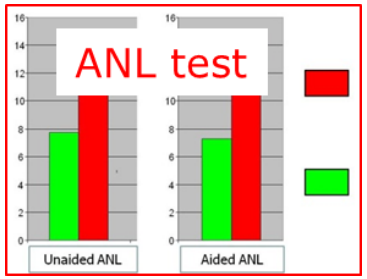
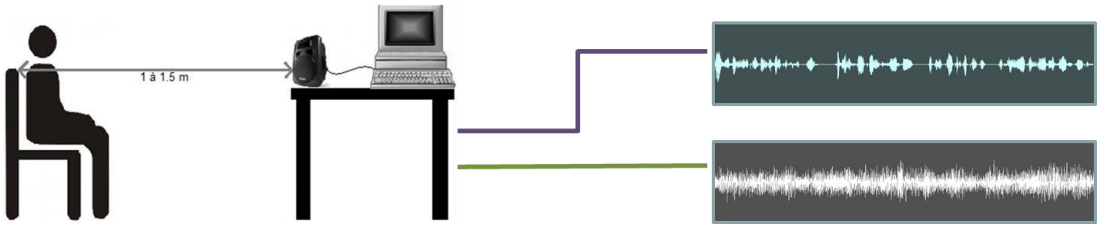
Noise Acceptance

THE UNIVERSITY of TENNESSEE HEALTH SCIENCE CENTER

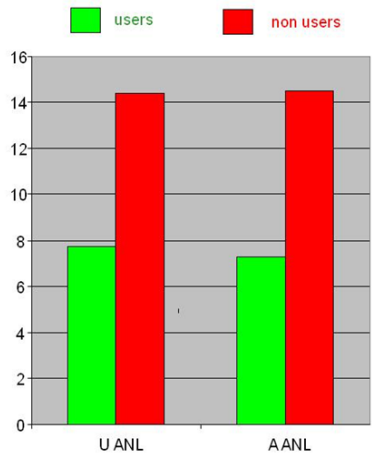
Anna K. Nabelek, Ph.D.

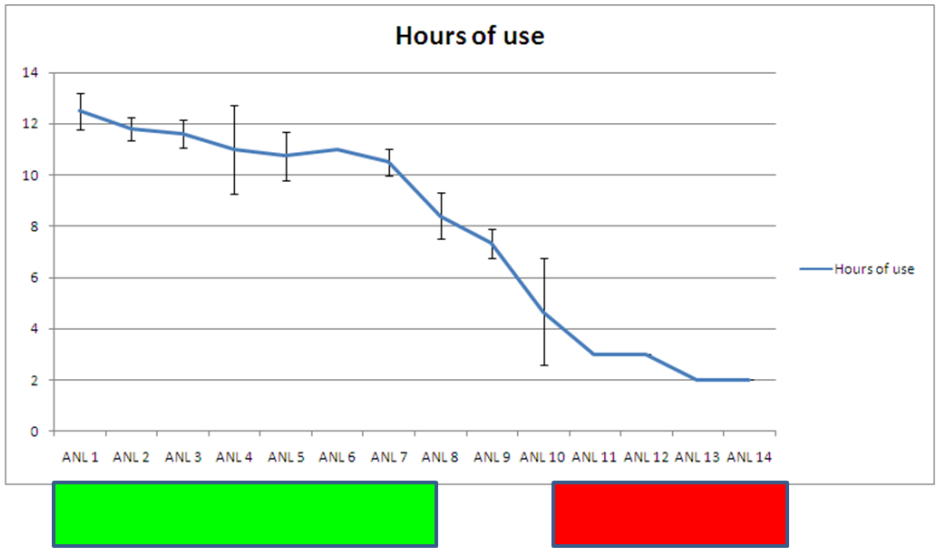




Audibility | Sp in Quiet | Sp in Noise | 360° | Noise Tol. | Localisation | Focus

Predictor of hearing aid success





Acceptable Noise Level: A Clinical Measure for Predicting Hearing Aid Outcome

Anna K. Nabelek
Guest Editor

Running speech = Comfortable Level *(e.g. remote control to listen all night television)*
Babble Signal (realistic) – Max level you can put-up with.

