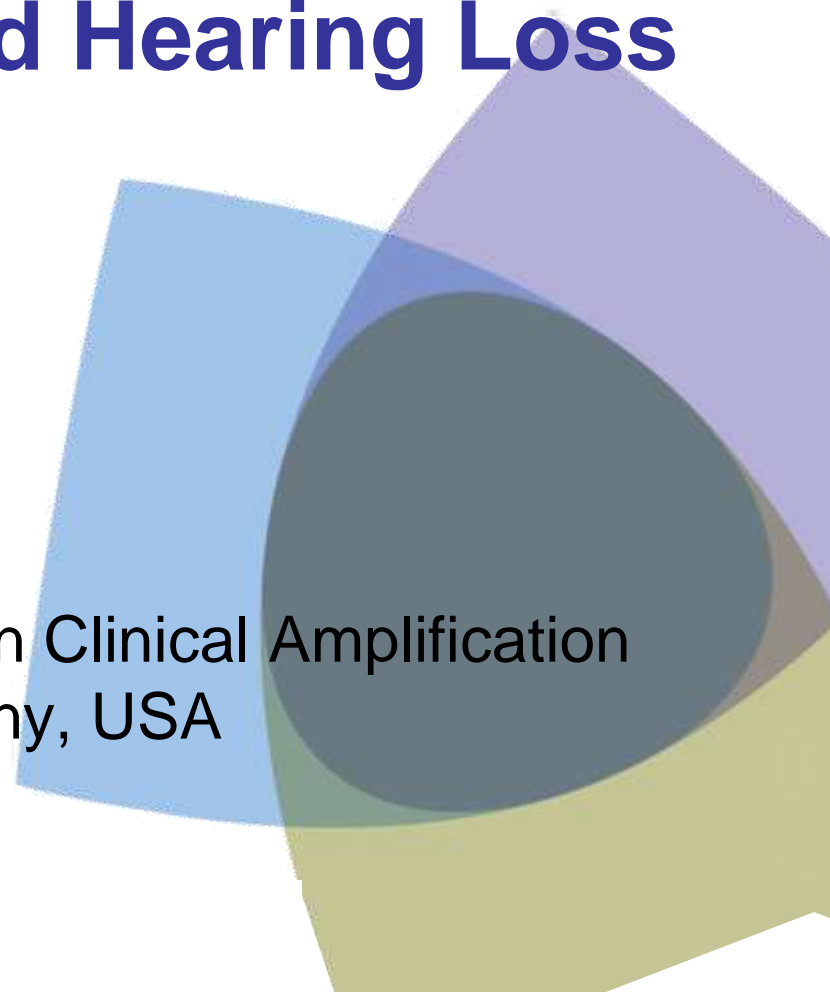


Application of Advanced Technology for Severe-to-Profound Hearing Loss

Heidi Peeters, M.A.

Widex Office of Research in Clinical Amplification
Widex Hearing Aid Company, USA



Why Continue to Evaluate Noise Reduction and Directional Mics?

What we don't know:

What we know:

-Do NR and/or directional microphones improve intelligibility for those (here) to improve listening comfort of hearing aid users with mild to severe hearing loss. Severe hearing loss listeners have more audibility difficulties than mild to severe listeners have.

- This population has a higher requirement for a better SNR

-**Directional mics provided improved** NR and directional microphones reduce signal audibility intelligibility in noise

- Do directional microphones and NR combined provide further improvement or decrease intelligibility in noise?

Objective

- To evaluate the effects of noise reduction and directional microphones on the speech understanding in noise (SNR) of individuals with a severe-to-profound hearing loss.



Subjects



- Eleven severe-to-profound experienced hearing aid wearers
 - PTA of the better ear was >70 dB HL
 - Three subjects were removed from averaging as their HINT performance exceeded limits of the equipment
 - » Data on 8 subjects were included in this report
- Subjects were fit with Senso Diva 19 BTE power hearing aids
 - Based on Widex targets and adjusted for best aided thresholds across frequencies
- Fit with vinyl skeleton closed molds

