

Field Study News

SoundRecover

Evidence of improvements in speech intelligibility in noise

Summary

SoundRecover is a proprietary Phonak algorithm which compresses frequencies above a pre-calculated cut-off frequency and shifts them to a lower frequency range, thereby enhancing high-frequency audibility. Amplification of the low and mid-frequency sounds, below the cut-off frequency, is not affected by the algorithm. Previous studies have already documented improved speech intelligibility in quiet as a result of the expanded audibility of high frequency sounds. This study investigated the potential for improvement in speech understanding also in noise resulting from the use of SoundRecover.

The performance of hearing instruments (HI) with SoundRecover was evaluated in comparison to conventional amplification using a speech understanding in noise test (Oldenburger Satztest – OLSA) and subjective questionnaires. Eleven experienced hearing aid users with a severe to profound sensorineural hearing loss participated in the study. The majority (seven) of the subjects showed improved speech understanding in noise with SoundRecover. Evaluation using questionnaires demonstrated an increased level of satisfaction after 2 months and after 4 months of SoundRecover usage, respectively, compared to conventional HIs.

Introduction

For most hearing losses, the primary goal of amplification is to provide a sufficiently audible signal across the entire speech range. People with a significant hearing loss have difficulties hearing high frequency speech information, such as /f/, /s/, and /sh/ (Pittman et al., 2003). Although the bandwidth of current HIs is wider than ever before, high-frequency gain in HIs drops off for the very high frequencies, also in so-called wide band devices. As such, the upper limit of audibility provided by conventional amplification is still below the peak frequencies of /s/ spoken by female and child talkers (Stelmachowicz et al. 2001). They showed that for male talkers, optimum performance requires a bandwidth of at least 4–5 kHz. Optimum performance for female and child talkers requires bandwidth of up to 9 kHz. The greater the hearing loss, more gain needs to be applied at these high frequencies in order to achieve audibility. However, in many

cases hearing sensitivity is so poor in the high frequencies that it is technically not possible to increase the gain sufficiently in order to achieve audibility. The gain can be limited by acoustic feedback, discomfort resulting from excessive loudness or the output abilities of the amplification system. Furthermore, in some cases, even when high frequency information can be made audible, it may not be discriminated due to irreversible damage to the hair-cell receptors in the inner ear.

As amplification on its own does not provide sufficient high frequency amplification, the alternative of shifting high frequency sounds to lower regions where audibility is available has been shown to be a viable alternative. Benefits of SoundRecover include improved audibility of high frequency sounds and better speech intelligibility in quiet. Anecdotal evidence has also suggested improved speech understanding in noise where first evidence is reported here.

Set-up of the Study

Audiometric tests and measurements were carried out at the University of Mainz, Germany. The OLSA, an adaptive speech in noise test was used. It comprises 40 lists with 30 nonsense sentences composed of 5 real words which are divided into three blocks of 10 sentences each. Test subjects were facing a loudspeaker at 0° azimuth from which the speech signal and noise were presented. Background speech babble noise consisted of the same long term spectrum as the target speech material and was presented at constant 65 dB. In contrast to the constant background noise, the speech signal was varied based on the standardized adaptive method described by Wagener et al., 1999. This test measures the Speech-Reception-Threshold (SRT). The speech test was conducted with the subjects own HI and with the experimental devices employing SoundRecover. In addition, a questionnaire was used to obtain subjective data on general benefit and sound quality of SoundRecover compared to the own HI. The questionnaire, especially developed for this study, used a scale reflecting five different categories of satisfaction and was handed out to the test subjects after objective testing. These categories were: "much worse than own HI", "worse than own HI", "as good as own HI", "better than own HI", "much better than own HI".

Subjects and Devices

Fourteen adults with a severe to profound hearing loss, 6 women and 8 men (age: 17–76 years; average age: 51.5 years), participated in the study. However, three subjects had to stop with the test due to personal reasons. After the initial fitting of Naída SP HI, SoundRecover settings were adjusted and fine tuned, if necessary, during follow-up sessions. The cut-off frequency was chosen individually for each subject based on the respective audiogram.

Results

Compared to the conventional HI, understanding of speech in noise was improved with the use of instruments employing SoundRecover. It is important to note that the experimental devices remained in omni-directional mode, so directional microphone technology was not a contributing factor to any results obtained. SRTs for the OLSA for all subjects are shown in Figure 1. The dark grey bars show the results with the subjects' own HI and the light grey bars show the results for SoundRecover at the last visit, after 4 months of acclimatization to SoundRecover.

