Evaluating Real-World Hearing Aid Performance in a Laboratory

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Mary Meskan – research audiologist

*Mead Killion is president of Etymotic Research, which funded the current study and which co-developed the R-SPACE™ sound-field system described in this talk.

**Larry Revit is founder of Revitronix, which co-developed to the R-SPACE™ sound-field system described in this talk.

BACKGROUND

In a joint project spanning 6 years, we developed a sound recording and playback system for accurate simulation of real-world acoustic environments, while offering the advantages of laboratory control and repeatability. This work focused on three goals:

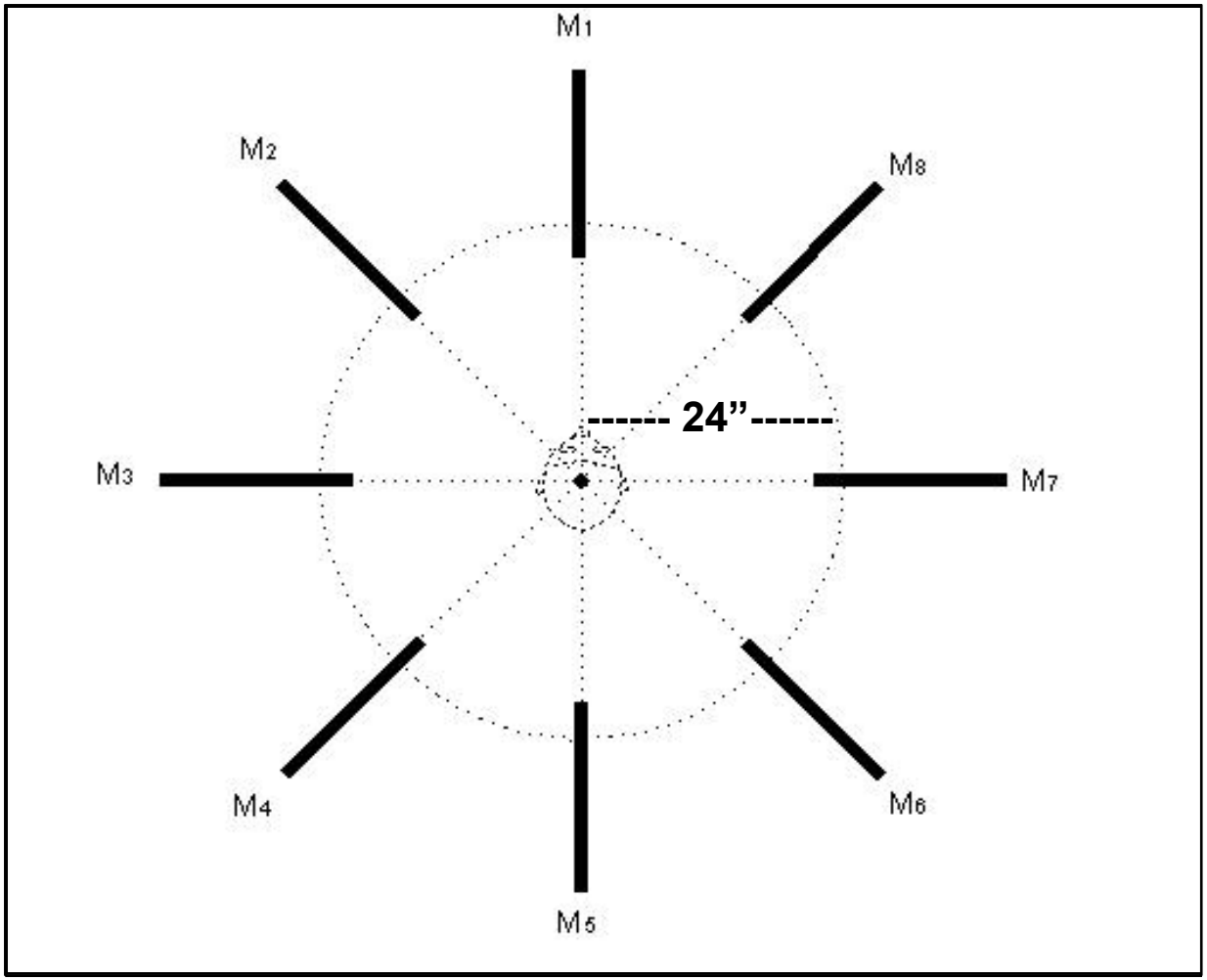
1] The simulated environments should sound real.

2] The simulated environments should allow hearing aids and the hearing mechanism to perform as they do in the real world.

