# The Importance of Natural Sound for Hearing Aid Users and Clinicians

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**Hearing aid manufacturers often talk about natural sound without specifying what makes sound natural and precisely how that helps hearing aid users. This article details a range of parameters for hearing care professionals to consider when natural sound is important for the user. Extensive survey data show how these parameters affect users in their acclimatization and life with hearing aids, and hearing care professionals in their clinical practice.**

The key promise of Widex hearing aids is that they provide a sound so natural that people forget about their hearing loss. This is the result of a consistent sound philosophy and the continuous technology choices made to support it. In this article, we take a closer look at technologies that support natural sound and how these matter to end users and hearing care professionals (HCPs).

## The Technologies of Natural Sound

As most readers will know, digital hearing aids operate by capturing sound through microphones, converting the sound from an analog to a digital signal, processing and amplifying that signal, before converting it back to analog and playing it out through the receiver. We detail the steps because, in such a multi-step process, the naturalness of the amplified sound and its fidelity to the original signal need to be considered at every step. Key issues to consider for an HCP looking for the most natural sound include the linear dynamic range of the input and the sampling rate. For both of these, higher values are better, resulting in a more accurate and complete signal without distortions at high input levels.

Another crucial factor is the hearing aid's filter bank, which splits the signal up into multiple frequency bands ready for further signal processing, including compression and noise reduction. Here, a key difference is between frequency-domain filter banks that prioritize a high number of bands at the cost of high hearing aid delay, and time-domain filter banks that operate with lower delay using frequency bands that are narrower in the lower frequencies and broader in the higher frequencies.[1]

Widex operates with time-domain filter banks because the design of the filters mimics the auditory filters in the cochlea, and because lower hearing aid delay results in a purer signal at the eardrum. This applies to vented fittings in particular because the amplified sound mixes with the direct sound coming through the vent[2]: if the amplified sound is delayed and therefore out of sync with the direct sound, there are audible artifacts. This makes it particularly important to consider hearing aid delay for users with mild and moderate hearing losses, who tend to get a better sound-quality experience from hearing aids with time-domain filter banks and the associated low delay.[3–5]

On top of these fundamental design choices comes the approach to amplification and signal processing. Central to this is slower compression, which allows for a more natural sound. A large body of research summarized by Windle and colleagues[6] indicates that slow compression should be the default, particularly for the majority of hearing aid users who have age-related hearing loss (see also [7,8]). Similarly, directional microphones and other noise-reduction algorithms should be set in a way that considers naturalness by balancing an enhanced focus on the signal of interest with awareness of the surroundings.

Although all these hearing aid design choices are crucial, naturalness and good sound quality can of course not be achieved by considering the hearing aid in isolation—the sound quality is only good if it is also right for the individual user. This starts with prescribing amplification that matches the audiometric thresholds of the wearer, but there is much more to it than that.

The initial fitting of the hearing aids should make sure that the amplification provided by the hearing aids accounts for the venting and resonances in the individual wearer's ear. This may be done by matching against real-ear measurements, but in Widex hearing aids such individual differences are accounted for from the initial fitting through the TruAcoustics algorithms that estimate how much direct sound enters the ear, how much amplified sound leaves the ear, and how the resonances of the ear canal contribute to the insertion gain. On top of this, the Sensogram measures hearing thresholds with the hearing aid in the ear and using the transducer that will also be providing the gain in daily life, for a sound that is tailored to the user when they leave the clinic.

Outside the clinic, the best sound quality remains individual and should be tailored to the situation. This can mostly be done automatically by changing the hearing aid processing adaptively through sound classification, but, though the classification is fine-grained, no hearing aid can read the user's mind to decode their precise listening intention.[9] Therefore, the HCP should consider tools that enable the hearing aid user to personalize the sound. The most basic tools are volume control and listening programs, but much more can be achieved using advanced tools like Widex My Sound in the hearing





