Allied Health Media AudiologyOnline

If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

Allied Health Media AudiologyOnline

This handout is for reference only. It may not include content identical to the powerpoint.

Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date..

Allied Health Media AudiologyOnline

Vanderbilt Audiology's Journal Club: Hearing Aid Features and Benefits - Research Evidence

Presenter: Todd A. Ricketts, Ph.D.

Moderator: Moderator: Gus Mueller, PhD - AudiologyOnline Contributing Editor

Allied Health Media AudiologyOnline

- Technical Assistance: 800-753-2160
- CEU Total Access members can earn credit for this course
  - Must complete outcome measure with passing score (within 7 days for live webinar; within 30 days of registration for recorded/text/podcast formats)
- Questions? Call 800-753-2160 or use Contact link on AudiologyOnline.com

VANDERBILT AUDIOLOGY
JOURNAL CLUB
Hosted by
Gus Mueller

VANDERBILT AUDIOLOGY
JOURNAL CLUB
Hosted by
Gus Mueller

Vanderbilt Audiology's Journal Club: Hearing Aid Features and Benefits - Research Evidence

Todd Ricketts, Ph.D.

Brought to you by
AudiologyOnline

VANDERBILT AUDIOLOGY
JOURNAL CLUB
Hosted by
Gus Mueller

Vanderbilt Audiology's Journal Club: Hearing Aid Features and Benefits - Research Evidence

Todd A. Ricketts, Ph.D.

Brought to you by
AudiologyOnline

Learning Objectives

- List 4 recent journal articles that address the benefit of hearing aid features or fitting.
- Explain the findings of 4 recent journal articles that address the benefit of hearing aid features or fitting.
- Describe how the results of 4 recent journal articles may impact the clinical process of hearing aid fitting and support evidence based practice.

Fitting Noise Management Signal Processing Applying the American Academy of Audiology Pediatric Amplification Guideline: Verification Protocols

Susan Scollie, Charla Levy, Nazanin Pourmand, Parvaneh Abbasalipour, Marlene Bagatto, Frances Richert, Shane Moodie, Jeff Crukley and Vijay Parsa

Journal of the American Academy of Audiology (2016), 27:237–251

What they asked . . .

- Broad in Purpose: I will focus on one of a few investigations described in this manuscript which explored whether variation across different brands of DNR are perceived by children who have hearing loss.

Why it matters. . .

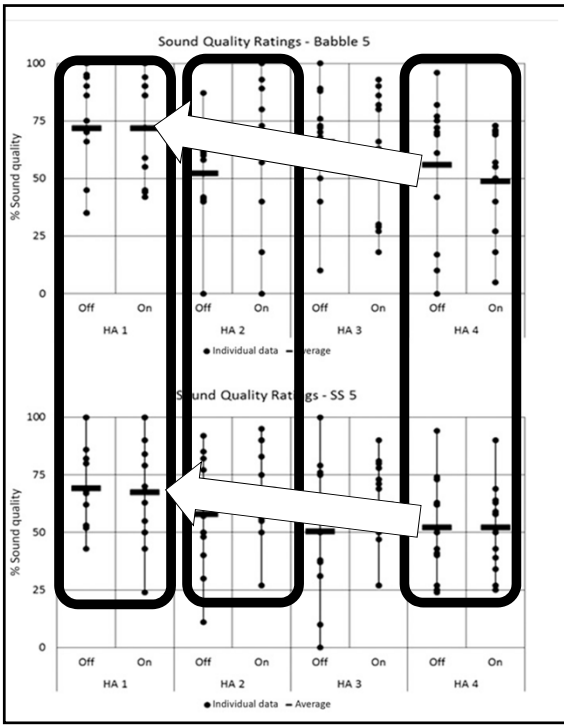
- While generally not affecting speech recognition, the potential benefits for DNR processing related to preference and other factors have been promoted previously.
- Potential differences in DNR preference across manufacturers had not been previously explored in children.

What they did . . .

