

Phonak

Field Study News

Significant improvement in speech intelligibility and listening effort in meetings with RogerDirect™ and Roger Table Mic II

Using a hearing instrument with RogerDirect in combination with Roger Table Mic II in meeting-like situations, can improve speech intelligibility by 69%, when compared to using hearing aids alone. In addition, listening effort can be significantly reduced. This is important information for people with hearing-loss-related workplace stress*.

Anna K Lejon / September 2019

Introduction

Today's work life often places us in many demanding communication situations, such as meetings with large distances to speakers. This can often be combined with background noise, which is a very challenging situation for people with hearing loss. Those with hearing loss often report poorer health and higher stress levels than normal hearing people (Hua, 2014).

Hearing loss may be a hidden disability and according to a survey by 'Actiononhearingloss.org', 18% of respondents hid their hearing loss at work. Many more (79%) in the same survey reported that they felt stressed at work because of their deafness or hearing loss. Improving the speech intelligibility within meetings is an important step toward improving the working life of those with hearing loss.

In previous studies, Roger microphones have been shown to improve speech intelligibility in situations with background noise and over distance at least for adults with severe degrees of hearing loss (Thibodeau, 2014; Selesho & Zwarts, 2016). However, even a small degree of hearing loss can make a workplace meeting extremely difficult; the position of the listener is typically fixed while several people may speak from different distances without facing the listener. These are the extra challenges that the Roger Table Mic was designed to address. In larger meetings of 8 or more participants, several Roger Table Mic II microphones can be combined wirelessly in a MultiTalker Network.

Another feature that ensures improved speech intelligibility in meetings is MultiBeam Technology. It utilizes multiple microphones inside the Table Mic II to create beams in six directions. It then calculates and compares the signal-to-noise ratio for all six directions and automatically selects

the beam with the best clarity, even across networked devices.

The latest development for the Roger product family is RogerDirect™. Any hearing device with RogerDirect is able to receive a streamed Roger signal from a Roger microphone without the need for an external receiver.

The aim of this study was to investigate speech intelligibility and subjective listening effort in a typical workplace meeting, for participants with a mild to moderate hearing loss who wore Phonak Audéo M with RogerDirect hearing instruments. The study compared results with and without a MultiTalker Network of Roger Table Mic II microphones.

Methodology

Participants

There were 13 participants in the study. Eight were male and five were female. The age range was 42 to 72 years, with an average of 58 years. All participants had sensorineural hearing loss with pure tone average (PTA) between 35 and 48 dB HL (Figure 1). All participants were experienced hearing aid users and had been using hearing aids for at least one year prior to testing. All were native Swedish speakers.

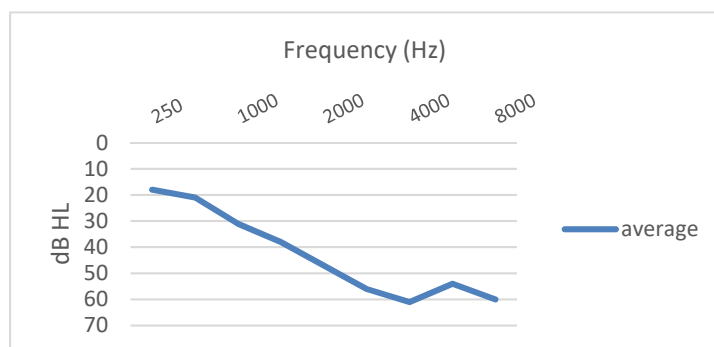


Figure 1 Mean PTA hearing loss for left and right ear of the 13 test participants

Equipment and procedures

The test set up is shown in Figure 2. The test room was a typical meeting room which was 48 m² in size. In the center of the room was a long conference table (L:5m W:1.5m). Each participant sat at the short end of the table.

There were four roof mounted loudspeakers (shown in red), one in each corner of the room. Another four loudspeakers (shown in blue) were set at the table in pairs, facing each other, at a distance of 3 and 4,5 meters from the participant.

Roger Table Mic II microphones were positioned in the middle of the table (shown as grey stars), also at a distance of 3 and 4.5 meters from the participant.