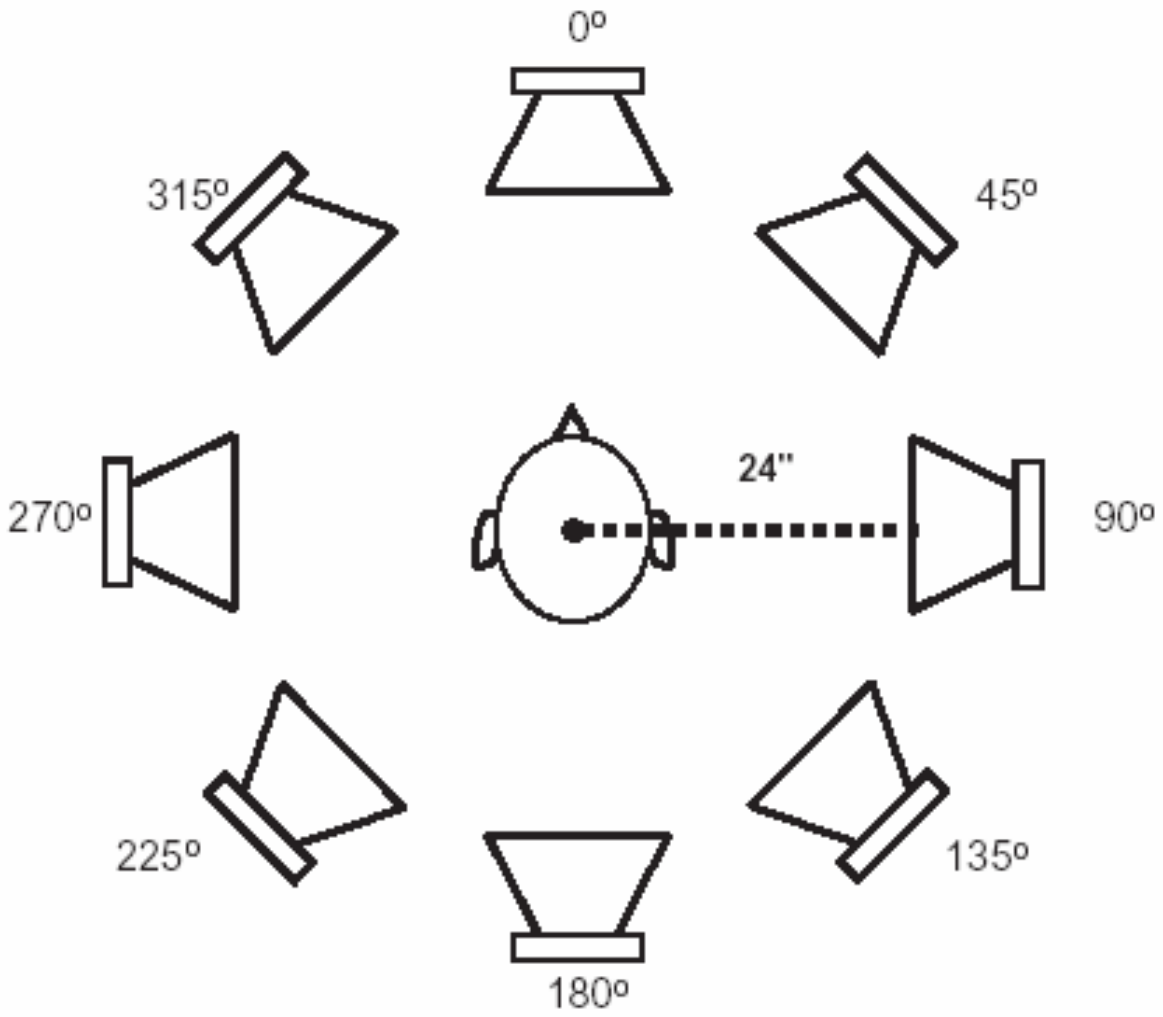
3] Cynthia Compton's dissertation (2002) was to confirm that lab results accurately predicted real-world results.

R-SPACE™ Recording System (patent-pending)

A multiple "long-gun" microphone array captures environmental sounds from all horizontal directions, before the sounds reach the center listening position.



R-SPACE™ playback system (patent-pending)



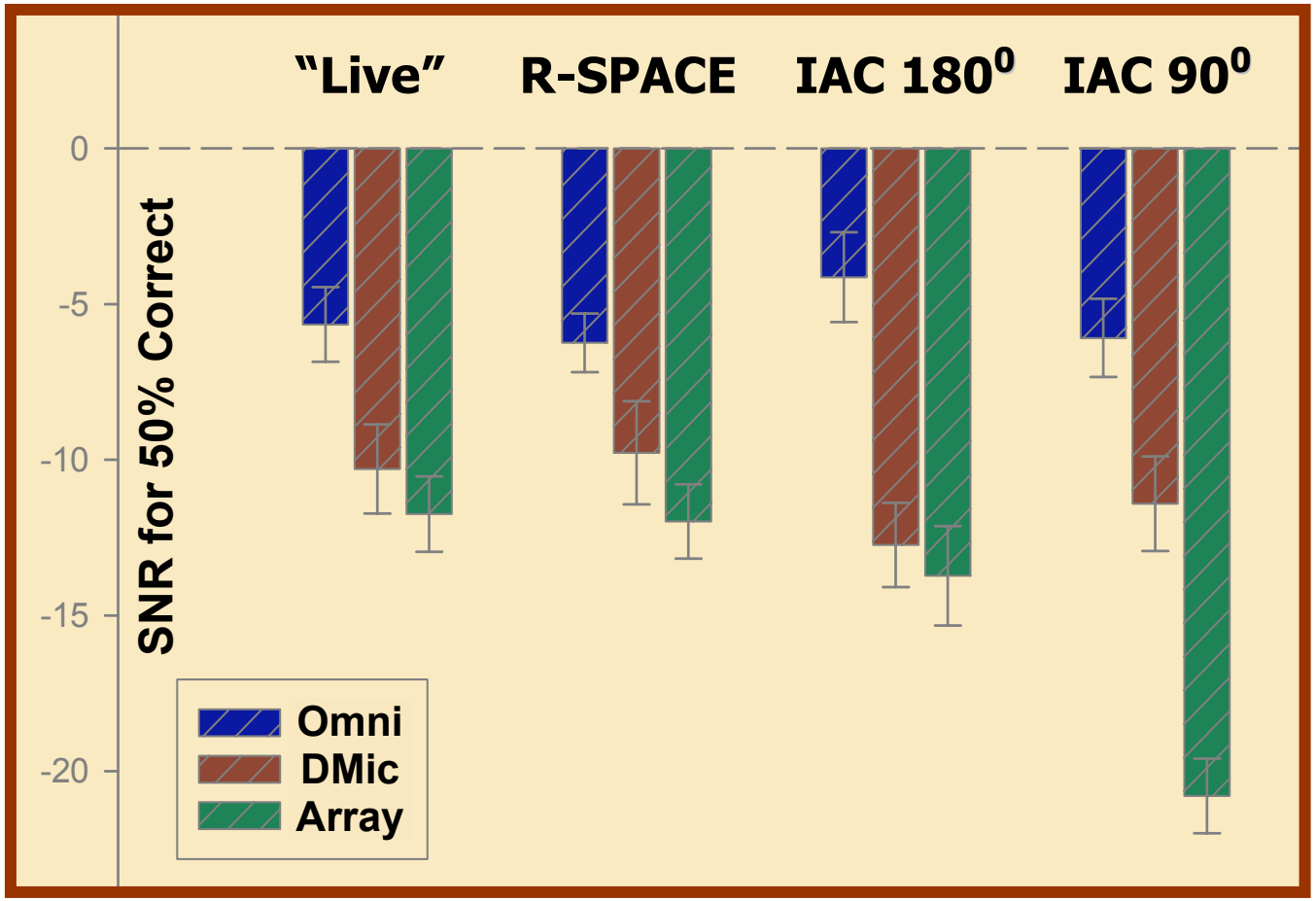
Lou Malnati's Restaurant with long-gun recording mic array and KEMAR for Compton's validation study.

