The effect of hearing aid technologies on speech recognition in cars

Rachel W. Stanziola, Yu-Hsiang Wu, Elizabeth A. Stangl and Ruth A. Bentler

Department of Communication Sciences & Disorders, The University of Iowa

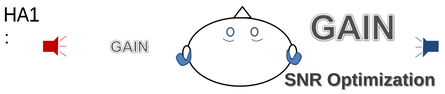
INTRODUCTION

- Difficulty understanding speech in the presence of background noise is one of the most common complaints of hearing aid users.
- Although directional (DIR) technology can improve signal-to-noise ratio (SNR), its success is based on the assumption that the listener could place the speech source at the direction that DIR microphones are most sensitive.
- In situations such as driving a car, the speaker is either behind or to the side of the listener. Traditional DIR technology designed to enhance speech arriving from listener's front does not aid in speech recognition in these situations.
- The purpose of this study is to compare the effectiveness of three new hearing aid technologies that may aid speech recognition in the car.

METHODS

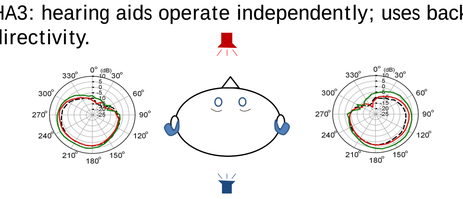
Hearing Aids

- HA1 :



- HA2: a wireless connection transmits the signal to the ear with the poorer SNR; also uses backward cardioid directivity.

- HA3: hearing aids operate independently; uses backward directivity.



METHODS

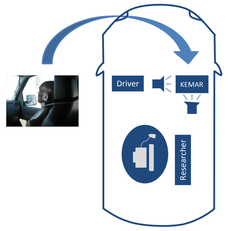
- The hearing aids were set to fit a mild-to-moderate sloping hearing loss. Each hearing aid was programmed to three technologies:
  - omnidirectional (OMNI) microphones
  - adaptive DIR microphones
  - new technology (NewTech).
- Digital noise reduction (DNR) algorithms remained active.

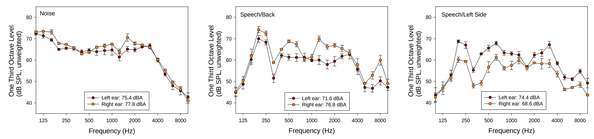
Subjects

- Twenty-five adults/ Age 44-86 (mean = 70.6)/ 10 Males, 15 Females
- Bilateral symmetric sensorineural hearing loss

Recording

- Connected Speech Test (CST) sentences/side or back /70 mph/ 2009 Ford E-150.
- The noise level was approximately 76 dBA.
- The level of CST sentences was set to achieve an SNR of -1 dB at the ear that had a better SNR.



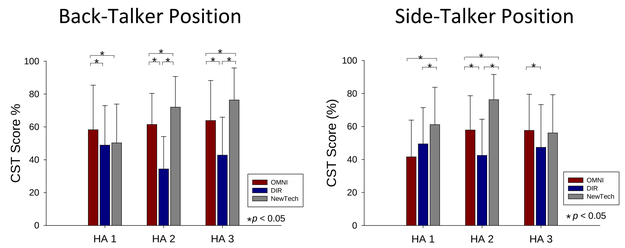


Procedure

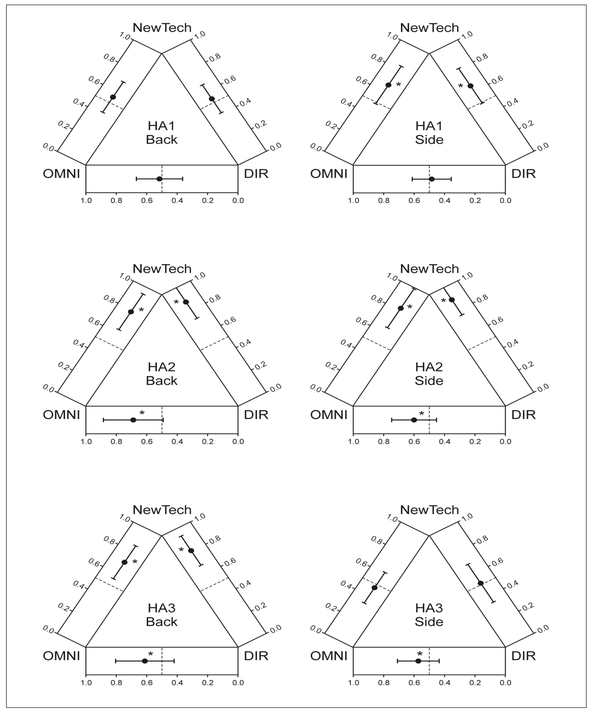
- The recorded hearing aid outputs were adjusted for the hearing loss of individual subject using NAL-NL1 targets and served as stimuli.
- In a sound treated booth, the stimuli were presented to subjects bilaterally using Sennheiser IE 8 earphones.
- Speech recognition scores were determined.
- User preference was determined using a paired comparison paradigm.
  - The three technologies were compared within each hearing aid.
  - The comparison between given two technologies was repeated 10 times.

RESULTS

Speech Perception



Paired Comparison



DISCUSSION

- In general, speech perception data were consistent with paired comparison data.
- For the back-talker position:
  - For all hearing aids, DIR had a detrimental effect on speech perception and user's preference relative to OMNI.
  - Because backward directivity improved the SNR, the NewTech of HA2 and HA3 provided better speech perception performance and were preferred.
- For the side-talker position:
  - For HA2 and HA3, DIR had a detrimental effect.
  - Only HA2's NewTech, which optimized the SNR of both ears, could improve speech perception.
  - The speech perception result of HA1 was less conclusive because the low score in the OMNI mode. This may have been a result of inconsistent road noise.
  - However, listeners' performance was better when HA1's new technology was activated (the NewTech condition) than when it was inactivated (the DIR condition).

CONCLUSIONS

- In noisy listening situations when the talker is not in front of the listener, a traditional automatic or adaptive DIR mode could be detrimental to speech understanding.
  - OMNI microphones could be better in these situations.
  - Therefore, it is important to counsel hearing aid users to try different microphone modes in different environments.
- The current study suggests that, in car listening conditions with one speech source, new microphone technology has the potential to improve speech understanding and could be preferred by listeners.
- The improved speech understanding may also help improve driving safety. Our next study tests speech perception and driving safety in a simulated driving environment.

ACKNOWLEDGEMENTS

•This project was funded by Siemens Hearing Instruments.
•The van was provided by Outcomes of Children with Hearing Loss (OCHL).

CONTACT

yu-hsiang-wu@uiowa.edu for further information

AudiologyNOW!
American Academy of Audiology
March 28-31, 2012
Boston, MA

BASIC & APPLIED RESEARCH