- Thirteen children and young adults (12.5 years - range: 8–22 years) completed the study (two unable).
- Evaluated four BTE hearing aid models (HA1: Fast speed, medium effect, HA2: Medium speed, medium–strong effect; HA3: Medium speed, weak effect; HA 4:Slow speed, strong effect.
- The hearing aids were fitted and verified once to DSL v5-quiet, and once to DSL v5-noise targets (DNR off and on/maximum + some with moderate DNR settings).
- Signals were recorded from each hearing aid and evaluated using the Multiple Stimuli with Hidden References and Anchors (MUSHRA; ITU, 2001; Parsa et al, 2013) method for sound quality evaluation.

What they did . . .

- One anchor, one reference (+10 and – 10 dB SNR) and five groups of stimuli were created for evaluation from recordings of DNR on and off: 1) speech in babble at +15 dB SNR; 2) speech in babble at 0 dB SNR; 3) speech in speech-shaped noise at +15 dB SNR; 4) speech in speech-shaped noise at 0 dB SNR; and, 5) speech in quiet.
- Testing in the sound field (booth) from a loudspeaker 1 m from the listener.
- Listeners were fitted with a laboratory pair of BTE hearing aids (Oticon AltaPro) - individually fitted to DSL v5-child targets with all signal processing disabled except for WDRC and DFS.
- Judged speech from poor (0%) to excellent (100%).



What they found (+15). . .

For some brands DNR activation had little to no average effect on sound quality.

For other brands DNR improved sound quality at least for some conditions.

Some brands generally resulted in higher sound quality ratings than other regardless of DNR status.

Why is this important?…

- These results are broadly consistent with those of Brons et al. (2013) which demonstrated differences in annoyance, listening effort, and speech intelligibility across DNR systems in adults.
- As the authors stated: “Taken together, these results call into question the assumptions that noise reduction and hearing aid sound quality are equivalent across brands and types of hearing aids.”
- Considering the DNR function and how each individual reacts to the sound quality may be important for optimizing sound quality of hearing aids in noisy environments.

Other considerations not discussed by the authors…

- The authors categorized DNR based on reduction in noise level and change in SNR, this does not really differentiate between Modulation Based DNR (gain reduction) and fast filtering (adaptive Weiner filtering/spectral subtraction) techniques.
- While these methods are commonly used in tandem, sound quality differences for speech in noise are typically attributed to the latter. Further, depending on brand, fast filtering may be always active, or adjusted by the DNR control.
- Compression and other processing differences can also affect sound quality.
- It may not be straightforward to predict preference based only on test box measures of DNR function.

Potential Clinical Application?

- The continued presence of preference differences after a period of experience should be confirmed.
- Also need to confirm that differences are present in real world environments and in the context of other hearing aid processing (e.g. directional microphones, etc.) and noise conditions (including noise only).
- Need to examine what factors affect preference.
- If results are generalizable and reliable, development of individualized fitting methods for DNR may lead to improved outcomes.

The effects of frequency lowering on speech perception in noise with adult hearing-aid users

Christi W. Miller, Emily Bates & Marc Brennan

(2016) International Journal of Audiology, 55: 305–312

What they asked . . .

What is the effect of application of three types of commercial frequency lowering technologies on speech recognition in adult hearing aid users?

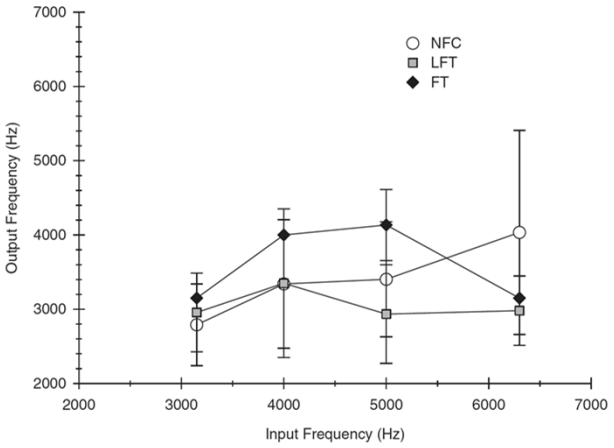
Why it matters. . .

- A variety of frequency lowering technologies are commonly available across manufacturers. Data demonstrating potential benefits in adult listeners is limited.

