Field Study News

April 2018

Roger and directional improves hearing performance

A study, conducted at the Hörzentrum Oldenburg in Germany, investigated the effects of hearing aids in a directional microphone setting, at the same time as using an advanced remote microphone. This new feature in Phonak Naída™ and Phonak Sky™ hearing aids is called `Roger and directional'. The results indicate significant improvements in speech intelligibility, listening effort and overall preference for Roger and directional over Roger coupled with an omnidirectional microphone.

Introduction

It is well established that wireless remote microphones significantly improve speech intelligibility in noise and over distance. These are the situations in which adults with severe to profound hearing loss face significant challenges. (Thibodeau, 2014; Wolfe et al, 2013). Until recently, due to technological restrictions, the use of any remote microphone meant that it was not possible to activate the directional microphone in the hearing aid. This meant that when a Roger™ device was in use, the hearing aids were always in omnidirectional microphone mode. The first hearing aids to overcome this are Naída V and Sky V. The functionality required to combine Roger use with directional microphones in the hearing aids is called 'Roger and directional'. The aim of this study was to investigate the benefits of this new feature.

Methodology

A new testing method was developed at Oldenburg University which measures the dynamic behavior between the hearing aid and remote microphones for speech-in-noise arising nearby (via hearing aid microphone) and at a distance (via a Roger remote microphone). There were 19 participants in the study:14 were male and 5 female, aged between 63 and 83 years (average was 72 years). All were experienced hearing aid wearers and had severe sensorineural hearing loss. The average audiogram is shown in Fig 1.

Each participant was fitted with Phonak Naída V90 SP BTEs and their own earmolds. The hearing aids were connected to Roger design-integrated receivers which were connected to a Roger Pen™. The hearing aids were programmed using Phonak Target 4.3 fitting software to have the following three programs;

P1: Roger & Naída-omnidirectional
P2: Roger & Naída-directional
P3: Naída-StereoZoom (no Roger)

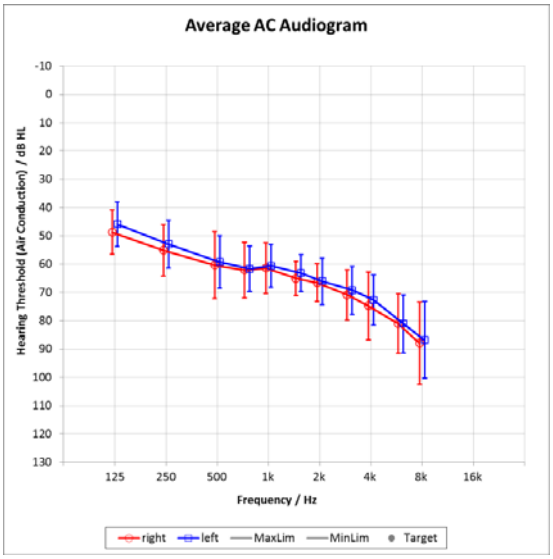

Figure 1: Average audiogram for the 19 participants, for the right (red) and left (blue) ears.

A diagram of the test set up is shown in Fig 2. In the diagram, the 8 loudspeakers shown in black are set to face the wall, so that a uniform background of diffuse cafeteria noise Leq = 62 dB SPL was created.

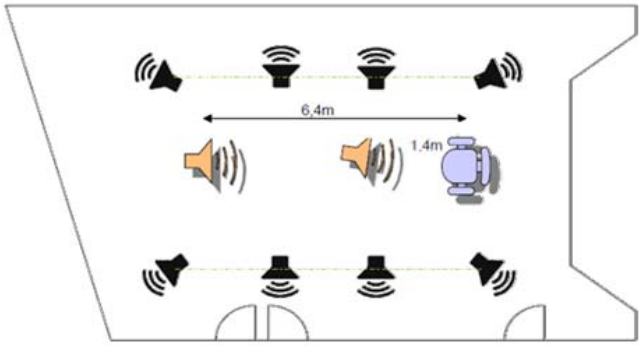

Fig 2 The test set-up used in the study, shown schematically.

