

Field Study News

DuoPhone

Easier telephone conversations with both ears

Summary

Wireless streaming of the full audio signal between two hearing instruments, is unquestionably one of the most important advances in hearing system technology over the past few years. This study reports a further application of binaural streaming, namely the transmission of a monaural input to both sides. Although this is naturally not desired during normal everyday use, it can make a lot of sense when using the telephone: the voice of the person at the other end heard not just on one side, but binaurally in both ears. This reduces any noise heard from the side facing away from the telephone while improving comprehension of the telephone signal. With the help of a speech test, this study compared binaural speech comprehension on the telephone using DuoPhone with monaural speech comprehension. Results show that when using the telephone, DuoPhone improves speech comprehensibility.

Introduction

Wireless streaming of the audio signal between two hearing instruments opens up a wide range of possibilities in hearing instrument control and the processing of acoustic signals. Mention should first be made of functions for synchronizing hearing instruments that only require a low bit rate. By transferring the current operating condition of one instrument to the other allows for the synchronization of the selected hearing instrument program or of the corresponding directional characteristics of the microphone. The user benefits are increased wearing comfort as well as improved localization abilities of sound sources, which would be impaired if the microphone exhibited differing directional characteristics [1].

DuoPhone makes having a telephone conversation easier for the person receiving the call because the caller can be heard in both ears and not, as is currently the case, in the ear holding the telephone receiver. With DuoPhone, the telephone signal is transmitted from one hearing instrument to the other through the wireless streaming of the audio signal. DuoPhone is an optional feature that can be used with EasyPhone or as a manual telephone program with or without DirectTouch. EasyPhone automatically switches the hearing instrument to the desired telephone program as soon as the telephone receiver is placed near the hearing instrument.

Objective of the study

The objective of this study was to investigate the benefits of binaural audio transmission for the measured and subjectively evaluated level of comprehension in a telephone conversation against background noise.

Method

Audiometric tests and measurements were carried out in the audio laboratory of the University of Applied Sciences, Lübeck. For the speech test and the "Just Follow Conversation" (JFC) test, six loudspeakers were set up in a circle around the test subject. Background noise was played through these loudspeakers. The noise level at the point where the test subjects were positioned was set at 55 dB(A) for all tests. The wanted signal (an extract from an audio book of Frank Schätzing's "Der Schwarm") was played through the receiver of a landline telephone. A computer transmitted the wanted signal directly to the telephone using a special audio adapter. For the first round of the speech test (WAKO "Dreinsilber" – three repeated monosyllables), sound levels were set to 70 and 75 dB(A), meaning that the signal-to-noise ratio was effectively 15 and 20 dB(A) respectively. Four subjects were re-tested at an SNR of 10 dB, as they had shown a level of comprehension of over 80% with and without DuoPhone (ceiling effect). For the JFC test, the level of background noise was kept constant at 55 dB(A) while the level of the wanted signal was adjusted by the investigator, following the test subjects' instructions, so that the criterion "I can only just follow the conversation" was fulfilled. This criterion varied considerably between subjects; for each subject per se ("intra-individually"), however, it remains highly stable and easily reproducible. The JFC test was only performed on 11 subjects (a random selection). The test conditions for the WAKO test and re-test (SNR 15/20; DuoPhone on/off) were assigned to different WAKO Dreinsilber test sessions at random.

Test subjects and hearing instruments

A total of 15 subjects with moderate to profound

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hearing loss participated in the study. The average hearing loss at between 0.5 and 4 kHz was 64.5 dB HL. All subjects were native German speakers, experienced hearing instruments wearers and accustomed to speaking on the telephone while wearing a hearing instrument. Before the tests started, the subjects were asked to state which ear they usually hold the telephone receiver. The participants then used this ear to listen to the receiver in all tests. During a practice WAKO test session, the participants could familiarize themselves with the telephone receiver and work out the best position in which to hold it to their ear.

Hearing instruments with DuoPhone were pre-calculated and set up binaurally using the subject's audiogram and iPGF 2.4. The two test conditions differed only in terms of the hearing instrument setting vis-à-vis DuoPhone ("on" or "off"). DuoPhone was set to hearing instrument microphone (without telecoil), taking into consideration each subject's preferred side for holding telephone conversations.

