

# Field Study News

January 2016

## Virto V90-10 performance and size benchmark

Proven to provide significantly better speech intelligibility, subjective preference and to be smallest in size

This study, conducted at the Hörzentrum in Oldenburg, investigated the performance of the Virto V90-10 custom hearing aids against two competitor devices. The Virto V90-10 was shown to be visibly smaller and have a lower volume, while providing statistically significant better speech intelligibility in noise. It provided 15% more speech intelligibility benefit than competitor I and 33% more benefit than competitor II. Paired comparison tests in two different sound scenarios revealed that it was also subjectively preferred by the majority of test participants.

### Introduction

Custom hearing devices have historically been chosen due to their small size and discretion. Making a very small hearing aid often means making compromises in terms of performance, as key components or features are sacrificed in order to reduce the size.

Previous to the launch of Phonak Venture Custom Products, the smallest Phonak custom wireless device with Binaural VoiceStream Technology™ was the Virto Q-312. Binaural VoiceStream Technology (Latzel, 2012 and Timmer, 2013) involves the exchange of audio data between hearing instruments and supports not only bilateral, but also binaural hearing. It allows for features such as StereoZoom which creates a very narrow beam to help hearing aid users focus on speech when in very noisy environments (Latzel, 2013).

Therefore, when developing Custom Products for the Phonak Venture platform, the goal was to make a product which was very small in size, without compromising on performance. The Phonak Virto V-10 uses a 10 size battery and is on average 25% smaller in size than its predecessor, the Virto Q-312. Although it is much smaller in size, it still incorporates all of the performance advantages of the Phonak Venture platform, including wireless connectivity and Binaural VoiceStream Technology.

The objective of this study was to benchmark the new wireless Virto V with size 10 battery, against two high-end competitive products, with regards to size and performance.

### Methodology

Fifteen subjects with moderate to severe hearing loss took part in the study. The average age of the subjects was 70.5 years and they were all experienced hearing aid users. All subjects were fitted with Phonak Virto V90-10 hearing aids, using the Adaptive Phonak Digital fitting formula. Additionally, they were fitted with custom devices from two competitors. The competitor hearing aids chosen were the highest-end, most performant, custom product models of two other manufacturers, in the smallest available size. Hearing aids were fit using the standard fitting procedure prescribed by each manufacturer. The devices were all produced in the manufacturer's lab facilities with the acoustic coupling based on the hearing loss of the participants and the manufacturer's recommendation. All devices were programmed with the following hearing programs: (1) omnidirectional microphone (2) directional microphone (binaural if available) (3) Car.

Photos were taken from angles of 90°, 120°, 240° and 270° for all three pairs of hearing aids in all subject's ears. This was in order to subjectively compare the size of the devices in the ears.

The following assessments tests were carried out with all three pairs of hearing aids:

#### Questionnaire on handling

Subjects filled in this questionnaire in order to report on how well they were physically able to handle the different devices for four different handling tasks: switching the device on and off, distinguishing between right and left, inserting the device and

removing the device. This was done to investigate any potential difficulties associated with handling a smaller device.

### Speech intelligibility in noise

Speech intelligibility of the three pairs of test devices 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. Subjects were asked to repeat what they heard and they were scored on the number of words correct. The test setup can be seen in figure 1. The subject was seated at the center of a circle of 12 loudspeakers, facing the speaker at 0° azimuth. The OLSA speech material was presented from this speaker. Modulated noise (ICRA250-5) was presented from all other 11 loudspeakers which created a diffuse noise environment. Speech levels were adaptive whereas noise levels were constant at 65 dB (A). In this way, Speech Reception Thresholds (SRT) (i.e. the signal-to-noise ratio with which 50% of all words are correctly understood) were determined for all subjects using all three hearing aid pairs.

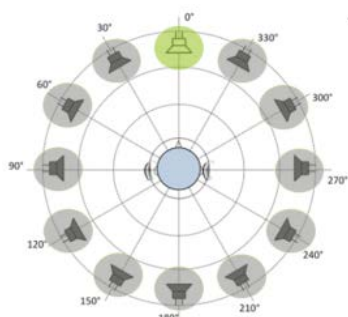


Figure 1: Setup 1 for the OLSA measurement, a diffuse noise environment was created by all 11 gray speakers presenting modulated noise.

**Paired comparison** - the subjects were presented different sound samples ("Speech in loud noise", "Speech in car") while wearing the different devices. Recordings were taken at the ear drum of the subjects. The recordings were later replayed via insert earphones and subjects were asked to compare the devices against each other in the dimensions of sound quality, speech intelligibility, suppression of noise and preference. For each dimension, they chose, via a touchscreen, which one of the recordings they preferred.

