

Phonak Insight



It's sync or stream

The difference between wireless hearing aid features and Binaural VoiceStream Technology™

Digital wireless hearing aids have been available for quite some time now. It is a common myth that these devices all share similar goals in terms of user benefits, or, are similar in their functionality. This paper explores some of the differences and user benefits from digital wireless technology that enables hearing aids to connect to each other.

Sync or stream

Wireless connectivity is a term embraced and seemingly well-understood by the hearing care industry. The ability to connect hearing aids to other audio devices such as MP3 players, personal computers, television and the like has meant tangible benefits to patients with hearing loss.

What appears to be less well understood is how wireless communication allows a pair of hearing aids to connect **with each other**, and how the wireless frequency inherent in the hearing aid technology enables, or limits, the features which can utilize this capability. In essence, a pair of hearing aids can transmit data codes or **synchronize** with each other, or can transmit full audio signal, or **stream** to each other. Moore (2007) distinguished these two capabilities as exchanging either control signals (in the case of synchronization) or audio signals (in the case of streaming). In part, the confusion about these different levels of wireless functionality may be due to hearing aid manufacturers applying the label "binaural processing" to all such wireless functionality, even when referring to simple command/control exchange. In actual fact, very few hearing aids available today do both. At Phonak, the ability to synchronize volume and program changes is called QuickSync and the ability to stream full audio is called Binaural VoiceStream Technology™.

All leading hearing aid manufacturers today offer hearing aids that synchronize through the exchange of control signal. Simple command codes are exchanged between such devices to synchronize

aspects such as volume, programs, compression characteristics or certain features such as microphone mode.

While there is agreement in the benefit of synchronized volume or program changes for user convenience, hearing performance benefits are scarce, with the literature showing limited improvement. Sockalingam, Holmberg, Eneroth and Shulte (2009) investigated localization and sound quality differences in synchronized and unsynchronized modes and whilst localization was significantly better when the hearing aids were synchronized, the user preference for this mode was unclear and depended on the listening situation. Smith, Davis, Day, Unwin, Day and Chalupper (2008) reported no significant difference in using hearing aids in a synchronized versus an unsynchronized mode, when measured by the Speech, Spatial, and Qualities (SSQ) of Hearing Scale. The final reported preferences for wearing the hearing aids in the synchronized mode may be attributed to a halo effect, as the users were not blinded to the hearing aid mode. Kreisman, Mazevski, Schum and Sockalingam (2010) showed improved speech understanding in noise when using a synchronized pair of devices, but as the comparison was to older technology using unsynchronized devices with a narrow frequency range, it is unclear if the benefit can be ascribed to the synchronization or to the difference in bandwidth between the two pairs of hearing aids.

The lack of empirical data to support the benefit of synchronizing hearing aid features may be explained by Beutelmann and Brand's (2006) finding that patients with a hearing loss were less able to make use of binaural cues than those with normal hearing.

Moore (2007) was not alone in suggesting that streaming audio signals between hearing aids could "lead to further benefits for the hearing impaired". Sandrock and Schum (2007) also envisaged this capability would improve "both directional hearing and listening in noise". Moore (2007) did point out that further investigation was necessary to examine the extent of the benefit. A number of such investigations have since been conducted, looking at the benefits of such binaural streaming when communicating in noisy environments, in windy situations, using the telephone and in the car.

Noisy environments

The development of directional microphones has been the hearing aid technology most instrumental in improving speech understanding in noisy environments. A review of the evidence for directional microphones, by Bentler (2005), supports the technology available at that stage and further progress has been made in the eight years since her review was published. Although the benefits of directional microphones may be reduced in the case of an open fitting, studies show that it is still more beneficial than using omnidirectional microphones (Kemp & Dhar, 2008; Magnusson et al., 2013).

The ability to stream a full audio signal between two hearing aids allows an even greater benefit of directionality, as it incorporates not two microphones per ear, but a network of four microphones across two hearing aids. This creates more advanced beamformer polar responses that were previously unavailable with directional microphones in hearing aids that were either not linked or merely synchronized.

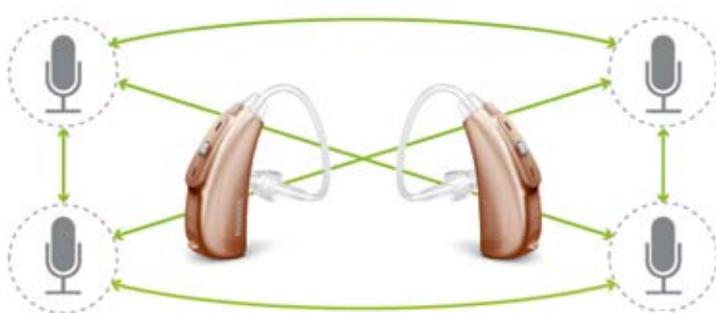


Figure 1
The exchange of full audio data between hearing instruments facilitates binaural signal processing such as binaural beamforming.

