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# Hearing Aid Selection and Fitting - Some Guidance from Recent Research

**Todd Ricketts, Ph.D.**

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# Hearing Aid Selection and Fitting - Some Guidance from Recent Research Findings

Todd A. Ricketts, Ph.D.

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# Gus's Pick Of The Month

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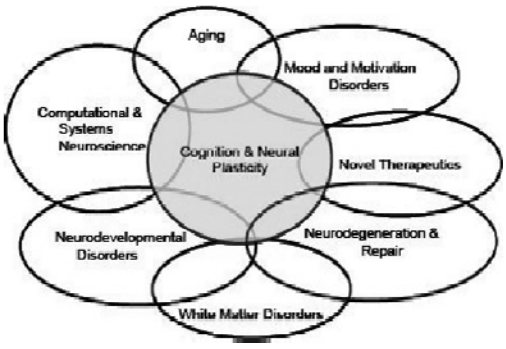
## The patient's cognition status and hearing aid processing




- Do you change the hearing aid processing for a patient with poor cognition?
- If so, how do you know if a patient has good or poor cognition? Or at what point is it bad enough that you should change things?

## Check out the August 20Q at *AudiologyOnline*

**"Cognition Measures: They might change the way you fit hearing aids!"**

20Q with Gus Mueller

**Pam Souza**

- Reports on recent research related to cognition and hearing aid signal processing
- Discusses the role of the audiologist related to clinical cognition testing. Is there a role?

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# What We're Planning At Vandy

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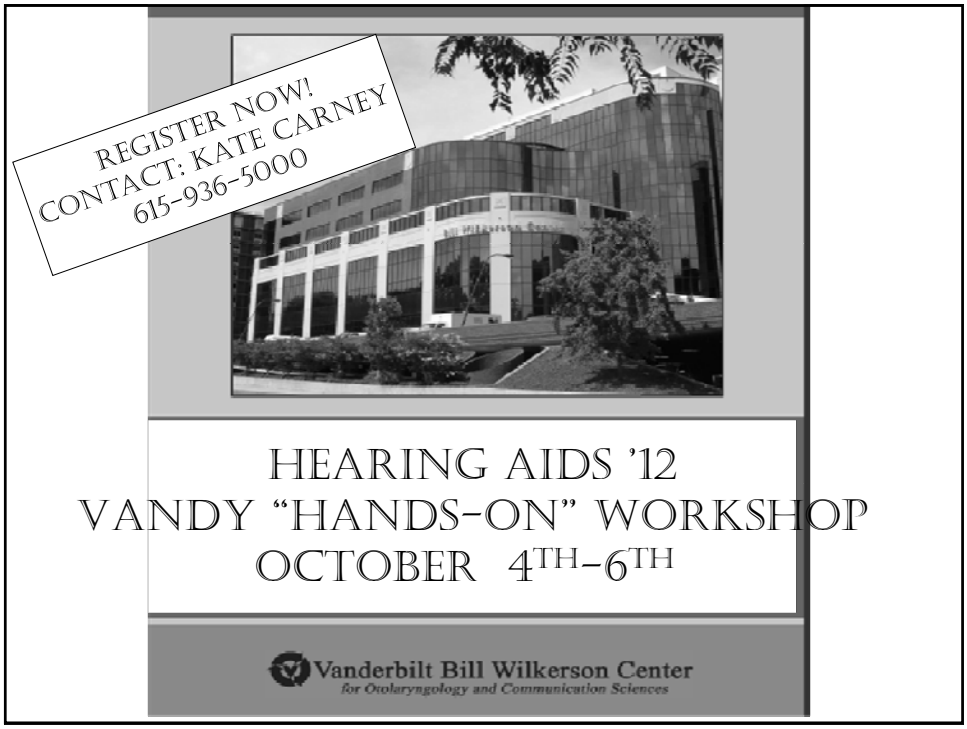
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3rd

## Today's Guest: Todd Ricketts

**Hearing Aid Selection and Fitting - Some Guidance from Recent Research Findings**

## The Influence of Audiovisual Ceiling Performance on the Relationship Between Reverberation and Directional Benefit: Perception and Prediction

Yu-Hsiang Wu and Ruth A. Bentler

Ear and Hearing, epub ahead of Print

## What they asked . . .

- Does reverberation interact with ceiling performance and affect directional benefit at typical SNRs?
- Can a modified speech intelligibility index (mSII) model predict directional benefit across AV listening conditions with different levels of reverberation?