### MUSHRA (Multi-Stimulus Test with Hidden Reference and Anchor) (EBU, 2000)

Subjects heard the recordings again and rated each pair of devices in terms of overall satisfaction, on a ten-point absolute scale from 0 to 1.

### Group session questionnaires

Participants were invited to attend a moderated focus group. Five to seven participants sat around a table and were offered coffee and cake while a moderator initiated conversation topics in which the participants were likely to both be interested in and to contribute to conversation (see figure 2). In order to make the listening situation more challenging, supermarket noise was played into the room via loudspeakers at 67 dB (A). Participants

wore each of the three sets of hearing aids for 15 to 20 minutes and then judged each pair of hearing aids against both other pairs. They did this by placing green stickers on three posters such as the example in figure 3. Each poster represented a dimension: speech understanding, sound quality and overall preference. Each corner of the triangle represented one of the test devices but participants were blinded as to which one was which. The distance which they placed the sticker with regards to the corner, corresponded to a rating scale from -5 to +5. Close to the corner (e.g. -5) meant that they preferred that device a lot more than the device in the opposite corner (+5), for that particular dimension.



Figure 2: Photograph to illustrate the setup used for the group sessions. Participants were encouraged to talk and communicate with each other whilst background noise was being played into the room via loudspeakers.

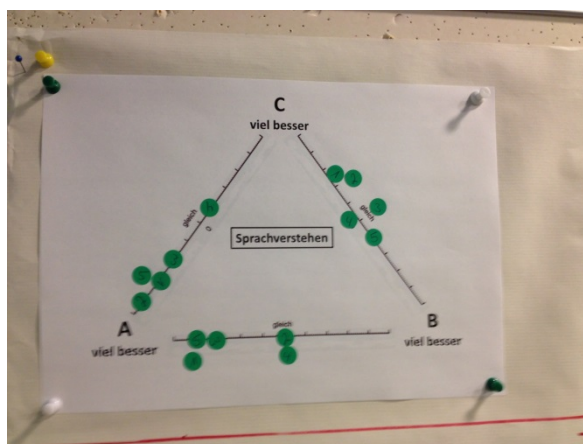


Figure 3: Poster questionnaire for the dimension speech understanding. Participants each placed a green dot between each pair of letters to indicate which of the two hearing aids they preferred for that particular dimension.

## Results

The photos which can be seen in figure 4 are a small sample of photos taken from a 90° or 270° angle of one ear of three participants. In each of the three rows is the same participant, wearing all three devices. This series of photos demonstrates that the Virto V is less visible when worn in the ear, than the two competitive devices.