Lou Malnati's Restaurant with long-gun recording mic array and KEMAR for Compton's validation study.

KEMAR was wearing three binaural pairs of hearing aid mics: Omni, Dmic, and Array mics for the "Live" condition in Compton's study.

Compton's Results

Mean "HINT" thresholds across three hearing aid microphone conditions and four noise delivery environments – 12 normal-hearing listeners.



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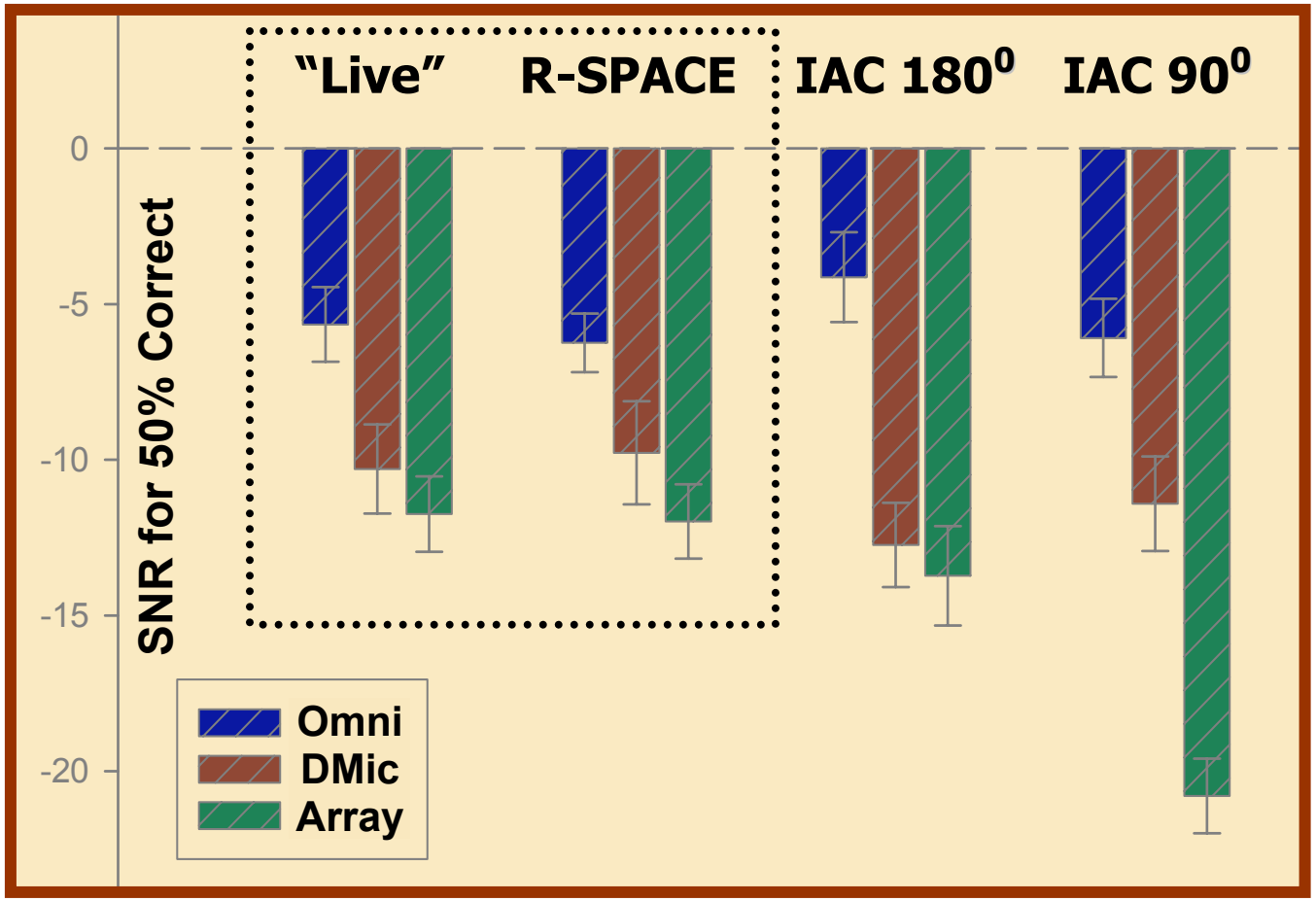


New Work

In recent advertising of a hearing aid, a manufacturer claimed 11-17 dB of "directional performance."

But how does this aid perform for listeners in terms of speech intelligibility in real noisy environments?

New Work

<u>Methods</u>:

1] The R-SPACE system was used to test speech intelligibility in noise for the "experimental" hearing aid.