Results

Speech test: WAKO "Dreinsilber"

DuoPhone's benefit to the individual is shown in Fig.1.

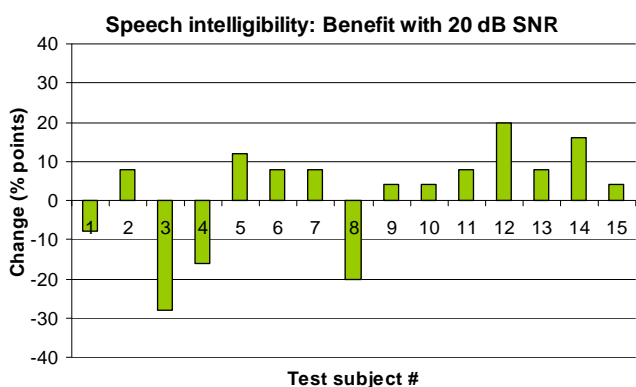


Fig. 1: Benefit to the individual of the bilateral presentation of a telephone signal. Values greater than 0 signify an improvement; values less than 0 signify deterioration in speech comprehension.

Whilst some test subjects benefited from the binaural signal presentation, four of the 15 test subjects experienced deterioration in the level of their speech comprehension. Across all test conditions (10 dB, 15 dB, 20 dB SNR), the median improvement in speech comprehension was four percentage points.

Just Follow Conversation (JFC) test

Figure 2 displays the individual results of DuoPhone with the JFC test. A positive value signifies an improvement: During the test, the speech level was reduced by the corresponding value while still fulfilling the criterion ("I can only just follow the conversation"). The JFC test revealed clear benefits of listening to a telephone signal binaurally versus monaurally. The average benefit of using DuoPhone is 2 dB SNR (median) or 3.1 dB SNR (mean). Only one test subject experienced deterioration when using DuoPhone; eight subjects improved and two noticed no difference.

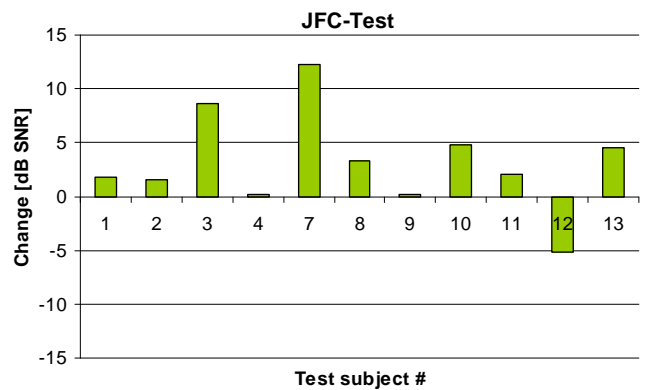


Fig. 2: Benefit to the individual of bilateral playing in the JFC test

A statistical evaluation (paired *t* test, bilateral) yielded a *p* value of 0.052. A value of 0.05 or smaller counts as statistically significant difference between two measurements. Although the statement that bilateral listening with DuoPhone is significantly better in performance, the JFC test fell just short of this value. One may suspect that this is because the sample size (*N*=11) was too small.

Conclusion

In the speech test, there was scarcely any difference between the two test conditions (monaural and binaural). A possible reason may lie in the difference in comprehensibility levels between the two tests. Whilst speech comprehension in the WAKO test was just under 70% on average, it was significantly higher in the JFC test. A speech comprehension level of 70% is generally not sufficient to be able to "only just follow" real life conversation. However, with the help of DuoPhone, an improvement can be seen to help people with a hearing loss understand better on the telephone.

References

- [1] G. Keidser, K. Rohrseitz, H. Dillon, V. Hamacher, L. Carter, U. Rass, E. Convery (2006). The effect of multi-channel wide dynamic range compression, noise reduction, and the directional microphone on horizontal localization performance in hearing aid wearers, *International Journal of Audiology* 45(19), 563-579.

For further information, please contact:
Myriel.Nyffeler@phonak.com