Hearing Aid Outcome Measures in Older Adults: 
What to Measure and When

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Hearing-Aid Outcome Measures

Objective Performance and Benefit
Subjective Benefit
Satisfaction
Usage
Objective Performance and Benefit

Aided and Unaided Speech Recognition

- Materials
  - Syllables, words, sentences

- Listening Conditions
  - Speech Level
  - Background
  - Azimuth
Subjective Benefit

- Subjective Scales
- Assessment of CHANGE from Unaided to Aided
- Examples
  - HAPI or SHAPIE
  - Benefit Profiles
    - PHAB, APHAB, COSI
  - Hearing Handicap
    - HHIE
Subjective Benefit

- Self-Report Scales

- Assessment of \textit{CHANGE} from Unaided to Aided via “helpfulness” of HA

- Example
  - HAPI, Hearing Aid Performance Inventory
Hearing Aid Satisfaction

Rate your satisfaction with the following HA features (VS, S, N, D, VD)

- Overall fit/comfort
- Hearing aid size
- Visibility to others
- Ease of adjusting volume
- Whistling/feedback
- Clearness of sound

Rate your satisfaction with the HA in the following listening situations

- Conversation with 1 person
- In small groups
- Outdoors
- In large groups
- Watching TV
- On the telephone

MarkeTrak series, S. Kochkin
Hearing Aid Usage

- Objective Measures
  - “Datalogger”
  - Battery weight

- Subjective Measures
  - single reports of “typical usage”
  - diaries or use “logs”
  - average hours used per day vs. recommended hours
Many Outcome Measures

- How are they related?
- Do they all measure the same thing?
- Do they interact in a simple or complex manner?
- Are some more important than others?
- ?????
Our Approach to Sorting this Out

- Obtain multiple measures of hearing-aid outcome from large numbers of hearing aid wearers at the same time (4-6 wks post-fit)

- Examine associations (correlations) among measures

- Determine if the large set of outcome measures can be reduced to a smaller set (factor analysis)
The IU Studies
(IU-1 to IU-4)

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+ many students!
IU-1 (Humes et al., 2001, 2002)

- Study with 173 HA wearers
  - Binaural full-concha ITE hearing aids
  - single-channel LINEAR Class D w/ OLC (NAL-R)
IU-2 (Humes et al., 2004)

- Study with 53 HA wearers
  - Binaural *ITC* hearing aids
  - 2-channel *WDRC* (FIG 6 Rx)
IU-3
(Humes, 2007; Humes et al., 2009)

• Study with 109 HA wearers
  – Binaural digital 4-channel WDRC ITE hearing aids
  – With directional mics (in ½ of wearers)
  – NAL-NL1
IU-4 (Humes et al., 2009)

• Follow-up IU study with 35 HA wearers
  – Binaural digital 6-channel WDRC BTE open-fit hearing aids
  – With directional mics
  – NAL-NL1
Common Features across IU Studies

• Shared set of 12 outcome measures
• Outcome measures completed at 4-6 weeks post-fit
• Strict protocol followed in each study, with many common features across studies
  – Older adults with typical bilateral sloping hearing loss as participants
  – Similar gain targets and real-ear verification
  – Same core team of clinicians in same clinic
Summary of Outcome Measures

• 12 outcome measures common to all four studies of hearing-aid outcome
  – 3 measures of speech recognition--aided & unaided (2x ea), plus difference between them
    • CST, 65 dB SPL, +8 dB SNR (babble), 0/180
  – 4 HAPI subscales
  – 1 HA Satisfaction (from MarkeTrak), HASS
  – 3 GHABP (use, benefit, satisfaction)
  – 1 HA Use (avg hours/day), from daily diaries
Results (N=368)

Different Colors:
Different HA Technol
Results (N=368)

Self-report Measures: Use and “Benefaction”
Factor Analysis Overview

- Attempts to reduce redundancy among measures or variables by examining the way in which the measures co-vary (correlations)

- # of factors can range from 1 to $n$, where $n$ is the number of measures

- “Goodness of fit” for the factor structure that emerges is indicated by % of variance accounted for by all factors, which also reflects the importance of each factor
Hearing Aid Outcome Measures
Factor Analysis Results (N=368)

Four factors emerged; % variance = 83.5
Conclusions re: What to Measure

• There are four dimensions of hearing-aid outcome
  – Subjective Benefit and Satisfaction ("benefaction")
  – Hearing Aid Usage
  – Aided Speech-Recognition Performance
  – Objective Benefit (Aided vs. Unaided Speech-Recognition Performance)
Norms (Humes et al., 2009)

The graph illustrates the proportion of group members requiring different levels of help, categorized as Little Help, Some Help, Helpful, and Very Helpful, across various conditions: Speech in Noise, Speech in Quiet, Reduced Cues, and Miscellaneous. The sample size, $N = 333$, is indicated on the graph.
Norms (Humes et al., 2009)

N = 333
When to Obtain Measures?

• Do the outcome measures change over time and, if so, in a similar manner for most people?
No substantial changes observed in group or individual data over first year (N = 134)

Smaller groups followed for 2 years (N = 43) and 3 years (N = 9) with the same results.
CONCLUSIONS re: *When* to Measure

- Few changes in “objective” performance or benefit were observed over time.

- Some changes in “subjective” measures (benefit, satisfaction, use) occurred over time.
  - Measures got WORSE after 1 month of use.

**Valid Outcome Measures Can Be Obtained at 4-6 Weeks Post-fit**