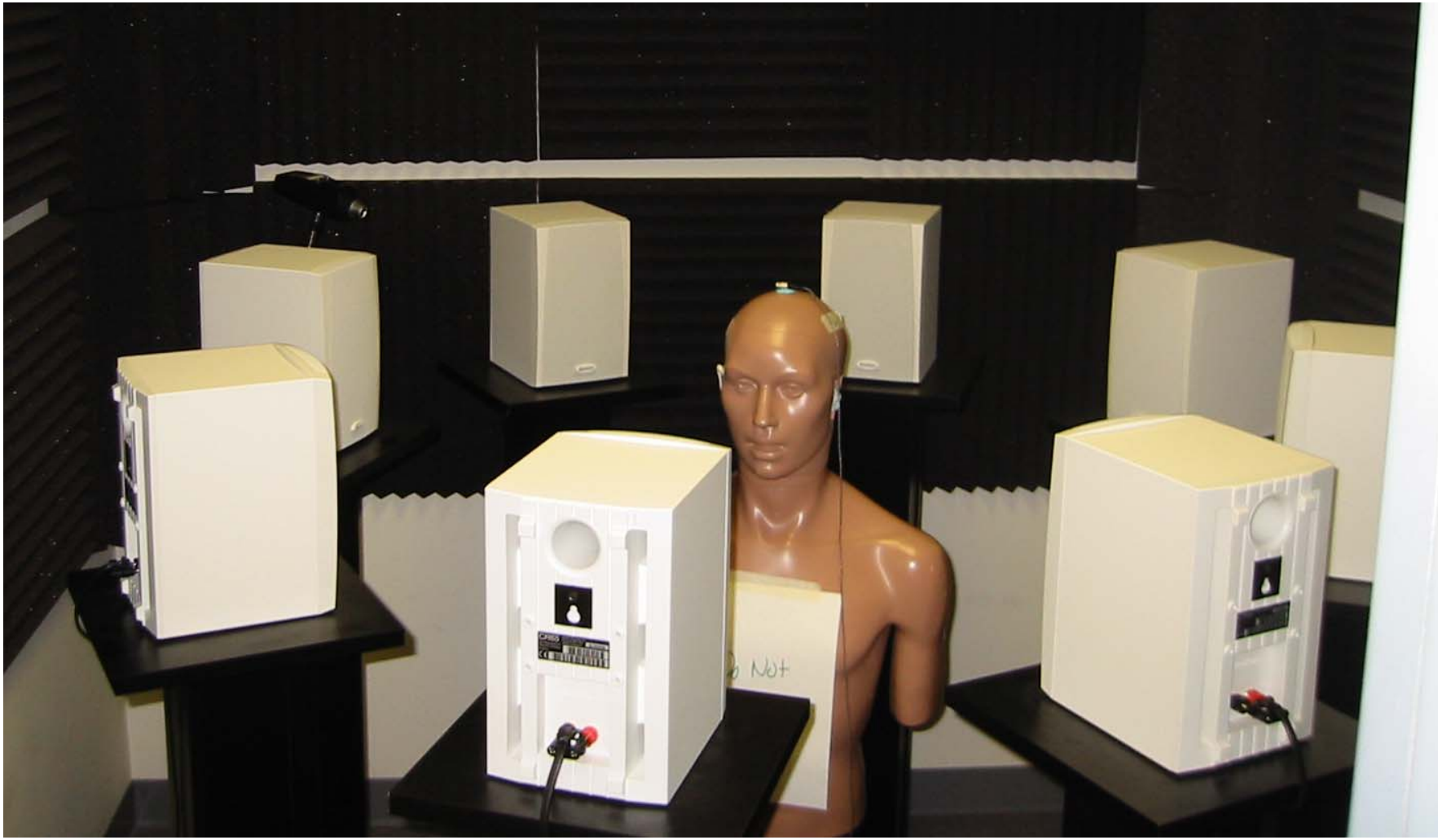
2] Omni and directional (CCmic) microphones served as the control and standard sound pickup conditions.

3] Concurrent with the R-SPACE trials, results were to be double-checked by a separate "*real-world*" evaluation using recordings made in the Etymotic Research lunchroom.

Mary Meskan's "R-SPACE" Trials

- **ITE test aids, omni, and CCmics worn by KEMAR in R-SPACE.**
- **"Quick & Dirty" SIN Test recordings were low-pass filtered at 2400 Hz to simulate hearing loss for 12 normal-hearing subjects.**

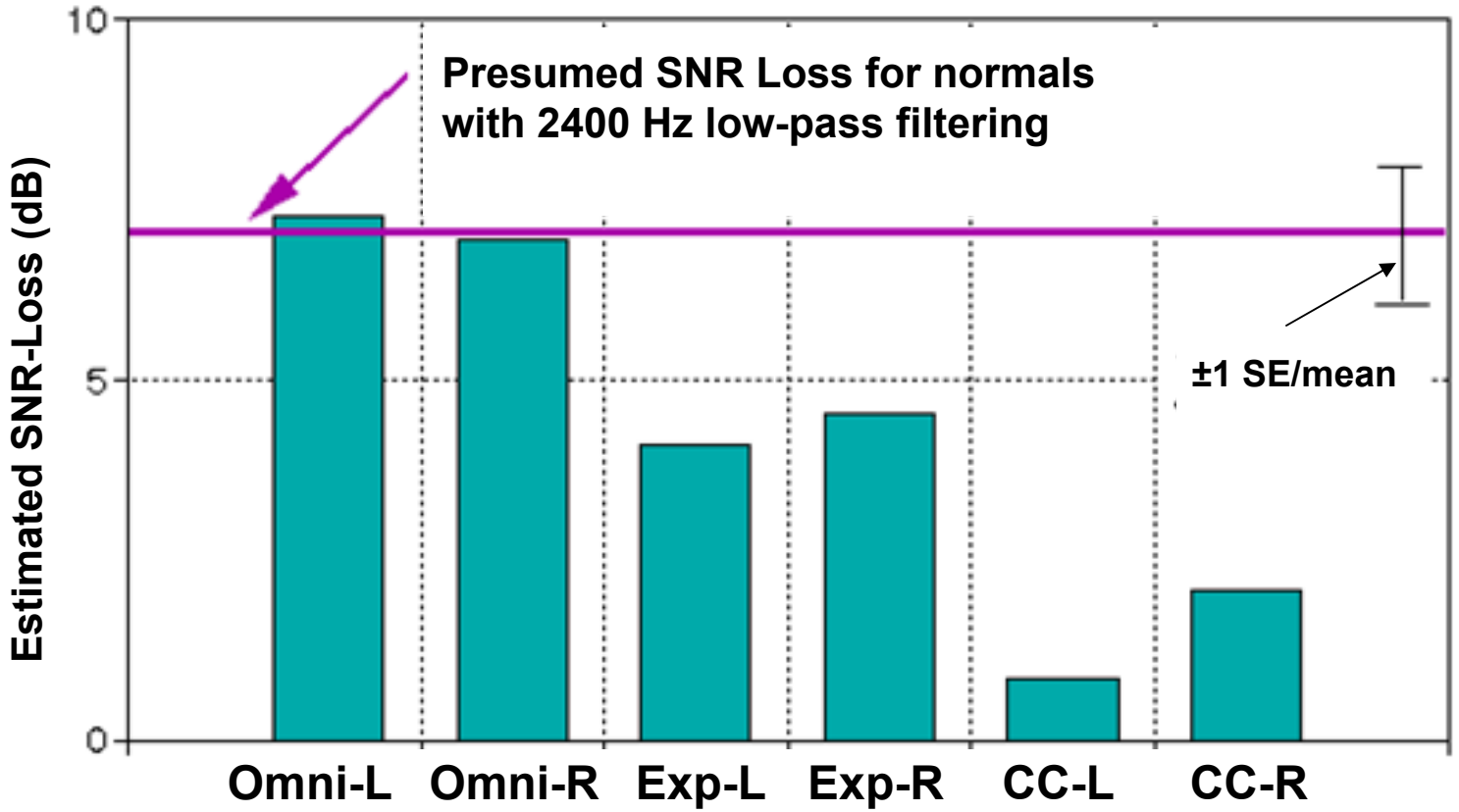
R-SPACE playback system at Etymotic Research



