Phonak Field Study News

Significant increase in the amount of social interaction when using StereoZoom

Positive behavioral changes were observed via communication analysis in a study at the Hörzentrum Oldenburg. It found that use of the binaural adaptive beamformer, StereoZoom, over a fixed directional beamformer approach, led to significantly increased overall communication (15%) and less leaning-in towards the talker.

Author: Michael Schulte, Markus Meis, Melanie Krüger, Matthias Latzel & Jennifer Appleton-Huber / September 2018

Introduction

Directional microphones improve understanding in complex listening situations, particularly situations with high levels of background noise (Ricketts, 2006; Hamacher et al., 2005). As a rule, these systems focus on speech coming from the front while attenuating noise from other directions.

StereoZoom, developed by Phonak, uses binaural directional microphone technology to create a narrow beam of acceptance for audio signals, in especially challenging listening situations. In conversations with loud background noise, StereoZoom improves the signal-to-noise ratio (SNR), resulting in improved speech intelligibility, better sound quality and higher suppression of noise (Latzel & Appleton-Huber, 2015; Appleton & König, 2014). StereoZoom has also been shown, via electroencephalography (EEG) (Winneke et al., 2018) and via behavioral measures (Picou et al., 2017) to reduce listening effort by up to 19% compared to competitor noise suppression technologies.

These benefits of StereoZoom have so far been proven via speech intelligibility testing, subjective feedback questionnaires and electroencephalography. A recently developed tool, communcation analysis, has been shown to detect changes in communication behavior in response to different hearing aids/settings (Paluch et al., 2015; Latzel et al., 2016; Meis et al., 2017). This methodology requires the participants to take part in moderated focus groups, which are video recorded while hearing aids/hearing aid settings are varied between sessions. Trained external assessors analyze the video recordings and rate the communication behavior of the participants, such as changes in body language, gestures, or choice of communication partners (one-on-one versus group conversation. The assessment is performed either online during the focus groups, or offline by watching the video afterwards.

The objective of the study was to evaluate the benefit of StereoZoom when listening to speech in a noisy environment. Specifically, the evaluation consisted of analyzing potential changes in communication behavior via observations made during communcation analysis.

Methodology

Participants

24 experienced hearing aid users participated in the screening part of the study. 12 were male, 12 were female. The mean age was 74.3 years (maximum was 80 and minimum was 67) and the mean PTA (pure tone average at 0.5, 1, 2 and 4kHz) was 51.1 dB HL. The mean audiogram can be seen in figure 1.

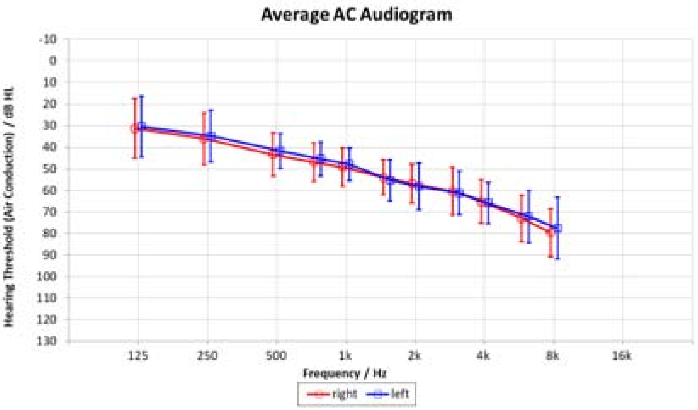

Figure 1. Mean audiogram of the 24 test participants (screening)

Hearing aids

Each participant was fitted with a pair of Phonak Audéo B90-312 hearing aids, coupled with closed SlimTips. They were fitted with the Phonak Adaptive Digital fitting formula at 100% experience level. Fine-tuning was not done. RECD was set at default, SoundRecover and adaptive features were disabled, in order to focus on the different directional microphone approaches only.

Procedures

The study consisted of a screening phase and a main phase. In the screening phase, participants were screened in order to find a contrast between performance with StereoZoom and another beamformer condition in noisy situations representative of real-life conditions. Hearing aids were programmed with four different programs with the following beamformer settings:
P1: Real Ear Sound (RES) – a directional setting in the high frequencies only, designed to preserve pinna cues.
P2: Fixed directional (FD)
P3: UltraZoom (UZ) – a monaural adaptive beamformer
P4: StereoZoom (SZ) – a binaural adaptive beamformer

All 24 participants underwent a listening effort test (Adaptive Categorical Listening Effort Scaling (ACALES)). This is an adaptive procedure where the subjectively perceived listening effort is rated while the SNR is varied (Krüger et al., 2017). Participants sat in the center of a circle of 12 loudspeakers. Speech test material was presented from an angle of 0° and shopping mall background noise was presented from all speakers (including also 0°) at a constant level of 68 dB. The participants started with a short training run and then performed one complete run for each of the four programs. The ten participants who showed the greatest difference between StereoZoom and the fixed directional setting (see results section for justification of beamformer choice) were selected to take part in the main phase of the study.