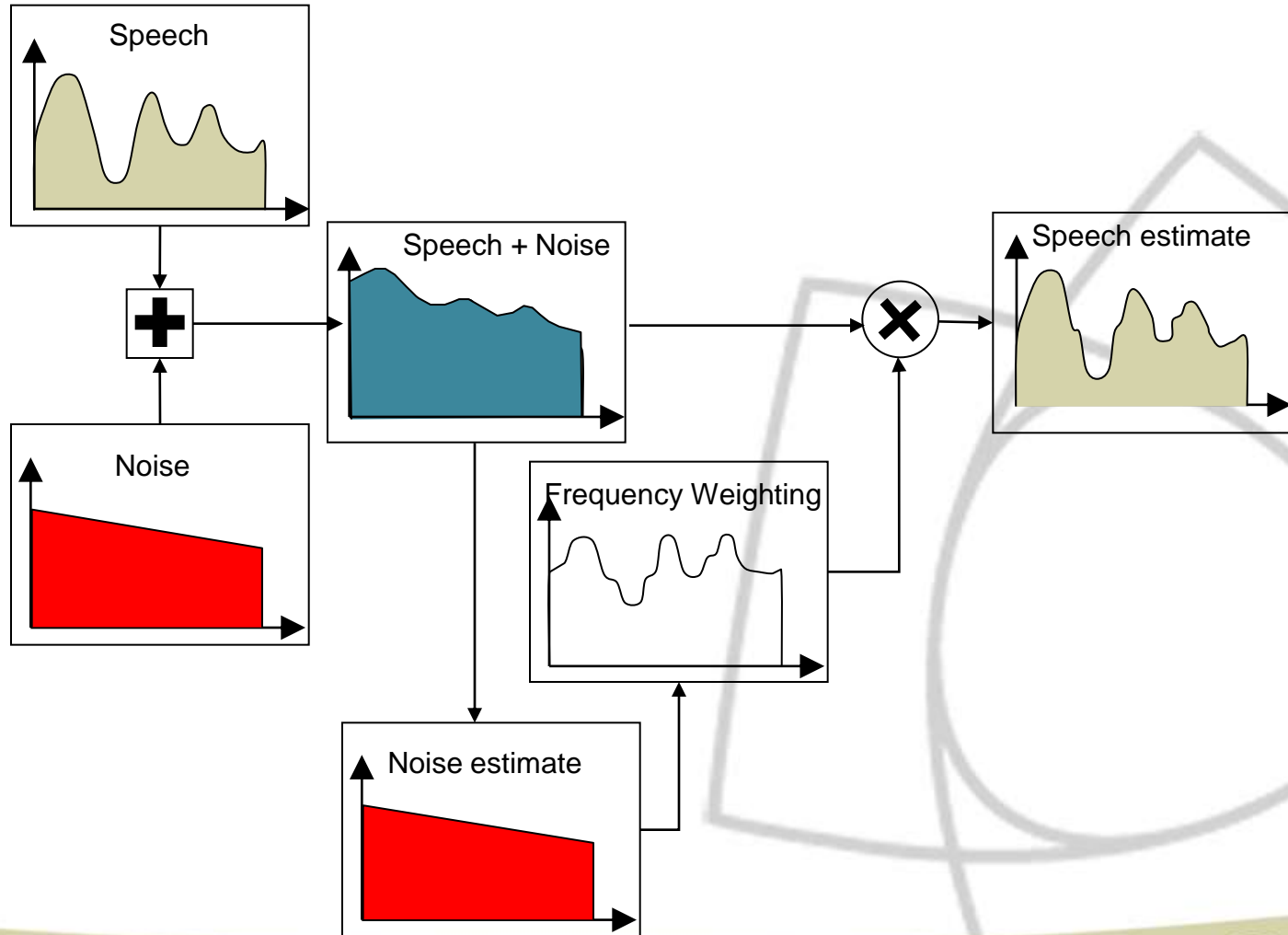
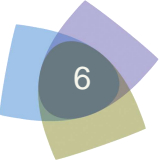
Study Hearing Aids

Senso Diva 19 BTE

- 15 Channels
- Fully adaptive directional microphones
- EDRC
 - Adaptive attack and release times
- Noise Reduction with eSIS
- Active feedback phase cancellation
- Multiple programs
 - Special programming software