What they did . . .

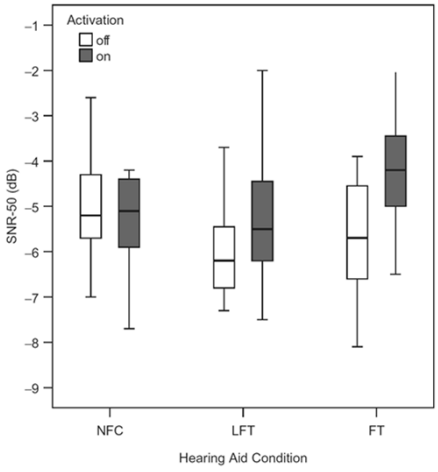
- 10 participants (some had experience with FL) were used to compare three hearing aids that used either non-linear frequency compression (NFC), linear frequency transposition (LFT), or frequency translation (FT – sometimes referred to as frequency duplication and lowering).
- For 65 dB SPL speech the highest audible frequency was approximately 4 kHz. The settings for each FL strategy were adjusted to provide audibility for the average level of a 6300 Hz band pass filtered speech signal (Audioscan Verifit).
- Sentence recognition in noise, subjective measures of sound quality, and a modified version of the speech intelligibility index (SII) were measured or calculated.

Frequency Specific Lowering (Hz)



Results would look very different for broadband; these results are for one narrow band at a time.

What they found. . .



- SNR-50 was not improved for any condition and decreased for some.
  - Role of experience particularly for LFT?
- No difference in calculated SII

Why is this important?…

- Several issues limit generalization of the results including limited experience, small N, optimal fitting methods for FL technologies are still being developed, greater high frequency hearing loss may be necessary to achieve benefits.
- What does it tell us? Adds to the growing pool of evidence suggesting FL may provide little or no significant improvements to sentence recognition in noise in adult listeners.
- Benefits more commonly consonant recognition in quiet.

A Randomized Control Trial: Supplementing Hearing Aid Use with Listening and Communication Enhancement (LACE) Auditory Training

Gabrielle H. Saunders, Sherri L. Smith, Theresa H. Chisolm, Melissa T. Frederick, Rachel A. McArdle, and Richard H. Wilson

(2016) Ear and Hearing 37(4), 381–396

What they asked . . .

Is the Listening and Communication Enhancement (LACE) program an effective supplement to standard-of-care hearing aid intervention in a Veteran population?

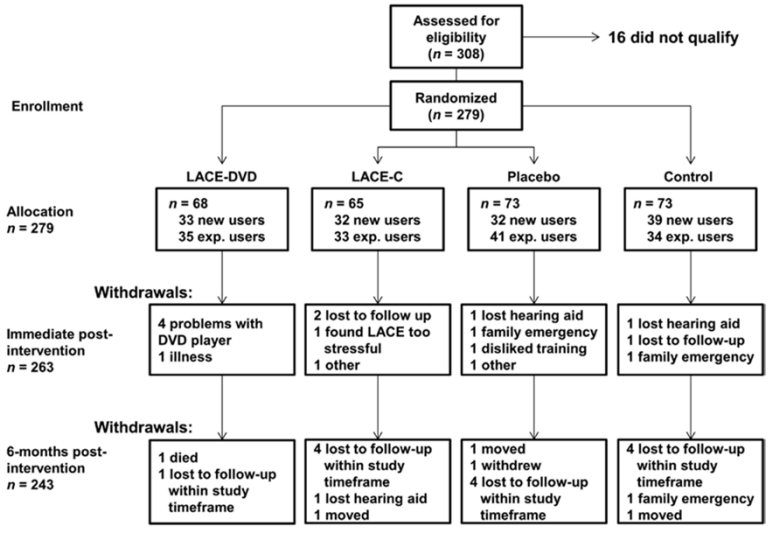
Why it matters. . .