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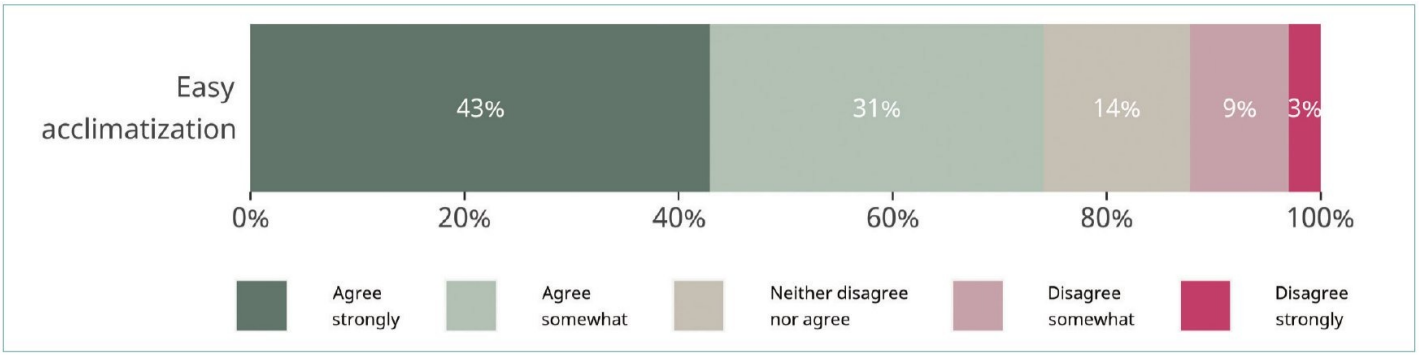



Figure 1: Respondents' answer to the question, "How important is the sound quality of your hearing aids to you?" The response options 'Not very important' and 'Not at all important' were chosen so rarely that the percentages cannot be displayed in the graph; they are 0.6% and 0.1%, respectively.

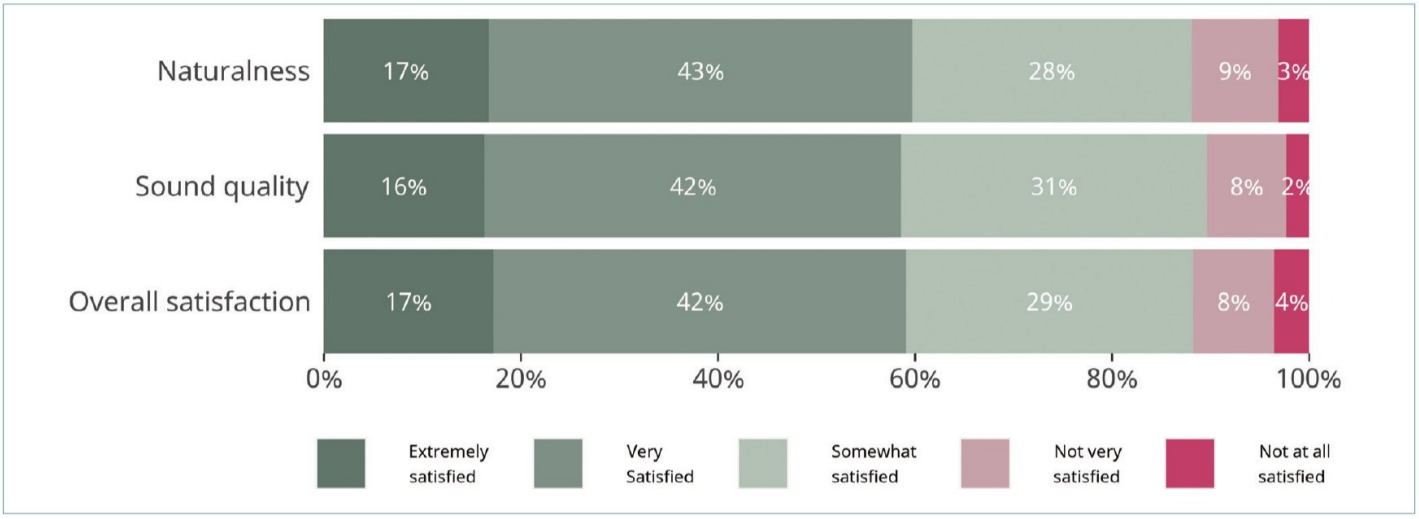



Figure 2: Respondents' ratings of satisfaction with naturalness and sound quality, and of overall satisfaction with their hearing aids.

aid app, which uses artificial intelligence to create hearing aid settings based on preferences that the hearing aid user indicates in specific situations. This allows the user to create a sound that is just right for them in the moment and empowers them to take control of their hearing life.

## The Importance of Natural Sound

A key question for hearing aid manufacturers and clinicians concerned with naturalness and sound quality is how these affect end users. To investigate this, a survey of hearing aid users was conducted. The details of the survey method may be found in Ziegler and colleagues[10], but, in brief, a total of 3,877 hearing aid users completed the survey. The survey was administered through the Enalyzer survey platform and shared with potential respondents when they opened their Widex Moment app in September 2023.

