

Field Study News

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roger



Comparison of Roger Pen automatic mode with manual mode

The Roger Pen is a wireless microphone that aims to help hearing instrument and CI users hear and understand in noise and over distance. The Roger Pen can be used in different listening situations and in different positions relative to the talker and the listener. It features three different manual microphone modes and one automatic microphone mode, that uses acoustical cues and a built-in accelerometer to determine its signal processing. In this study the automatic mode was compared with the three manual modes. No significant difference in speech reception threshold was found between the optimal manual mode for different orientations of the Roger Pen and the automatic mode, indicating that the automatic mode works well for all tested conditions.

Introduction

Wireless microphone systems have been available for decades to improve listening and understanding in challenging listening environments,¹ but the acceptance by adults has always been hindered by factors like design and perceived complexity.² The Roger Pen addresses these barriers by its inconspicuous design and its easy to use automatic microphone mode. Previous FM wireless microphones targeted at adults offered different microphone modes – like the ZoomLink+ and SmartLink+ by Phonak with an omni, zoom and superzoom setting. These different settings were manually chosen by the user. Successful use required training of the hearing care professional and also training for each user regarding when to use which microphone mode. There has always been the risk that for a particular listening situation a non-optimal mode would be selected. Along with three manual microphone modes, the Roger Pen offers an automatic microphone mode which is the default setting. The gain, noise cancellation and beam

forming in the automatic mode depend on the presence or absence and the level of the speech signal, the level of the background noise and the orientation of the Roger Pen with respect to gravity.³ The Roger Pen can be hung around the neck of a talker or held in the hand by the user and pointed at the speaker. The Roger Pen can also be placed flat on a table to pick up voices from all directions. The sound it picks up is sent wirelessly to Roger receivers. In the hearing aid the signal is mixed with the hearing instrument microphone signal, processed, amplified and delivered to the ear. This context dependent signal processing aims to provide the listener optimal speech recognition in all acoustical circumstances and every geometrical constellation of the listener, talker and noise sources. Ideally no manual mode would give a better performance than the automatic mode. This hypothesis was tested in research carried out at the University of Melbourne, Department of Audiology & Speech Pathology.

Methodology

Eleven hearing instrument users, 8 males and 3 females, aged 52 to 89, participated in the study. Hearing losses ranged from mild-to-moderate to severe-to-profound. 8 participants had sensorineural hearing loss and 3 participants had mixed hearing loss. Table 1 shows an overview of the participants and the average hearing loss is depicted in Figure 1.

Participant	Gender	Age	Degree of Hearing Loss	Type of Hearing Loss
1	F	66	Moderate to profound	Mixed
2	M	89	Moderate to profound	SNHL
3	M	73	Severe to profound	Mixed
4	M	70	Severe to profound	SNHL
5	M	59	Mild to moderate	SNHL
6	M	54	Moderate to severe	SNHL
7	F	64	Moderate to severe	SNHL
8	F	65	Moderate to severe	SNHL
9	M	77	Moderate to profound	Mixed
10	M	61	Mild to moderate	SNHL
11	M	52	Severe to profound	SNHL

Table 1
Overview of participants

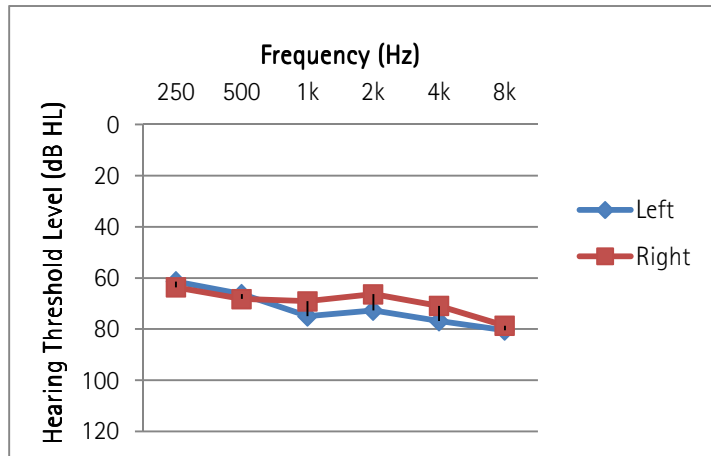


Figure 1
Average audiogram of the 11 participants in the study

All participants were fitted with either Phonak Naída Q-90 RIC hearing aids with Roger 15 receivers (design-wise dedicated for the Naída RIC hearing aids) or Phonak Naída Q-90 UP hearing aids with Roger 10 receivers (design-wise dedicated for the Naída UP hearing aids). All hearing aids were matched to NAL-NL1 insertion gain targets. A Roger Pen was used as the wireless microphone for all test conditions. Speech reception thresholds (50% words correct) using Bamford-Kowal-Bench-like (BKB-like) sentences were

measured in a laboratory test set-up. The sentences are very similar to BKB sentences, however there are more lists so that the same list does not have to be presented twice. The lists used in this study are spoken by an Australian female speaker. Sentences presented at 65 dB SPL were delivered from a speaker at 0 degrees (in front of the listener) while noise was delivered from 12 speakers positioned in the front hemisphere around the subject. The noise that was used was 12-talker babble, a combination of male and female Australian speakers. The speech level remained fixed throughout testing while the noise level was adaptive. Each of the three manual microphone modes and the automatic mode were tested with the Roger Pen positioned vertically, horizontally and also handheld. The test set-up can be seen in Figure 2 and the test conditions in Table 2.