- Hearing aid outcomes vary widely, cannot restore the auditory system to normal, hearing aid processed signals differ acoustically from unprocessed signals – particularly when a large amount of advanced signal processing is applied, and the auditory system of a patient acquiring hearing aids likely has been deprived of normal auditory input for several years.
- Auditory training (systematic listening practice), relies on the assumption that neurons in the brain can reorganize and restructure and the possibility that an adult with hearing loss could be "trained" or "retrained" to use bottom-up and top-down auditory processing skills.

What they did . . .

- Evaluation involved 279 veterans (new and experienced hearing aid users) enrolled at 3 VA sites. Randomized into one of four treatments after fitting.
- 1) LACE training using the 10-session DVD format; 2) LACE training using the 20-session computer-based format; 3) placebo auditory training (AT) consisting of actively listening to 10 hrs of digitized books on a computer; and, 4) a control group which received educational counseling. Groups compared and compliance tracked.
- Data for five behavioral and two self-report measures were collected during three research visits: 1) baseline; 2) immediately following the intervention period; and, 3) 6 months post-intervention.
  - Speech in Noise (WIN)
  - Rapid Speech in Noise
  - Speech in Speech Understanding
  - Word Memory (Digit Span)
  - Use of Linguistic context (R-SPIN)
  - Activity Limitations and Participation Restrictions (APHAP; HHIE)

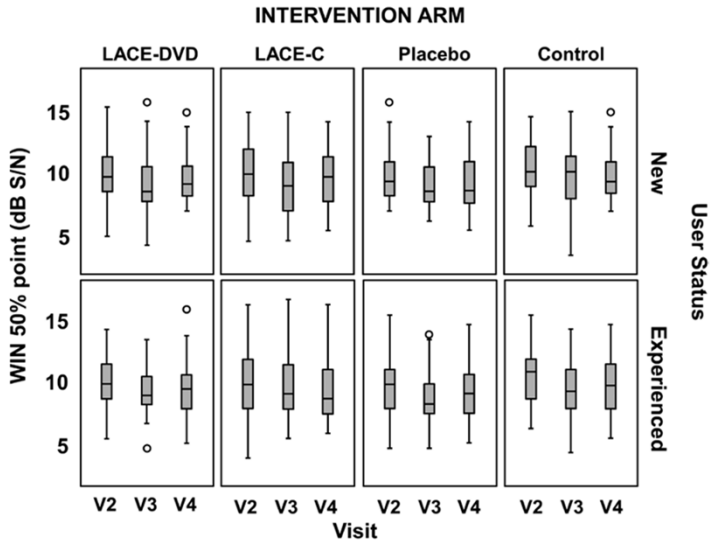
Patient Flow…



What they found…

Example results (WIN), all others are similar…

No significant differences on any measure.



Why is this important?…

- The authors concluded that LACE training does not result in improved outcomes over standard-of-care hearing aid intervention alone.
- However, they suggest benefits may exist using other tools (e.g. sentence materials).
- More importantly, they encourage assessment of individual differences to evaluate whether AT with LACE has any benefits for particular individuals.
  - Cite a previous study which found significant LACE benefits had a relatively high dropout rate (~20%) and subjects were their own controls.

Wind noise within and across behind-the-ear and miniature behind-the-ear hearing aids

Justin A. Zakis and Daniel J. Hawkins

(2015) Journal of the Acoustical Society of America, 138(4):2291-300

What they asked . . .

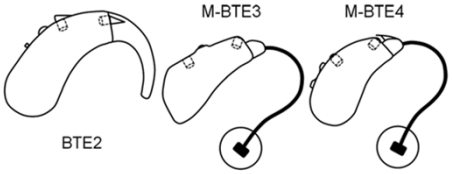
- How does BTE hearing aid style (traditional and mini-BTE) affect wind noise and predicted speech intelligibility (SII)?

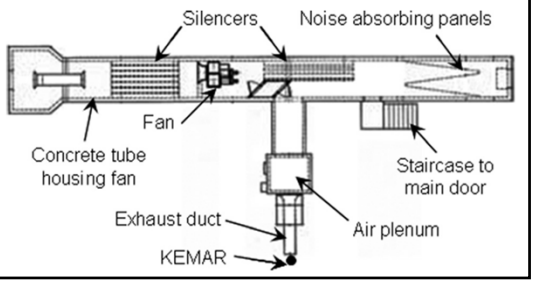
Why it matters. . .

