Comparison of hearing aids and PSAPs in ecologically relevant situations

Lisa Brody, Yu-Hsiang Wu, Elizabeth Stangl
University of Iowa

INTRODUCTION

- 1.5 million people with hearing impairments use either a Personal Sound Amplification Product (PSAP) or mail-ordered hearing aid to compensate for their communication difficulties (Kochkin, 2010).
- Many over-the-counter (OTC) devices provide unsuitable amounts of low-frequency gain and little high-frequency gain, resulting in an inability to meet prescriptive targets for the typical high-frequency, sloping hearing loss (Cheng & McPherson, 2000; Callaway & Punch, 2008; Chan & McPherson, 2015; Smith et al. 2016).
- Electroacoustic evaluations suggest PSAPs are not suitable for the typical patient with presbycusis. However, research has shown some OTC devices to provide real-world objective and subjective benefit (McPherson & Wong, 2005).
- Data evaluating the effectiveness of PSAPs relative to conventional hearing aids (HAs) in the real-world is limited.
- In this study we compared commercially purchased PSAPs to well-fit hearing aids in ecologically relevant situations in the laboratory to estimate their real-world effectiveness for adults with mild-moderate hearing loss.

METHODS

Participants

- 20 adults, Aged 56-83 yrs (mean = 70.35 yrs; SD = 8.19 yrs)
- 11 males and 9 females
- Mean PTA:
  - Right= 41.58 dB HL
  - Left= 42.42 dB HL
- Average hearing aid use= 7.75 yrs (SD = 8.99 yrs)

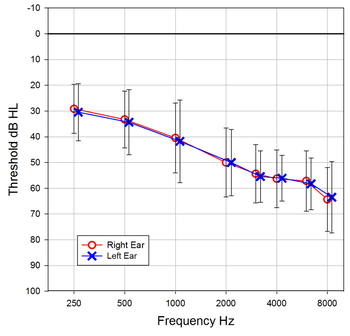


Figure 1. Composite audiogram of all study participants

Devices

- 1 intermediate level HA from a major manufacturer
- 3 PSAPs:
  - SoundWorld Solutions CS50+
  - FocusEar RS2
  - Tweak Focus

Device Fitting

- HA fit to NAL-NL2 targets with average speech level input using clinically appropriate dome.
- PSAPs fit using default earpiece.
- Subjects were presented with various samples of speech in noise and selected preferred volume levels and gain-frequency responses available for each device and each program (P1 and P2).

METHODS

Testing Set Up

- Participants were seated in a calibrated sound field inside of a booth surrounded by an 8 speaker array.
- Prototype listening environments (PLE) determined based on Wu et al., 2016 (Figure 2).
- P1: all-around (PLEs 1,2,3)
- P2: speech in noise (PLEs 4,5,6)
- Testing was completed during a series of two, two-hour sessions.

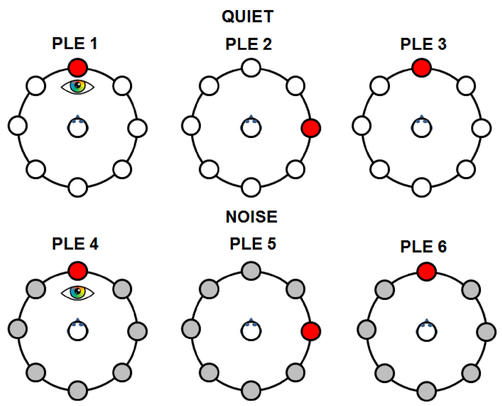


Figure 2. Prototype Listening Environments
Red circle indicates speech signal location

Outcome Measures

Aided Audibility

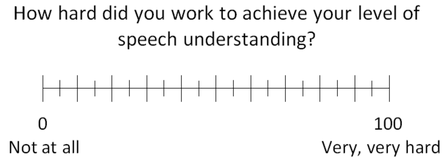
- Aided Speech Intelligibility Index (SII)
  - On-ear (Audioscan Verifit) in P1 and P2
  - Subject-selected settings

Speech Perception

- Hearing in Noise Test (HINT; Nilsson et al. 1994)
  - Quiet
  - Noise (65 dBA)
- Connected Speech Test (CST; Cox et al. 1987)
  - Aided (four devices), unaided
  - SNR
    - Quiet: +20 dB (speech 60 dBA) (PLEs 1,2,3)
    - Noisy: +7 dB (speech 68 dBA) (PLEs 4,5,6)
  - Modality
    - Audiovisual (PLEs 1 and 4)
    - Audio Only (PLEs 2,3,5,6)

