Phonak
Field Study News

Media streaming: The sound quality preferred by hearing aid users

This study conducted at DELTA SenseLab in Denmark reveals that the latest solution for television listening from Phonak, the Audéo™ Marvel™ hearing aids in combination with the TV Connector, is regarded among the best for streamed sound quality. The enhanced AutoSense OS™ 3.0 now includes classification of streamed signals and is rated as the overall preferred solution and very close to the sound quality described by hearing aid wearers as 'ideal'.

Tania Rodrigues / July 2018

Introduction

Preferences for media consumption vary across generations with overall time spent increasing in older adults and driven by traditional television and radio sources (Nielsen, 2017). According to the New York Times online, the average American spends just over 5 hours of their day watching media, whether that be live television or streamed content, with people over the age of 50 years watching the most – around 50 hours per week (Koblin, 2016). This phenomenon is not limited to one particular country. By the year 2021, it is projected that 1.68 billion households worldwide will own at least one television. For seniors, watching television has been shown to have positive benefit, offering "an active way to remain socially integrated, to structure daily life, and to satisfy needs for reflection and contemplation" (Oestlund, Jönsson & Waller, 2010). Unfortunately for those with hearing loss, watching television can be a frustrating experience for various reasons:

Firstly, volume preferences for different listeners within a household vary. In a survey conducted in 2015, 45% of respondents reported that one of their main difficulties when watching television was that

when they set the volume to a comfortable level, others complained that it was too loud (Strelcyk et al., 2015). To overcome this, hearing aid wearers now have the option to connect their hearing aids with an audio streaming solution, streaming the input directly and wirelessly to their hearing aid. This allows them to control their preferred volume independently of that which is set for other listeners.

Further reasons for frustration according to Strelcyk et al. (2015) include the fact that actors may have foreign accents, loud background music is often present, and a lack of visual cues can make understanding speech difficult.

Automatic and adaptive classification of sound has become standard practice for processing acoustic input signals reaching hearing instrument microphones directly. Phonak set the bar with AutoSelect in the Claro platform in the late nineties and we have continued to enhance the sound experience to meet the needs of the wearer in their everyday listening environments through AutoSense OS over the years. Studies on sound performance reveal that hearing aid wearers consistently rate the speech clarity in noise produced by the program or blending selection of the AutoSense OS classifier as 20% better than that of the manual program selected by the wearer. (Übelacker & Tchorz, 2015) – but what about the need for classification of streamed signals? To date, the processing of streamed media sound has not taken into account the fact that, similar to acoustic signals, media signals also vary in their sound characteristics. Up to now, streamed signals have been processed uniformly using one program, based on acoustical characteristics present in a calm situation. However, statistics show that drama series, reality TV shows, and international sporting events comprised the most watched TV programs in the mid-2010's (Statista, 2017) – and these broadcasts are composed of a combination of speech only, speech in noise/music, or music only inputs.

In an internal study conducted at PARC (Phonak Audiology Research Center) in the USA, participants emphasized separate preferences for clarity of speech for dialogue-dominated sound samples versus sound quality for music-dominated samples. This applied not only for the acoustic input through the hearing aid microphones but also for media directly streamed to the hearing aid (Jones, 2017) .

A previous study revealed that the Phonak TV Connector, in combination with the Audéo B-Direct hearing aids, outperformed its competitors in terms of preference, in particular for television broadcasts containing speech. It also showed sound quality of the system to be very close to the ideal profile, as defined by hearing aid wearers (Legarth et al., 2017). Since this study, AutoSense OS functionality has been expanded. AutoSense OS 3.0™ now also includes the classification of media streaming into the sound classes, Speech vs Music, based on the nature of the signal (i.e. dialogue versus music dominant). The purpose of the following study was to benchmark the impact of this innovation against a prior product as well as current competitive solutions.

Methodology

Participants

Fifteen trained hearing impaired participants with mild to moderate hearing loss were recruited for the study; 9 males and 6 females, with a mean age of 73.7 years (range: 64 – 83 years). All participants were native Danish speakers and experienced hearing aid wearers, considered expert listeners as a result of

training and familiarization with listening tasks received prior to the study (Legarth et al., 2012).

Equipment

Participants tested 7 different hearing aid and respective TV streaming solutions. These included the new Phonak Audéo Marvel hearing aids, Phonak Audéo B-Direct hearing aids, and the latest premium hearing aids from 5 competitors. The recommended default first fit using closed SlimTips was selected for all hearing aids and frequency lowering algorithms were turned off, if available. The Phonak fittings deviated in one parameter from the recommended fit in that the RECD was adjusted to match that of KEMAR (Knowles Electronics Manikin for Acoustic Research) in order to reduce variability and equalize settings across manufacturers.

The streaming program was activated on manual button press for all hearing aids (where available), and it was configured to have both streamed and acoustic input in the manufacturers' recommended balance.