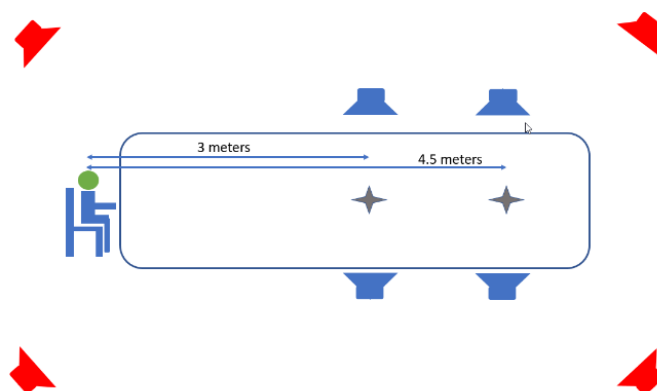


Figure 2: Sketch of test set-up. The blue loudspeakers at 3 and 4.5 meters presented HINT sentences randomly and the red loudspeakers presented HINT-noise. Stars indicate where the Roger Table Mic II microphones were placed.

Speech

Swedish HINT sentences (Nilsson et al, 1994; Hällgren et al, 2006) were presented at a fixed level of 65 dB SPL. Two lists were presented for each test condition. To simulate a fast moving meeting, each sentence from the list was presented randomly from any of the four loudspeakers set at the table (blue).

Background noise

HINT noise was presented from all four roof-mounted (red) loudspeakers simultaneously, resulting in a uniform and fixed background noise level of 50 or 60 dB SPL. These noise levels are the recommended background levels for communication in meetings as specified by the Swedish Work Environment Authority. (Arbetsmiljöverket, 2005)

Borg CR-10 Scale

Subjective listening effort was measured using the Borg CR-10 Scale. The Borg scale is often used to rate physical effort, but has also been used to rate listening effort. It has been found to be sensitive for both hearing impaired and normal hearing listeners (Borg, 1990; Hua 2014). It consists of a scale of 7 "verbal expressions" or statements ranging from "very easy" to "very difficult". This scale is a combination of ratio and category scaling where "verbal expressions" and numbers are used congruently on a scale ranging from 0 to 10 (Hua, 2014, p20).

Hearing aid

Each participant was fitted with Audéo M-312 according to their hearing loss and no fine tuning was done. All participants had vented domes.

Before testing, the network consisting of two Roger Table Mic II microphones were wirelessly connected to the hearing aids using RogerDirect.

Method

The participants were tested in two levels of background noise. At each noise level, they were tested with their hearing aids alone and with a MultiTalker Network. The four test conditions can be seen in Table 1. The four test conditions were randomized. Speech intelligibility was measured as a percent correct score for each of the four test conditions.

Participants were asked to listen to each HINT sentence and repeat what they heard, regardless of whether it was a single word or the whole sentence. The number of correct words were used to calculate a percentage correct score for speech intelligibility. The percentage was averaged across the two lists of HINT-sentences used in each test condition. After each of the four test conditions, the participant selected the Borg-Scale statement which best described their listening experience for that condition.

Background noise level	Test condition
50 dB	Audéo M-90 312
	Audéo M-90 312 + 2 Roger Table Mic II
60 dB	Audéo M-90 312
	Audéo M-90 312 + 2 Roger Table Mic II

Table 1. The four test conditions.

Results

Results of the speech intelligibility test are shown in Figure 3. They indicate that using two Roger Table Mic II in a MultiTalker Network in combination with hearing instruments with RogerDirect significantly ($p > 0,03$ t-test was used for calculation) improves speech intelligibility compared with hearing aids alone in background noise levels of 50 and 60 dBSPL.