In the main phase the communication analysis methodology was used to evaluate whether StereoZoom changes the communication behavior of hearing aid users in a complex listening environment, representative of a typical real-life situation. The participants were divided into two groups of 5. Each group took part in a focus group discussion which was video recorded via three cameras, for offline analysis. The focus group discussion took place in a room with a round table. Around the table, the five participants were seated at equal distance to both their direct neighbors and the participants who were sitting opposite to them. Background noise (shopping mall) of 71 dB(A) was presented by six loudspeakers which were equally spaced around the group of participants. The group discussion was split into 5 sessions, with a median length of 12 minutes, each with a different discussion topic in the realm of hearing loss or hearing aids, as this would be a topic which all participants could contribute to.
Note: In this publication the results of only the first two sessions were analyzed in which all participants used the same setting.

In session 1, the hearing aids were set to P1 (StereoZoom) and in session 2 to P2 (FD). A moderator was present who helped to change the hearing aid programs and initiated the discussions.

Following the two group discussions, the video recordings were analyzed, using a fixed annotation scheme, by raters who had been trained in communication analysis of communication interactions. Interrater reliability of the four raters had been tested and found to be good up to excellent, (Koo and Li, 2016) indicating that the annotation of the video sessions was reliable and reproducible. Raters viewed the recordings and used a computer software to select one out of eight options (see figure 2) every time a communication interaction had been observed. The options described the following type of observations:

- Amount of communication partners in a given conversation (one-to-one, group conversation or non-speech interaction)
- Proximity to communication partner (near or at distance)
- Body position (leaning forward or leaning back)

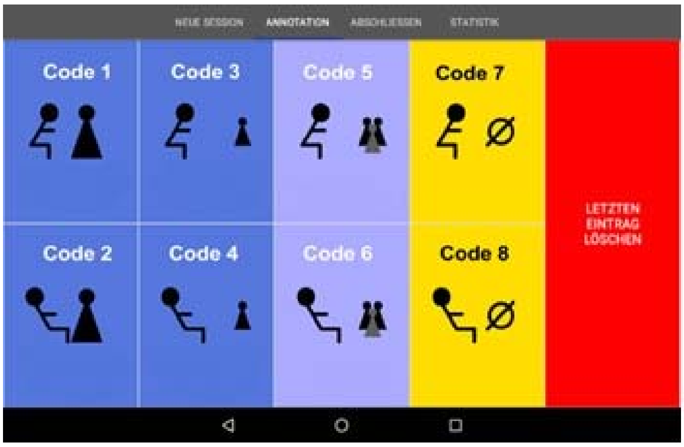

Figure 2. Annotation scheme used by the raters: Code#1: leaning forward, talking to direct neighbor. **Code#2:** leaning backward talking to direct neighbor. **Code#3** leaning forward, talking to distant partner. **Code#4** leaning backwards, talking to distant partner. **Code#5 l**eaning forward, talking to group**. Code#6** leaning backwards, talking to group. **Code#**7 leaning forward, not talking. **Code#8** leaning backwards, not talking

Results

In the screening phase, participants compared StereoZoom to three other beamformer conditions in terms of listening effort, via an ACALES test. The StereoZoom program resulted in the lowest listening effort ratings and the RES setting resulted in the highest. In addition to significant differences between StereoZoom and RES (25% difference), StereoZoom and Fixed directional could also be proven to differ significantly from each other in respect to listening effort. This difference was 22% in the SNR region of +3 dB to +7 dB. This SNR region corresponds to normal conversation in noisy situations in real-life and thus to the situations simulated during the video sessions. Fixed directional was therefore identified to be a perfect counterpart to StereoZoom for communication analysis and was chosen to be used in the main phase of the study.

Communication analysis compared differences in communication behavior when testing StereoZoom (SZ) versus fixed directional (FD). The data show that when participants were using SZ they had more communication interactions (345) than when using fixed directional (290). This difference of 15% is statistically significant (Wilcoxon-Test, U = -2.492, p = 0.013). Figure 3 shows the average total number of communication interactions for each participant, for both beamformer conditions.