Subjective Listening Effort

- Participants subjectively rated their listening effort on a 21-point scale after each condition



RESULTS

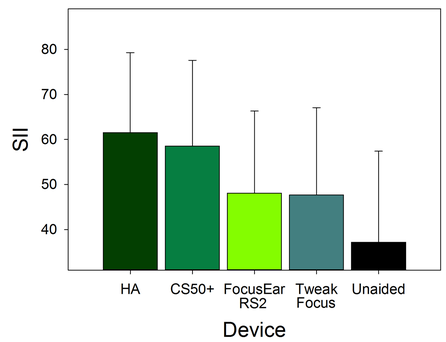


Figure 3. Better Ear Speech Intelligibility Index (P1)

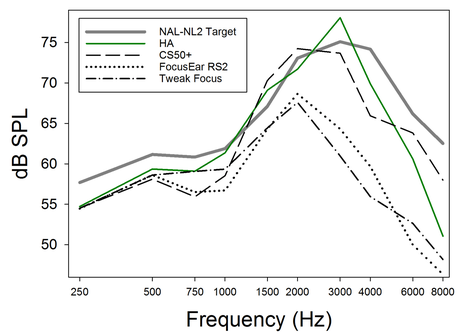


Figure 4. Real Ear Aided Response (P1)

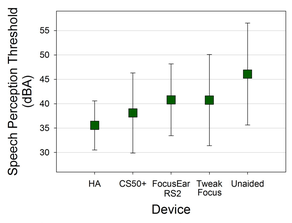


Figure 5. HINT Quiet

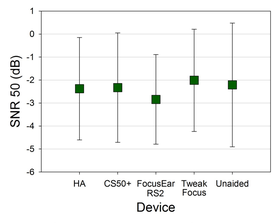


Figure 6. HINT Noise

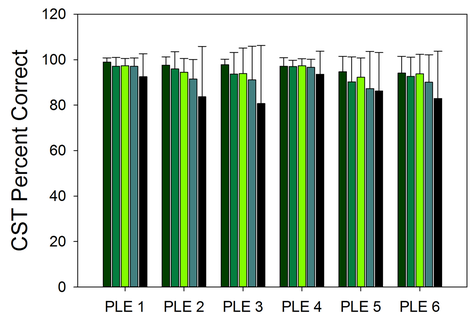


Figure 7. Speech Recognition Percent Correct

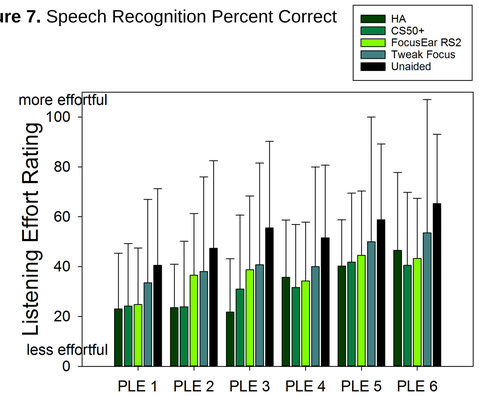


Figure 8. Subjective Listening Effort

SUMMARY

Aided SII:

- **HAs fit traditionally provide the best aided audibility compared to PSAPs in both P1 and P2.**

HINT:

- ***Quiet:* Aided performance is better than unaided. The test HA has the best performance overall.**
- ***Noise:* No significant difference in performance between aided and unaided conditions.**

CST:

- ***Speech recognition in quiet:* The test HA and PSAPs improve performance compared to unaided.**
- ***Speech recognition in noise:* When visual cues are present, no differences are observed between aided and unaided conditions. In the absence of visual cues, the test HA improves performance in noise compared to unaided while benefit from PSAPs is more limited.**
- ***Listening effort:* The test HA and some PSAPs reduce listening effort in both quiet and noisy environments compared to unaided.**

CONCLUSIONS

- **Well-fit HAs provide better aided audibility than PSAPs.**
- **Despite this, HAs and PSAPs may provide comparable benefit in real-world settings for those with mild-moderate hearing loss.**

CONTACT FOR MORE INFORMATION

- Lisa Brody: lisa-brody@uiowa.edu
- Yu-Hsiang Wu: yu-hsiang-wu@uiowa.edu
- Elizabeth Stangl: elizabeth-stangl@uiowa.edu

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