## A little background. . .

- Wu & Bentler (2010) concluded that directional benefit was limited in AV environments at "typical" SNRs (-3 dB SNR and better).
- Acoustically, directional microphone hearing aids are less able to improve signal-to-noise ratio in more-reverberant environments. However, because AV omnidirectional performance is less likely to approach the ceiling level in more reverberant environments, listeners may perceive significant directional benefit in these environments.

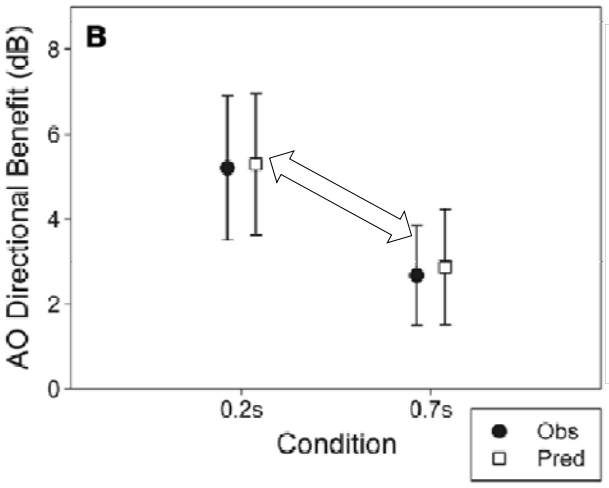
## Why it matters. . .

- If directional microphone hearing aids do not provide significant advantages during AV listening, perhaps their real world benefit has been overstated.

## What they did . . .

- Measured directional benefit in nineteen adults with sensorineural hearing loss using the AO HINT and the AV CST in environments containing either low or moderate levels of reverberation (reverberation time = 0.2 sec and 0.7 sec, respectively).
- Calculated mSII for both speech materials. To predict AV directional benefit, the AO mSII was converted to the AV mSII using the correction ANSI S3.5-1997 (R2007) and new equations developed based on the data previously collected in a low-reverberation sound booth (Wu and Bentler 2010).

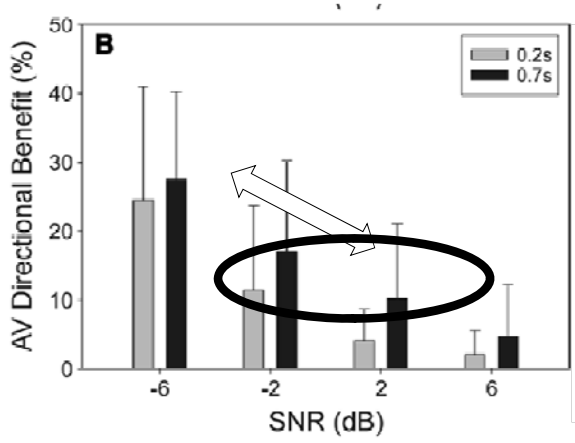
# What they found (AO) . . .