Good Predictor for Hearing Aid Candidacy

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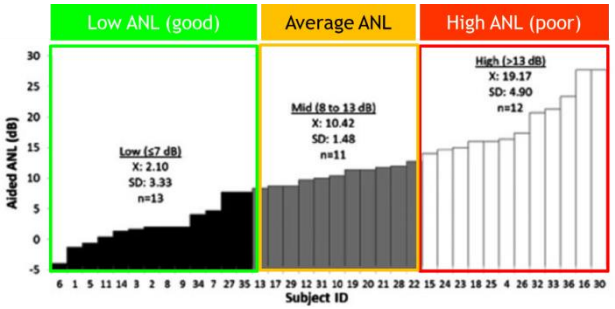
Noise Acceptance

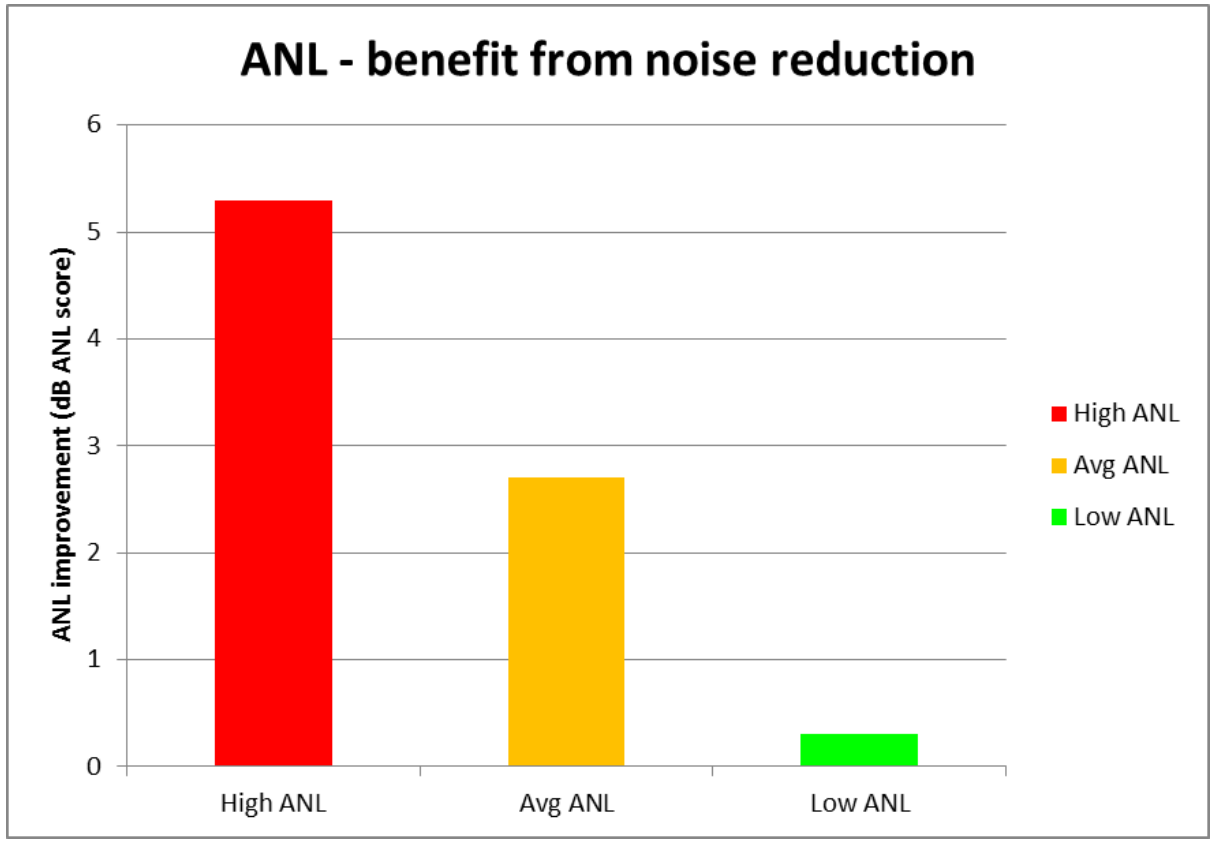


Noise Reduction Impact on ANL

High (poor) ANL : >5 dB impact

Average ANL : 2,5 dB impact

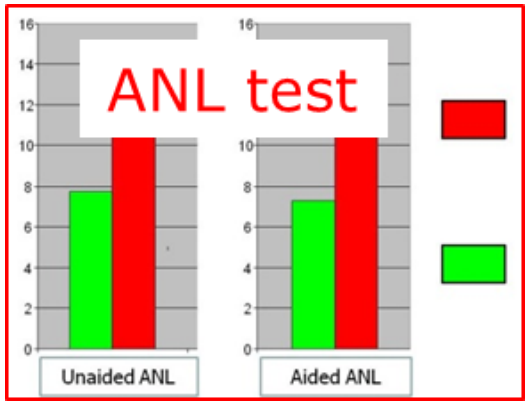
Low (good) ANL : 0 dB impact



High ANL (poor) | Average ANL | Low ANL (good)

Eddins & al – Galster - EUHA 2014

