

Study finds that non-linear frequency compression boosts speech intelligibility

By Myriell Nyffeler

Hearing loss is often associated with poor high-frequency hearing. Recently, Phonak has developed SoundRecover (SR), a non-linear, frequency-compression algorithm designed specifically for wearers who have difficulty hearing key high-frequency speech information, such as the fricatives /f/, /s/, and /sh/. Beside extending the audible range by compressing and shifting otherwise inaudible high frequencies into an adjacent lower frequency area, SR is also designed to prevent acoustic feedback and discomfort resulting from excessive loudness due to high levels of high-frequency amplification.^{1,2}

Clinical field studies have shown that the use of this algorithm restores high-frequency audibility and results in high spontaneous user acceptance, quick acclimatization, and improvements in the wearer's own voice quality.^{1,3,4}

The main goal of the trial discussed in this article was to evaluate the impact of Naída (a Phonak hearing instrument) with SR turned on for wearers with a severe to profound hearing loss in both quiet and noisy situations.

STUDY DESIGN

The study, conducted at the University Clinic of Mainz in Germany, included both objective and subjective measurements. The Oldenburger Satztest (OLSA), a standardized sentence-in-noise test, was used to evaluate speech intelligibility in noise. The study compared the performance of test subjects while wearing prototypes of Naída UltraPower with SR turned on with their performance using their own hearing aids.

The OLSA speech material consists of 40 lists with 30 sentences divided into three blocks

of 10 sentences each. The adaptive speech-reception threshold (SRT) test measures speech intelligibility of short nonsense sentences containing five words. While the noise was presented at a constant level of 65 dB, speech levels were adaptive and 50% of word recognition was measured. The basic sentence structure used is name-verb-numeral-adjective-object. The test sentences are selected based on a random combination of 50 words.

In addition, the trial used questionnaires to evaluate subject acceptance of Naída with SR on as well as different sound impressions and acclimatization effects.

Subjects and devices

Eleven participants with moderately severe to profound sensorineural hearing loss were recruited for the study (Figure 1). All were experienced wearers of amplification using either analog (n=2) or digital (n=9) hearing instruments. The subjects had a mean age of 51.5 years with a range from 17 to 76 years (SD = 17.1 years).

After a first assessment for audiologic diagnostics, all subjects were binaurally fitted with a prototype of Naída UltraPower with the SR non-linear, frequency-compression feature

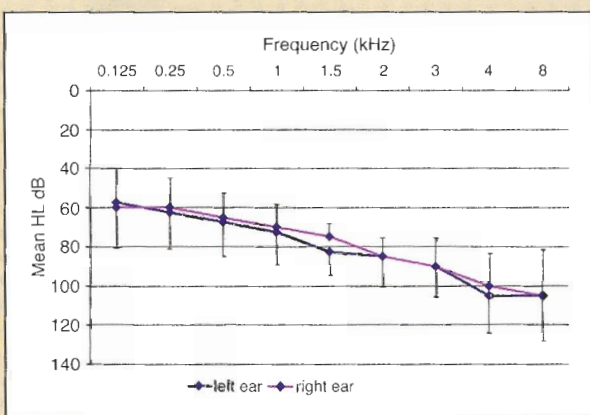


Figure 1. The averaged audiogram of both ears of test subjects.