The result from this StereoZoom binaural beamforming is greater speech understanding and user preference, compared to other advanced directional microphones (Kreikemeier, 2012; Latzel, 2012; Nyffeler, 2010).

A recent study presented by Picou (2012) showed that, compared to the omnidirectional mode, the binaural beamformer improved speech recognition in noise, decreased listening effort, and improved recall. A speech recognition advantage was also found in comparison to an advanced monaural directional mode.

In windy situations

Wind noise is an environmental effect which can be disturbing to wearers of hearing aids. Kochkin (2010) reports that in terms of signal processing or sound quality, the Marketrak respondents were least satisfied with their hearing aid in wind noise. Several solutions have been suggested in the past to combat this, from completely-in-the-canal fittings (Fortune & Preves, 1994) to various mixed omnidirectional and directional microphone modes (Chung, 2012). These clearly incorporate making a compromise, be it on hearing aid fitting style or speech understanding by reducing directional benefit. The ability to stream a full audio signal between two hearing aids allows the pair of devices to detect where the better speech-to-noise ratio is and present only those low frequencies with the least amount of wind noise to the listener. This binaural streaming algorithm, called Speech in Wind, ensures not only comfort but also improved speech intelligibility in windy listening situations (Buddis, 2012; Latzel, 2012)

Using the telephone

Picou & Ricketts (2011) found that presenting the telephone signal to both ears resulted in significantly better speech recognition than a telephone listening strategy that presented the telephone signal to only one ear. Binaural telephone listening can be accomplished by using a relay or streamer that acts as intermediary between the telephone and the hearing aids. However, in technologies that allow for data streaming between two hearing aids, such a relay is unnecessary and the listener can enjoy binaural hearing on the phone simply by holding up the handset or mobile phone to one ear (Singh, 2013).

In the car

Among the various everyday listening situations, listening while driving a car may be one of the most challenging. Several studies have shown that the car is a common, complex and loud sound environment for patients (Jensen & Nielsen, 2005; Wagener et al., 2008; Wu & Bentler, 2012). A number of hearing aid features have been developed to deal with this, such as using asymmetrical directional settings or asymmetrical gain settings in a pair of hearing aids. These tactics can help make the listening situation more comfortable, but may not enhance speech understanding. Phonak auto ZoomControl harnesses the streaming ability of Binaural VoiceStream Technology™ to improve speech understanding when the signal that the listener wants to hear may not be in front of them, such as when driving a car. When comparing different hearing aid technologies in a car listening situation, (Stangl et al., 2012) showed that only the pair of hearing aids that streamed the full audio signal from one hearing aid to the other was able to improve speech perception both when the speaker was seated either next to the listener and behind them.

New solutions for CROS and BiCROS fittings

Another significant benefit from Binaural VoiceStream Technology™ is for those patients who need a CROS or BiCROS fitting. The Phonak CROS solutions require no cables, or audio shoes, but offer high-end signal processing and access to a large number of hearing aid features. This results in hearing performance and user preference not previously seen with CROS applications (Williams et al., 2012; Ward & Schafer, 2012).

Innovation with purpose

As Kochkin (2007) suggests, the more listening situations in which hearing aids can satisfactorily perform, the more hearing aids, in general, would be recommended by those who wear them.

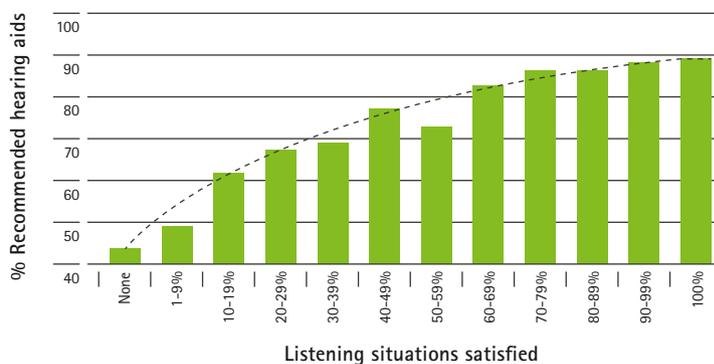


Figure 2
The relationship between satisfaction and the number of environments in which the wearer benefits from their hearing aids. Adapted from Kochkin (2007).

Binaural VoiceStream Technology™ provides solutions for sound environments which have not been sufficiently addressed by any other hearing aid technology. It is such innovation with purpose that will support overall satisfaction with hearing aids.

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