Audibility | Sp in Quiet | Sp in Noise | 360° | Noise Tol. | Localisation | Focus



Predictor for Noise Reduction Benefit

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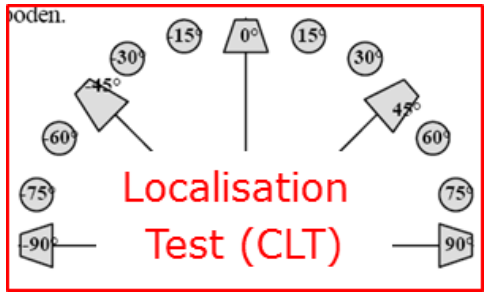
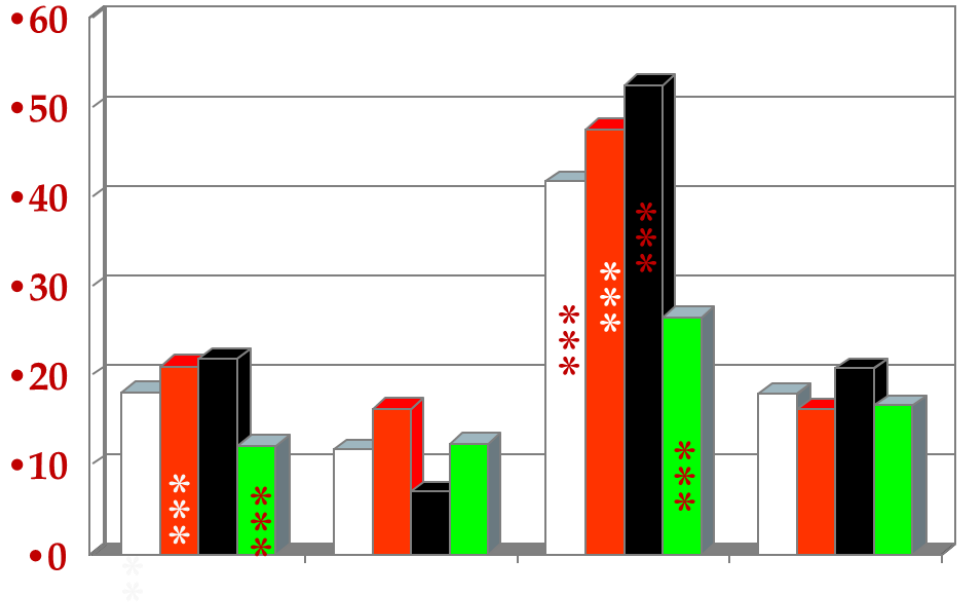
Localisation





Audibility | Sp in Quiet | Sp in Noise | 360° | Noise Tol. | Localisation | Focus

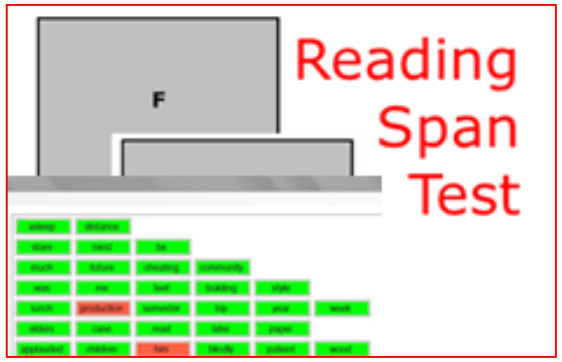
- Total
- Hearing Impaired
- Control NH
- Young NH