- Wind generates turbulence resulting in wind noise at the hearing aid microphone output. Only 58% of hearing aid users are satisfied with their devices in wind noise, lower than in other noisy situations (Kochkin, 2010).
- Mini-BTEs are currently the most common style of hearing aid dispensed; however, prior to this study, properties of wind noise in this style were unknown.
- A better acoustic understanding of wind noise could lead to the design of hearing aid shells and/or signal-processing algorithms that improve satisfaction in windy situations.
- Decreased wind noise is expected to lead to greater satisfaction with hearing aids used in windy environments.

What they did . . .

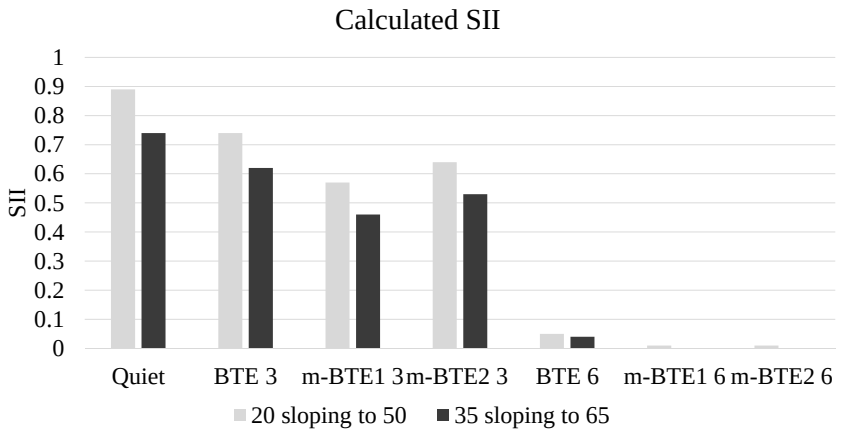
- Measured wind-noise levels across one BTE and two mini-BTE devices, and between the front and rear omni-directional microphones within devices.
- Levels were measured at two wind speeds (3 and 6 m/s) and 36 wind azimuths (10 degree increments).



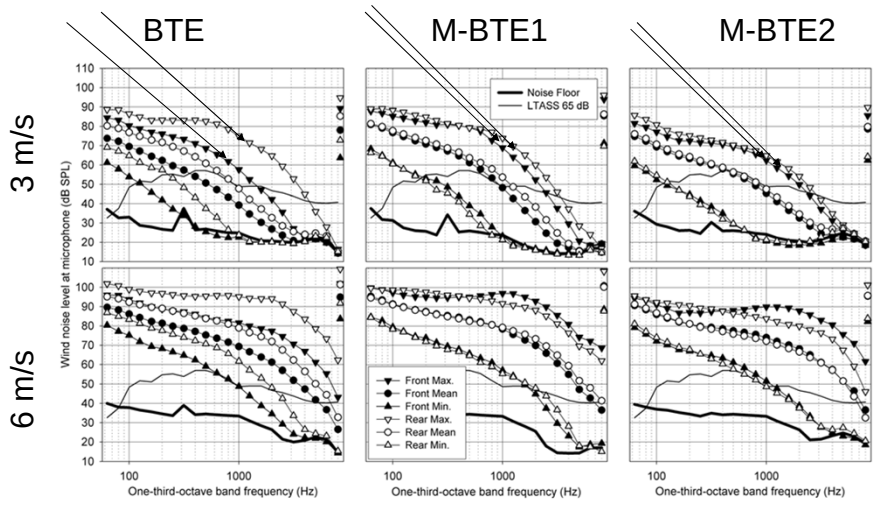


What they found…

Wind noise can partially (3 m/s) or fully (6 m/s) mask out important speech information



