Phonak Insight

Phonak AutoSense OS™ 3.0
The new and enhanced automatic operating system

Today's world is a busy and "acoustically dynamic" place making it challenging to hear, understand and actively engage in, especially for a hearing impaired listener. The Phonak automatic program has been designed to adapt seamlessly based on the acoustic characteristics of the present environment and the benefit is well established. AutoSense OS™ 3.0 is the enhanced automatic operating system in Phonak Marvel™ hearing aids. It delivers clarity and quality of sound enabling the wearer to actively participate in everyday life.

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Optimal sound quality in every listening environment is always the goal of hearing aid manufacturers and hearing care professionals alike. "Hearing well in a variety of listening situations is rated as highly important to hearing aid wearers and has a direct impact on the satisfaction of hearing aid use throughout daily tasks and listening environments." (Kochkin, 2010).

Previously, the sound processing of hearing aids was limited to one amplification setting used for all situations. However, since the soundscape around us is dynamic, where the acoustical environment changes frequently, it is unrealistic for a hearing aid with only one amplification setting to deliver maximum benefit in every environment. The evolution of hearing aids has seen the introduction of sound cleaning features such as, noise cancellation, dereverberation, wind noise suppression, feedback cancellation and directionality. These features offer maximum benefit to overall sound quality and speech intelligibility when they are appropriately applied, based on analysis of the sound environment. Rather than having these sound cleaning features permanently activated, their impact is greatest when they are applied selectively. For example, a wearer may not hear oncoming traffic if noise cancellation is permanently suppressing sound from all directions. Thus, defaults are set in the system for different environments.

Of course the possibility exists to have manual programs added to accommodate acoustic characteristics of specific listening environments, i.e. an "everyday" program with an omnidirectional microphone enabled and a "noise" program with a directional microphone enabled, however having several manual programs increases the complexity for the hearing aid wearer. Research data shows the increasing preference of wearers for automatically adaptive sound settings over manual programs for different environments (Rakita and Jones, 2015) and this is further confirmed by data-logging statistics which reveal a decline in manually added programs with the launch of newer technology platforms. (Phonak AG. ID2017 -04, 2017).

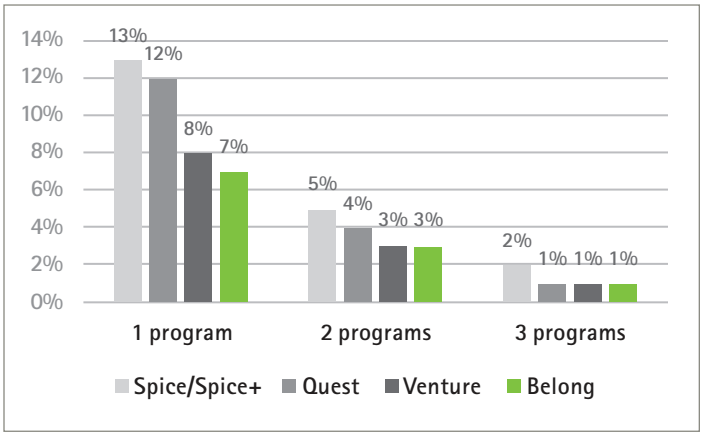

Figure 1. Market research data 2017: Percentage of fittings with manual programs at 2nd session across hearing aid platforms Spice/Spice+, Quest, Venture, Belong (n = 183'331)

First generation AutoSense OS

Results of studies focusing specifically on speech intelligibility also show that the majority of participants achieve a 20% improvement in speech understanding whilst listening in AutoSense OS than in a "preferred" manual program across a wide variety of listening environments, suggesting that manual programs may not always be appropriately or accurately selected (Überlacker et al., 2015). Even more interesting is the fact that users rate sound quality as being equal between the automatic and manual programs (Rakita and Jones, 2015). According to Searchfield et al. (2017), a possible explanation for this may be that the practical application of selection relies on the wearer's manual dexterity, normal cognition, noticeable benefit and motivation levels. Furthermore, their research confirms a bias towards selection of the first program in the setup, whether or not this would be considered "audiologically" optimal.

When Phonak AutoSense OS was originally developed, data from several sound scenes was recorded and used to "train" the system to identify acoustic characteristics and patterns. These characteristics include level differences, estimated signal-to-noise ratios and synchrony of temporal onsets across frequency bands, as well as amplitude and spectrum information. Probabilities of the degree of match between "trained" versus "identified" acoustic parameters in real time are then calculated for the most optimal selection of sound settings in each environment. There are seven sound classes: Calm Situation, Speech in Noise, Speech in Loud Noise, Speech in Car, Comfort in Noise, Comfort in Echo, and Music. Three of the programs, Speech in Loud Noise, Music, and Speech in Car, are "exclusive classes," whilst the other four programs can be activated as a blend, when it is not possible to define complex, real world environments by one acoustic classification. For example, Comfort in Echo and Calm Situation can be blended with respect to how much each of these classifications are detected in the environment.