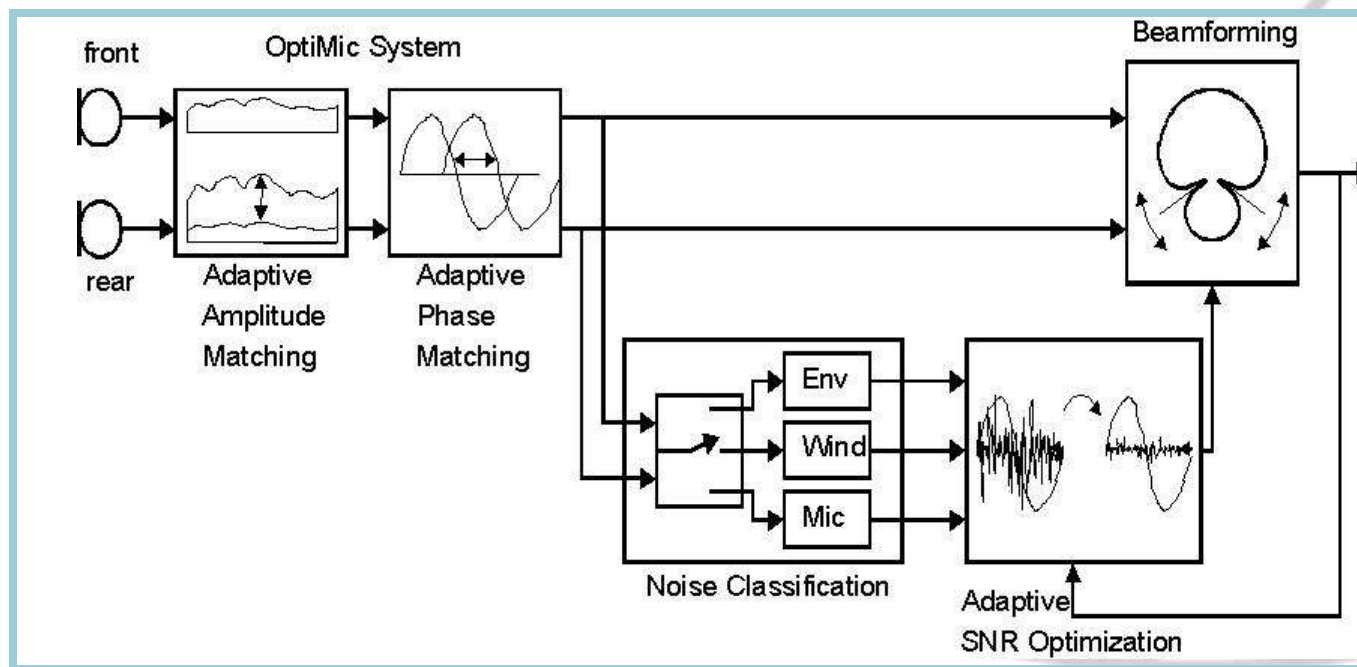
Noise Reduction Algorithm With SIS



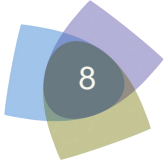
Directional Microphones

Senso Diva Locator

- Fully adaptive dual mic
- DI of 4-6 dB



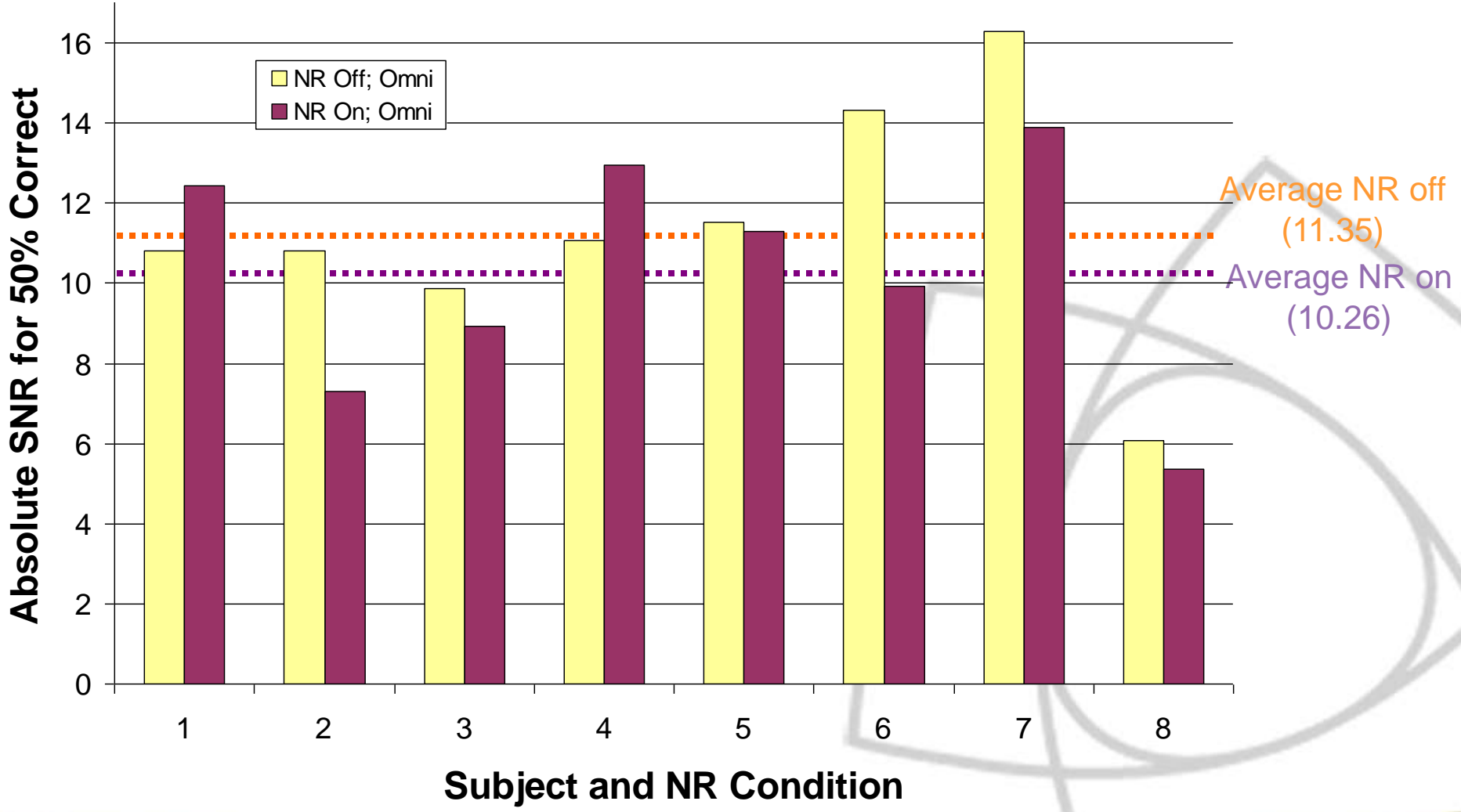
Study Design



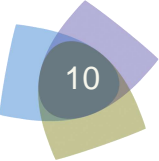
HINT sentences in continuous HINT (speech-shaped) noise