Significant directional benefit on all AO conditions. However…

directional benefit **<u>decreased</u>** with increasing reverberation

# What they found (AV) . . .

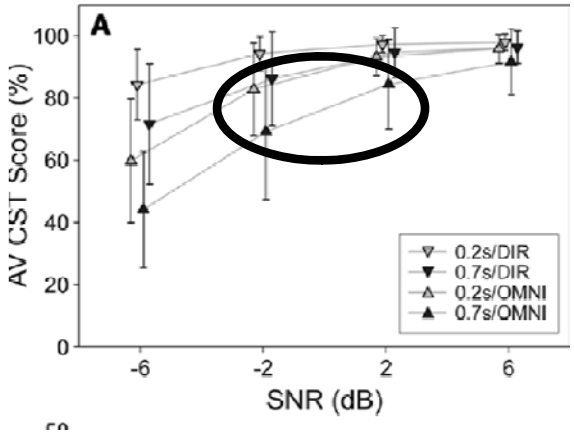



Decreasing directional benefit with increasing SNR. However…

significant directional benefit was present in AV conditions even at +2 dB SNR in the moderately reverberant environment.

More directional benefit with **<u>more</u>** reverberation.

## What they found – AV ceiling effects . . .

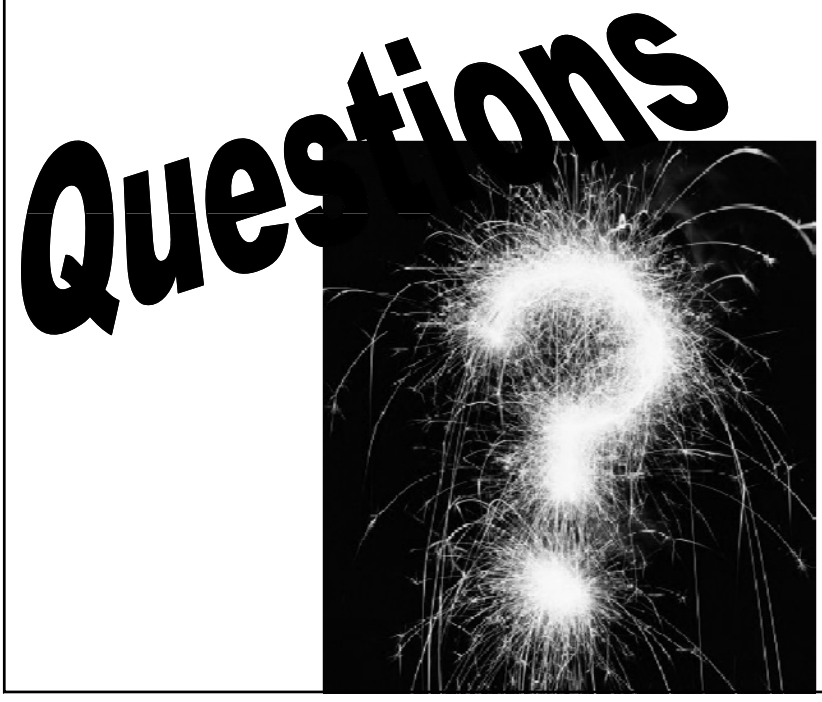



## What they found – Predictions

- The mSII model accurately predicted AO directional benefit.
- The mSII model underestimated AV directional benefit in both reverberation conditions.
- The newer model resulted in more accurate predictions in the low-reverberation condition; however, AV directional benefit in the moderately reverberant condition was still underestimated.

## Why is this important…

- Hearing aid users are expected to achieve the greatest directional benefit in situations in which they do not reach ceiling performance.
- The present study suggests that, in the real world, these situations may include face-to-face communication occurring in environments with moderate or higher reverberation.



## Determination of Preferred Parameters for Multichannel Compression Using Individually Fitted Simulated Hearing Aids and Paired Comparisons

Brian C. J. Moore, Christian Fullgrabe, and Michael A. Stone

Ear & Hearing 32(5): 556-568, 2011.

## What they asked . . .

- What are the preferred gain and compression parameters of a 5-channel compression hearing aid (simulated)?
- How do these preferred parameters obtained though paired comparisons compare to those of a validated prescriptive procedure (CAMEQ-HF2)?

## Why it matters. . .

- Still mixed results regarding how much some compression parameters matter.
- Renewed interest in high frequency extension and what the optimal settings should be.

- Aside… Does paired comparison lead to a different average result (starting point) than a validated prescriptive method?