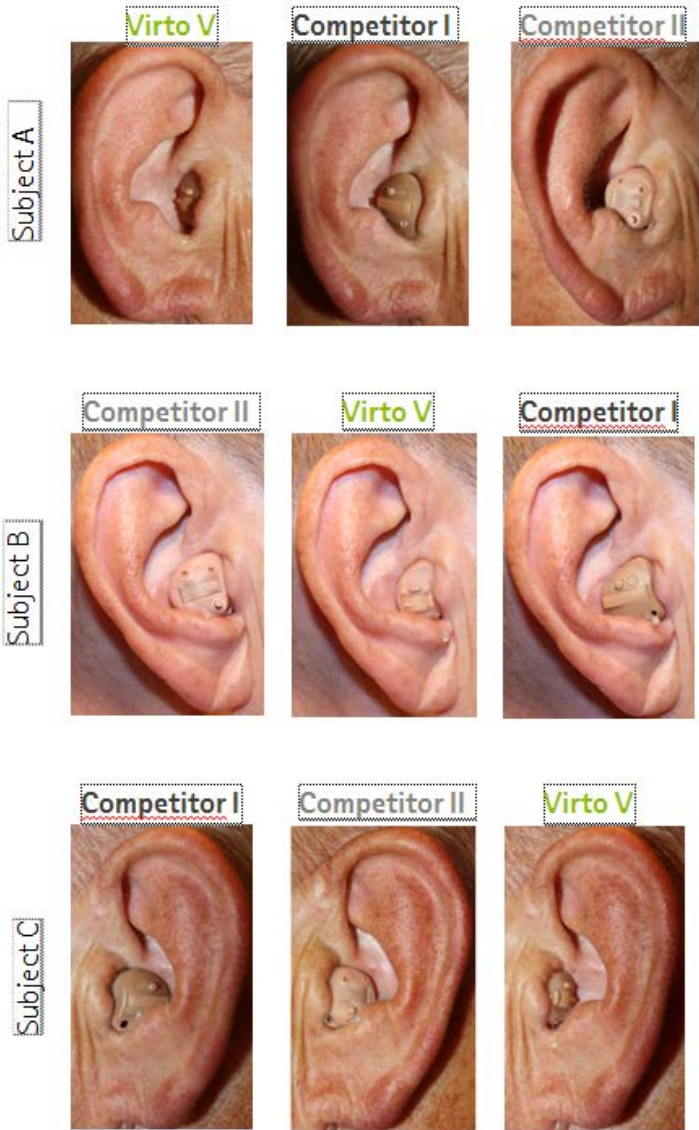


Figure 4: A small sample of the photos taken to subjectively compare the size of the devices in the participants' ears.

Following completion of the study, all hearing aids used were sent to the Custom Product Services team, at Phonak Headquarters in Switzerland. All 90 hearing aids were scanned with the DuoScan 3D custom product scanner. The 3D files which were generated were uploaded into a CAD program (Magics), which calculated the volume of each custom shell. The volume of the Virto V90-10 hearing aids was compared with their corresponding competitor hearing aids (for that particular subject and ear). This resulted in 30 comparisons of Virto V against competitor I and 30 comparisons of Virto V against competitor II. In 100% of cases, the volume of the Virto V90-10 was smaller than that of both competitors. An average hearing aid volume was calculated for each competitor as shown in figure 5.

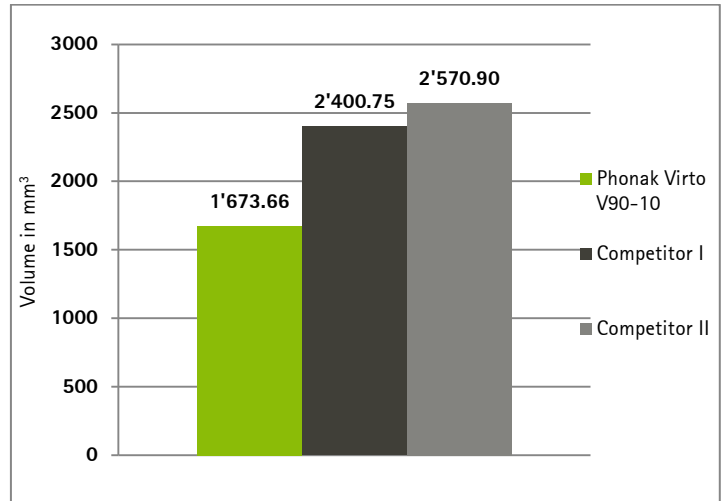


Figure 5: Average volume (in mm<sup>3</sup>) of the 30 custom products from each competitor.

The handling questionnaire found no statistical differences between the hearing aids in terms of ease of handling, indicating that the size of the device does not influence how easy or difficult it is to use it.

The results of the speech intelligibility in noise test (OLSA) can be seen in figure 6. The graph shows the benefit of the different directional microphone systems, related to the performance of the omnidirectional microphone. The Phonak Virto V90-10 performed clearly better than both competitors and an ANOVA test of repeated measures revealed, that this difference was statistically significant.

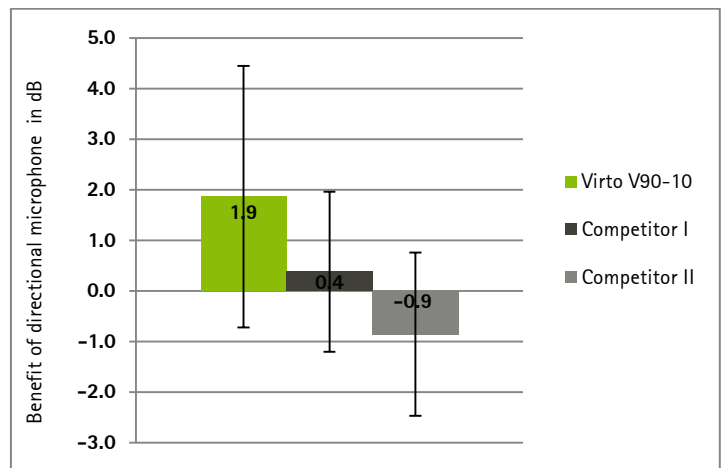


Figure 6: Results of the OLSA speech intelligibility test. The graph shows the amount of calculated benefit of the directional microphone in dB. The numbers within the colored bars represent the mean value for all 15 participants, and the thin lines represent the standard deviation (95%).