- Speech was presented at 0°
- Continuous noise was played for 30 s before the test began
 - 68 dB SPL from 90°, 180°, and 270°
 - NR evaluation
 - NR on and NR off conditions
 - Omnidirectional microphones were used
 - Directional microphone evaluation
 - NR off
 - Fixed directional and omnidirectional conditions
- Reported data were averaged over six sessions/trials
 - Subjects wore HA home in different combinations of NR and Dir mic for a total of 15 weeks

Effect of Noise Reduction



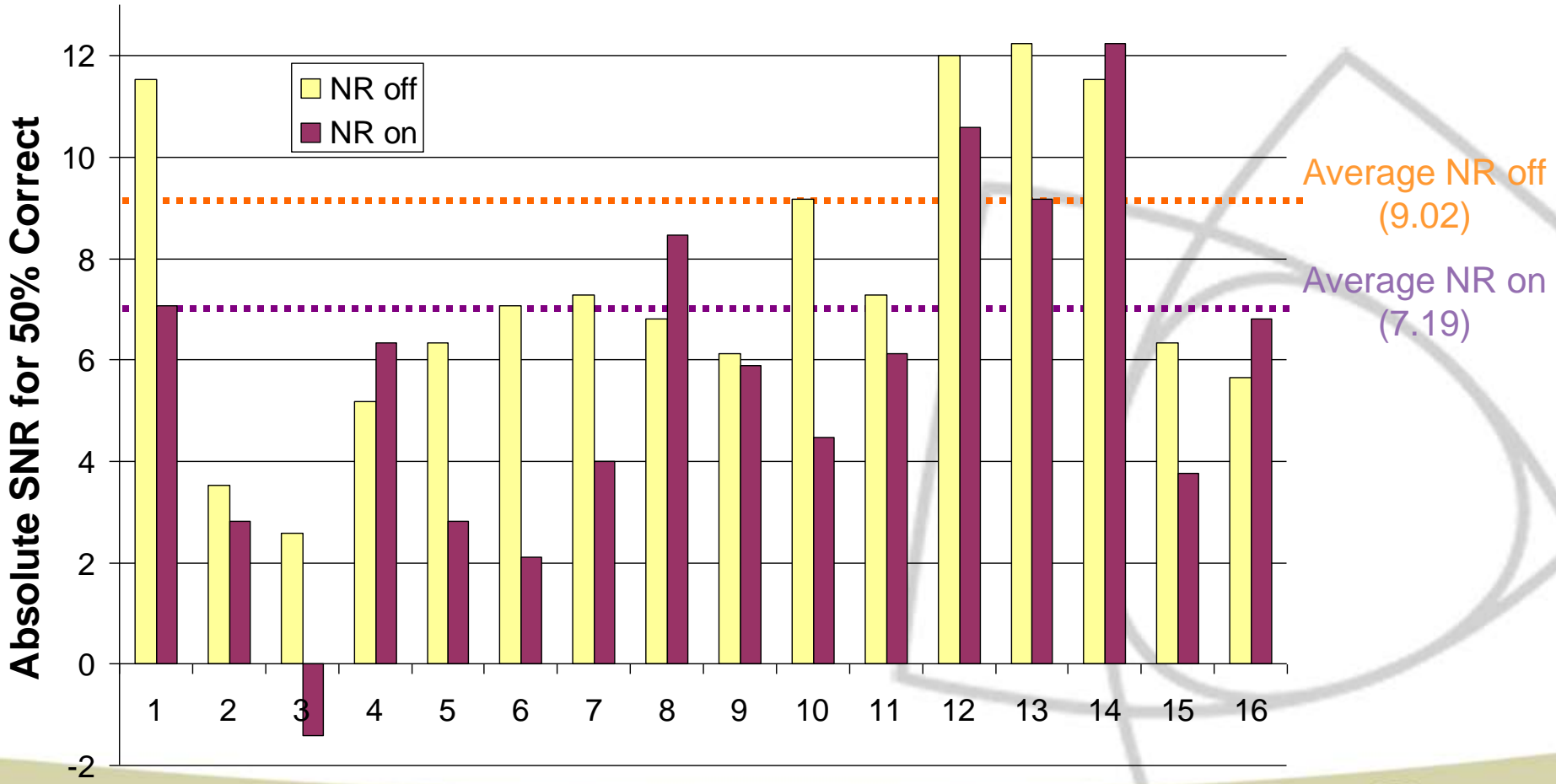
How Does Performance Compare With Less Severe Hearing Loss?



