

SmartLink: Better access to mobile phones for the hearing impaired

Summary

SmartLink utilizes wireless technology to connect mobile phones with hearing instruments. Interference and feedback issues which often make it difficult or even impossible for hearing impaired to use mobile phones are eliminated. Compared to using hearing instruments alone or with a loopset, SmartLink allows for substantial improvements in speech understanding when using a mobile phone. This is confirmed by the subjects in everyday experience. Thus, SmartLink gives hearing impaired much better access to mobile communication which is an essential part of modern communication.

During recent years, mobile phones have become more and more popular. Today, mobile phones are an integral part of the everyday life of people in many societies. Hearing impaired people, however, are often excluded from using mobile phones. One reason is the radiation of electromagnetic interference from the mobile phone. When a digital mobile phone communicates with a base station in a network, it sends electromagnetic waves in a pulse pattern which is picked up by the hearing aid and causes a buzzing noise. The level of that noise is dependant on the distance between the mobile phone and the base station (the longer the distance, the higher the energy of the pulse pattern sent out by the mobile phone), and on the susceptibility of the hearing instrument to electromagnetic interference. The buzzing noise is not only annoying but also degrades speech understanding over the telephone. A recent study which examined speech understanding with mobile phones in hearing impaired listeners showed a massive degradation of speech intelligibility, compared to landline phones [1]. Speech understanding dropped from 62% over

the landline phone to only 26% using a mobile phone under the same test conditions. When using a loopset (which is carried around the neck and transmits the incoming speech to the hearing instrument's T-Coil), speech understanding was still slightly worse, compared to the landline phone.



Utilizing wireless technology

The SmartLink FM transmitter represents a new technology for hearing impaired to use mobile phones. The mobile phone is connected to SmartLink via wireless Bluetooth. SmartLink passes on the voice of the caller to the FM receiver of the hearing instrument. The user's own voice is picked up by SmartLink and transmitted to the mobile phone. The potential of this new technology to improve speech understanding and satisfaction with mobile phones was assessed in a clinical trial*.

Setup

In total, 19 experienced hearing aid users participated in the trial. Their age ranged from 11 to 72 years (mean: 41.2), and their hearing losses ranged from moderate to severe (PTA: 74 dB). Some of the subjects had their own mobile phones, which they mostly use for exchanging short text messages, as understanding speech over the phone is actually too difficult for them. The trial consisted of speech tests in the research facility and practical experience in daily life. Two different speech tests were conducted: the Monosyllabic German Rhyme Test, and the Oldenburg Sentence Test. The latter was conducted at 65 dB with added broadband noise at 7 dB SNR, which represents a typical situation

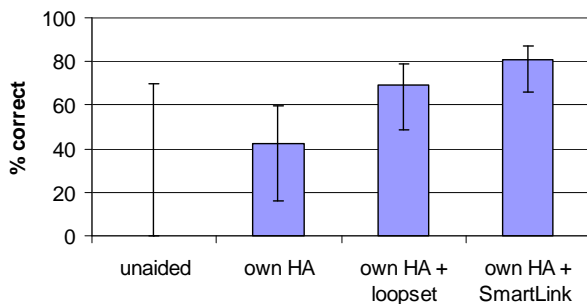


Fig. 1: Speech tests results in quiet with 65 dB input (median values and 25% / 75% percentiles).

for using a mobile phone (which often takes place in public and noisy locations). The speech test material was presented from a loudspeaker and picked up by a landline telephone receiver which was fixed at a distance of 0.5 m from the loudspeaker. The subjects sat in another room where the loudspeaker could not be heard. The signal was transmitted to the mobile phone (Nokia 6230) over a dialed-up telephone connection. The level of the speech test was 65 dB at the receiver of the landline phone which resulted in 63.5 dB at the speaker of the cell phone measured with a Brüel & Kjær artificial head. The speech tests were conducted in 4 conditions in randomized order:

- 1.) unaided
- 2.) own hearing instruments
- 3.) loopset (hearing instruments set to T-Coil)
- 4.) SmartLink (hearing instruments set to FM)

In conditions 1-3, the subject used their preferred ear for using the phone. In condition 4, the speech was presented bilaterally.

Results

Figure 1 shows the speech test scores for the Rhyme Test in quiet. Unaided performance was quite poor (median: 0% speech understanding), but with large interindividual differences. With hearing aids alone, the median score was 43%. The loopset increased speech understanding to 69%, and SmartLink allowed for 81% speech understanding. Compared to using their hearing aid alone, all subjects except one benefited from using SmartLink. All differences except unaided vs. own HA are significant. Figure 2 shows the speech test scores for the Sentence Test in noise

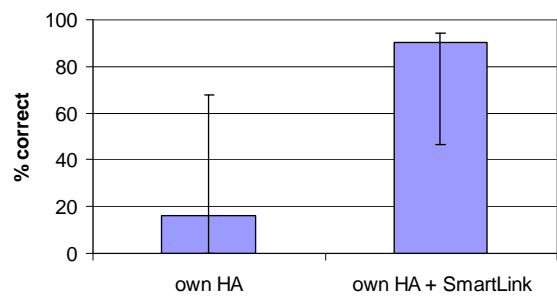


Fig. 2: Speech tests results in noise at 7 dB SNR (median values and 25% / 75% percentiles).

which was conducted in two conditions only. Compared to using the hearing aids alone, SmartLink allows for clearly improved speech understanding in noise.

Sixteen out of nineteen subjects met the criterion which has been set for testing the mobile phones in daily life (at least 50% speech understanding over the mobile phone in the best condition). These subjects kept diaries of situations where they used the mobile phone and rated subjective speech understanding and sound quality. For two weeks, they used their mobile phones together with SmartLink, and for another two weeks without SmartLink. In total, 154 and 127 individual mobile phone calls with and without SmartLink were described and rated, respectively. Two of the 16 subjects could not use the mobile phone without SmartLink at all and were not included in the statistical analysis. In terms of subjective speech understanding, listening effort and perceived loudness, phone calls with SmartLink were rated significantly better than without ($p < .05$). In terms of handling, there was no significant difference between using the mobile phone with or without SmartLink, respectively.

In conclusion, SmartLink allows for substantial improvements in speech understanding when using a mobile phone. Thus, it gives hearing impaired much better access to mobile communication which is an integral part of today's societies.

*The study was conducted by Michael Schulte, PhD, Hörzentrum Oldenburg, Germany

Reference

[1] Sorri M et al. (2003). *Ear & Hearing* 24(2):119-132