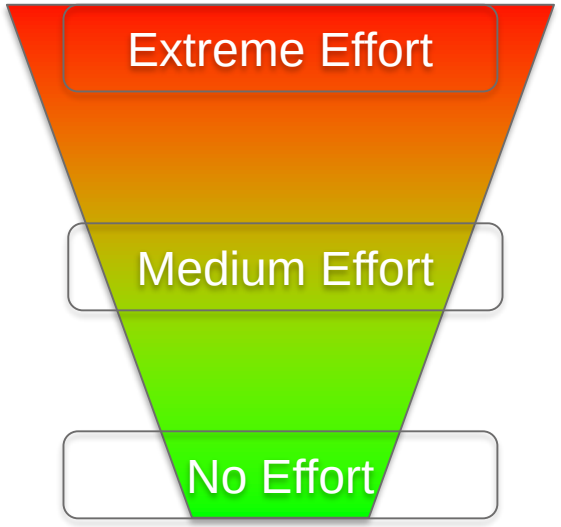
T/R= (Test/Retest) Absolute Average Error!

The most reliable test procedure to evaluate the added value of binaural fitting

Can be used both the fine-tune binaural fitting and to evaluate impact of signal processing

Focus – Working Memory / Listening Effort





Reading Span Test (Working Memory) = Easy to use, but experienced as negative by older subjects … they push back when a test is related to cognition

Speech in Noise with Speech Weighted Noise Masking versus Informational Masking is a possible alternative

Objective (EEG – Pupilometry) and Subjective evaluation (Scaling) of Listening Effort is the object of many studies right now.

Good procedure to evaluate signal processing and gain selection

COSI – Client Oriented Scale of Improvement

COSI

GOALS

SATISFACTION

National Acoustic Laboratories
A division of Australian Hearing

NAL
CLIENT ORIENTED SCALE OF IMPROVEMENT

Name : _____ Category. New _____
Audiologist : _____ Return _____
Date : 1. Needs Established _____
2. Outcome Assessed _____

SPECIFIC NEEDS

Indicate Order of Significance

☐ _____
☐ _____
☐ _____
☐ _____
☐ _____

Degree of Change

Worse	No Difference	Slightly Better	Better	Much Better

CATEGORY

Final Ability (with hearing aid)
Person can hear

10%	25%	50%	75%	95%
Hardly Ever	Occasionally	Half the Time	Most of Time	Almost Always

Specific Goals/Objectives → Degree of Change → Final Ability

J Am Acad Audiol 8: 27–43 (1997)

Client Oriented Scale of Improvement (COSI) and Its Relationship to Several Other Measures of Benefit and Satisfaction Provided by Hearing Aids

Harvey Dillon*
Alison James†
Jenny Ginis‡

Harvey Dillon

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COSI – Client Oriented Scale of Improvement

COSI

GOALS SATISFACTION

COSI®, Client Oriented Scale of Improvement

Name: MARK LAUREYNS

Date of Birth: September 09, 1960

Audiologist: ABC

Hearing Instrument:

Date: Needs established: March 08, 2013

Date: Outcome assessed:

Specific Needs:	Priority:	Degree of change "Because of the new hearing instrument, I now hear..."					Final Ability "I can hear satisfactorily..."				
		Worse	No difference	Slighty better	Better	Much Better	10 % (Hardly ever)	25 % (Occasionally)	50 % (Half the Time)	75 % (Most of Time)	95 % (Almost Always)
Understanding the customers in my bakery shop	1	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐
Following a conversation with my sisters (4) during dinner at home	2	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐
Understanding my husband in a restaurant (calm)	3	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑
	-	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	-	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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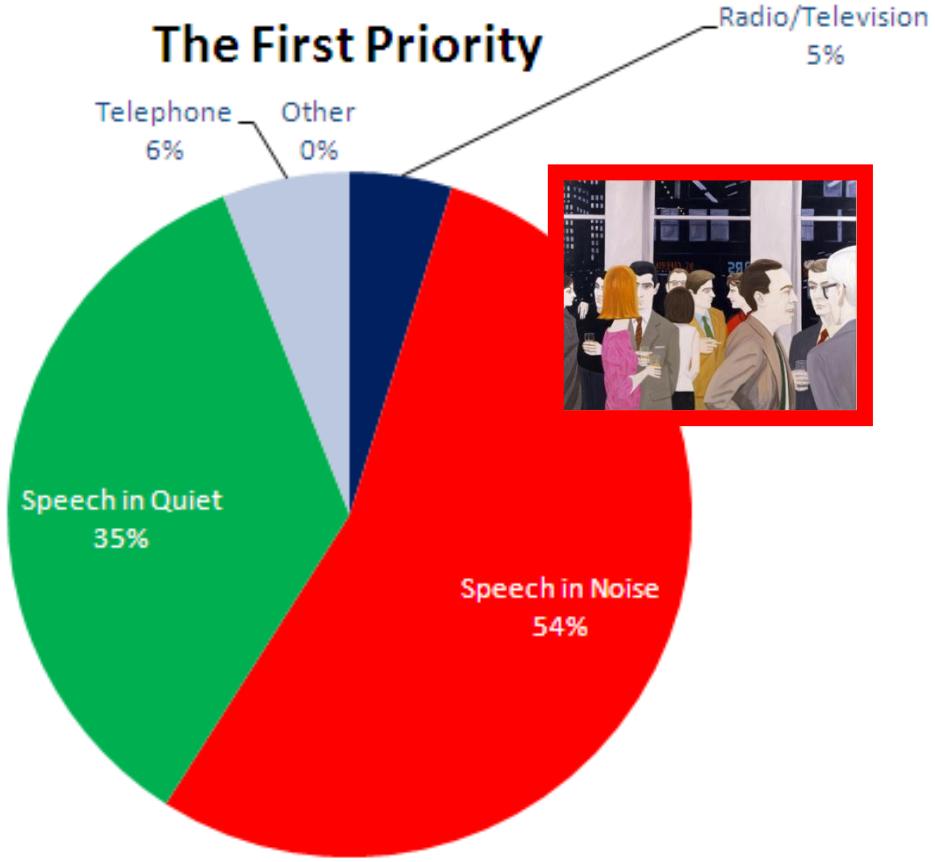
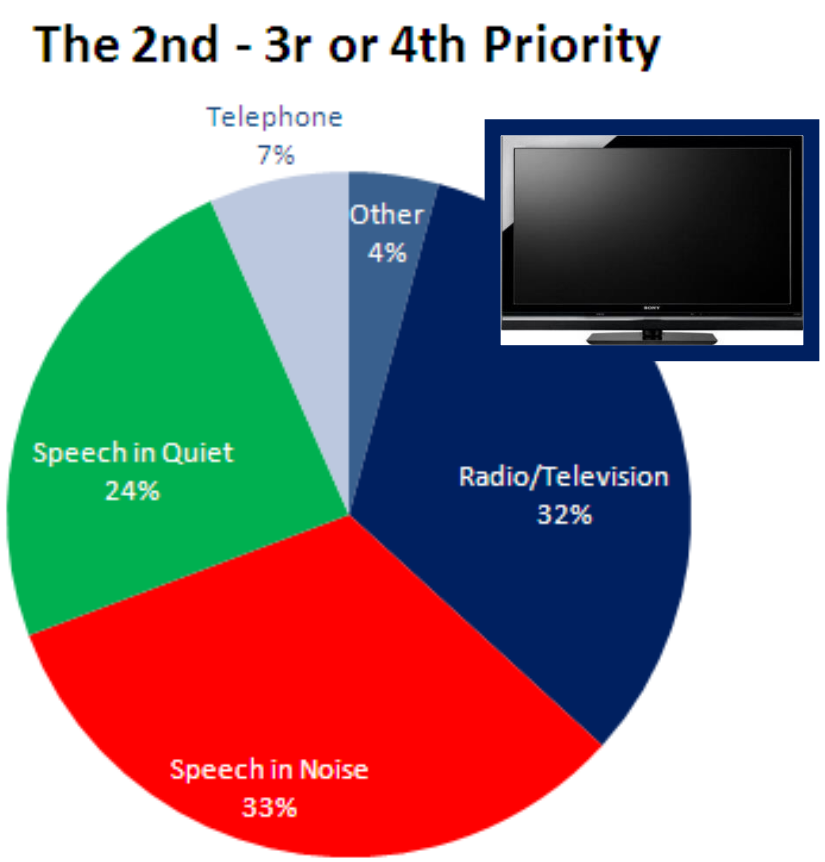
COSI – Client Oriented Scale of Improvement