R-SPACE RESULTS:

Signal-to-Noise Ratio Loss

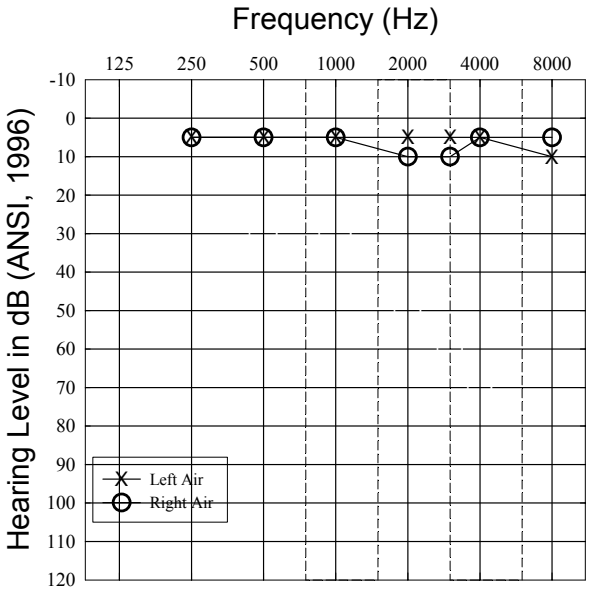
2400-Hz Low-Pass – 12 Normal-Hearing Ss

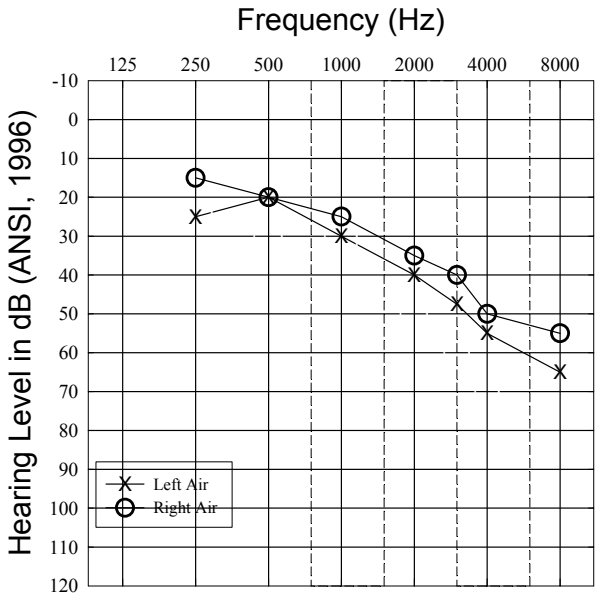


Experimental aids appear to offer an improvement over omni mics, but not even as much as "standard" 5-dB AI-DI directional microphones – only about 3 dB of "directional performance"!