All hearing aids were wirelessly paired to their corresponding TV streaming devices which were connected via cable to a 49" Samsung TV. The TV was connected via HDMI to a lab PC and the original uncompressed audio stream of the broadcast samples were transmitted from Adobe Audition 3.0 running on the lab PC via the TV streamers to the hearing aids.

Six different audio-visual TV broadcast samples were selected as representative of a range of Danish television material to test the streaming solutions, including speech only, music only, and various speech in noise samples (Table 1).

Recordings of the output of all 7 pairs of hearing aids and corresponding TV streamers were made in a standardized room on a KEMAR. Participants listened to the audio recordings via calibrated headphones whilst watching the corresponding time-aligned video recordings on TV.

	Sample description
1	Theme song "Broen" Title music from Danish TV series
2	Music Eric Clapton live concert at Royal Albert Hall "I shot the sheriff"
3	Dialogue "Broen" Dialogue from Danish TV series
4	DR news News from Danish television
5	Sport Champions League football match
6	Speech in noise "Broen" Action scene from Danish TV series

Table 1. List of Danish TV broadcast samples used for recordings of the hearing aid streamer solutions at KEMAR positioned 3m from the acoustic output.

Procedure

After recordings had been produced, the study was executed in 4 steps:

(1) The 7 relevant attributes for the perceptual evaluation of the hearing aid media streamers were identified by the study participants. The attributes were required to capture the key characteristics that differentiated the hearing aid streamers in the test. Therefore, eight of the participants attended a preliminary appointment and were presented with all recordings of the streamers and took part afterwards in a consensus meeting, which led to the attributes, anchors and definitions that would be used for the evaluation of the hearing aid profiles. The attributes which were identified and their descriptions are as follows:

- Bass - the deep tones. A sound perceived as thin and tenuous has little Bass. A sound perceived as dark and deep has a lot of Bass.

- Treble – the bright tones. A little Treble can sound like 'listening under a quilt' where details disappear. A lot of Treble can sound like lisping and sometimes sharp and shrill.
- Reverberation - a lot of reverberation sounds as if the sound does not die out. If an echo is heard, this would be a lot of reverberation.
- Naturalness – is the sound stream natural and realistic in relation to content shown on the TV?
- Dynamics – an expression of how lively the sound is perceived. Flat dynamics means the content sounds flattened and less intrusive. Varying Dynamics can sound alive and seem more realistic.
- Details – do details disappear and are blended and muddy? Or are details distinct and clear with high separation? High separation can contribute to better speech intelligibility of the voice.

(2) An overall evaluation of preference was made for all seven hearing aid streamers with the six broadcast samples. All 15 participants completed the preference test twice, in order to check for reliability. Participants rated their preference (double-blind randomization) using SenseLabOnline™ (a proprietary software for facilitating listening tests), on a scale ranging from 0 = dislike extremely to 15 = like extremely. All samples were equalized for loudness to avoid bias.

(3) The third step was a double-blind randomization test and involved all 15 participants. Study participants identified the preferred rating for a given attribute using SenseLabOnline. The software guided the participant through so that they would rate all hearing aids with corresponding streaming solution for each broadcast sample, for each given attribute. Following this, participants then determined the ideal point for each attribute based on their experience with the different sound samples. This created an ideal profile.

(4) Overall preference ratings were then retested and shown to be consistent with the original ratings indicating a high test reliability.

Results

Phonak Audéo Marvel with the TV Connector is a close match to the ideal profile

The profile plot in figure 1 shows the ideal profile which the test participants defined across all 6 sound samples as described above. The ideal rating of the different attributes reflects the average rating which subjects would expect to be optimal. The Ideal profile is characterized by:

- Balanced Timbre and Bass
- Medium level Reverberation
- Low Sharpness
- A high level of Dynamics, Details and Naturalness

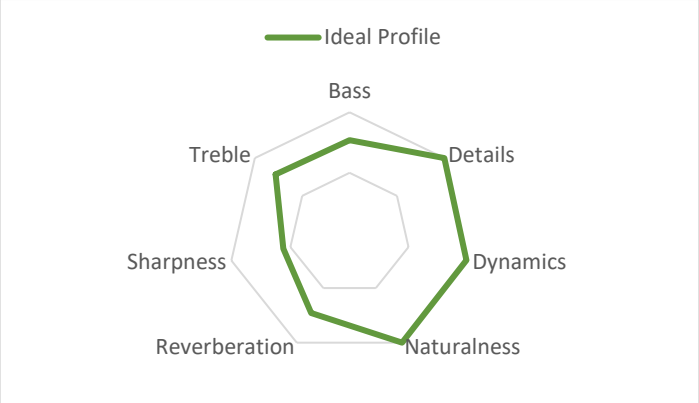

Figure 1. The Ideal sound profile across all 6 sound samples, as defined by the test participants.