- Compared performance of severe-to-profound loss subjects with results from a subject group tested in another study with milder hearing losses
 - 16 subjects with mild sloping high frequency hearing loss, and flat hearing loss
 - Subjects were fit with Senso Diva 9 BTE hearing aids utilizing various vent sizes
 - Compared data from closed mold condition

Mild to Severe Loss: Absolute SNR

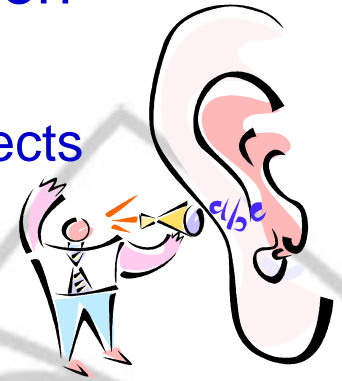
With NR On and Off



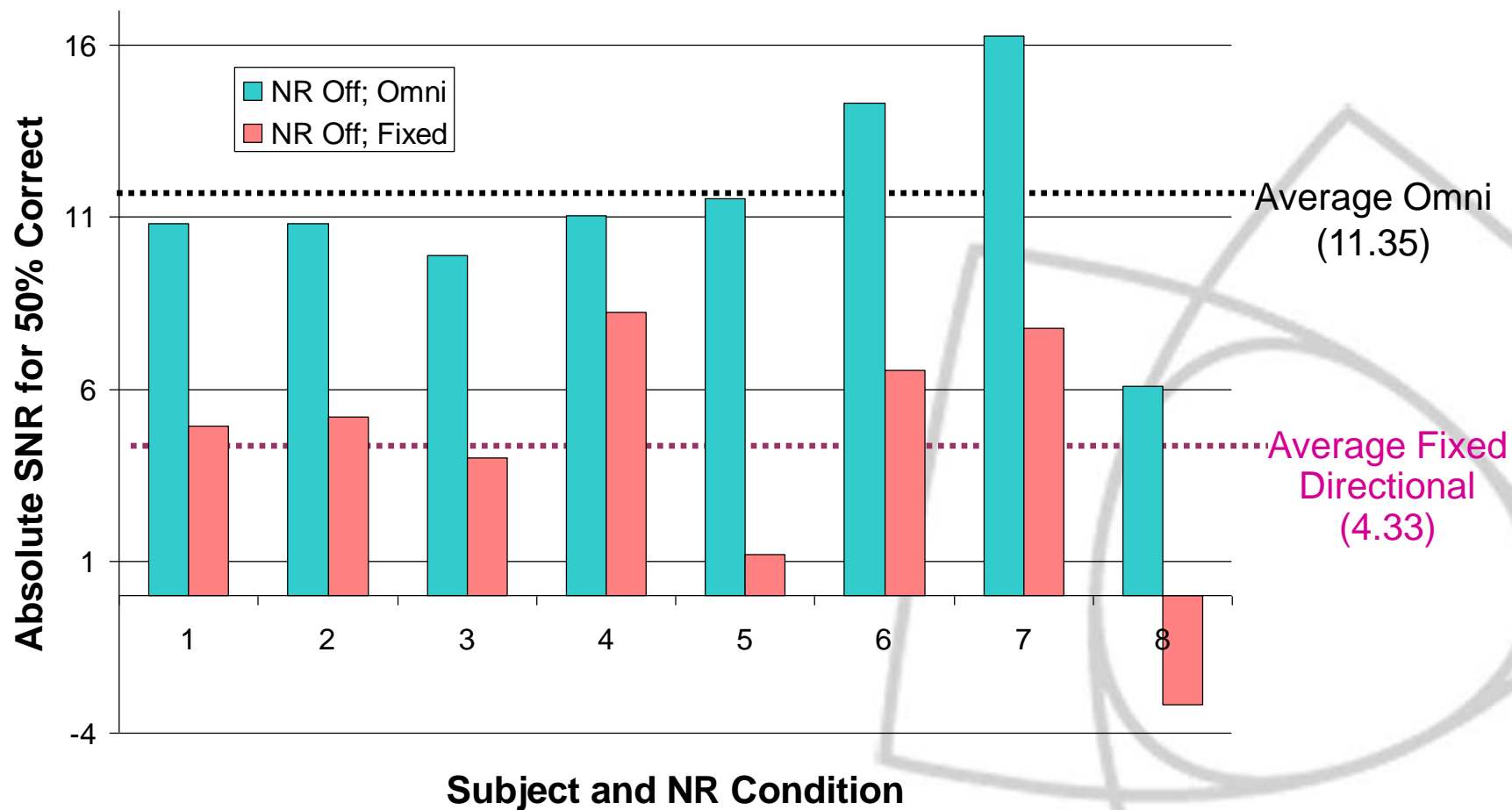
Subject and NR Condition

Noise Reduction Benefit

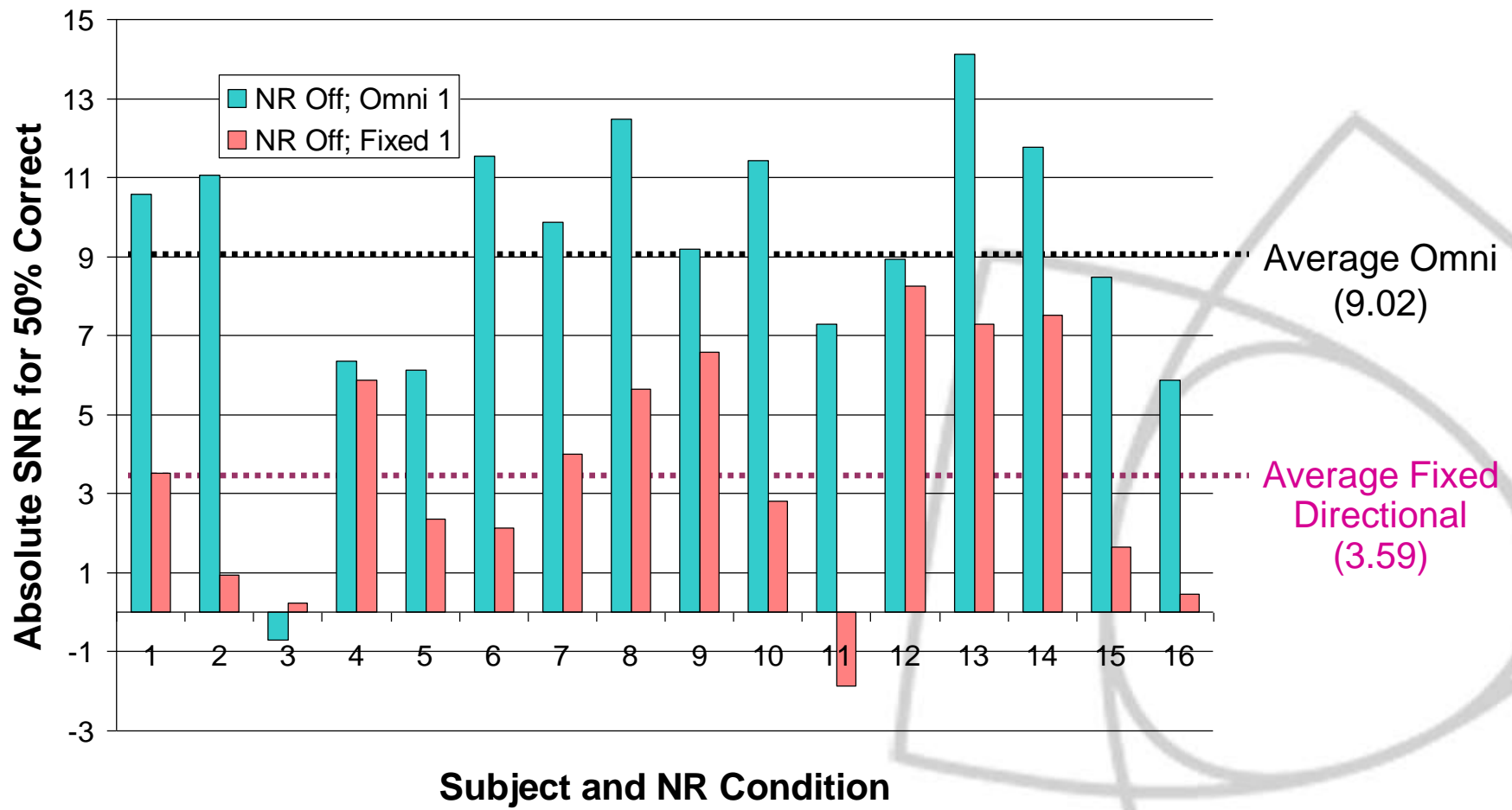
- Six of 8 (75%) severe-to-profound hearing loss subjects showed improvement with NR turned on
 - Twelve of 16 (75%) mild to severe hearing loss subjects showed improved performance with NR on
- $NR \text{ benefit} = SNR \text{ NR off} - SNR \text{ NR on}$
 - Severe-to-profound performance was not significantly different from mild to severe performance ($p > 0.05$)
- Mild to severe: average 1.83 dB NR benefit
- Severe-to-profound: average 1.09 dB NR benefit
 - NR on performance was not significantly different from NR off performance ($p > 0.05$)