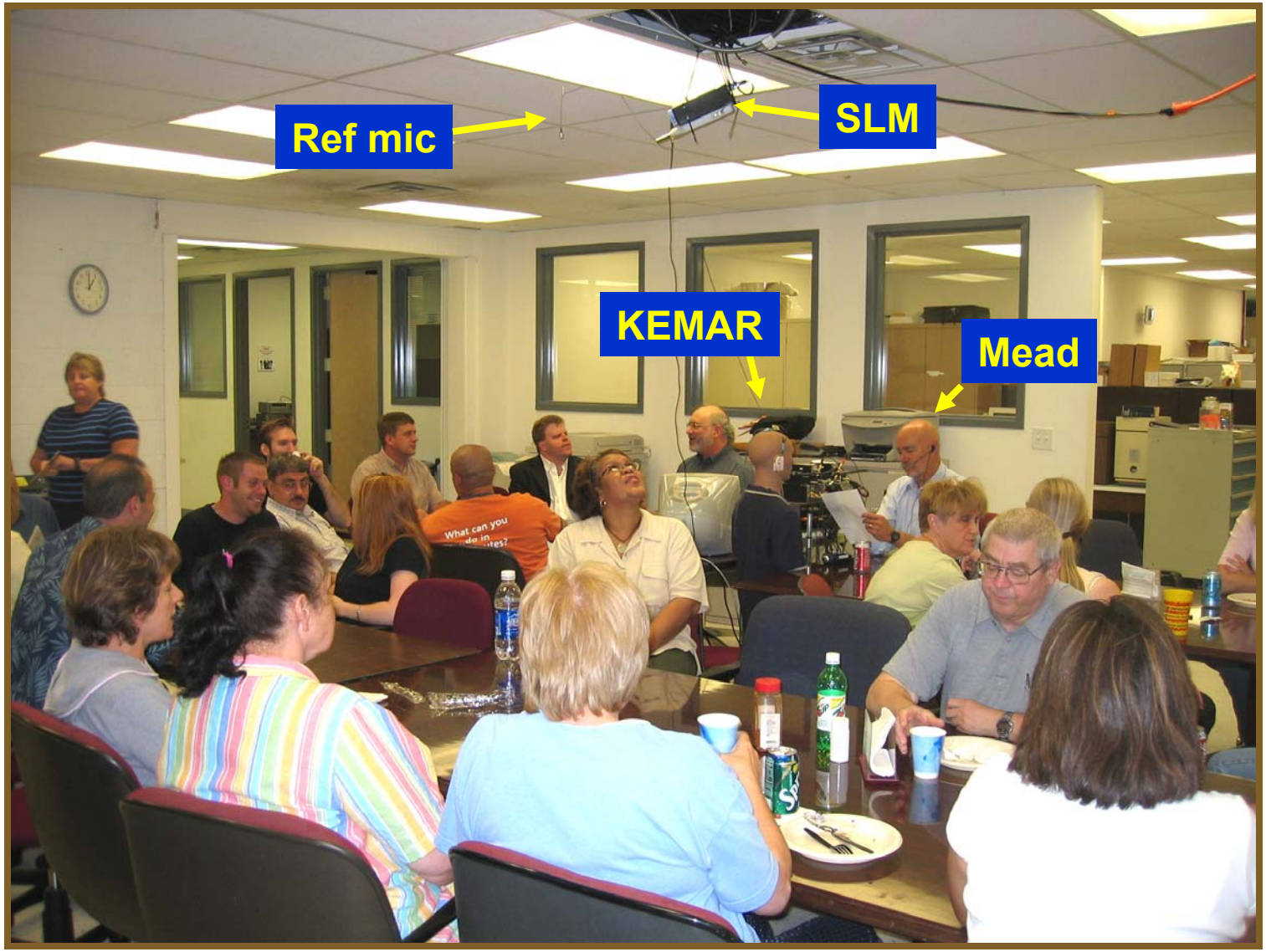
Ruth Bentler's "Lunchroom" Trials

- **BTE test aids, omni, and CCmics worn by KEMAR in ER Lunchroom.**
- **Normal (N=15) and hearing-impaired (N=15) subjects.**
- **New "Lunchroom SIN" test by Mead Killion.**