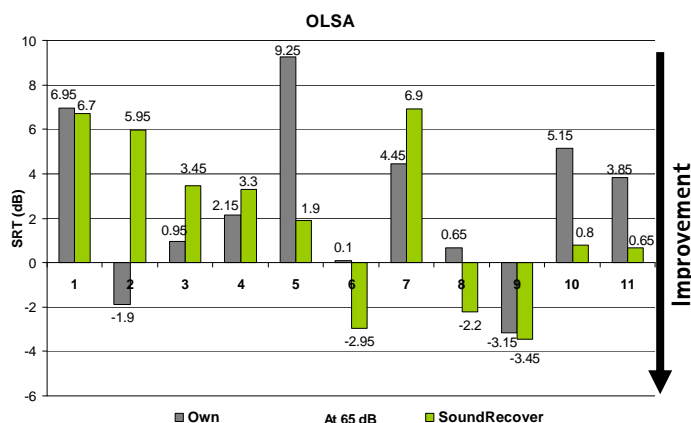


Figure 1: Speech Reception Threshold (SRT). Dark grey bars show the results with the subjects' own HI and light grey bars show the results for SoundRecover at the last visit.

Seven of 11 subjects showed improvements of speech intelligibility in noise with SoundRecover, ranging from -7.35 dB to -0.25 dB in SRT (reduction of SRT). Although not significantly so, these results show a clear tendency that SoundRecover provides additional benefit in noise. However, it is important to note that measured benefits of SoundRecover in noise are highly dependent on both, the type of noise as well as a profitable Signal-to-Noise-Ratio (SNR) in the frequency range affected by SoundRecover.

Beside their participation in speech intelligibility tests, the subjects also answered questionnaires to gauge subjective perception of sound quality. The mean value of satisfaction increased significantly after 2 ($p < 0.01$) and 4 ($p < 0.05$) months of use of the devices with SoundRecover. Most subjects reported more satisfying sound quality for fricatives in quiet compared to conventional amplification. The mean value for sound quality increased after 2 ($p < 0.05$) and 4 ($p < 0.05$) months. Overall impression of the SoundRecover frequency compression algorithm, depicted in Figure 2, was rated very positively. Subjects 4 (66% higher than conventional HI), 9 (33% higher), and 14 (20% higher than conventional ones)

found sound quality with SoundRecover to be very satisfactory. Mean values of satisfaction of SoundRecover were significantly different from conventional HI either after 2 ($p < 0.05$) or after 4 months ($p < 0.05$) of testing. No subject reported worse sound quality and listening effort was reported as being less compared to conventional amplification.

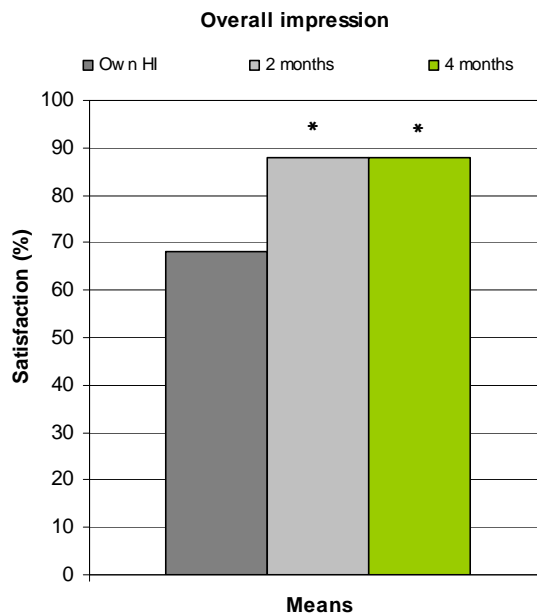


Figure 2: Overall impression of SoundRecover. Mean satisfaction levels in percent obtained by the 11 hearing-impaired subjects, comparing the means of the overall impression of own HI and SoundRecover. Statistical significance is shown by asterisk symbols: * $p < 0.05$.

Conclusion

These data show evidence for improved speech intelligibility in noise with SoundRecover. Thus, 7 of 11 subjects showed objective benefits as tested with the OLSA. Further, SoundRecover positively impacted subjective ratings of sound quality and notably decreased the listening effort. Thus, the compression and shifting of selected high-frequency signals into a lower frequency range, where the listener has better residual hearing, enabled more effective use of the additional audible speech information resulting in improved speech intelligibility in noise and was reported to have lowered the listening effort for difficult listening situations.

References

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