Directional Microphone Benefit



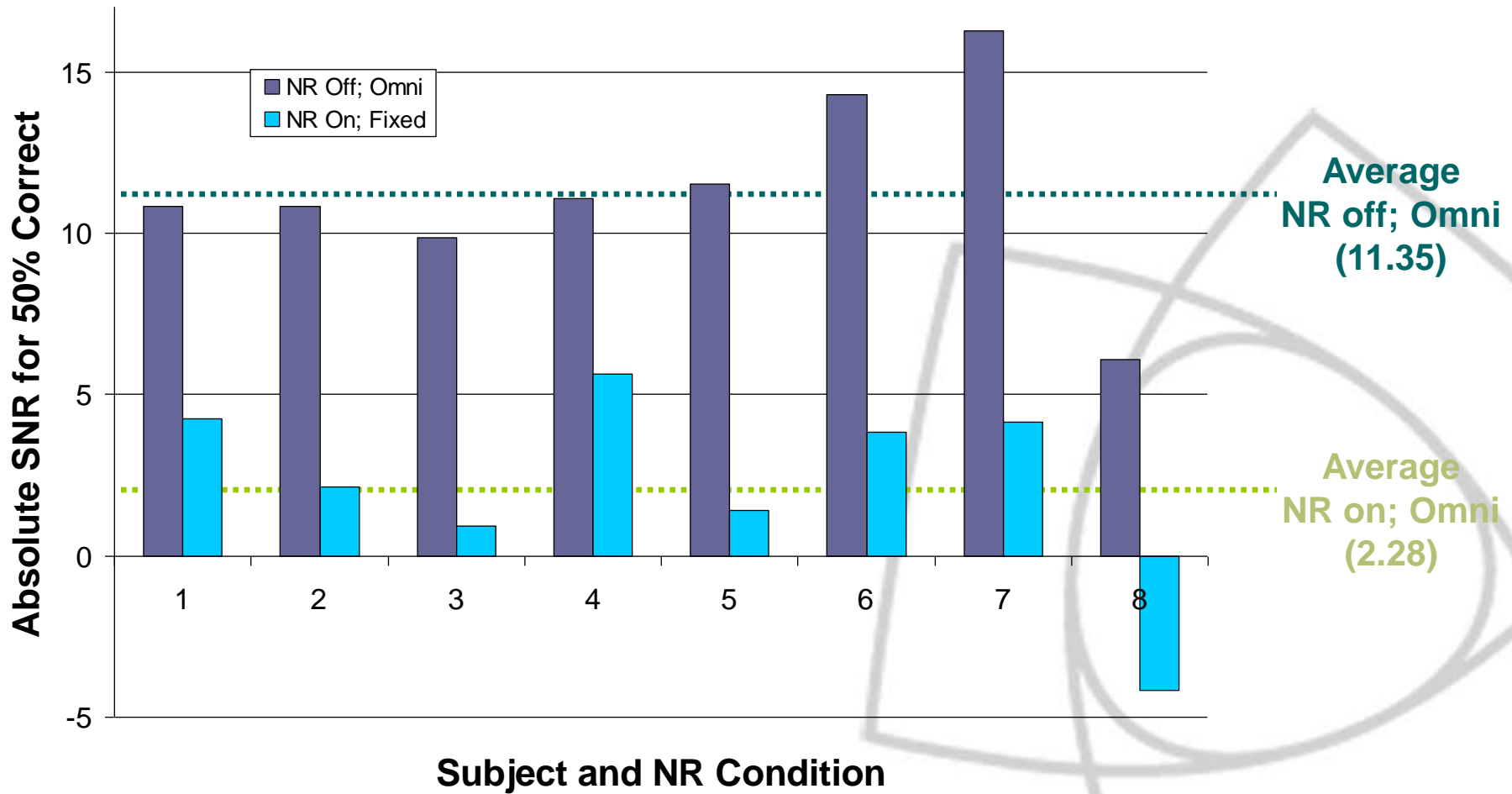
Mild to Severe Loss: Directional Mic Benefit