## What they did . . .

- Participants with mild to moderate hearing loss expressed preference for pairs of sounds including speech sounds (a male talker and a female talker) and musical sounds (a percussion instrument, orchestral classical music, and a jazz trio).
- The sounds in each pair were derived from the same token and differed along a single dimension in the type of processing applied.
- For the speech sounds, participants judged pleasantness or clarity (in noise); for musical sounds, they judged pleasantness.

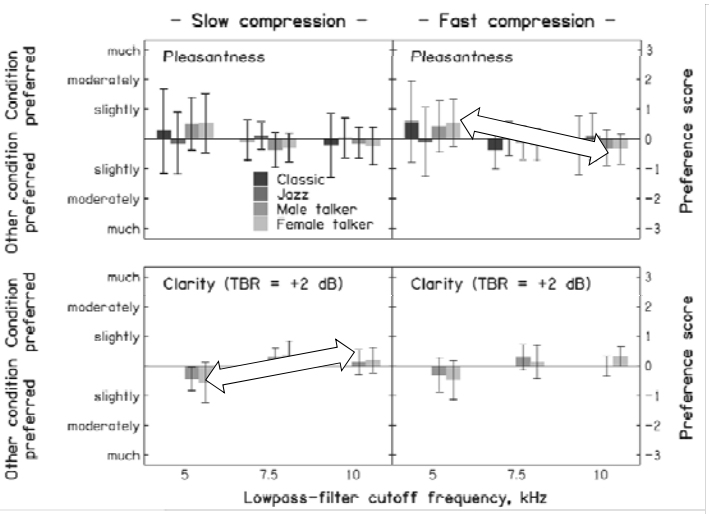
## What they did (4 separate experiments) . . .

- Time delay of the audio signal relative to the gain control signal (the alignment delay)
  - Sometimes called look ahead compression (0, 2.5, 5 and 10 ms)
- Compression speed (attack and release times)
  - 50 ms attack/3000 ms release (slow), 20 ms attack/300 ms release (medium), 10 ms attack/100 ms release (fast)
- Bandwidth (5, 7.5, or 10 kHz)
- Gain in the high frequencies

## What they found (alignment delay) . . .

- No effects at all for speech or most musical signals
- No effects for clarity
- Significant, but small, effects for pleasantness (none for clarity) – only for the percussive sounds and fast time constants (10 ms attack/100 ms release)
  - Increasing delay improved pleasantness
  - However – increasing delay results in an actual delay and can have several negative consequences.
- Authors concluded that a 2.5 ms delay may be the best

# What they found. . .




There was a trend for pleasantness to decrease slightly with increasing bandwidth (significant for female speech) with fast compression.

Hearing loss slope effects?

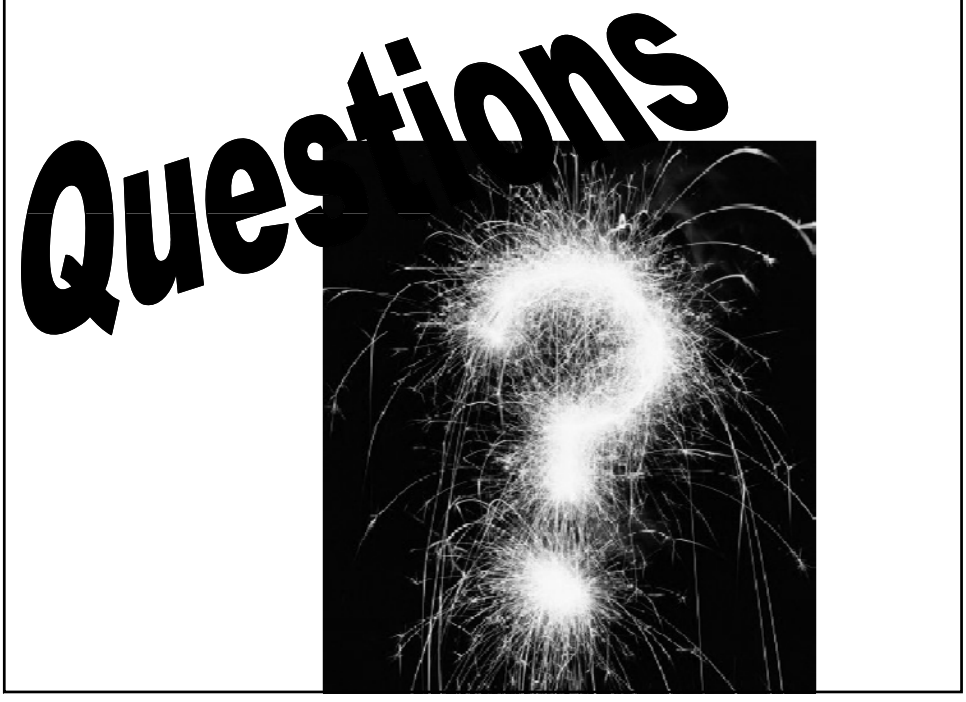
Judged clarity was significantly higher for the 7.5- and 10-kHz bandwidths than for the 5-kHz bandwidth for both slow and fast compression and for both talker genders.