Audéo Marvel and AutoSense OS 3.0

With AutoSense OS 3.0 Phonak has gone a step further and incorporated data from even more sound scenes for the classes Calm Situation, Speech in Noise and Noise into the training for additional robustness of the system. Enabling the desired signal processing is the goal of AutoSense OS 3.0, so to support the wearer's understanding of speech in noise situations the program Speech in Noise is activated even earlier than before.

Audiological improvements

AutoSense OS 3.0 is the foundation for steering the signal processing and applying the most appropriate setting for the wearer based on the acoustics present in the environment. Refinements to the audiological settings within this are always sought to further enhance the user experience and the improvements occur in different areas of the signal processing.

In order to maintain the natural modulations of speech in noise as well as streamed media **dual path compression** is available and activated based on the listening environment. This means that the temporal and spectral cues in speech are easier for the wearer to identify and use (Gatehouse, Naylor, and Elberling, 2006).

We know that a full and rich sound is preferred by wearers whilst streaming and have therefore further enhanced the sound quality of streamed audio signals by increasing the **vent loss gain compensation**. This increases the low frequency gain by up to 35dB which is especially beneficial to overcome the vent loss of a RIC hearing aid most likely to be fitted with an open coupling due to the hearing loss or client comfort. This low frequency "boost" is applied tostreamed signals (or any other alternative input source, e.g. Telecoil) whilst inputs received directly to the hearing aid microphones remain uncompromised, maintaining the frequency response of a Calm situation.

Adaptive Phonak Digital for Audéo Marvel has been enhanced for **spontaneous first fit acceptance**. The gain for first time wearers starting at an adaptation level of 80% has been softened for frequencies above 3kHz in order to reduce reported shrillness but without compromising speech intelligibility. The desired effect of this is that the wearer experiences a comfortable sound quality from the outset.

Classification of media signals

Listening to music and enjoying it is achieved by an alternate setting than that used to attain optimal speech understanding. In an internal study conducted at the Phonak Audiology Research Center (PARC), participants emphasized their preferences for **clarity of speech** for dialogue-dominated sound samples and **sound quality** for music-dominated samples (Jones, 2017). This preference applies not only in the acoustic environment where signals reach the hearing aid microphones directly, but also for streamed media inputs via the Phonak TV Connector or Bluetooth connection to a mobile device.

Phonak Audéo Marvel with AutoSense OS 3.0 now incorporates streamed inputs into the automatic classification process offering the wearer speech clarity as well as an optimal music experience. A recent study conducted at DELTA SenseLab in Denmark confirmed that the new Audéo Marvel in combination with the TV Connector is rated by wearers as close to the ideal profile of sound attributes for streamed media across a range of samples including, speech, speech in noise, music and sport (figure 3). The Audéo Marvel streaming solution was also rated among the top streaming solutions across 7 competitor solutions (Legarth et al., 2018). This confirms that the way in which Phonak Audéo Marvel now classifies streamed media into the sound classes Speech versus Music is yet another way in which AutoSense OS 3.0 provides ideal hearing performance for wearers in their everyday life.

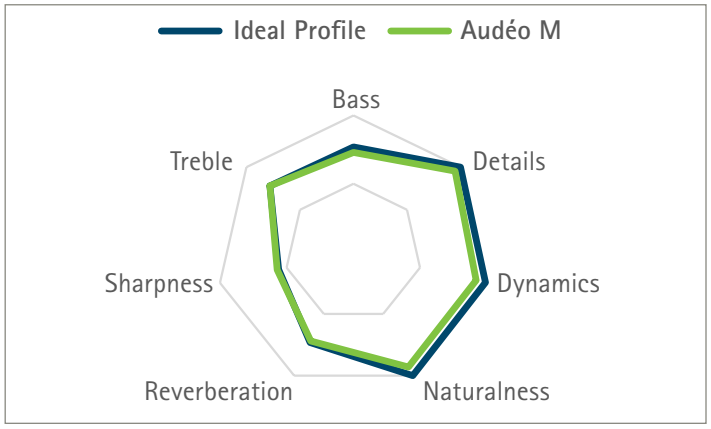

Figure 3. Sound attributes plot for Ideal Profile vs Phonak Audéo Marvel with TV Connector plot

Binaural VoiceStream Technology™

Our sophisticated Binaural VoiceStream Technology has been reintroduced into Audéo Marvel with AutoSense OS 3.0. This technology facilitates binaural signal processing such as binaural beamforming and enables programs and features such as Speech in Loud Noise, Speech in 360° and DuoPhone. The ability to stream the full audio bandwidth in real time and bi-directionally across both ears improves speech understanding and reduces listening effort in challenging listening situations (Winneke et al., 2016).

Summary

The ability of a hearing aid to automatically adapt to multiple situations increases the adoption rate of the hearing aid, indicating that "hands-free" listening is possible and acceptable (Kochkin, 2010). The enhanced AutoSense OS 3.0 achieves this by selecting the most appropriate settings for the wearer optimizing hearing performance in all listening environments, and now during media steaming too. The hearing aid wearer is freed from expending energy on effortful listening and can focus their enjoyment instead on tasks which are more meaningful to them, secure in the knowledge that their hearing aids will automatically take care of the rest.

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Authors

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