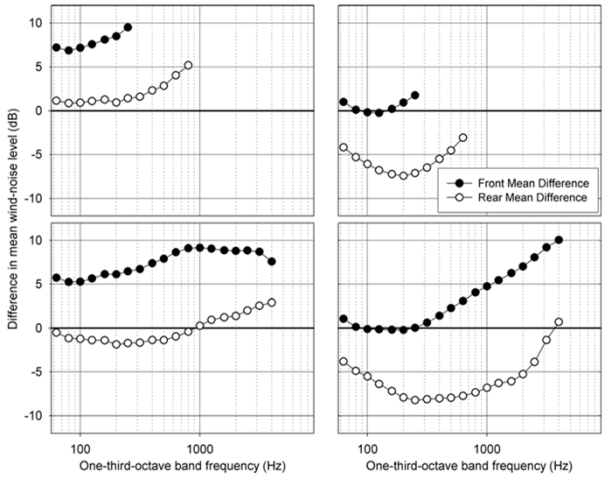
What they found…



Microphone noise in the m-BTEs varied in a complex fashion

Differences relative to BTE…

M-BTE1 minus BTE M-BTE2 minus BTE



Why is this important?…

- Mean wind noise levels were markedly different across the mini-BTE devices, except at high frequencies.
- Small differences in microphone location, shell design, and/ or wind shielding can result in large differences in wind noise levels across mini-BTE aids.
  - Since this is true one might also expect large individual differences based on fit!
- Mean levels in the BTE were higher, lower, or similar to those of the mini-BTE devices, depending on the comparison mini-BTE device, microphone (front or rear), and frequency band.
- For the mini-BTE devices, wind-noise levels were lower at the rear microphone for up to half of all azimuths. For the BTE device, it was likely that wind shielding differences strongly affected level differences between its microphones.
- Wind noise had the potential to reduce speech intelligibility at 3 m/s, and totally mask speech at 6 m/s, across BTE and mini-BTE devices.

The Effects of FM and Hearing Aid Microphone Settings, FM Gain, and Ambient Noise Levels on SNR at the Tympanic Membrane

Linda W. Norrix, Kristen Camarota, Frances P. Harris, James Dean, Journal of the American Academy of Audiology (2015), 27:117–125

What they asked . . .

- How do FM and hearing aid microphone settings including FM Gain (mix ratio) and background noise levels influence SNR at the tympanic membrane and speech recognition in noise?

Why it matters. . .

- FM configuration (FM only, versus FM + EM), setting of the hearing aid microphones and the FM gain relative to hearing aid gain (mix ratio) have all been previously shown to affect SNR. Clear information regarding these trade-offs are clearly important for clinical decision making and expectations counseling.
  - Despite the fact that previous work has shown activation of the hearing aid microphones greatly reduces FM benefit, FM+EM is often the default recommendation to allow for monitoring and overhearing.
- The increased introduction of remote microphone technologies (e.g. spouse microphones) expands the utility of this information to new populations.

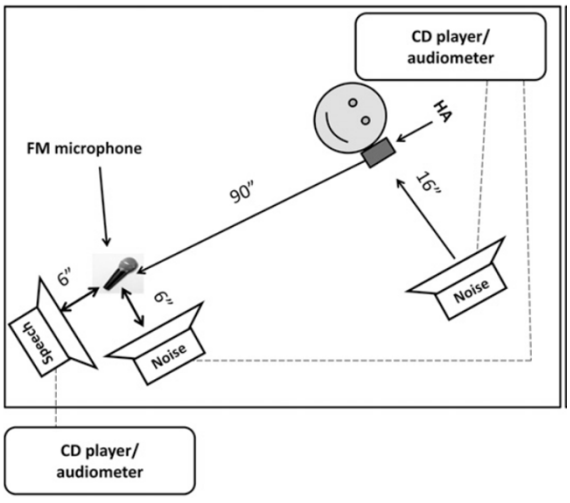
What they did . . .

- Thirteen children and young adults (12.5 years - range: 8–22 years) completed the study (two unable).
- Evaluated four BTE hearing aid models (HA1: Fast speed, medium effect; HA2: Medium speed, medium–strong effect; HA3: Medium speed, weak effect; HA 4: Slow speed, strong effect.
- The hearing aids were fitted and verified once to DSL v5-quiet, and once to DSL v5-noise targets (DNR off and on/maximum + some with moderate DNR settings).
- Signals were recorded from each hearing aid and evaluated using the Multiple Stimuli with Hidden References and Anchors (MUSHRA; ITU, 2001; Parsa et al, 2013) method for sound quality evaluation.