Figure 2 shows the profile plot which the participants defined for the Phonak Audéo Marvel hearing aids

paired with the TV Connector and which is a very close match to the Ideal profile.

Only one of the 5 competitor solutions produced a profile plot which is similar to that of Phonak and hence similar to the Ideal profile, although participants also rated this solution as Sharper than the preferred Ideal and Phonak Audéo Marvel solution.

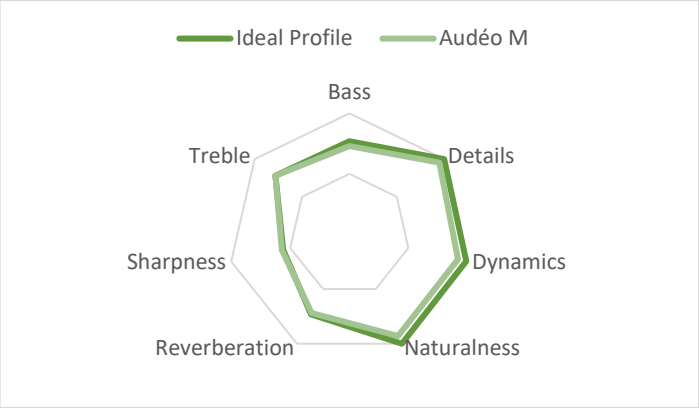

Figure 2. The profile of Audéo M hearing aids paired with the TV Connector and overlaid onto the Ideal profile.

Phonak Audéo Marvel with TV Connector is preferred over competitor solutions

Although not statistically different from two competitors, an overall preference for the Phonak Audéo Marvel solution was documented by test, re-test design as shown in figure 3.

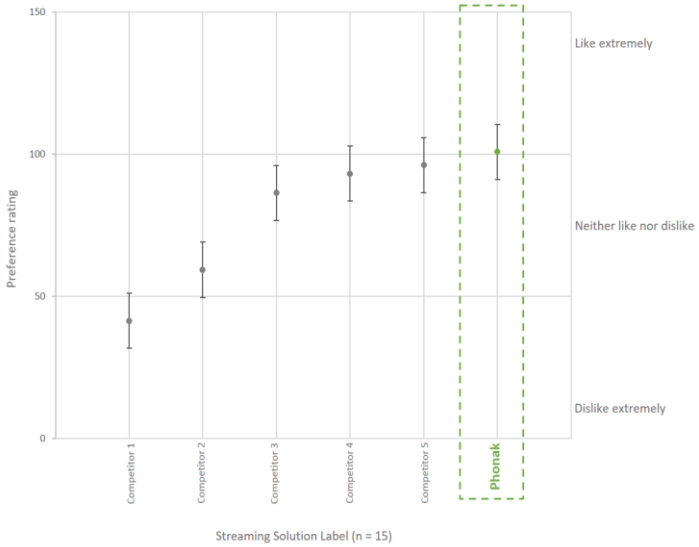

Figure 3. Overall preference ratings averaged for all broadcast samples used, showing high re-test reliability.

Summary

Market research reveals television watching to be a popular activity enjoyed worldwide. Hearing aid wearers report frustrations relating to differing volume preferences within the household, as well as a lack of speech clarity and visual cues, whilst watching television.

Wearers rate speech clarity for dialogue-rich inputs and sound quality for music- and/or noise-dominant broadcasts, as their two main preferences when steaming audio media (Jones, 2017).

Phonak Audéo Marvel hearing aids paired with the TV Connector closely matches the ideal profile for streamed media and is rated among the top streaming solutions for hearing aid wearers. This demonstrates that the unique way in which Phonak Audéo Marvel with AutoSense OS 3.0 is now able to classify streamed media is yet another way in which Phonak technology provides ideal hearing performance for wearer's in their everyday life.

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Authors and investigators

External principle investigator

Søren Vase Legarth graduated from the Technical University of Denmark in 2004 as M.Sc.E.E. with key interest and attention towards Acoustics. After graduation he was employed at the acoustics department in DELTA and in 2007 when SenseLab was started he had the responsibility of setting up a trained test panel, lab facilities and develop test software. In 2011 he became Head of Department.

Internal principle investigator

Matthias Latzel studied electrical engineering in Bochum and Vienna in 1995. After completing his PhD in 2001, he carried out his PostDoc from 2002 to 2004 in the Department of Audiology at Giessen University. He was the head of the Audiology department at Phonak Germany from 2011. Since 2012 he is the Clinical Research Manager for Phonak AG, Switzerland.

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Tania qualified as an Audiologist at the University of Cape Town, South Africa. She gained diverse experience in clinical practice working within both the public and private sectors in the United Kingdom, before joining Phonak in 2013. She is now the Audiology Training & Education Manager at Phonak HQ, Switzerland.