“Assessing outcomes of hearing aids in adults”

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What do most assess?
What are the issues?

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. 1

**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 3

**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
What should we assess?
Speech in Quiet

SRT = Speech Reception Threshold (50%)

SRT reference = Speech Reception Threshold (50%)

SRT ~ Fletcher Index

SRT reference = Speech Reception Threshold (50%)

Speech audiometry

Audiogram
Speech in Quiet

SRT = Speech Reception Threshold (50%)

Speech audiometry

Under <> Correct Compression

Gain

dBSRT

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

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

Speech in Noise

Speech Audiometry in Noise

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.
Speech in Noise

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

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

Improved auditory functionality: Aided SNR improvement

<table>
<thead>
<tr>
<th>≥ 2 dB SNR deterioration</th>
<th>Little or no difference (difference &lt; 2 dB)</th>
<th>≥ 2 dB SNR improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>% 14%</td>
<td>25%</td>
<td>61%</td>
</tr>
</tbody>
</table>

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.)

High Frequency Gain
Correct Compression
Directionality
Good Binaural Fit
Optimised Localisation
Noise Acceptance

**ANL test**

- **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**
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

Eddins & al – Galster - EUHA 2014
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

Specific Goals/Objectives → Degree of Change → Final Ability

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

Harvey Dillon

Harvey Dillon*
Allison James*
Jenny Grinto*
**COSI – Client Oriented Scale of Improvement**

**COSI®**, Client Oriented Scale of Improvement

<table>
<thead>
<tr>
<th>Specific Needs</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the customers in my bakery shop</td>
<td>1</td>
</tr>
<tr>
<td>Following a conversation with my sisters (4) during dinner at home</td>
<td>2</td>
</tr>
<tr>
<td>Understanding my husband in a restaurant (calls)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Degree of change**

"Because of the new hearing instrument, I now hear..."

- Worse
- No difference
- Slightly Better
- Better
- Much Better

**Final Ability**

"I can hear satisfactorily..."

- 0% (Hardly ever)
- 25% (Occasionally)
- 50% (Half the time)
- 75% (Most of the time)
- 95% (Almost Always)
COSI – Client Oriented Scale of Improvement

The First Priority
- Speech in Quiet: 35%
- Speech in Noise: 54%
- Telephone: 6%
- Other: 0%
- Radio/Television: 5%

The 2nd - 3rd or 4th Priority
- Speech in Quiet: 24%
- Speech in Noise: 33%
- Radio/Television: 32%
- Telephone: 7%
- Other: 4%
COSI – Client Oriented Scale of Improvement

**Degree of change - First <> Experienced**

- **Worse**: 0%
- **No difference**: 5%
- **Slightly Better**: 10%
- **Better**: 15%
- **Much Better**: 20%

**Final Ability- First <> Experienced**

- **Nearly never**: 0%
- **Sometimes**: 5%
- **Half of the time**: 10%
- **Most of the time**: 15%
- **Nearly always**: 20%

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**Final Ability - First <> Experienced**

- **L First**: Green
- **L Experienced**: Red

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**Degree of change - First <> Experienced**

- **L First**: Green
- **L Experienced**: Red

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**Final Ability - First <> Experienced**

- **L First**: Green
- **L Experienced**: Red
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.
SSQ Questionnaire

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

Speech
14 Questions

Spatial
17 Questions

Quality
18 (+1) Questions

Not at all

Perfectly

tick if not applicable

or wouldn’t hear it
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.
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)
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