Ninety-four percent of respondents indicated wearing two hearing aids, and 53% indicated that their current hearing aids were their first, while 47% had previously owned other hearing aids. They had owned their current hearing aids for between 0 and 3½ years, and the majority (75%) had acquired them based on their HCP's recommendation, while 16% chose Widex among several options and 9% had made a prior decision to get Widex hearing aids.

The survey's key finding with respect to sound quality is the users' response to the question, "How important is the sound quality of your hearing aid(s) to you?". The results are summarized in **Figure 1** and show that 94% of respondents found the sound quality of their hearing aids very or extremely important. This crucial importance of sound quality may be more pronounced for Widex users because of the brand's emphasis on sound quality, but given the strength of the result it is likely to apply more generally. This shows why we believe sound quality and naturalness should be a central concern for HCPs.

Having established the importance of sound quality to users, we are also interested in investigating how satisfied they are with the sound quality and naturalness of their current Widex hearing aids (see **Figure 2**). A total of 88% were satisfied with naturalness and 90% with sound quality. Overall satisfaction, which includes a broad range of parameters, showed a similar satisfaction rate of 88%. Importantly, overall satisfaction appears to be linked to satisfaction with both sound quality and naturalness, with more than 90% of respondents' ratings on overall satisfaction being the same as or no more than one point away from the ratings on the sound quality parameters.

## Individualization of Sound

As argued above, truly natural sound must be tailored to the individual because of the large variation in users' hearing abilities, ear anatomies, everyday listening intentions, and preferences. Such individualization, along with a fundamental commitment to naturalness, is likely the reason for the positive ratings shown in **Figure 2**. Both individualization and naturalness are also likely to contribute to an easier acclimatization process for end users, which is a key aspect for users in their hearing journey, as well as

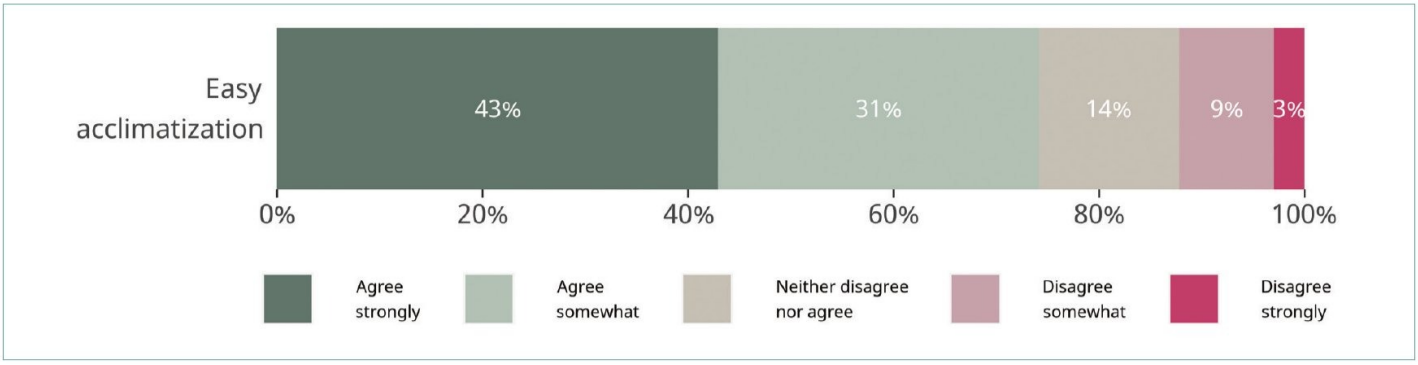



Figure 3: Respondents' agreement with the statement, "It was easy to become accustomed to the sound from my Widex hearing aid(s)."

for the clinicians serving them, who are likely to spend less time with patients who find acclimatization easy.

In the end-user survey, respondents' experience of acclimatization was investigated by asking about respondents' agreement with the statement, "It was easy to become accustomed to the sound from my Widex hearing aid(s)." The results are illustrated in w, where we see that 74% of respondents agreed that acclimatization was easy, while 14% neither agreed nor disagreed. Only 12% disagreed, although acclimatization to hearing aids is commonly considered a challenge. Similarly, we believe the careful tailoring during a Widex fitting is likely to help drive the finding reported by Ziegler et al.[10] that users experience easier acclimatization and a more individualized fitting with Widex than with other hearing aid brands that they have tried.