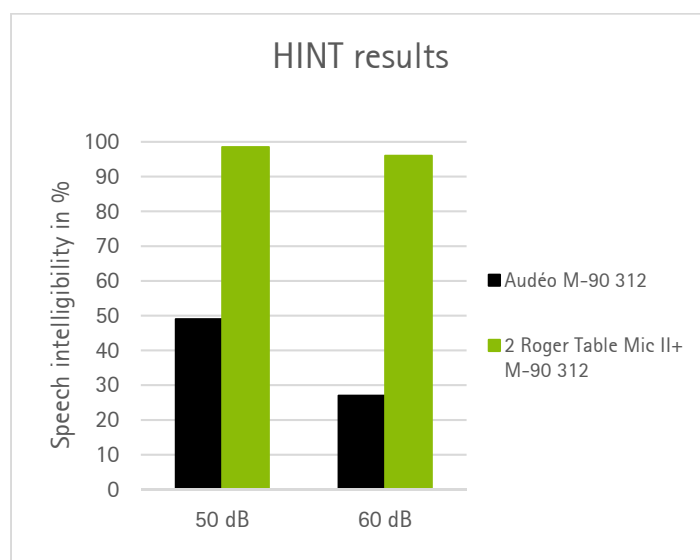


Figure 3: HINT results. Y-axis showing speech intelligibility in %, measured with HINT in Swedish. X-axis shows the level of background noise. Hearing aid alone condition (black). MultiTalker Network with 2x Roger Table Mic II (green)

The subjective ratings from the Borg Scale (Figure 4) show that the perceived effort was very greatly reduced when using the MultiTalker Network, compared with using hearing aids only. The results show that the perceived listening effort was significantly ($p > 0,03$ t-test was used for calculation) lower in both 50 and 60 dBSPL of background noise.

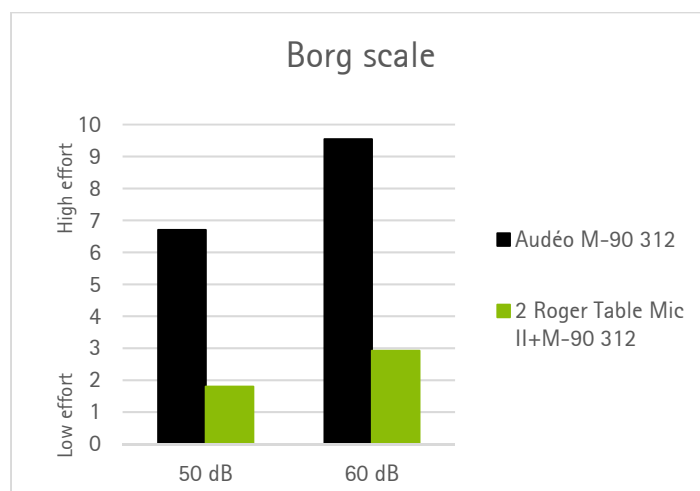


Figure 4: Subjectively rated perceived listening effort: Borg CR-10 Scale. Y-axis shows listening effort, the lower the score the less perceived listening effort. X-axis shows the level of background noise in dBSPL. Hearing aid alone condition (black). MultiTalker Network with 2x Roger Table Mic II (green).

Discussion and conclusion

The results show that over distance and in background noise, the participants benefit significantly, with both objective measures of speech intelligibility and subjective rating of listening effort, when using a MultiTalker Network consisting of hearing instruments with RogerDirect and two Roger Table Mic II microphones.

In fact, this study shows a significant improvement in speech intelligibility of 69% in 60dB of background noise and a two thirds reduction on the listening effort scale.

The results of the simulation are compelling with regard to the improved communication that can be achieved in typical meeting situations, for people with some degree of hearing loss who are active in the workplace. Despite low levels of background noise, the scale of the improvement in speech understanding accompanied by an equally dramatic decrease in subjective effort, suggests that future research might confirm that routine use of the Roger Table Mic II results in a reduction in hearing-loss related workplace stress¹.

The results show that the participants benefited greatly when using Roger Table Mic II with MultiBeam Technology in a MultiTalker Network in a simulated meeting situation compared with using hearing aids alone.

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Authors and investigators



Anna Karlsson Lejon completed her Master in Audiology 2002 at Lund University in Sweden. Anna has experience from audiological diagnostics and rehabilitation with hearing aid fittings for adults. Since 2014, she is the Audiology and Validation Manager in the team for Roger Worklife in Halmstad, Sweden.

* Please note that this observation relies on the reasonable assumption that reduced listening effort with improved speech understanding is correlated with reduced stress. Future research is needed to confirm whether Roger Table Mic II can reduce hearing-loss-related workplace stress.