

Speech-intelligibility and sound-quality benefits of hearing aids over PSAPs in a blinded laboratory study

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To blind the test subjects to what they are listening through is important to avoid placebo effects. Klangfinder head offers elegant solution to this challenge.



Presented at World Congress of Audiology, Vancouver, Canada, September 2016

Background

In recent years, a new category of hearing amplification devices has been introduced. Personal Sound Amplification Products (PSAPs) offer a cheaper alternative to hearing aids, and some studies (e.g. Xu et al., 2015, Kim et al. 2016, Reed et al. 2015) have concluded that they could offer similar user benefits as regular hearing aids for people with mild-to-moderate hearing losses. However, very few of the published studies that have compared the two product types have ensured test-subject blinding, and none has ensured both test-subject blinding and used individualized fit of the devices.

Objectives

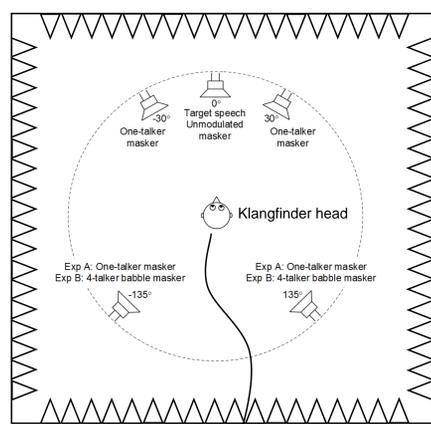
1. To demonstrate the use of a test setup where test-subjects are blinded to the device they are listening to.
2. To evaluate the performance of two high-end PSAPs against a hearing aid, in two perceptually important outcome measures.

Test setup

Test-subjects were blinded to the device by use of the Klangfinder HS8 Pro artificial head. This allowed for easy and smooth switching between devices.



Experimenter controlling experiment.



Test subject seated outside anechoic chamber.

Test subjects: 10 (A) and 11 (B) test subjects with mild-to-moderate hearing losses.

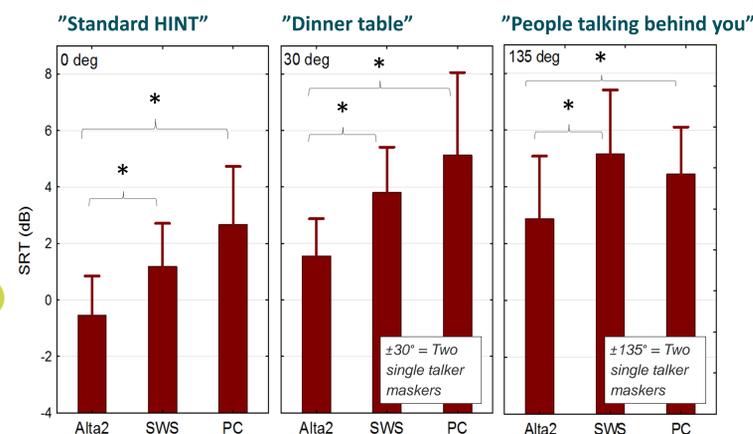
Presentation levels:
HINT: Target speech presented at 70 dB SPL. Masker levels were adaptively varied.
SQ: Sound samples varied from 50 dB (Bird chirping) to 80 dB (dialogue in traffic).

Balancing: For both Experiment A and B, the position of devices on the Klangfinder head was balanced across subjects, as were the order of test conditions and HINT test lists.

Speech Intelligibility results

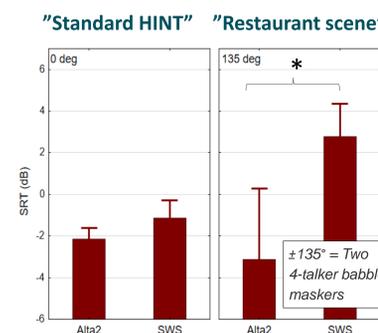
Experiment A

- The HA was shown to provide better speech intelligibility in all three spatial configurations.



Experiment B

- No difference in 0° condition was observed.
- Highly significant difference observed when adaptive directionality kicks in for the HA.



Programming and fit of devices

Basic philosophy: Fit all three devices as standard as possible

- If possible use prescribed mode with no fine tuning.
- No use of program switch or volume control during or between test conditions.

Summary of fittings

Oticon Alta2 Pro (Alta2)

- Prescribed fit to the VAC+ rationale.
- Features (e.g. adaptive directionality) in automatic mode.
- Test subjects not allowed to switch between programs or adjust volume during test.

Sound World Solutions CS50+ (SWS)

- Fitted according to the accompanying app-based hearing test.
- Test subjects not allowed to switch between the three inbuilt programs or adjust volume during test (Program 1 "Everyday" selected).

Perfect Choice HD (PC)

- No fitting possible.
- Test subjects not allowed to switch between the three inbuilt programs or adjust volume during test (Program 1 "Speech" selected).

Initial volume adjustment of PSAPs

The volume control of the two PSAPs were in experiment A fixed such that the objectively measured loudness was equal to that of the HA. The philosophy was that all three devices should be perceived as being equally loud, so that particularly the sound quality experiment would not be affected by a "loud is always better" effect. In experiment B (thus, only SWS), it was investigated if it would change the results if; 1) the test subjects were allowed to adjust the volume them selves prior to the experiment, and 2) if the volume control was left as determined by the app. No significant effects of this was found.

Sound Quality results

Experiment A (5 samples, 3 devices, 5 repetitions)

Alta2 and SWS performed alike. Both were significantly better than PC. Significance is denoted "**".



Experiment B (6 different samples, 2 devices, 4 reps)

Alta2 performed significantly better than SWS

Discussion

Speech Intelligibility

An effect size of approximately 1dB can be detected with approximately 20 test subjects. Thus, the non-significant result in the 0° condition of experiment B, could be caused by the small sample size (11 subjects).

Sound Quality

Due to the audiogram-based fitting the HA provides much more high frequency amplification than both PSAPs. In experiment A, a jazz sound sample was selected that had much high frequency content, and some test subjects described the sound of the HA in this condition as sharp or shrill, whereas for a more regular wide band jazz sample selected in experiment B, the test subjects described the sound of the HA as clear and crisp. It could be speculated that the HA suffers from the lack of fine tuning that would have been offered in a regular fitting situation.

Conclusion

Speech Intel.: The tested HA performed significantly better than both tested PSAPs in speech intelligibility.

Sound Quality: The tested HA performed better than both PSAPs in most sound environments. However, with sound samples with much high frequency content the SWS was preferred equally often.

Test setup: To blind the test subjects to what they are listening through is important to avoid placebo effects. The Klangfinder artificial head offers an elegant solution to this challenge.

Conflict of interest. The authors are both employed by Eriksholm Research Centre which is a part of Oticon A/S.

Literature

- Kim, J., Moon, I.J., Hong, S.H., 2016. Comparative clinical study of speech performance using hearing aid and personal amplification product. Poster presented at American Auditory Society meeting, Scottsdale, AZ, USA.
- Reed, N.S., Betz, J., Polyak, N., Grabowski, J., Korczak, P., et al, 2015. Objective Analyses and Comparisons of Personal Sound Amplification Products. Poster presented at NCRAR conference, Portland, OR, USA.
- Xu, J., Johnson, J.A., Cox, R.M., Breitbart, D., 2015. Laboratory Comparison of PSAPs and Hearing Aids. Poster presented at American Auditory Society meeting, Scottsdale, AZ, USA.