The participant sat in a chair represented by a violet chair in the diagram. Sentences from the Oldenburg sentence test (OLSA Wagener and Brand 2005) were randomly presented via the two orange speakers from a distance of 1.4 m (near field) or 6.4 m (far field). The level of the speech and the noise was fixed for each participant, providing an SNR which would result in 50% correct with the hearing aid set to P1: Roger & Naída-omnidirectional.

On average, the resulting SNR was +2dB. The actual set-up used at Oldenburg University is shown in the photograph in Fig 3. The participant's chair is in the foreground and the two speakers used to present the OLSA sentences can be seen in the near and far fields.

Fig 3 Test set-up as used at Hörzentrum Oldenburg.

Paired comparisons were also measured using the Oldenburg virtual hearing aid principle, where the output of the hearing aids is recorded at the ear drum and replayed afterwards by means of ear phones. Participants were asked to judge the dimensions: loudness, intelligibility, listening effort and overall preference for each pair. For the paired comparisons, the sound scenario was recorded for P1 and P2 only. Recordings for the near field were rated separately and again in combination with the far field recordings.

Results

The results of the speech intelligibility testing are shown in Fig 4. The horizontal axis shows the test conditions; Roger microphone and the hearing aid in P1: omnidirectional or P2: directional or with hearing aid alone P3: StereoZoom. A comparison of P1: Roger+Omni (omnidirectional) and P2: Roger+Dir (directional) in the near field indicated that activating the directional microphone in the hearing aids (P2) significantly improved the speech intelligibility in the near field. A benefit for speech intelligibility was surprisingly also found in far field. Using a repeated measures one way ANOVA and a post hoc Tukey-Kramer test, the improvement was found to be statistically significant.

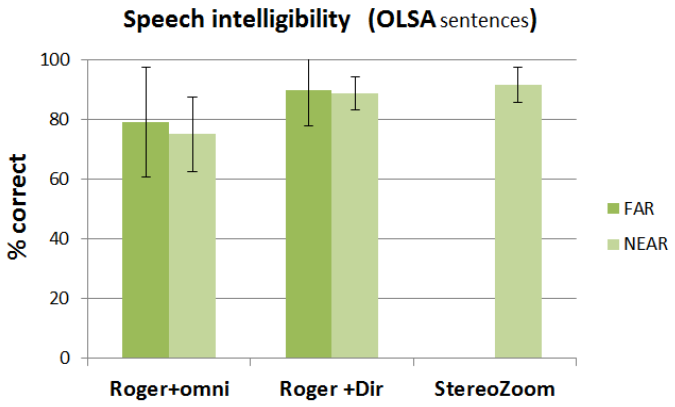

Fig 4 OLSA speech intelligibility scores for speech-in-noise when speech arises in the far field "FAR" or the near field "NEAR". The hearing aid programs are P1: Roger & Naída-omnidirectional, P2: Roger & Directional and P3: Naída-StereoZoom (no Roger) with and without acclimatization to Roger.

The finding of significantly improved intelligibility for speech arising from the far field, can be seen by comparing the darker bars for Roger+Dir (directional) to Roger+Omni (omnidirectional) in Fig 4. The finding is exciting and unexpected. On consideration, it was thought that the increased speech intelligibility in noise may have resulted from an improvement of the signal-to-noise ratio due to the additional noise reduction from the directional microphone in the hearing aid.

The condition: Naída-StereoZoom (no Roger) in the near field, resulted in equal speech intelligibility to Roger+Dir (directional) for the near field. There were no correct responses when using the hearing aid alone (StereoZoom) in the far field condition (dark bars). This finding illustrates that although the directional setting performed very well in the near field, this was not the case when the speech was at a distance and in noise. In this very challenging situation, adding a Roger microphone dramatically improved speech intelligibility as seen by comparing the darker bars for Roger+Dir (directional) with far field and hearing aid alone (StereoZoom) (Fig 4).