COSI

GOALS

SATISFACTION





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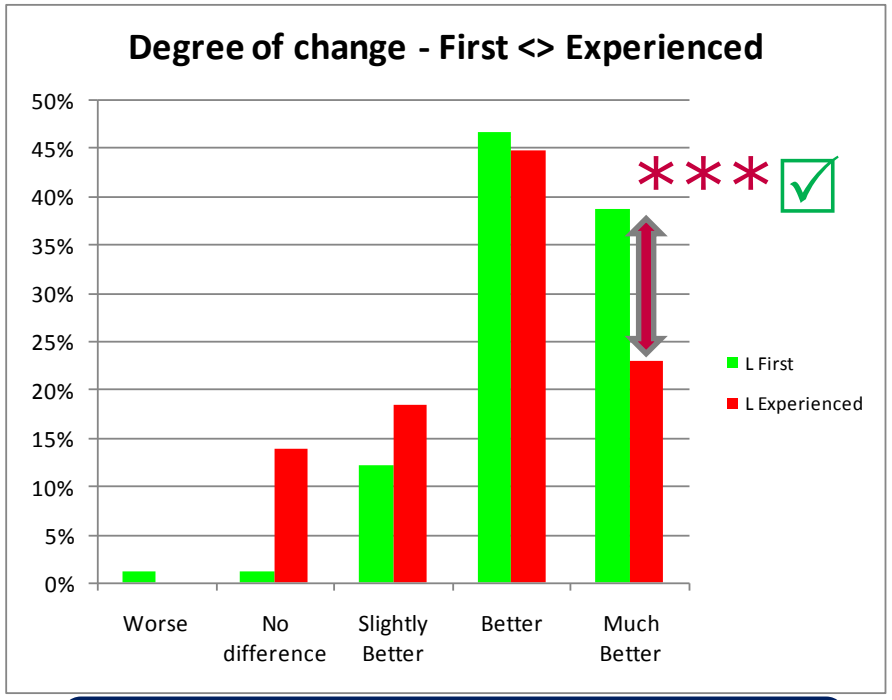
COSI – Client Oriented Scale of Improvement

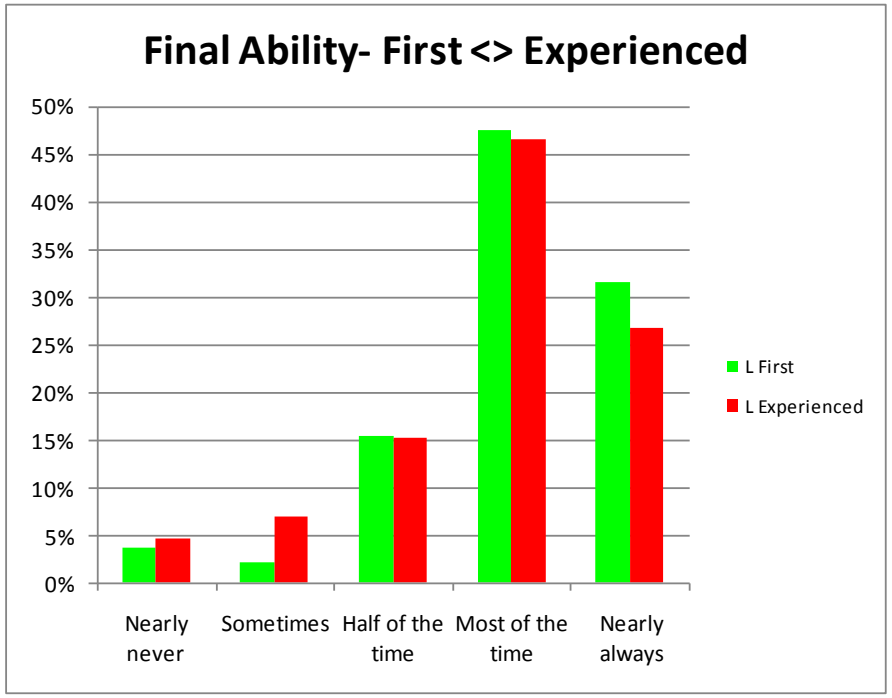
COSI

GOALS

SATISFACTION



Degree of change



Final Ability

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QUESTION

SSQ Questionnaire

*Stuart Gatehouse**
William Noble†

International Journal of Audiology 2004; 43:85–99

The Speech, Spatial and Qualities of Hearing Scale (SSQ)

First publication – 2004
Gatehouse & Noble
International Journal of Audiology

Particular attention is given to hearing speech in a variety of competing contexts, and to the directional, distance and movement components of spatial hearing.