# What they found (compression speed and high frequency gain) . . .

- Compression speed did not effect pleasantness at 50- or 65-dB SPL input levels, but slow was judged slightly more pleasant than fast for 80-dB SPL input level.
- Clarity was higher for slow than fast for 80 and 65 dB SPL only.
- Maximum pleasantness for CAMEQ2-HF gains and below - Speech clarity was not affected by changing the gain at high frequencies.

## Why is this important?…

- There are many individual differences, and effect sizes were small, but a few general trends:
  - Don't worry much about alignment delay – effects are very small
  - Effects of time constants are also small, but slower was judged as slightly more clear on average.
  - Extending high frequency bandwidth may make things slightly more clear – particularly for individuals whose hearing loss slope is shallow.
  - The optimal amount of high frequency gain my be equal OR LESS than prescribed by CAMEQ2-HF.



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# Mixing Things Up a Bit

# Clinical Tidbits: Some interesting research findings

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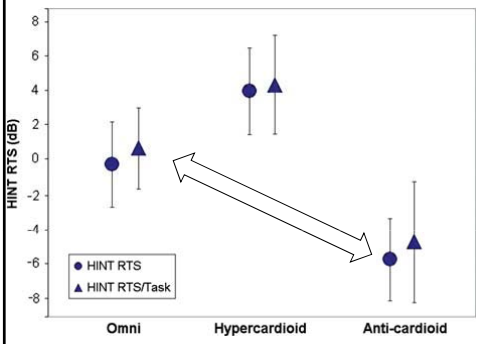
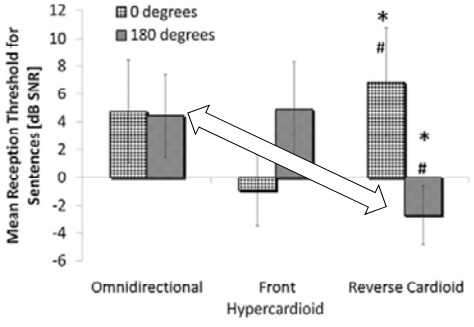
Reverse directional microphones provide significant benefits when speech is from the back (e.g. car)




**Mueller, Weber & Bellanova, IJA 2011; 50: 249–254**

**Kuk & Keenan, JAAA 23:64–73 (2012)**

## Further evidence for the need to control for placebo effects in hearing aid trials

**TABLE 2. Sound quality ratings for "new" and "conventional" hearing aids**

| | Comfort | Clarity | Overall Impression | Overall Sound Quality Rating |
|---|---|---|---|---|
| Mean rating "new" (SD) | 8.95 (1.12) | 9.28 (1.15) | 9.00 (1.11) | 9.12 (1.02) |
| Mean rating "conventional" (SD) | 8.40 (1.21) | 8.61 (1.28) | 8.1 (1.47) | 8.35 (1.17) |
| $z^*$ | −1.94 | −2.77 | −2.96 | −2.88 |
| $p$ (two-tailed) | 0.053 | 0.006 | 0.003 | 0.004 |
| Effect size ($r$) | 0.23 | 0.27 | 0.29 | 0.33 |