Figure 2
Test set-up

A balanced design was used where microphone position and microphone mode varied for each subject. The test order between subjects varied as well. For each condition two lists of 16 sentences were used, giving a total of maximum 32 sentences per condition. The software however stopped the test automatically when a significant result was obtained.

Condition	Speech (dB SPL)	Noise	Roger Pen orientation	Roger Pen microphone mode
1	65	Adaptive	Vertical	Automatic
2	65	Adaptive	Vertical	Interview
3	65	Adaptive	Vertical	Conference
4	65	Adaptive	Vertical	Lanyard
5	65	Adaptive	Horizontal	Automatic
6	65	Adaptive	Horizontal	Interview
7	65	Adaptive	Horizontal	Conference
8	65	Adaptive	Horizontal	Lanyard
9	65	Adaptive	Handheld	Automatic
10	65	Adaptive	Handheld	Interview
11	65	Adaptive	Handheld	Conference
12	65	Adaptive	Handheld	Lanyard

Table 2
Overview of test conditions

Results

The mean SNR required for 50% words correct per condition is shown in Figure 3. A general linear ANOVA showed that the following are significant factors that contribute to the speech reception threshold:

- orientation of the Roger Pen,
- the microphone mode and the
- subject tested

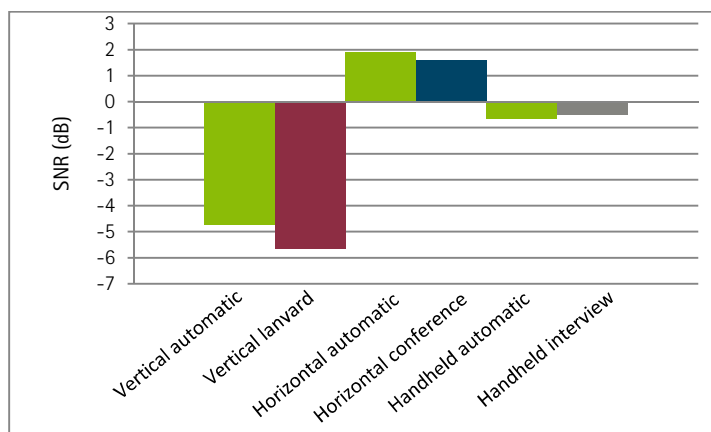


Figure 3
Mean SNR required for 50% words correct tested with BKB-like sentences for the different positions and microphone modes. N=11. Lower bars mean better results (more negative SNR for 50% correct).

The mean SNR required for 50% words correct per condition is shown in Figure 3. The different ways the microphone can be held has a clear influence on the pick-up of the speech signal coming from the loudspeaker at 0 degrees. Three paired t-tests between the best manual and automatic results for each of the 3 microphone orientations (vertical, horizontal and hand-held by subject) did not show any significant differences.

Paired t-tests using data from all 11 participants shows that when the Roger Pen was in a horizontal position on the desk between the participant and speaker it was possible to get a poorer result with the Roger Pen in the "Lanyard" (see Table 3) or "Interview" (see Table 4) manual microphone mode compared with the automatic mode.

Paired t-test and CI: H automatic, H lanyard

	N	Mean	StDev	SE Mean
H automatic	11	1.91	5.53	1.67
H lanyard	11	5.15	5.47	1.65
Difference	11	-3.243	1.521	0.459

Table 3
95% CI for mean difference: (-4.265, -2.221); T-test of mean difference = 0 (vs ≠ 0): T-Value = -7.07 P-Value = 0.000. A significant difference was found in results between automatic and lanyard microphone mode when the Roger Pen was placed flat on a conference table. The automatic setting resulted in a SRT at lower signal-to-noise ratio.

Paired t-test and CI: H automatic, H interview

	N	Mean	StDev	SE Mean
H automatic	11	1.91	5.53	1.67
H interview	11	8.23	5.72	1.73
Difference	11	-6.315	3.071	0.926

Table 4
95% CI for mean difference: (-8.379, -4.252); T-test of mean difference = 0 (vs ≠ 0): T-Value = -6.82 P-Value = 0.000. A significant difference was found in results between automatic and interview microphone mode when the Roger Pen was placed flat on a conference table. The automatic setting resulted in a SRT at lower signal-to-noise ratio.

Discussion

The best results were found in vertical mode (both lanyard and automatic), which can be explained by the proximity of the Roger Pen to the loudspeaker generating the speech.

As the results obtained in the automatic microphone setting showed no significant difference to those obtained in the best manual mode, it can be determined the automatic microphone mode accurately and successfully chooses the correct microphone setting for optimal speech recognition.

In practice the positive effect of the automatic mode could be greater, as it eliminates the possibility of a user selecting a non-optimal manual mode. Based on these results, all users can benefit from the accuracy of the Roger Pen automatic microphone mode and it could be argued that for some users it would be better to eliminate the manual microphone mode completely to avoid selection of a less than optimal microphone setting.

References

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- ³ H.E. Mülder, Phonak Insight. Roger Pen – Bridging the understanding gap.

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