In addition, the abilities both to segregate sounds and to attend to simultaneous speech streams are assessed, reflecting the reality of hearing in the everyday

Qualities of hearing experience include ease of listening, and the naturalness, clarity and identifiability of different speakers, different musical pieces and instruments, and different everyday sounds.

QUESTION

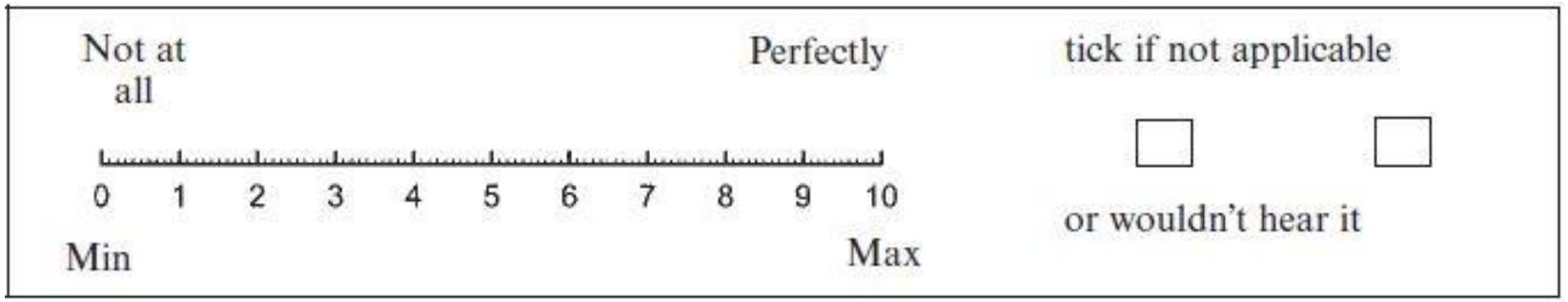
SSQ Questionnaire


*Stuart Gatehouse**
William Noble†

International Journal of Audiology 2004; 43:85–99

The Speech, Spatial and Qualities of Hearing Scale (SSQ)

Speech	Spatial	Quality
14 Questions	17 Questions	18 (+1) Questions



SSQ Questionnaire

A short form of the Speech, Spatial and Qualities of Hearing scale suitable for clinical use: The SSQ12
William Noble et al.
International Journal of Audiology 2013; 52: 409–412.