Figure 7 also shows these same OLSA speech intelligibility results, recalculated as benefit of the directional microphone in percent. It can be seen that the Phonak Virto V90-10 provided 15% more speech intelligibility benefit than competitor I and 33% more than that of competitor II.

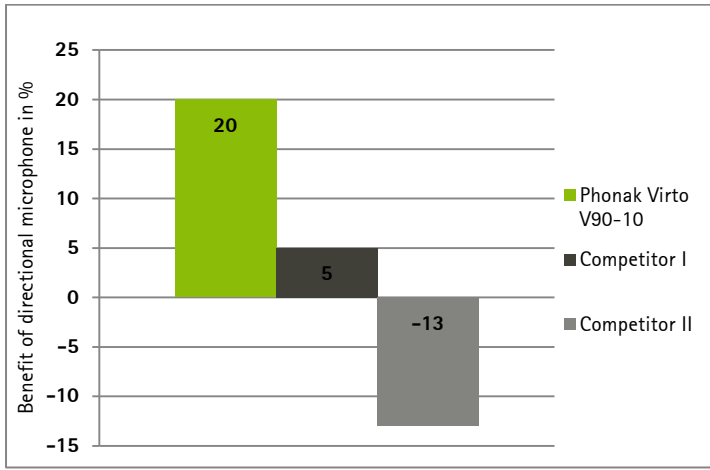


Figure 7: The results of the OLSA speech intelligibility test recalculated to show the benefit of the directional microphone as a percentage. The numbers within the bars represent the mean benefit, in percent, for all 15 participants.

Figure 8 and 9 show the results of the paired comparison test for the listening scenarios 'Speech in Loud Noise' and 'Speech in Car', both for the dimension 'preference'. For both scenarios, the Phonak Virto V90-10 was rated as more preferable than both of the competitor hearing aids by the majority of the participants.

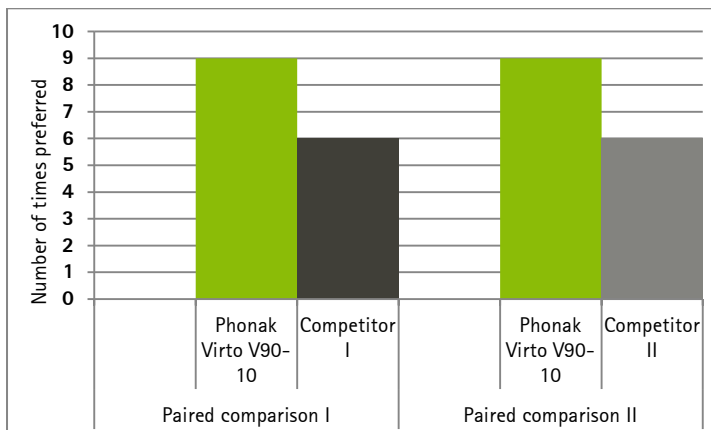


Figure 8: Results of the paired comparison test for the scenario 'Speech in Loud Noise' for the dimension 'preference'. The y-axis corresponds to the number of subjects who preferred that particular device.

For the scenario 'Speech in Car', only seven subjects took part and for each of the two paired comparisons, they were tested with speech coming firstly from the left (270°) and then from the right (90°). This simulated the situation in a car when the hearing aid user is the driver or co-driver. This resulted in a total of fourteen comparisons for each of the two paired comparison tests. We see the results of this in figure 8. The preference of Virto V compared to that of competitor II is significantly different based on the binomial distribution.

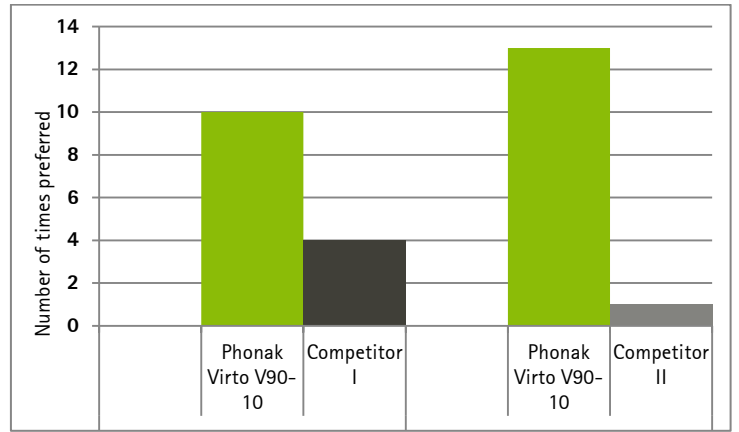


Figure 9: Results of the paired comparison test for the scenario 'Speech in Car' for the dimension 'preference'. The y-axis corresponds to the number of times that particular device was preferred.

