Phonak
Field Study News

Adaptive compression results in less listening effort for those with moderate hearing loss

AutoSense™ OS 3.0 adapts multiple features to match the acoustics present in the environment. It steers the signal processing and applies the most appropriate setting for the hearing aid wearer. Adaptive compression speed is provided based on the listening situation. This study reveals a significant improvement in listening effort when AutoSense™ OS 3.0 automatically applies slow compression for those with moderate hearing loss in speech-in-noise situations.

Authors: Sofie Jansen & Jennifer Appleton-Huber. February 2019

Introduction

Compression speed is defined on how quickly the hearing aid reacts to changes in sound (i.e. attack time), as well as how it behaves when this sound is removed (i.e. release time). Compression speed and the optimal compression time constants within hearing aid algorithms is a topic covered in a large amount of studies from the last decades, showing varying outcomes (Moore, 2008).

A dual compression algorithm has been available in Phonak hearing aids for more than 10 years and has now been developed further for Phonak Marvel hearing aids. This algorithm aims to combine the advantages of fast compression with the advantages of slow compression. In several studies, the benefit of the slow compression over a purely fast acting syllabic compression system has been proven for certain hearing aid user profiles and for certain situations/tasks (Jansen & Fulton, 2018).

Bohnert et al. (2007) found a significant benefit for speech intelligibility in noise, in a study with severe to profound hearing impaired listeners, when using slow compression over fast compression. For speech in quiet and for real-life ratings, slow and fast compression yielded the same outcomes.

Subjective ratings from Mandarin speaking hearing aid users (Stenzel, 2014) showed an improvement in clarity (speech in quiet) and naturalness (speech in noise) with the slow algorithm in combination with a slightly modified low-frequency gain setting.

In a music quality study with hearing aid wearers with moderate hearing loss, it was concluded that slow compression leads to improved dynamic and spatial perception (Kühnel, 2014). Changing from fast compression to slow compression also had a positive impact on the quality rating for streamed signals, for both music and speech signals, and for listeners with different degrees of hearing loss. (Kühnel & Anderson, 2014, Strelcyk, 2015).

In Phonak hearing aids AutoSense™ OS is the foundation for steering the signal processing and applying the most appropriate setting for the wearer, based on the acoustics present in the environment. In order to maintain the natural modulations of speech in noise as well as streamed media, slow compression is available and activated depending on the input signals. Since the introduction of Marvel hearing aids, the Adaptive Phonak Digital fitting formula uses slow compression for all hearing loss configurations in the speech in noise and speech in loud noise settings as well as in the streaming programs: Media speech and Media music. In all other cases, a fast compression is used.

The objective of the study was to assess whether speech intelligibility and listening effort can be improved for adult hearing aid wearers with moderate hearing loss by using slow compression, in comparison to fast compression.

Methodology

Participants

Thirty participants (18 male, 12 female) took part in the study. They had an average age of 75 years (standard deviation:7) and bilateral moderate hearing loss (figure 1). They had all been wearing hearing aids for a minimum of 2 years.

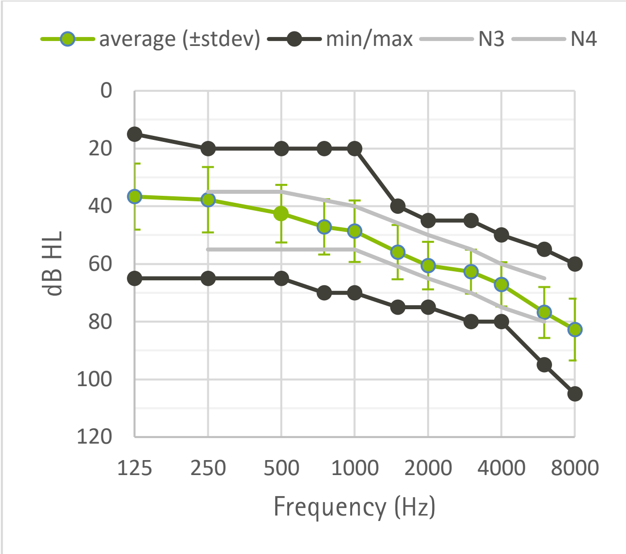

Figure 1. Average pure tone audiogram of the study participants.