The results of the paired comparison test are shown in figures 5 and 6. The results indicate that when using a remote Roger microphone, the hearing aid with the directional microphone active was rated significantly better than with the omnidirectional microphone active for speech intelligibility and listening effort. This was true when the scenario was rated for the near field only (Fig 5) and when the scenario was rated for the near and far field (Fig 6). Loudness was rated as equal indicating that differences between the other dimensions tested could not be attributed to differences in loudness.

The rating of overall preference is shown in Fig 6 for speech-in-noise from the near and the far field. The results indicate that Roger and directional was the most preferred.

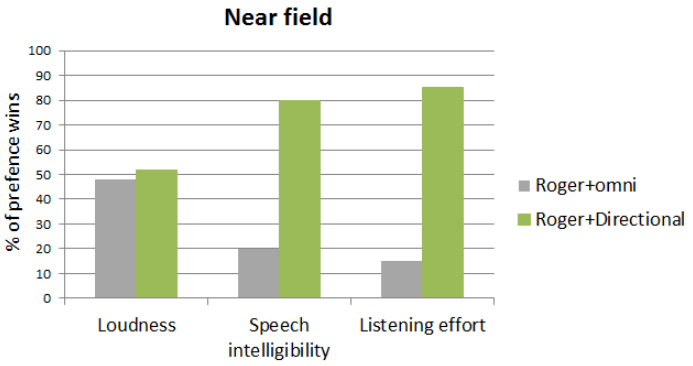

Fig 5 Paired comparisons for near field speech-in-noise in the dimensions; loudness, intelligibility and listening effort. Roger and directional is shown in green and Roger with Naída-omnidirectional is shown in grey.

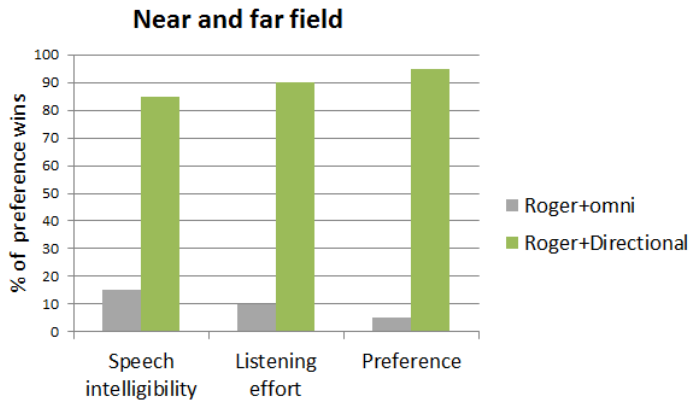

Fig 6 Paired comparisons for the near and far field speech-in-noise in the dimensions; speech intelligibility, listening effort and overall preference. Roger and directional is shown in green and Roger with Naída-omnidirectional is shown in grey.

Conclusion

The first hearing aids which can combine a directional microphone in the hearing aid with a remote microphone system are available in Naída V, Sky V. Evidence from the study at Hörzentrum Oldenburg confirms that combining hearing aid directional microphones with Roger remote microphones, improves speech intelligibility in the near field. Roger and directional significantly improved the speech intelligibility score even in the far field due to the noise reduction effect obtained with the directional microphone. The evidence shows that the performance of small and advanced remote microphones, such as Roger, can be enhanced when the hearing aid and remote microphone function together seamlessly.

References

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Bernadette Fulton completed her training in Clinical Audiology at Melbourne University (Australia) after undertaking a BA in Linguistics at Monash University (Australia). She has extensive clinical experience in audiology, including aural rehabilitation, hearing aids and diagnostic audiology in private and government clinics. In 2015, she joined the team dedicated to adults with severe to profound hearing loss at Phonak Communications in Murten as Audiology Manager.