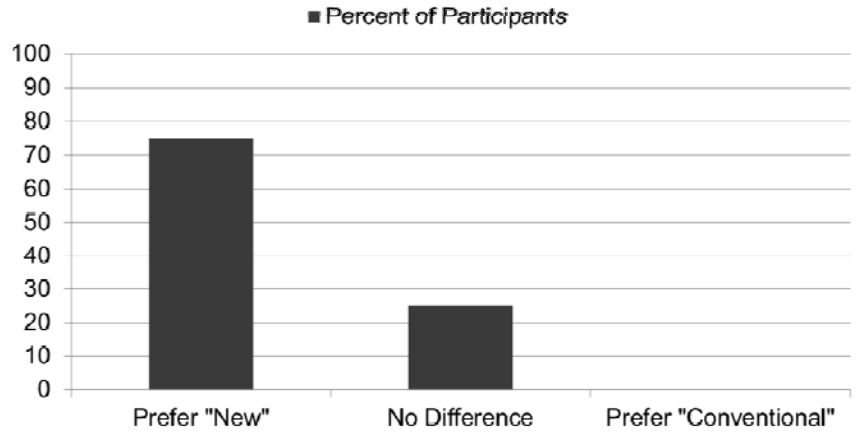
* *Wilcoxon signed-rank test statistic.*

Same hearing aid fitted to the same prescription.

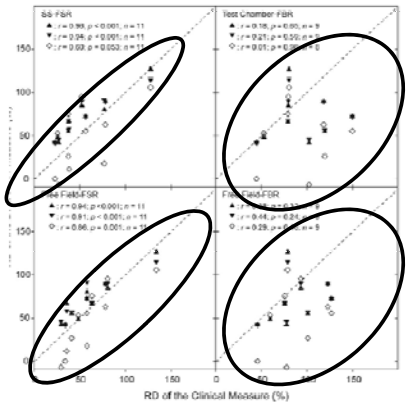
Speech recognition even trended slightly (2%) higher!

**Dawes, Powell, and Munro, Ear & Hearing, 2011, 32(6), 767–774**

## Final "Technology" Preference



## Front-to-side ratio may be a better early clinical predictor of DM failure than FBR

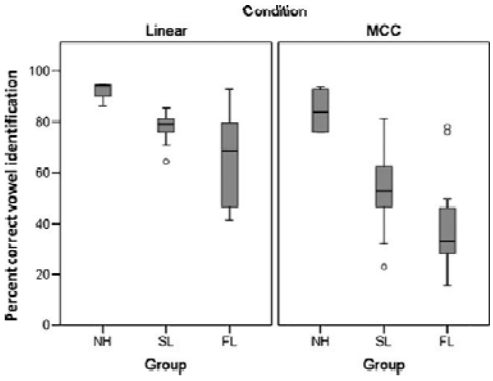


Left Panels:
FSR versus DI

Right Panels:
FBR versus DI

**WU AND BENTLER, Ear & Hearing, 2012, 33(1), 44-56**

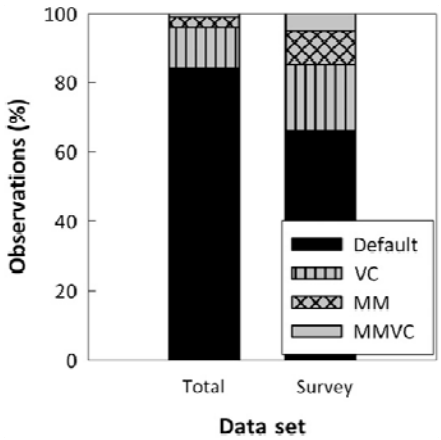
## Compression considerations for those with flat hearing loss




(1) 16 channel compression (MMC) reduced vowel recognition compared to linear.
(2) Reduction was greater for flat hearing losses (broader auditory filters in the low frequencies).