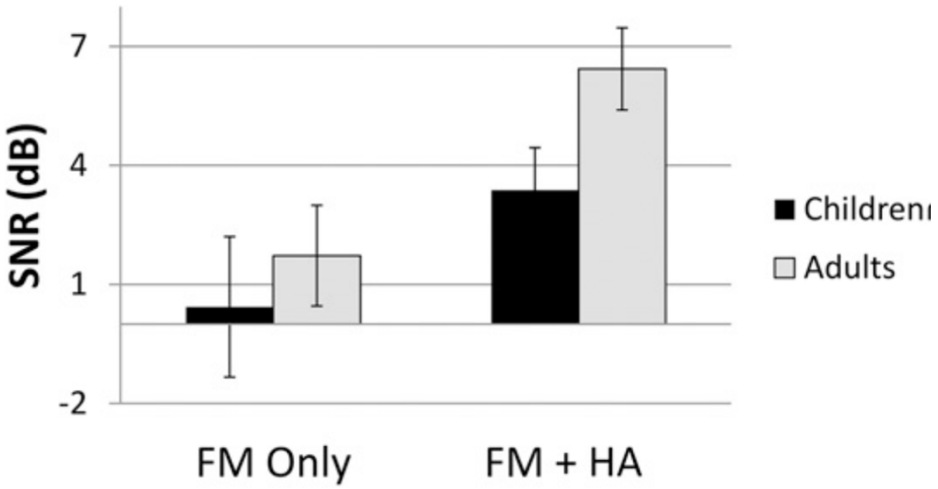
What they did . . .

- Calculated estimated SNR as a function of noise level and microphone conditions based on a theoretical model.
- Evaluated speech recognition in noise in 10 adults and 10 children with normal hearing across aided conditions.
- The same BTE HA, FM transmitter, and FM receiver were used with each participant (some high frequency gain).
  - Custom, fully occluding acrylic full-shell earmold with appropriate slim tube.
- The HA was set to omnidirectional microphone, DNR off, and a direct audio input setting of 0 dB. The FM gain was set to +12 dB, pre- and FM de-emphasis and digital signal processing were off.

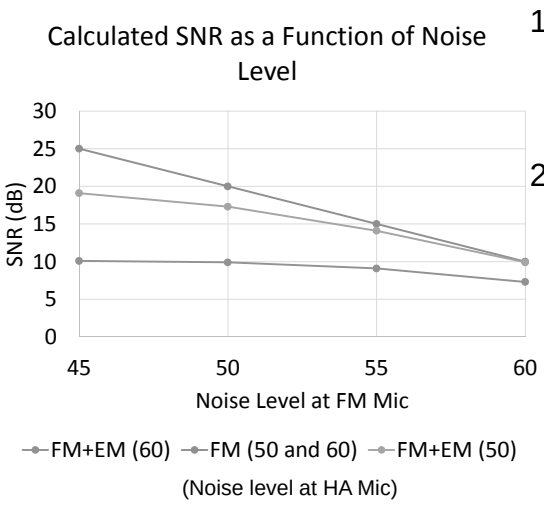
Behavioral Test Set Up (55 dB SPL noise)



What they found . . .



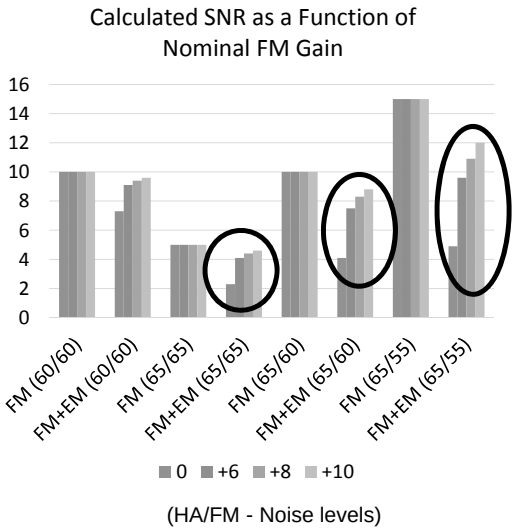
What they found . . .



