Field Study News

February 2018

StereoZoom provides benefit to those with severe hearing loss

This study, carried out at the Hörzentrum Oldenburg, investigated the use of StereoZoom for hearing aid users with severe hearing loss, when listening to speech within a noisy environment. It revealed improved speech intelligibility and subjective preference including reduced listening effort, when using the binaural algorithm StereoZoom, versus a monaural algorithm.

Introduction

Directional microphones improve understanding in difficult listening situations, particularly situations where there is a lot of background noise (Ricketts, 2006; Wouters et al., 1999; Chung, 2004; Hamacher et al., 2005). In general, they focus on speech coming from the front while attenuating noise from behind.

The adaptive monaural beamformer, UltraZoom, has been shown to improve speech understanding in situations with a prominent source of background noise present (Wouters et al., 2002; Ricketts & Henry, 2002). It focuses on speech from the front which improves the signal-to-noise ratio and enhances speech understanding. On the other hand, the binaural beamformer, StereoZoom, has been shown to provide directional benefit in situations where the noise environment is diffuse (Nyffeler, 2010; Stuermann, 2011; Picou et al., 2014; Latzel, 2012).

This binaural beamformer, StereoZoom, works by creating a bidirectional network of four microphones which produces a strongly focused directional effect. The enhanced directional characteristic, which provides a considerably improved attenuation of background noise, produces a very narrow focus compared to the monaural beamformer and thereby improves the signal-to-noise ratio (SNR) further.

A recent study by Picou and Ricketts (2017) investigated the impact of BVST technology on how a patient was feeling. For example, they observed BVST technology to enable participants to feel less tired than when using a monaural directional algorithm.

Objective

StereoZoom has been proven to be beneficial to hearing aid wearers with a moderate hearing loss. The aim of this study was to assess whether this is also true for those hearing aid wearers with severe hearing loss.

Methodology

Twelve hearing impaired participants with severe hearing loss took part in the study. Participants were fit with binaural Phonak Naída Q90-SP hearing aids. A test against participant's own hearing aids was to be included. In order to exclude gain settings from having an impact on the test results, the frequency response of the Naída Q90-SP hearing aids was adjusted to match that of their own hearing aids for a speech signal input of 65
dB.

The four test conditions can be seen in table 1.

Hearing aids	Directional Microphone	Directional microphone functionality
Own hearing aids	Individual	Unknown
Naída Q90-SP	Real Ear Sound (RES)	Omnidirectional
Naída Q90-SP	UltraZoom	Monaural, adaptive
Naída Q90-SP	StereoZoom	Binaural, static

Table 1. The four test conditions used for the directional microphone evaluation

Speech intelligibility of the directional microphone 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 (figure 1), facing the speaker at 0° azimuth. The OLSA speech material was presented from this speaker, whilst street noise was presented from all other loudspeakers. Speech levels were adaptive whereas noise levels were constant at 65 dB (A). 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 all four directional microphones.

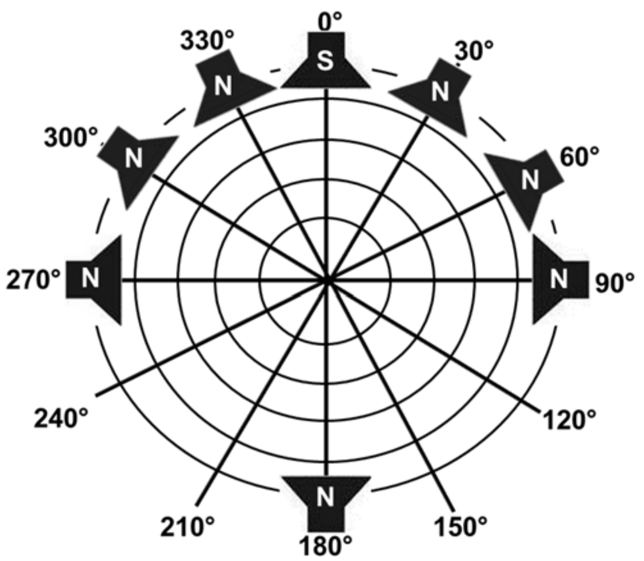

Figure 1. The test setup for the OLSA measurement during the directional microphone evaluation. Speakers labelled with S indicate the direction from which the speech material was coming from. Speakers labelled with N indicate from where noise was coming from.

Participants then carried out a subjective assessment of the directional microphones. For this, their own hearing aids were omitted from the test so that they did not have to switch hearing aids. They walked around a busy cafeteria with a tester, who faced the participant and spoke with them in order for the participant to try out the three directional microphone settings of the Naída Q hearing aids, via pressing the program change button. They then returned to the laboratory, where they filled out a questionnaire which had been designed specifically for this study. The questionnaire requested the participant to compare a program against another program on a scale of -5 to +5 for seven different categories (overall loudness, loudness of speech, speech perception, listening effort, loudness of noise, sound quality of speech and overall impression). A score of 0 meant that they rated the programs as equal to one another for that particular category. A score of -5 or +5 meant that they rated one of the programs to be much better than the other one. Following this, the participants went with the tester out onto a busy street where they again tested out the three different programs, before returning to the laboratory to complete the questionnaire again.