The results of the MUSHRA ratings can be seen in figures 10 and 11 for the situations 'Speech in Loud Noise' and 'Speech in Car' respectively. The subjective rating represents the average of all 15 subjects for each of the three test hearing aids. For both scenarios, the Phonak hearing aids are rated similar to competitor I but significantly better than competitor II.

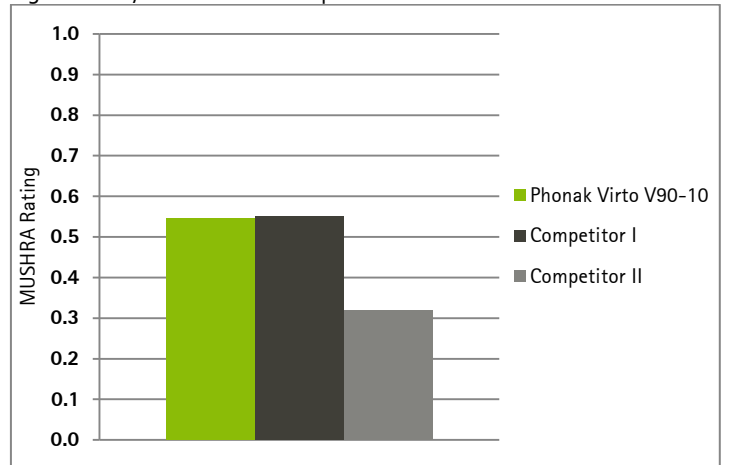


Figure 10: Mean MUSHRA rating for the 15 participants for the three different test devices in the scenario 'Speech in Loud Noise'.

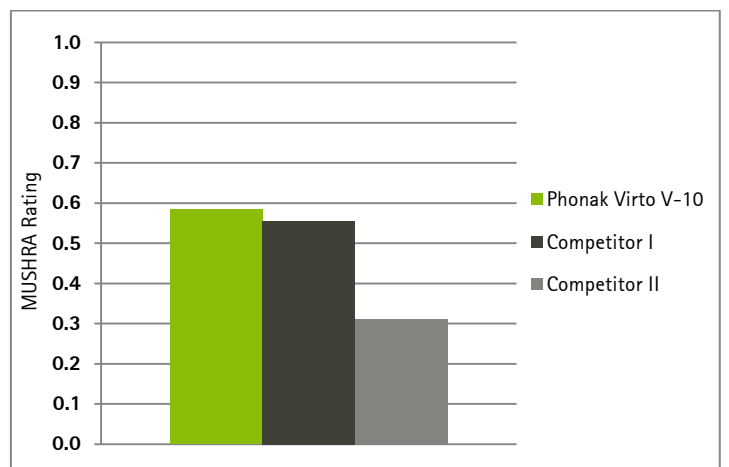


Figure 11: Mean MUSHRA rating for the 15 participants for the three different test devices in the scenario 'Speech in Car'.



---

## Conclusion

The Phonak Virto V90-10 has not only been shown to be visibly smaller, but has also objectively been shown to have a smaller volume, than the two best-performant competitor hearing aids in their smallest size. The small size has been shown to have no influence on handling. It has also been proven to provide significantly better speech intelligibility, within noisy environments. Subjective paired comparisons also revealed that the Phonak Virto V90-10 was preferred to its competitors in the situations 'Speech in Loud Noise' and 'Speech in Car'.

---

## References

EBU (2000). MUSHRA – Method for Subjective Listening Tests of Intermediate Audio Quality. Draft EBU Recommendation, B/AIM 022 (Rev.8)/BMC 607rev.

Glaser BG & Strauss AL (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. Chicago

Latzel, M. (2012). Binaural VoiceStream Technology™ - Intelligent binaural algorithms to improve speech understanding. Phonak Insight. Phonak AG: 2012

Latzel, M. (2013). Concepts for binaural processing in hearing aids. Hearing Review, March 2013

Timmer, B. (2013). It's Sync or Stream! The Difference Between Wireless Hearing Aid Features! Hearing Review. May 2013.

Phonak Insight (2008). Open Fit - Custom CIC as a valid alternative to a microStyle BTE. Phonak AG

---

## Authors and investigators

### Internal principal investigator



*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 HQ.*

### Author

Jenny Appleton-Huber, Scientific Editor, Phonak AG  
[Jennifer.Appleton-Huber@Phonak.com](mailto:Jennifer.Appleton-Huber@Phonak.com)