QUESTION

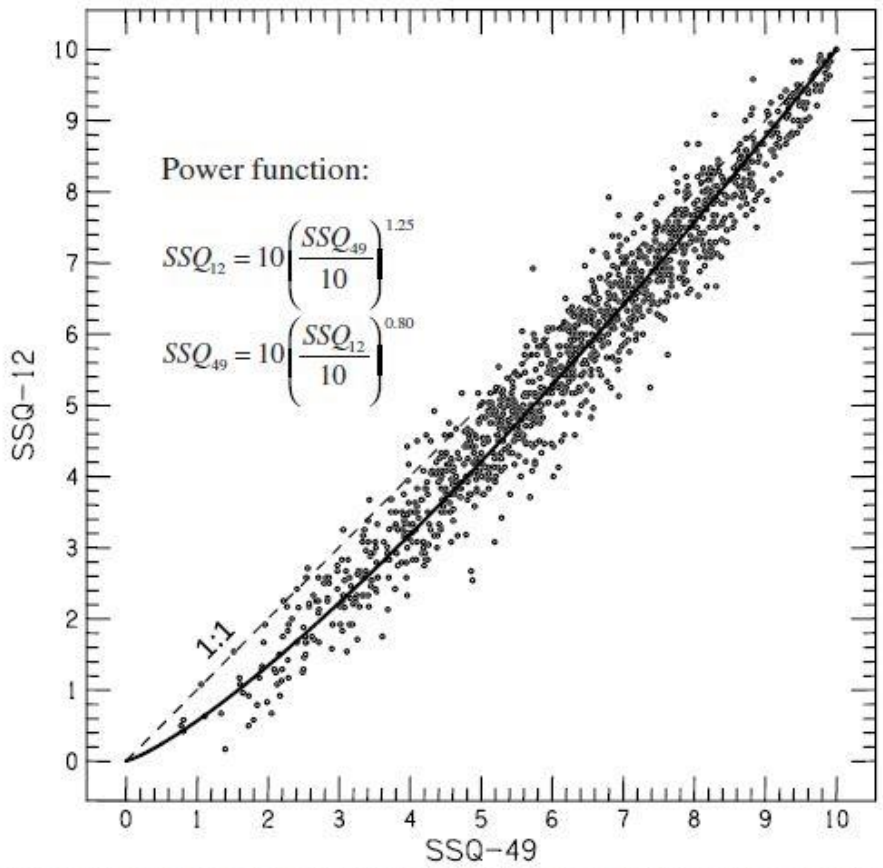


Figure 1. Scatter-plot of average SSQ12 scores against average SSQ49 scores for 1220 cases; comprising 386 unaided, 627 unilaterally aided, and 207 bilaterally aided.

The SSQ12 provides similar results to SSQ49 in a large clinical research sample.

The slightly lower average SSQ12 score and the slightly steeper slope reflect the composition of this short form relative to the SSQ49.

Although the complete SSQ performed best, in terms of test-retest reliability, when given as an interview both times (Singh & Pichora-Fuller, 2010), test-retest performance using a mailed version followed by an interview was observed in that study to provide the next most stable results.

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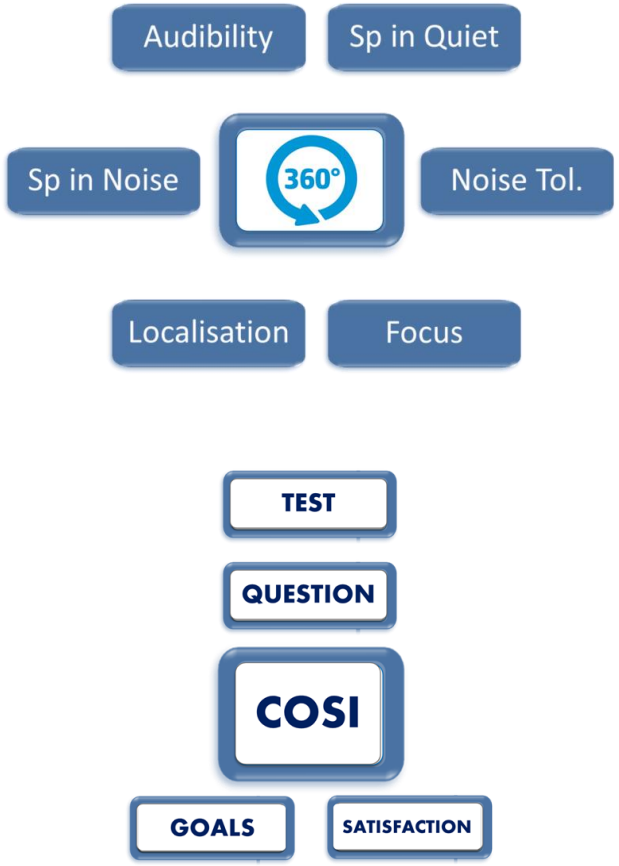
Conclusion



- In most cases – Assessment is limited to Tonal Audiometry and Speech Audiometry in Quiet
  - Speech in Noise Audiometry (Adaptive Procedure) should be the main focus.
    - Also much more realistic and better call to action (can also be done as self-test … “hearWHO” self test)
  - Noise Acceptance – Localisation and Focus (Working Memory / Listening effort) offer good potential.

- Questionnaires need to be included
  - COSI – Client Oriented Scale of Improvement: Define Goals and Evaluate results (improvement & satisfaction)
  - SSQ – Speech, Spatial and Quality of Hearing Scale 12: Understanding in noise, Localisation, Quality and Effort evaluation.

- Personalised Quality Hearing Care must be based on a much wider assessment before (selection) and after fitting (evaluation)

"Assessing outcomes of hearing aids in adults"

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