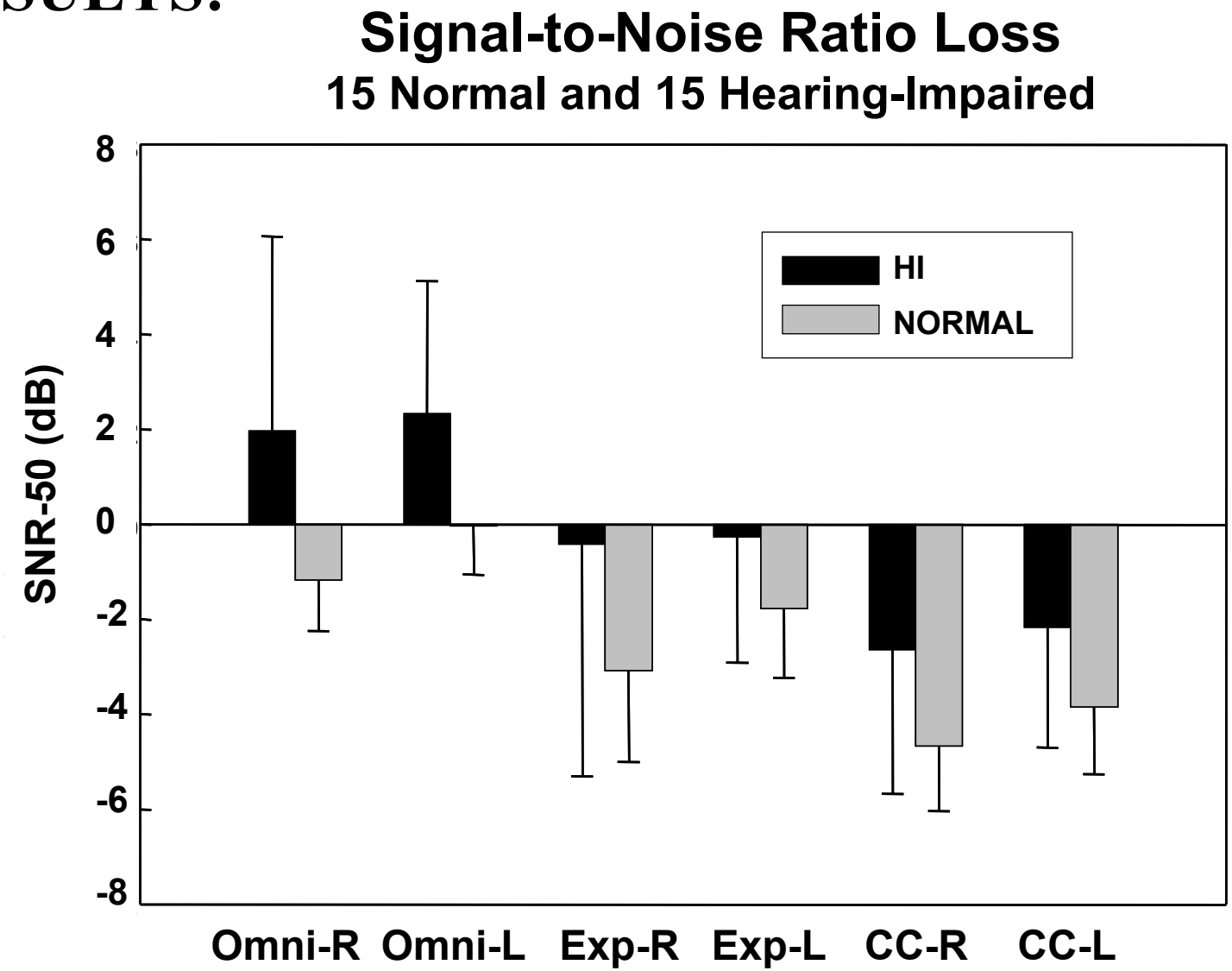


The Etymotic Lunchroom

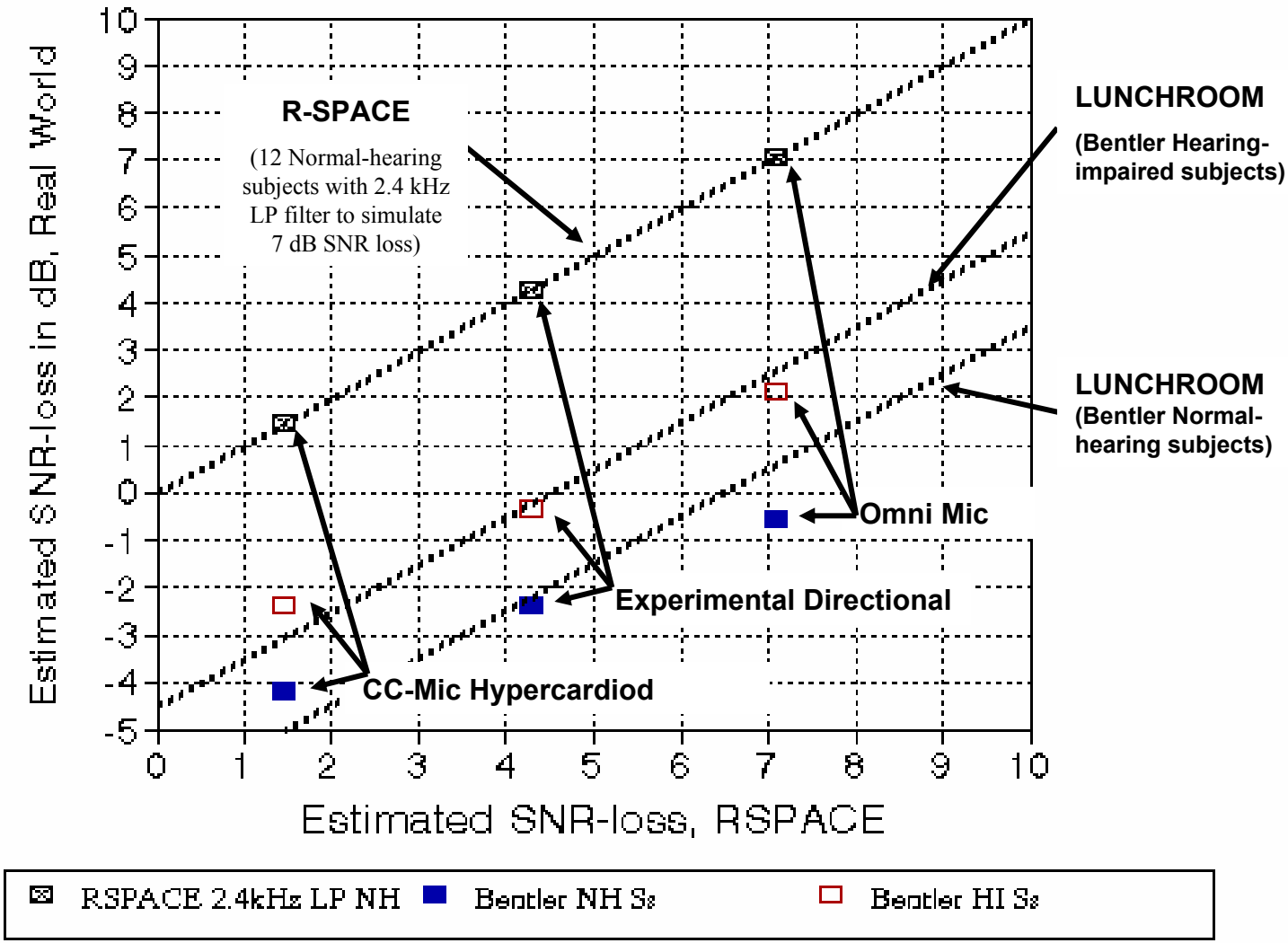


Mini shotgun mic used for sentences calibration. Boom mic used by MCK (with modified SLM) to monitor his voice level.

LUNCHROOM RESULTS:



Comparison of Real-World to RSPACE



Comparison of Two Studies

Compton Study

- **Normal-hearing subjects.**
- **Repeated measures – each S got all conditions.**
- **Same test materials across conditions (modified HINT)**
- **Same mics across all environment conditions.**
- **Wide differences in directivity across microphone conditions.**

New Study

- **Normal-hearing and hearing-impaired subjects.**
- **Different Ss and test materials for Live and R-SPACE conditions.**
- **Test aid was BTE for Live, ITE for R-SPACE.**
- **Small differences in directivity across microphone conditions.**

