BassBoost: benefits for speech-in-noise comprehension.

Providing low-frequency amplification to patients with severe-to-profound hearing loss

Summary

Additional low frequency amplification provided by the Phonak **BassBoost** feature was surveyed in Savia Art devices regarding effects on speech intelligibility in noise. The Oldenburger Satztest (OLSA), an adaptive speech in noise test, was used to detect changes in speech reception thresholds (SRT) when **BassBoost** was activated. Results were benchmarked to competitive product selected for its overall technical similarity to Savia Art. The results show that when provided with additional low frequency gain and output, there was a significant improvement in speech reception in noisy environments.

Introduction

The **BassBoost** feature was specially developed for customers with severe-to-profound hearing loss (HL) who have high audibility needs. **BassBoost** is an adjustable frequency specific gain and output enhancer that will add up to 6 dB SPL below 1 kHz (Fig. 1). This feature was recently made available in all Phonak power devices (411 BTE and 33P ITE) in the Savia Art, Eleva and eXtra lines).

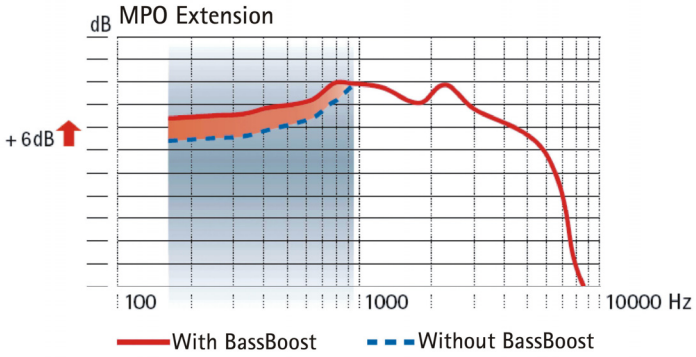

Fig. 1: Range and amount of MPO extension of BassBoost set to level 2 (+6dB) in a power (411) BTE instrument.

The first salient effect of turning the **BassBoost** feature "On" will be a pleasant improvement of sound fullness and audibility in addition to a clear enhancement of loudness experience, providing an extremely satisfactory sound. But there might be more here. Although it is acknowledged that many important speech cues are in the high frequency range, many other crucial speech cues like consonantal sounds are present in the lower frequency range. Moreover, it is a fact that people with severe-to-profound HL often have very poor high frequency thresholds and therefore do not get much high frequency speech cues at all. Research has shown that users compensate for this by relying more efficiently on low frequency speech cues than normal hearing subjects (e.g. Turner and Cummings, 1999; Turner and Brus, 2001). On top of that, patients with profound HL often have cochlear dead regions. In the presence of a cochlear dead region at high frequencies, patients do not profit from high frequency amplification either in quiet (Vickers, Moore and Baer, 2001), or in noisy environments (Baer, Moore and Kluk, 2002).

All these observations suggest that providing an increased low frequency boost to users with severe-to-profound HL might improve their speech comprehension abilities, particularly in the presence of noise.

Goal of the study

The goal of this field trial was to evaluate how the **BassBoost** feature affects speech intelligibility in noise for a group of participants with severe-to-profound HL.

Participants and hearing instruments

20 participants fit with Savia Art devices, 10 power full shell ITE users and 10 power BTE users entered the study. The age range was 40 to 82 years, 71 on average in the ITE group and 60 in the BTE group. Participants' experience with hearing instruments ranged from short term users (6 months-3 years), to long term users (over 6 years). Fig. 2 displays the average air conduction thresholds of the 20 participants.

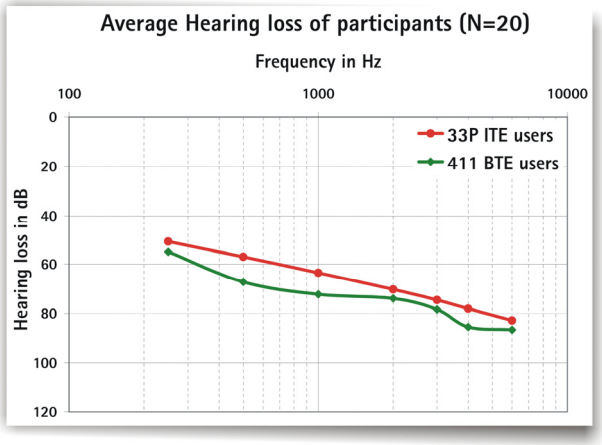

Fig. 2: Average air conduction thresholds for the 20 participants.

The chosen benchmark instrument was a newly launched and commercially available device from a competitive brand. This HI was selected for its similarities in technical features and comparable market positioning to Savia Art (referred to in this note as "Compared Device"). Fitting strategies for both products were kept constant.