Equipment

Participants were fitted with Phonak Audéo B30 hearing aids with cShells, xP receivers and an Acoustically Optimized Vent (AOV) (average vent size = 2.4 mm, calculated for a 2 cm long vent). Hearing aids were set with two programs:

- Fast compression
- Slow compression

Both programs used the Adaptive Phonak Digital precalculation in the Calm Situation setting. Fine-tuning was performed if necessary, but was the same for both programs. The static compression ratio for the average hearing loss was 2.1 to 2.5, depending on the frequency band.

Procedures

Speech intelligibility of both programs was assessed using the Oldenburger Satztest (OLSA), a speech-in-noise sentence test. Subjects heard sentences consisting of five words (open set) in the presence of background noise (Wagener & Brand, 2005). Subjects were asked to repeat what they heard and they were scored on the number of words which they repeated correctly. The subject was seated at the center of a circle of loudspeakers, facing the speaker at 0° azimuth. Both the OLSA speech material and noise signal were presented from this speaker, so that no effect of directional microphones were to be expected. Speech levels were adaptive whereas noise levels were constant at 70 dB SPL. This produced Speech Reception Thresholds (SRT) (i.e. the signal-to-noise ratio with which 50% of all words are correctly understood) for all subjects using both hearing aid programs.

An adaptive categorical listening effort scaling test (ACALES) (Krüger at al., 2017) was performed where participants were asked to rate their perceived listening effort on a 14 point scale. Speech test material (OLSA) mixed with spectrally matched unmodulated noise at a fixed noise level of 70 dBA was presented at varying signal-to-noise ratios covering an individual range from “no effort” to “extreme effort”.

The programs were randomized: Half of the participants started with the fast compression program and the other half with the slow compression program. A test and retest with each program was carried out.

Results

Speech intelligibility tests revealed no significant differences between fast and slow compression programs.

Listening effort scaling resulted in significantly lower signal-to-noise ratios (SNRs) for slow versus fast compression, for the first five listening effort categories (figure 2). This indicates that listening with a slow compression program requires less listening effort than when listening with a fast compression program.

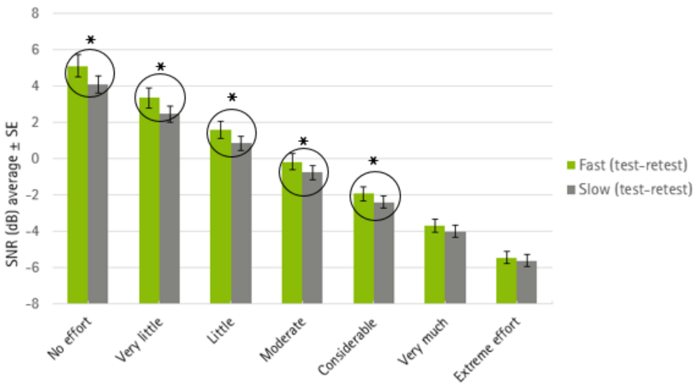

Figure 2. Listening effort scaling results. * = significantly different SNRs ($p<0.05$)

Conclusion

Previous research has shown that slow compression can be beneficial in noisy situations, to hearing aid users presenting with severe hearing loss. The current study has confirmed that the benefits of slow compression can be extended to hearing aid users presenting with moderate hearing loss too. The adaptive compression algorithm in Marvel combines the advantages of fast compression with the advantages of slow compression. Specifically, results show slow compression leads to significantly reduced listening effort in noise compared to fast compression.

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Jennifer Appleton-Huber received her M.Sc. in Audiology from the University of Manchester in 2004. Until 2013, she worked as an Audiological Scientist mainly in the UK and Switzerland, where she worked with adults and pediatrics, in the areas of hearing aids and cochlear implants. Her current role is Technical Editorial Manager at Phonak Headquarters.