microSavia
Digital Bionics

Field Study News

Digital SurroundZoom significantly improves discrimination in noise with open fittings

Summary
The use of directional microphones for open fittings is sometimes disputed because of insufficient evidence of benefit. In our study, 17 of 20 subjects fit with microSavia digital SurroundZoom, demonstrated a significant improvement in Signal to Noise Ratio threshold (SNR improvement of -1.5dB) as compared to the unaided condition. There was no improvement in cases where an omnidirectional system was used.

microSavia- the most recent member of the microSavia family- combines occlusion-free, open fittings with significantly improved speech understanding in noise.*

microSavia with digital SurroundZoom (dSZ)

The Signal to Noise Ratio (SNR) resulting in a sentence discrimination score of 50% correct (SNR threshold) is clearly shifted towards higher levels, and thus poorer, in individuals with ski slope hearing loss. These individuals perceive acoustic signals with higher distortion because the frequency resolution is impaired only in the high frequency area; this leads, in turn to speech discrimination difficulties in everyday situations where background noise is present. Until now, it has been claimed that conventional directional microphones are ineffective in open fittings, because the open canal is the predominant sound path for environmental noises. Thus, it is claimed, speech understanding in difficult environments still remains unaddressed, even when a directional microphone is used. It is argued that it is sufficient to use an omnidirectional microphone in an open fitting, as even sophisticated directional microphones are incapable of signal processing effects in the non-amplified (lower frequency) range.

The following study examines this hypothesis and analyzes the additional benefit in noise of an advanced directional microphone system (digital SurroundZoom) as compared to an omnidirectional system to wearers of a sophisticated, open fitted hearing instrument.

Study setup

Speech understanding in noise with open hearing systems was tested with 20 hearing impaired subject, ranging in age from 47 to 79 years with a median age of 65 years. The average hearing loss had a high frequency slope of 15db per octave (re. pure tone average) from 1000 Hz and above. The subjects were fitted binaurally with microSavia 100 dSZ. The Signal-to-Noise Ratio threshold was measured in three conditions: with an omnidirectional microphone, with digital SurroundZoom, and without the hearing instrument.

The Oldenburger Sentence Test (OISa) was employed to derive the SNR threshold. The sentence construction of each test signal in olsa is constant in a "noun-verb-numeral-adjective-object" format. The noise component of OISa is a diffuse cafeteria noise delivered at 70 dB SPL.

In our study, both speech and noise signals were presented simultaneously. The subjects were asked to repeat every word they understood. This task is a huge challenge for hearing impaired subjects, because the diffuse noise and the desired signal are identical in long term spectrum. Thus, the spoken sentence is very strongly masked by the noise. The task can be accomplished only with a high degree of speech understanding, without the support of redundancy. The diffuse cafeteria noise was presented from 5 loudspeakers (LS) which were located 360° around the subject, each separated by 60°. Speech was

presented from a single loudspeaker at the front (0° azimuth). While noise was held constant, the speech level was changed according to the response of the subjects to reach an effective SNR threshold. A training run was conducted prior to each test.

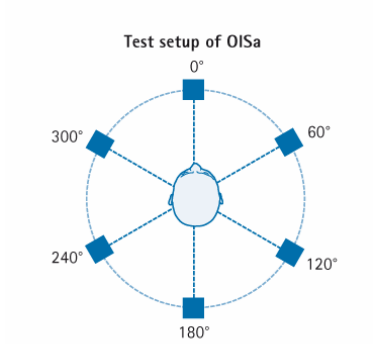

Figure 1 Test setup of the Oldenburger Satztest (OlSa)

Results

The data analysis clearly shows that the use of an adaptive microphone in microSavia dSZ provides better results than an omnidirectional microphone in difficult listening situations. In fact, the use of an omnidirectional microphone did not show any improvement in the SNR threshold. In contrast, digital SurroundZoom improved the SNR threshold significantly in 17of 20 subjects ($p<0.05$). The adaptive directional microphone with 20 independent frequency bands had a positive influence on signal processing, despite the unwanted effect of the outer ear, and significantly improved speech understanding in noise.

This study shows that microSavia with its adaptive directional microphone helps hearing impaired people to communicate better than without hearing instruments. Even when the desired signal is 5.3 dB lower than the noise, the hearing impaired subjects using microSavia were able to understand half of the spoken language-- performance equal to that of normal hearing individuals. In the two other test conditions- unaided and omnidirectional – subjects only reached the SNR threshold of 3.9dB for 50% understanding. If the noise were to have increased, one would assume that conversation would not be possible. These results strongly demonstrate that the use of an omnidirectional microphone does not support improved speech discrimination in difficult listening situations as compared to listening without hearing instruments(Figure **2**).

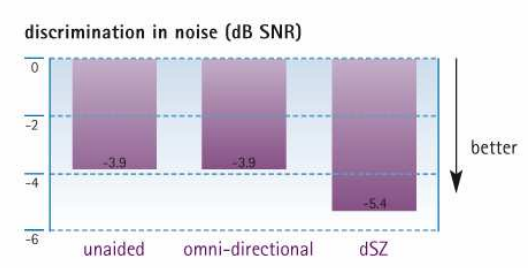

Figure 2: The adaptive directional microphone of microSavia 100dSZ significantly improves the SNR threshold by 1.5dB.

In a second study using the same protocol to measure speech intelligibility in open fittings, subjects scored on average 0.5 dB SNR poorer in the aided condition with an omnidirectional microphone than they did without a hearing instrument. The adaptive 20 channel directionality in microSavia, however, clearly provided significant benefit in noise (-4.9 dB SNR). Digital SurroundZoom therefore is beneficial and recommended in open ear fittings.

- The study was conducted at the Hörzentrum Oldenburg, Germany (2005).