Results

The speech intelligibility results (OLSA measurement) for the directional microphone evaluation can be found in figure 2. Both directional microphones were found to provide an improvement of more than 2 dB in Speech Reception Threshold (SRT) compared to the RES setting and to the participants' own hearing aids. This was found to be statistically significant ($p < 0.01$). There was an improvement in SRT of 0.4 dB between UltraZoom and StereoZoom (not significant).

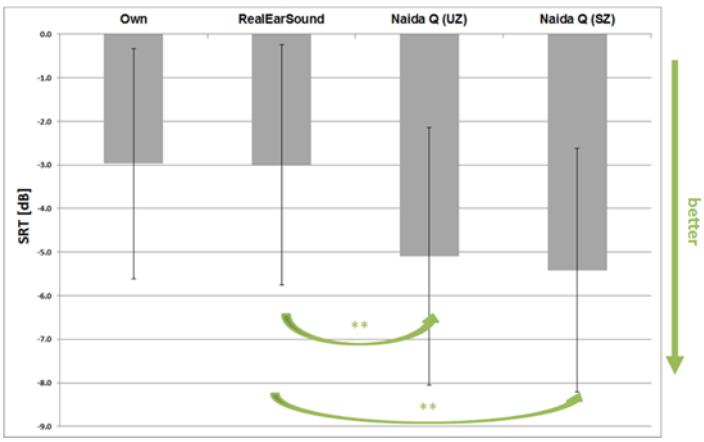

Figure 2. SRT for the four directional microphone conditions. UZ = UltraZoom, SZ = StereoZoom. ** = significantly different.

Figure 3 shows the results of the questionnaire based on when participants were in a cafeteria and tried out the different directional microphones. StereoZoom was rated better for all categories in comparison to both UltraZoom and

RES. StereoZoom was rated significantly better than UltraZoom for listening effort, overall loudness, loudness of noise and overall impression. The finding of reduced listening effort aligns with the findings of Picou and Ricketts, 2017 where participants felt less tired when using BVST technology than when using a monaural directional algorithm.

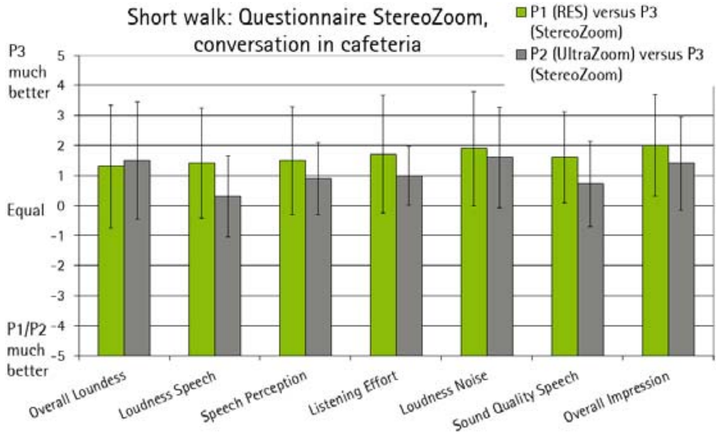

Figure 3. Results of the questionnaire for the cafeteria situation. Statistically significant results are marked with an asterisk (* p = 0.05, ** p = 0.01)

Figure 4 shows the results of the questionnaire based on when participants were listening to a talker who was facing them while on a busy street. The results show that StereoZoom was clearly preferred over RES for all categories. Many participants commented that with StereoZoom, there was better suppression of background noise and that speech was clearer. Results also show that StereoZoom was slightly preferred over UltraZoom when on a busy street but the differences were not as big as for the cafeteria situation and were not significant.

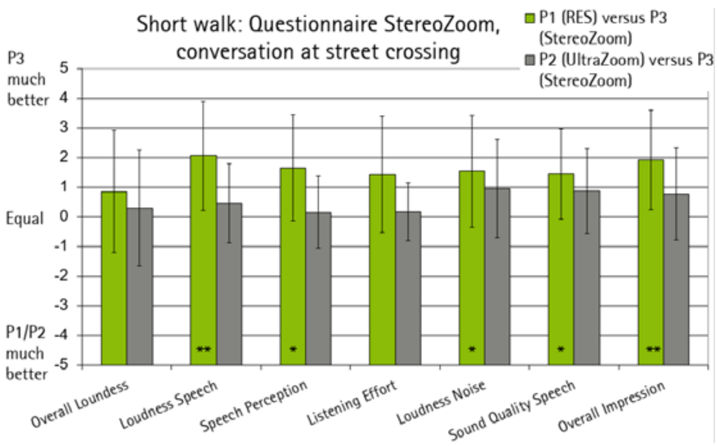

Figure 4. Results of the questionnaire for the busy street situation. Statistically significant results are marked with an asterisk (* p = 0.05, ** p= 0.01)

Conclusion

Binaural Voice Stream Technology, streaming full bandwidth audio from one hearing aid to the other, has been proven to be beneficial to hearing aid users with mild-moderate hearing loss. This study confirms that the BVST algorithm – StereoZoom is also beneficial, to hearing aid users, with severe hearing loss. The benefit is found to be significant for both objective and subjective measures.

Objective measures showed that speech intelligibility improved significantly with use of a directional microphone in noisy conditions. Further improvements were noted when this directional microphone was binaural, although the difference was non-significant.

Subjective measures also found that use of a binaural algorithm led to improved perception in a range of dimensions, such as listening effort.

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