1) For FM-only the SNR at the TM is determined primarily by the SNR at the FM microphone.
2) For FM+EM the SNR is determined by the highest level of the speech (at the FM microphone) and the highest level of noise (either the FM or HA microphone).

Speech 58 dB SPL at HA, 70 dB SPL at FM Mic

What they found . . .



1) Increasing FM gain has no impact on SNR for FM-only condition.
2) For FM+EM increasing FM gain improves SNR.
3) When the noise levels are similar at the two microphones, an improvement in SNR of +2 dB is expected.
4) Greater improvement is expected when the level of the noise at the FM microphone can be reduced relative to the level at the HA microphone.

Why is this important?…

- Activation of the HA microphone in the FM+EM condition can greatly limit FM benefit.
- SNR at the FM microphone can greatly limit benefit, and noise level at both microphones is important.
  - Caveat – the speech level at the FM microphone was lower than sometimes expected. A better SNR than in this study would be expected with higher speech input levels at the FM microphone.
- Improving the SNR at the FM/Remote microphone is important to maximize benefits when noise sources are near the individual wearing the remote microphone.

VANDERBILT AUDIOLOGY JOURNAL CLUB

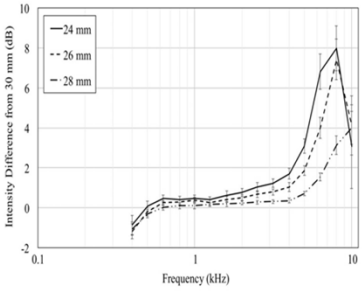
Hosted by Gus Mueller

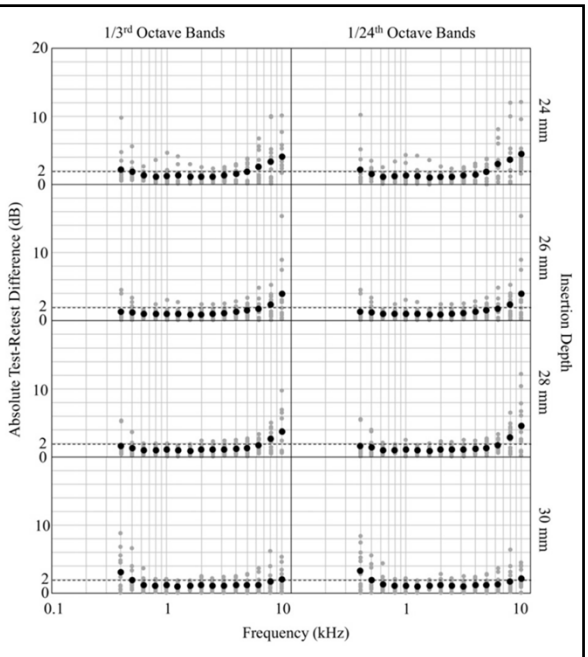
Clinical Tidbits: Some interesting research findings

Brought to you by AudiologyOnline

Accuracy of measuring extended high frequencies using probe microphone increases with depth of placement

Size and direction of error is predicable





Jonathan M. Vaisberg, Ewan A. Macpherson & Susan D. Scollie (2016). Extended bandwidth real-ear measurement accuracy and repeatability to 10 kHz, International Journal of Audiology, 55:10, 580-586

Effects of NFC on Music perception in listeners with and without hearing loss and with and without musical training?

- Less NFC preferred for music perception across all groups.
- Those with training had stronger preferences for no NFC.
- Listeners with normal hearing had stronger preferences for no NFC than listeners with hearing impairment.
- However, mild amounts of compression may not be highly detrimental to perceived sound quality, particularly in listeners with impaired hearing.

Bruna S. S. Mussoi & Ruth A. Bentler (2015) Impact of frequency compression on music perception, International Journal of Audiology, 54:9, 627-633.

VANDERBILT AUDIOLOGY
JOURNAL CLUB
Hosted by
Gus Mueller