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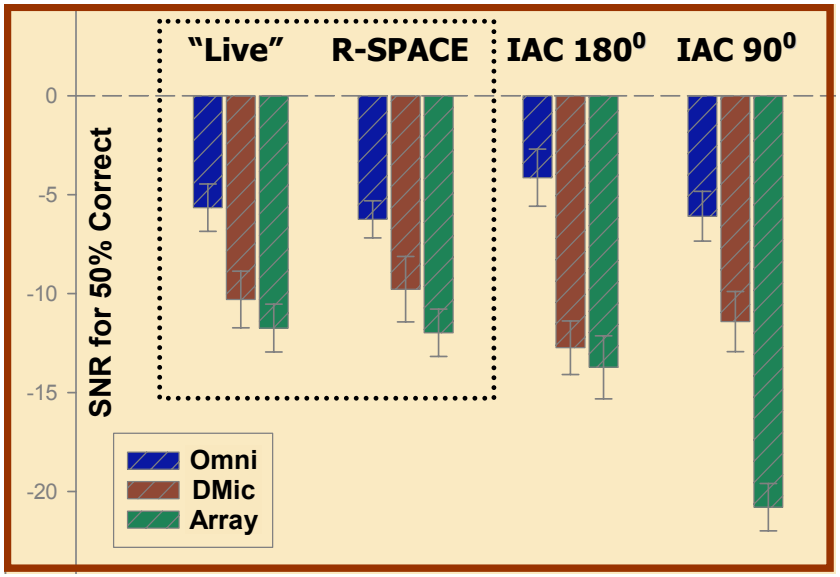
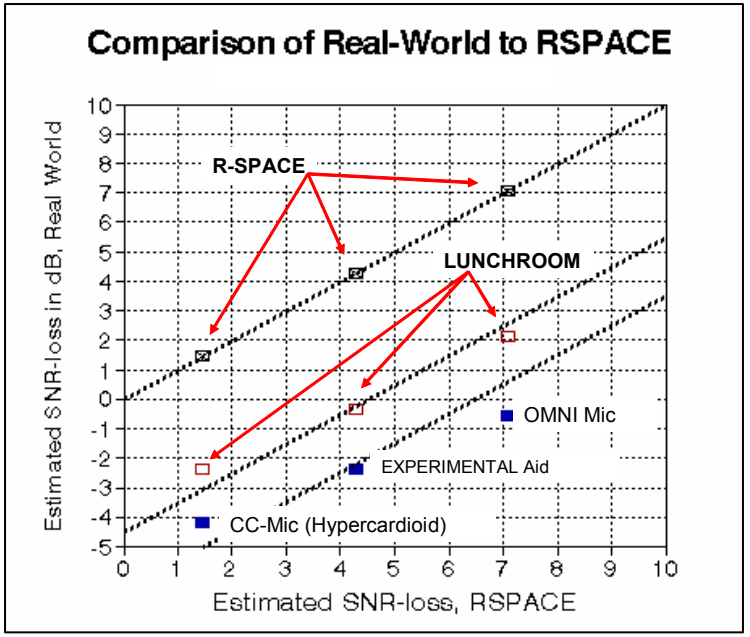
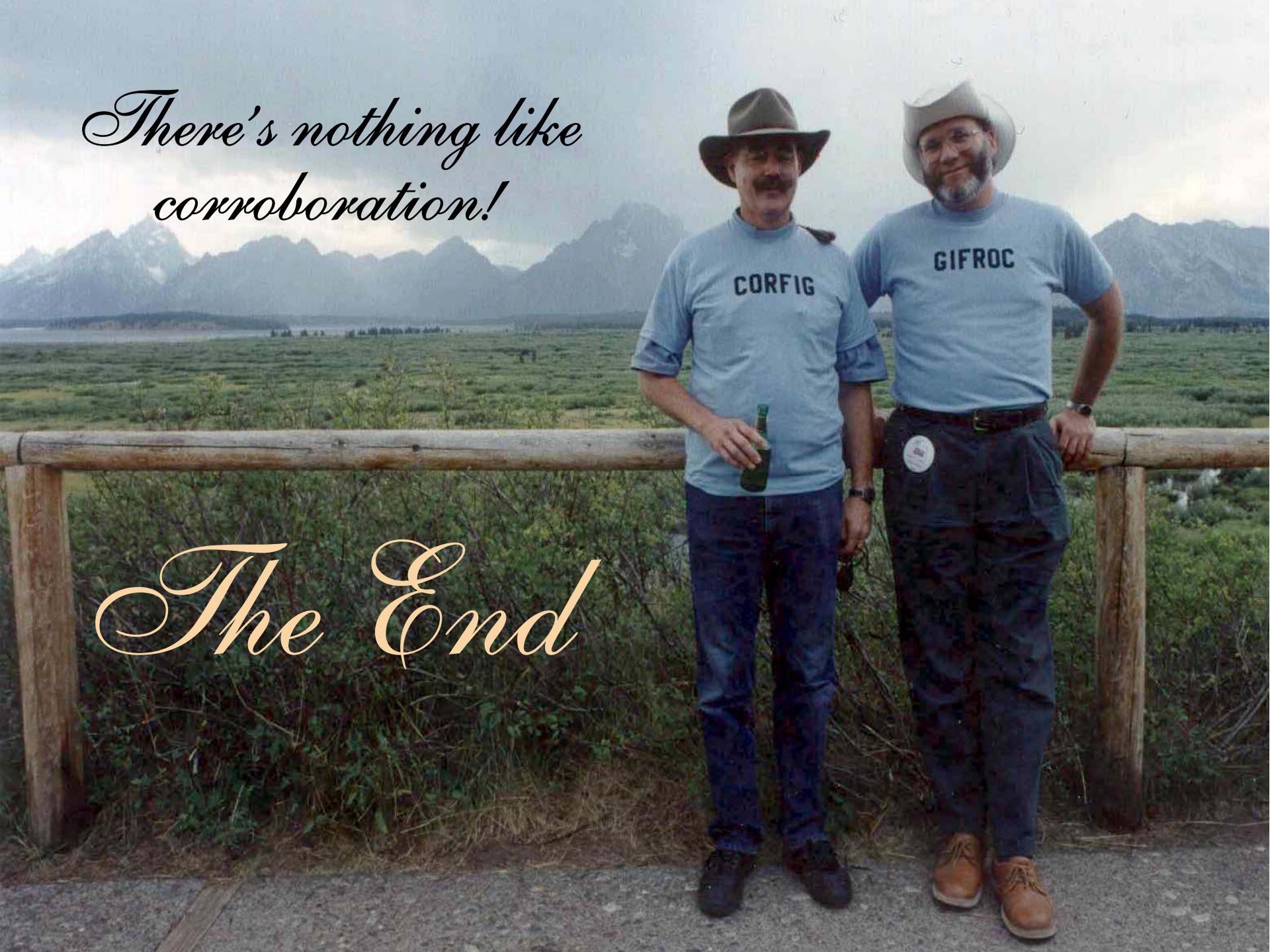
SUMMARY and CONCLUSIONS
R-SPACE vs. Real-World

Speech intelligibility in noise data were obtained from normal-hearing, hearing-impaired, and filtered-normal-hearing subjects listening to recordings made in the ER lunchroom and in R-SPACE.

As in Compton's (2002) study, the R-SPACE data in the present study agreed quite well with the real-world data. This was true not only in terms of rank ordering across conditions, but the R-SPACE and real-world trials gave approximately the same relative SNR-50 values across conditions.






There's nothing like corroboration!
CORFIG
GIFROC
The End