A survey of 246 HCPs[11] shows a related result, with a lower number of follow-up appointments for Widex than for other hearing aid brands (see **Figure 4**). This may of course be driven by a number of different factors, but likely to be chief among these is the commitment to naturalness at all stages, as well as the individualization of the sound. This individualization may take a little longer during the first appointment but is nonetheless likely to contribute to efficiency by resulting in a lower need for follow-up appointments.

## Clinical Implications

As the survey data reported above show, sound quality is of crucial importance for hearing aid users and is closely associated with their overall satisfaction with their hearing aids. This makes naturalness and sound quality a crucial concern for clinicians, who can benefit from considering the following insights when choosing hearing aids and fitting patients:

- The higher the sampling rate and the larger the linear input dynamic range, the more accurate and complete a signal the hearing aid will be able to provide.
- Slow compression results in a more natural sound and should be the default choice for those with age-related hearing loss.[6]
- For vented fittings in particular, the hearing aid's processing delay should be considered. If the delay is above approximately 1 millisecond,[3] the mixing of delayed amplified sound and direct sound coming through the vent will result in audible artifacts.
- On top of hearing aid design choices, individualization of the fitting is crucial for a sound that is natural for the individual user. Although steps such as measuring in-situ hearing thresholds and accounting for vent effects may take a little extra time during the initial fitting, it can pay off through easier acclimatization and fewer necessary follow-up appointments.
- Finally, intuitive tools for personalization of sound during real-life use empowers the end user to take control of their hearing life. This may make fine-tuning by the HCP irrelevant or contribute important information to the HCP for optimizing the hearing aid settings.

Together, these elements as implemented in Widex hearing aids are key drivers of the high satisfaction ratings, easy acclimatization, and relatively few follow-up appointments observed in surveys of end users and hearing care professionals. In short, the natural sound of Widex hearing is not natural sound for the sake of it, but natural sound for the sake of natural hearing—resulting in a range of benefits for hearing aid users and clinicians. ◗

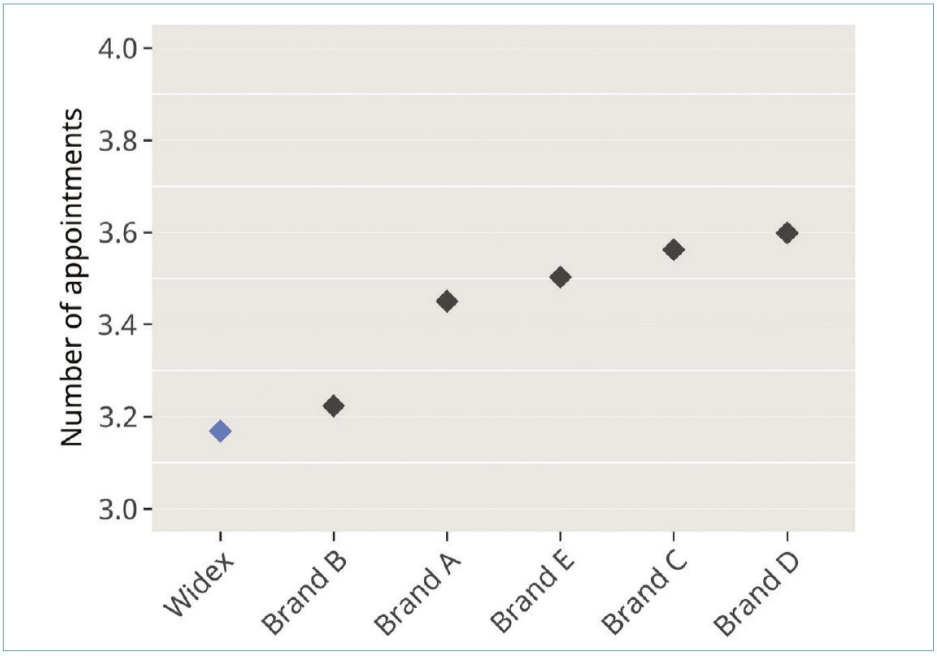



Figure 4: Mean of HCPs' estimates of the number of follow-up appointments within six months of fitting for the six major brands investigated by Helmink & Sasaki-Miraglia (2023).[11]