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

Larry E. Humes
Department of Speech & Hearing Sciences
Indiana University
Bloomington, IN
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 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)

KEY COLLABORATORS:
Nathan Amos
Amy Arthur
Nancy Barlow
Gretchen Burk
Carolyn Garner
Lisa Goerner
Dana (Wilson) Kinney
Elizabeth Thompson
+ 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)

AGE  binhfpta  uncSTrau

binhfpta  0.17  -0.23  -0.65

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)

![Graph showing the relationship between HAPI Scale Score and Proportion of Group for different conditions: Speech in Noise, Speech in Quiet, Reduced Cues, Miscellaneous. The graph includes data points for 333 participants.](image)

- **Little Help**
- **Some Help**
- **Helpful**
- **Very Helpful**

**N = 333**
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