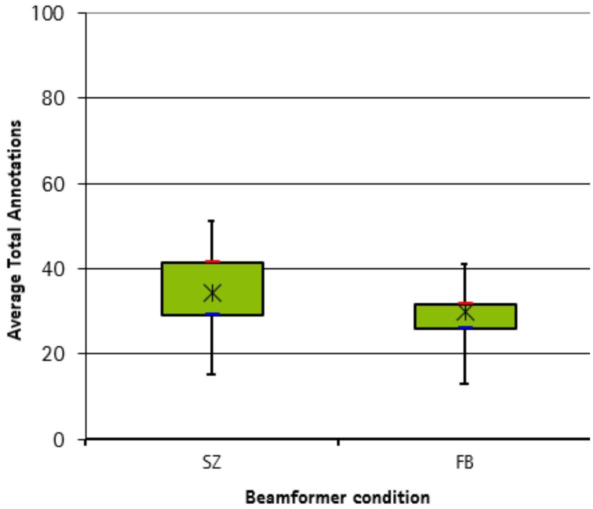

Figure 3. Average total number of communication interactions for each participant for both beamformer conditions (SZ and FD)

Figure 4 shows the interaction behavior divided into whether participants were observed to be leaning forward or leaning backwards when communicating with the whole group. Participants were found to lean forward more often with FD than with the SZ beamformer, meaning they had a more relaxed position during communication with SZ. This difference could be confirmed as statistically significant (p = 0.028).

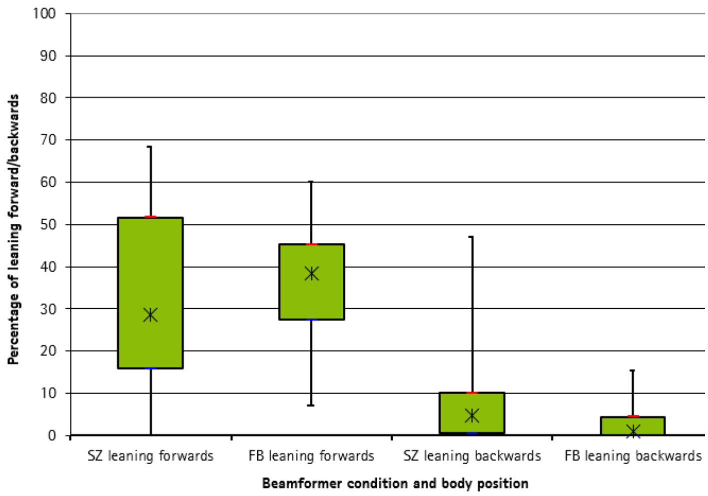

Figure 4. Interaction behavior in % for group communication divided into "leaning forwards" (the two left boxes) and "leaning backwards" (the two right boxes) for StereoZoom (SZ) and Fixed Beamformer (FB). Sum of all annotations (see figure 2) within each beamformer condition is 100%.

Conclusion

StereoZoom, compared to a fixed directional system was shown to provide 22% less listening effort, when measured via a subjective rating of listening effort (ACALES). This led to the benefit that with StereoZoom, people communicate significantly more (15% more) and appear to be more relaxed during communication. This was identified by the new method called communication analysis. This has been demonstrated to be an effective tool, able to assess hearing aid benefit in real-life situations, relevant for the hearing aid user by analyzing unconscious behavior changes caused by different hearing aid technologies. This method seems to be meaningful to evaluate hearing aids in realistic environments which results are relevant for typical applications of hearing aid user.

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Authors and investigators

External principle investigators

Since 2004, Michael Schulte has been with Hörzentrum Oldenburg GmbH, Germany, where he has been responsible for audiological studies in publically funded projects as well as in cooperation with the industry. In 2002, he received his Ph.D. from the Biomagnetism Centre at the Institute of Experimental Audiology, University of Münster, Germany. From 2002 to 2003, he worked as a postdoc at the F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen, Netherlands. Michael Schulte's research interest is in the evaluation of hearing systems with a special focus on listening effort.

Following her vocational training to become a hearing aid acoustican Melanie Krueger studied Hearing Technology and Audiology at Jade University of Applied Sciences, Oldenburg, Germany from 2009 to 2013. After her bachelor thesis she successfully completed industry internships for several months in Singapore and Switzerland. In 2015, Melanie Krueger received her Master of Science from the University of Oldenburg and has been working as a researcher at Hörzentrum Oldenburg since then.

Dr. Markus Meis, is Divisional Director of the Department for Market and Effects Research at Hörzentrum Oldenburg GmbH. He received his Ph.D. in Medical Psychology from Ludwig Maximilians University in Munich in 1997 and was a postdoctoral fellow at the Oldenburg Graduate School of Psychoacoustics from 1997 to 1999. He is coordinator of publicly financed projects, such as Health Services Research in the domain of Audiology and related areas. He coordinates projects in the realm of industrial contract research, especially for the hearing aid and CI industry, regarding real life listening environments, behavior analyses, and quality of life

Study coordinator

Matthias Latzel studied electrical engineering in Bochum and Vienna in 1995 . After completing his PhD in 2001, he carried out his PostDoc from 2002 to 2004 in the Department of Audiology at Giessen University. He was the head of the Audiology department at Phonak Germany from 2011. Since 2012 he is the Clinical Research Manager for Phonak AG, Switzerland.

Author

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.