**Souza, Wright, and Bor, JSLHR, 55, 474–486, 2012**

## While listeners mostly use default settings, they still like VCWs and multiple memories

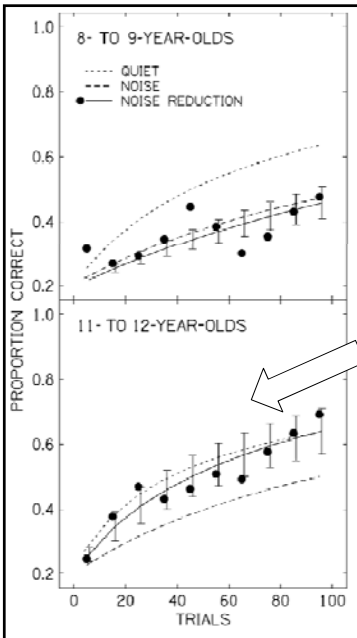



(1) the "use" setting was preferred most often,

(2) the preferred hearing aid settings were mostly bilaterally symmetrical,

(3) non-default settings were often used in difficult listening situations.

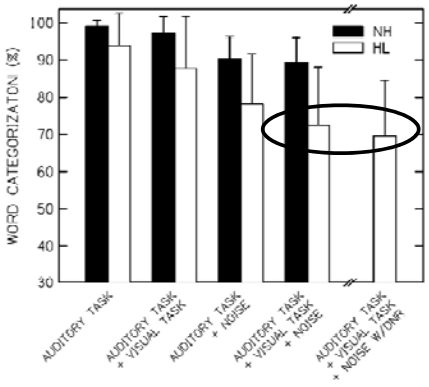
**Banerjee, JAAA, 22:359–374 (2011)**




Less gain in noise helps older children?

**Pittman, JSLHR 2011; 54: 1248-63.**

## More evidence that some types of DNR do not affect speech recognition/word categorization, but show other benefits.




**Pittman, JSLHR 2011; 54: 1224-39.**

# Questions

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# Commodore Award

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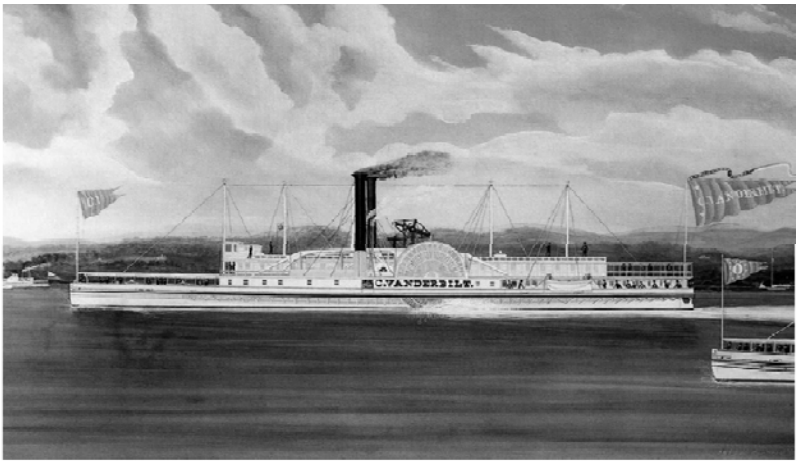
Commodore Cornelius Vanderbilt

Commodore Vanderbilt Steamship (circa 1860)





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## Preference for One or Two Hearing Aids Among Adult Patients

Robyn Cox, Kathryn S. Schwartz, Colleen M. Noe, and Genevieve C. Alexander

Ear and Hearing; 32: 181-197, 2011

## What they asked . . .

- What portion of patients with symmetrical hearing loss prefer one or two hearing aids after being fitted for a period of time?
- Are there pre-fitting variables that can be used to predict which patients will prefer one hearing aid rather than two?