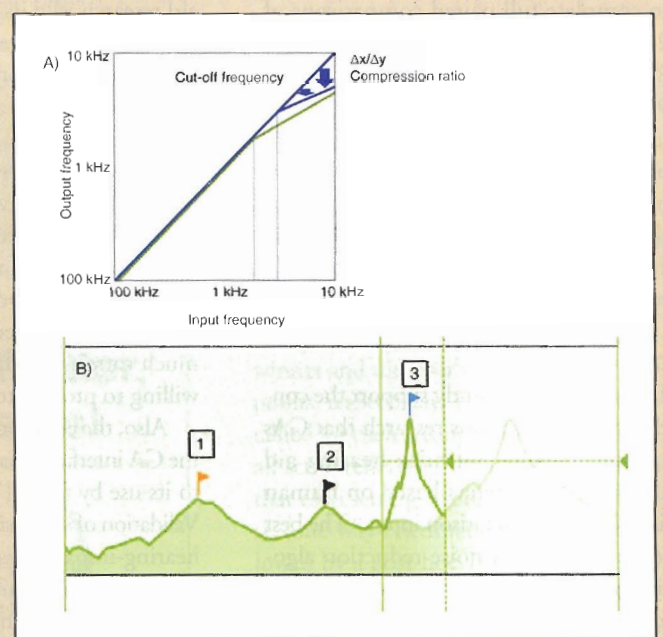


Figure 2. SoundRecover extends the audible range by compressing (A) and shifting inaudible high-frequency input into an adjacent area with audible hearing (B), without interfering with the audibility of the lower frequency sounds, which remain unchanged.

turned on. Compared with conventional processing, this algorithm compresses frequencies above a programmable cut-off (Figure 2A) and shifts them to a lower range to improve high-frequency audibility (Figure 2B). At the same time, frequencies below the cut-off are amplified normally, preserving a natural sound quality.

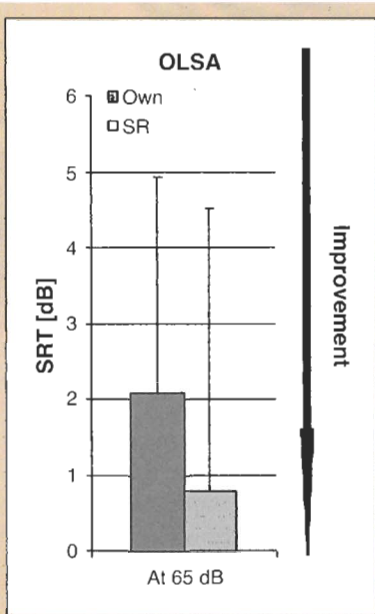


Figure 3. SoundRecover improved speech intelligibility in noise by reducing the SRT about 1.3 dB compared to subjects' own HI.

Subjects were asked to compare the test devices with SR on to their own HIs in daily life. The subjects wore the test devices for at least 2 months and they all attended a total of five assessment sessions to fine-tune them, if necessary, and for the objective tests to be conducted. After each assessment, all the subjects were given questionnaires to complete at home.

RESULTS

Speech intelligibility in noise was evaluated using the OLSA test for both instruments (Figure 3). The first assessment session looked at intelligibility with each subject's own hearing instruments. Results compare performance with the test instrument in the fourth assessment session after 2 months to baseline measurement with their own HI.

Comparison of the two devices revealed an improvement of 1.3 dB of the SRT at 65 dB. This represents an improvement in speech intelligibility of approximately 26% ($p=0.4$; see Figure 3). Because of the small number of test subjects due to protocol deviations, the improvement in speech intelligibility did not reach statistical significance.

However, when the results from the subjective evaluation questionnaire are combined with the objective findings,

they show a significant benefit from Naída with SR on over conventional processing.

Subjects were asked to critically compare their own current instrument to the test instrument with SR. In quiet, the device with SR on produced significantly increased subjective satisfaction rates (Figure 4A). A similar picture emerged in noisy environments (Figure 4B). The satisfaction rating shown in Figure 4B after 2 weeks of use indicates that subjects needed to acclimatize to SR. Further improvements in satisfaction over time reflect the effects of acclimatization to the new hearing instrument in general and to the SR signal processing in particular.

Questions about the sound quality of specific sounds revealed that subjects initially found that fricatives sounded different. This may reflect the effect of the non-linear frequency compression on the audibility of high-frequency sounds. Over time, the sound quality ratings improved consistently (Figures 5A and B). In addition, subjects rated their own voice sound quality as more pleasant with Naída with SR on than with their own hearing instrument (Figure 5C).

Overall, acclimatization to the experimental device took a short time, and results and ratings improved after 1 month of use and again after 2 months of use (Figure 5D).