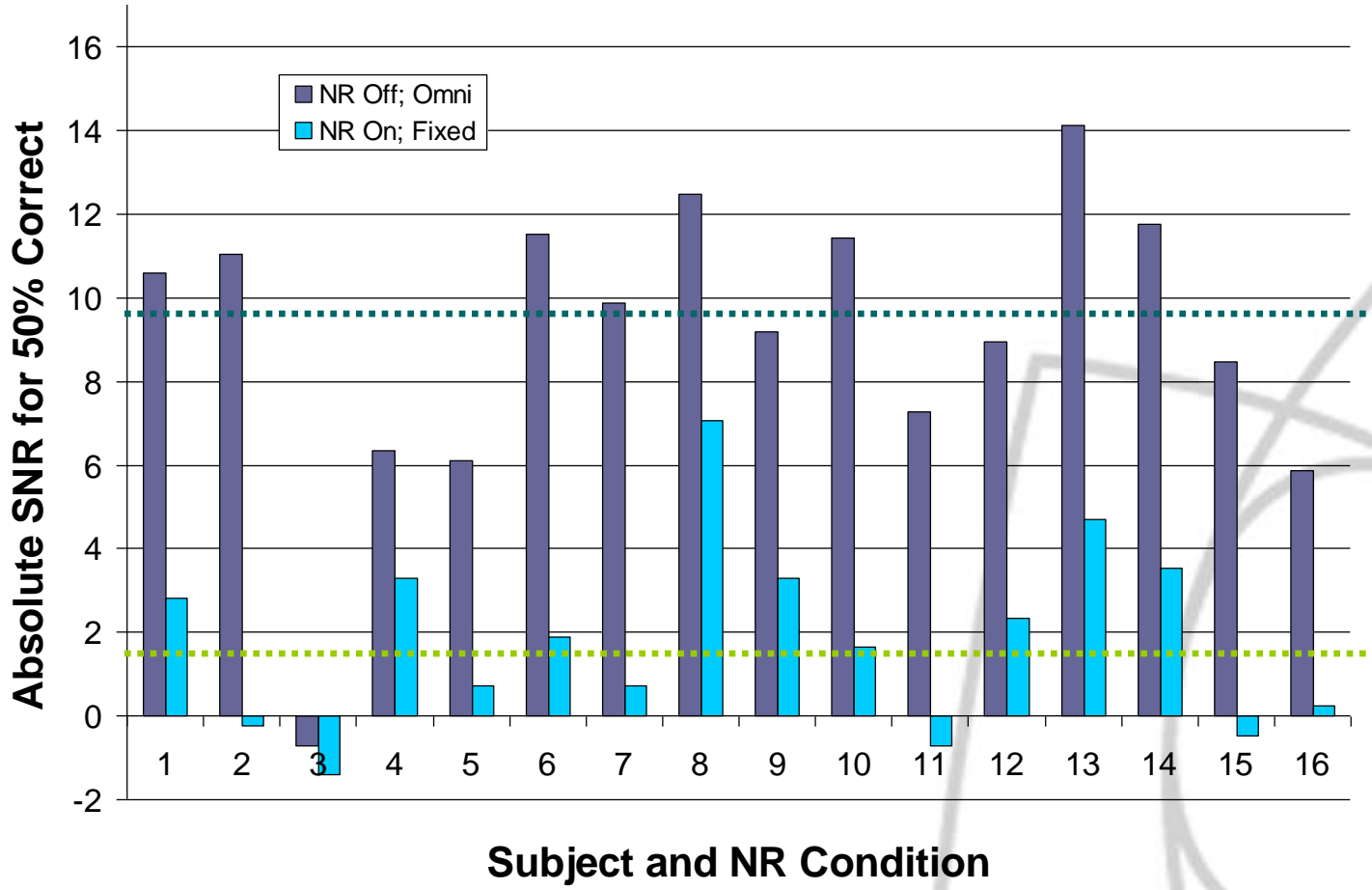
Directional Benefit

- Performance of all eight severe-to-profound subjects (and all but one mild to severe subjects) improved with directional microphones
 - Severe-to-profound subjects' performances improved by at least 5 and up to 12 dB SNR
 - Mild to severe subjects' performances improved by 0 to 10 dB SNR
- Dir Mic benefit = $\text{SNR}_{\text{omni}} - \text{SNR}_{\text{fixed}}$
 - Severe-to-profound performance was not significantly different from mild to severe performance ($p > 0.05$)
- Mild to severe: average 5.43 dB Dir benefit
- Severe-to-profound: average 7.01 dB Dir benefit
 - Fixed dir performance was significantly different from Omni performance ($p < 0.05$)

Noise Reduction and Directional Microphones



Mild to Severe: Noise Reduction and Directional Microphones



Average NR off; Omni (9.02)

Average NR on; Omni (1.84)

Benefit of NR and Directional Mics

- Performance of all eight severe-to-profound subjects (and all mild to severe subjects) improved with directional microphones and NR
 - Severe-to-profound subjects' performances improved by at least 7 and up to 12 dB SNR
 - Mild to severe subjects' performances improved by 0 to 10 dB SNR

- Dir Mic and NR benefit = SNR omni; NR off - SNR fixed; NR on
 - Severe-to-profound performance was not significantly different from mild to severe performance ($p > 0.05$)

- Mild to severe: average 7.18 dB benefit

- Severe-to-profound: average 9.07 dB benefit
 - NR on; Fixed performance was significantly different from NR off; Omni performance ($p < 0.05$)

Conclusions

- Severe-to-profound listeners receive benefit from NR and directional microphones similar to those with less severe hearing loss
 - Noise Reduction
 - Listeners receive about a 1 dB NR benefit on average
 - Benefit may vary from 0 to 6 dB
 - Directional Microphones
 - Listeners receive about a 7 dB directional benefit on average
 - In agreement with previous studies
 - Benefit may vary from 5 to 12 dB
 - Noise reduction and directional microphones combined
 - Provide the greatest benefit: 9 dB on average

Implications

Severe-to-profound population should be fit with NR and directional microphones in order to improve SNR when listening to speech in noise.