Method

Speech intelligibility in noisy environments was assessed with the adaptive OLSA test. This test measures the speech-reception-threshold (SRT: signal-to-noise ratio for 50% intelligibility) of five-item sentences presented from the front direction (0°) against a broadband uncorrelated cafeteria noise played from 4 background loudspeakers (60°, 120°, 240°, 300°). Participants were asked to repeat the sentences they heard while the noise intensity was kept constant at 65 dB SPL and the intensity of speech signals varied according to a standardized adaptive method (Wagener, Brand & Kollmeier, 1999). The HI operated in defined settings to have comparable conditions (e.g. transient input limiter in both devices always on default). The BassBoost feature in Savia Art devices was set to "Off" or "Level 2" (+6 dB) in randomized order during testing.

Results

Results from the OLSA test showed a clear advantage of the BassBoost feature. SRT improved for both BTE users (improvement = -1.19 dB; SRT = -3.04 dB without BassBoost vs. SRT = -4.23 dB SPL with BassBoost) and ITE users (improvement = -1.35 dB; SRT = 0.19 dB without BassBoost vs. SRT = -1.16 dB SPL with BassBoost). Note that BTEs were tested in the directional mode (dSZ), whereas ITEs only have an omnidirectional mode, hence the global difference between BTE and ITE results.

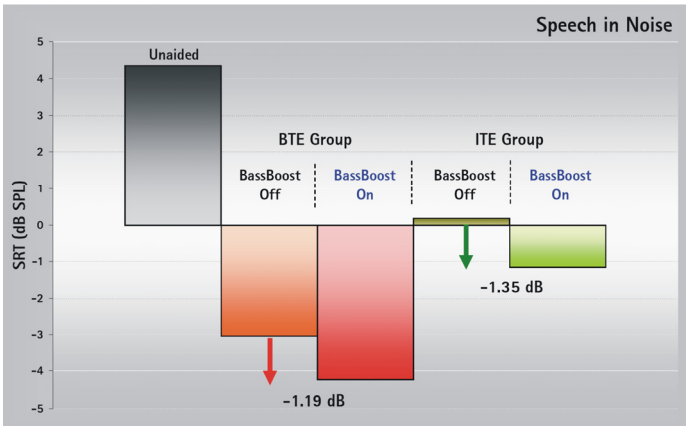

Fig. 3: Results from the OLSA test. BTE results with directional microphone (red) and ITE results (green).

A paired t-test on dependent samples comparing comprehension scores with and without BassBoost led to a significant effect of BassBoost ($N = 10$; $t = 2.38$; $p < .05$) in the BTE group and ($N = 10$; $t = 2.29$; $p < .05$) in the ITE group (see Fig. 3).

The compared device set to directional mode performed significantly worse than Savia Art under the same conditions (SRT = -1.53 dB for compared device in directional mode vs. SRT = -3.04 dB without BassBoost vs. SRT = -4.23 dB SPL with BassBoost for Savia Art) (Fig. 4).

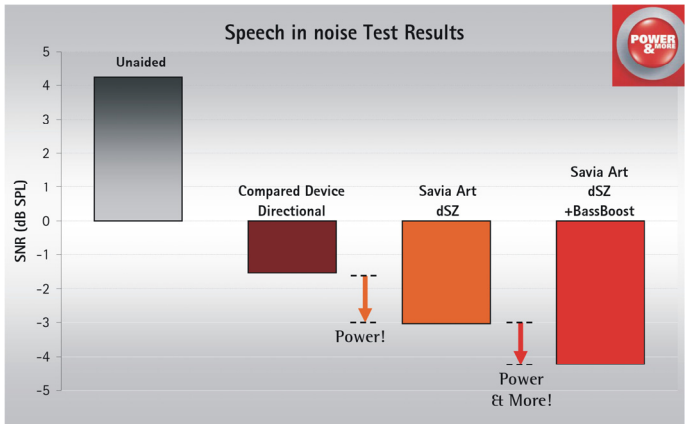

Fig. 4: Results from the OLSA test. Benchmark product in directional mode vs. Savia ART without and with BassBoost.

Conclusion

The present test series demonstrated that the Phonak **BassBoost** feature does provide significant improvement of speech intelligibility in noise.

This might be attributed to better fundamental frequency extraction facilitated through augmented audibility of low frequency cues which potentially facilitate the tracking of relevant speech information against a background of mixed speech and non speech noises.

In addition to its outstanding effects on subjective sound loudness and quality, the **BassBoost** feature can enhance speech comprehension abilities in noisy environments for people with high frequency severe-to-profound HL.

References

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