## Why it matters. . .

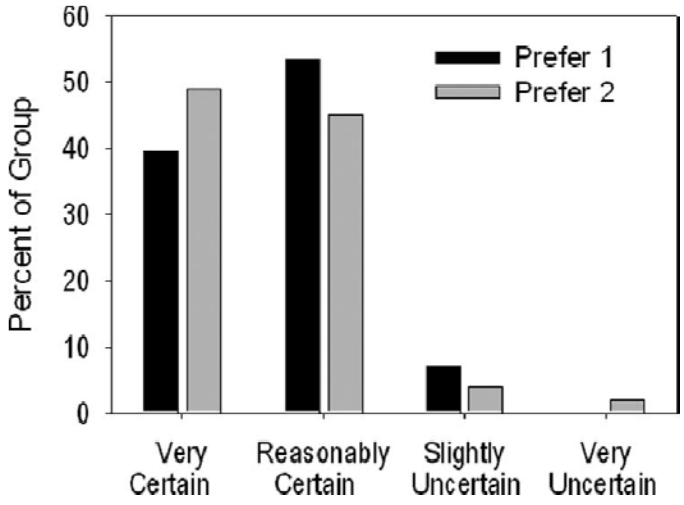
- Most practitioners believe that use of two hearing aids is the ideal fitting for adults with bilateral symmetrical hearing loss.
- However, previous research has consistently shown that a substantial proportion of these patients actually prefer to use only one hearing aid.
- Defaulting to bilateral can lead to the perception that we "push" hearing aids, while defaulting to unilateral is expected to limit potential HA benefits.

## What they did . . .

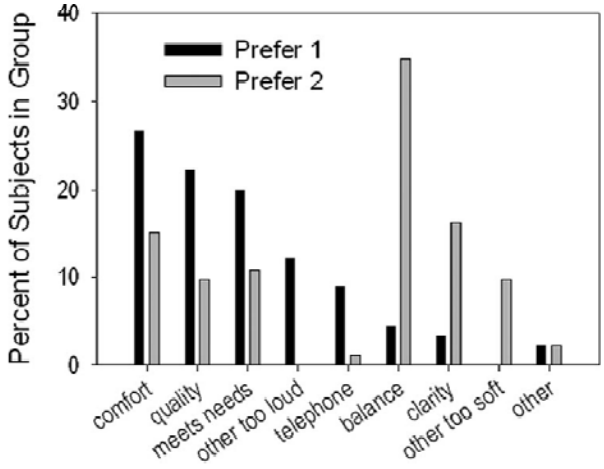
- 94 subjects (50-85 yrs) with mild to moderate bilaterally symmetrical hearing loss were bilaterally fit with 2005–2007 era hearing aids. "Open minded" about 1 or 2.
- 12-week field trial including 3-week structured and 9-week unstructured use of one and two hearing aids.
- After the field trial, each subject stated his or her preference for one or two hearing aids and completed three self-report outcome questionnaires for their preferred fitting.
- Measured potential predictors including demographic, audiometric, auditory lifestyle, personality, and binaural processing variables.

## What they found. . .

- 54% of subject preferred using two hearing aids.
- Audiometric hearing loss, previous experience, and auditory lifestyle were not predictive of aiding preference!




## What they found – reasons for preference?



## What they found – group differences?

- Subjects who preferred two hearing aids:
  - tended to report better real-world outcomes
  - reported more hearing problems in daily life
  - experienced more binaural loudness summation
  - had ears more equivalent in dichotic listening tasks

## Why is this important?…

- The best predictive approach from this study yielded accurate predictions for only two-thirds of the subjects!
- Author's Suggestion?
  - Recognize that many patients who seem to be ideal candidates for bilateral aiding will actually prefer to wear only one hearing aid.
  - Consider conducting a candid unbiased systematic field trial allowing each patient to compare unilateral and bilateral fittings in daily life.
  - However… This might necessitate more fitting sessions must weigh against potential for increased patient satisfaction and selecting the most cost-effective patient-centered solution.

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