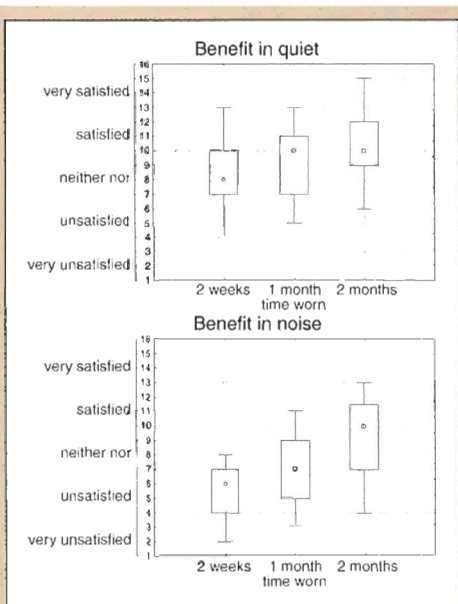


Figure 4. After 2 months, the benefit of SR on was significantly enhanced both in quiet (A) and in noise (B). Squares highlight medians, rectangles represent 25%-75% confidential interval, and lines depict non-outlier ranges.

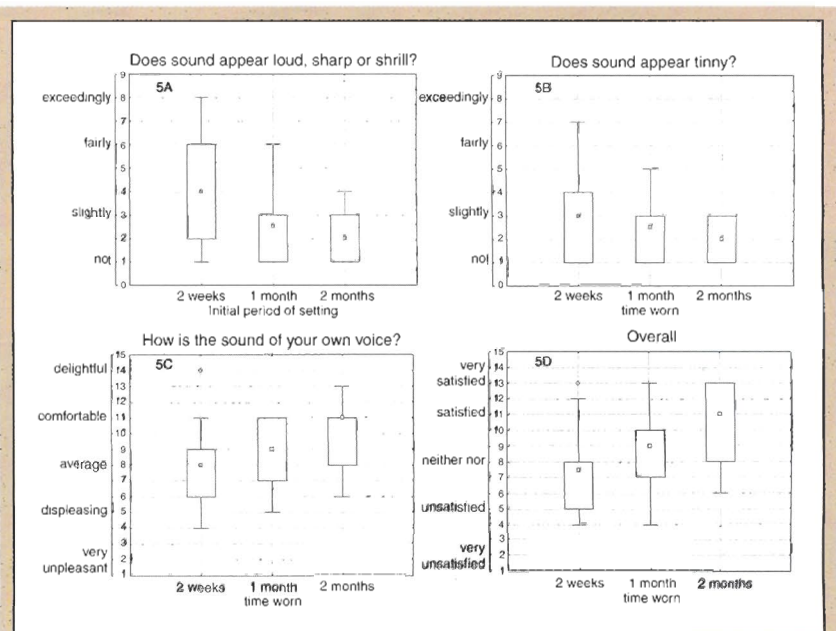


Figure 5. Naída with SR on positively enhanced sound quality (A, B), the sound of the wearer's own voice (C), and overall impression after 2 months of fitting (D). Squares highlight medians, rectangles represent 25%-75% confidential interval, and lines depict non-outlier ranges.

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CONCLUSION

The selective non-linear compression and shifting of high-frequency signals into a narrower lower frequency range could enable more effective use of the audible speech information and thereby result in a very satisfactory rating. Results obtained by Naïda with SoundRecover on further support this new, non-linear frequency-compression algorithm.

SoundRecover has proven beneficial for users with moderately severe to profound hearing loss by significantly improving their listening experience in quiet and in noisy situations. Moreover, SoundRecover was found to increase the pleasantness of sound and of the subject's own voice, resulting in a highly satisfactory overall impression.

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REFERENCES

1. Simpson A, Hersbach AA, McDermott HJ: Improvements in speech perception with an experimental non-linear frequency-compression hearing device. *IJA* 2005;44(5):281-292.
2. Simpson A, Hersbach AA, McDermott HJ: Frequency-compression outcomes in listeners with steeply sloping audiograms. *IJA* 2006;45(11):619-629.
3. Scollie S, Glista D, Secwold R: Speech quality ratings of nonlinear frequency compressed speech by normal and hearing-impaired listeners. *Ear Hear* (submitted).
4. Bagatto M, Scollie S, Glista D, Pasa V, et al.: Case study outcomes of hearing-impaired listeners using nonlinear frequency compression technology. *Audiol Online*, 2008.

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