Phonak Field Study News.

Sound quality improvements with APD 3.0

Study participants prefer APD 3.0 over APD 2.0 due to increased listening comfort, reduced noise intrusion, and overall sound quality.

Voss, S. C., Sheikh, B. & Cui, E. M. August, 2025

Introduction

Phonak's continuously evolving fitting formula Adaptive Phonak Digital 2.0 (Adaptive Phonak Digital APD, 2013; APD 2.0; Woodward, 2020; Wright, 2020) ensures that hearing aid users receive appropriate audibility while maintaining listening comfort. A reduction and an increase in insertion gain for specific frequency bands may further enhance sound quality in the newest APD version, APD 3.0 (see Figure 1).

This study tested the hypothesis that these modifications would result in increased sound quality, and it also evaluated whether they had an impact on speech intelligibility.

A preliminary investigation with hearing aid fittings and modified frequency curves showed that participants had less difficulty indicating a preference for a hearing program when listening in the real world than sitting in a soundbooth and listening to sound presented from one speaker only (unpublished data). Consequently, this study created sound scenes using ambisonic recordings, which create a highly realistic acoustic environment that preserves spatial elements of the recorded scene.

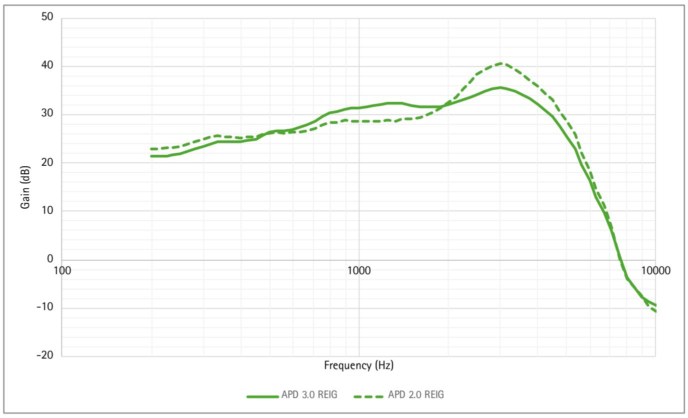

Figure 1. Hearing aid output measured with speech in quiet in Verifit2 using the International Speech Test Signal at 65 dB SPL. The APD 2.0 curve was measured with Phonak Audéo P90-R, the APD 3.0 curve was measured with Audéo I90-R. Both hearing aids were fitted to a 50 dBHL flat hearing loss and occluded cShells.

Another consideration incorporated in this study was the signal-to-noise ratio (SNR) when having conversations in noise. The acoustic phenomenon known as the Lombard effect motivates people to speak louder when talking in the presence of background noise (Lane & Tranel, 1971), resulting in positive real-world SNRs. However, research shows that the speech level does not always increase by the same amount as the background noise (Weisser & Buchholz, 2019). Some sound scene recordings used in this study contained only background noise. When adding speech passages to these scenes, the research team used Weisser & Buchholz' findings about real-world speech-in-noise levels to set a realistic SNR for each scene.

Methodology

All study participants attended three appointments between May and October 2023 at the Innovation Centre Toronto in Kitchener (Canada). Participants signed a consent form at the first appointment, and had their audiograms measured and earmold impressions taken. Hearing aids were fitted at the second appointment, and participants conducted the sound quality preference task. To avoid fatigue, speech intellgibility testing was completed at the last appointment.

Participants

The study sample consisted of 10 male and 10 female participants with an average age of 68.7 years (SD: 13.3) and an average hearing aid experience of 14.7 years (SD: 13.1). All participants had binaural, sensorineural, symmetric moderate-to-severe hearing loss. The average left and right hearing thresholds are shown in Figure 2.

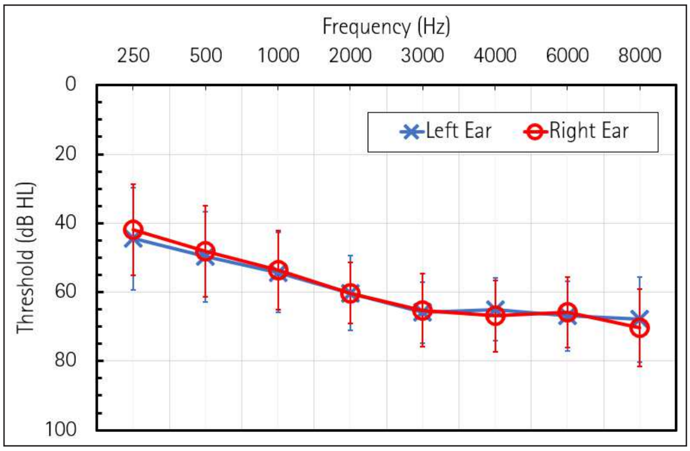

Figure 2. Average hearing thresholds for the left (blue) and right (red) ears of all participants.

Hearing aid fitting

Phonak Audéo L90-R hearing aids were fitted to participants' individual hearing thresholds using M- or P-receivers and custom SlimTips with a 1 mm vent. The hearing aids had two different Calm situation programs with two frequency response curves based on APD 2.0 and APD 3.0, respectively. SoundRecover 2 was switched off across all fittings. Adaptive features (e.g., Real ear sound, NoiseBlock, WhistleBlock) were activated at their recommended default setting.

Speech Intelligibility Testing

Participants were seated in the centre of a circle consisting of eight loudspeakers. Sentences of the American English Matrix Test (HörTech GmbH, 2014) were presented through the loudspeaker in front of them, while the other loudspeakers presented speech-shaped noise. Participants were asked to repeat the sentence they heard. As the noise is held constant, and the speech level varies over the course of 20 sentences, this procedure estimates the SNR threshold where the listener can understand 50% of speech presented in background noise. This sentence recognition threshold (SRT) is expressed in dBSNR. On the onset, both speech and noise were presented at 65 dB SPL (0 dBSNR). The lower the resulting SRT50, the lower the speech level at which a listener can understand 50% of the presented speech (lower = better).

Speech test results were tested for normal distribution and analyzed using analysis of variance (ANOVA). Post-hoc pairwise comparisons determined which SRTs differed significantly from each other.

Live Sound Quality Preference Task

Participants were seated in the centre of a circle consisting of 12 loudspeakers. 12 sound scenes were presented using all loudspeakers for a realistic recreation of the specific acoustic environment. A monitor screen positioned below the loudspeaker facing the participants displayed a video of each presented sound scene for better immersion in the scene (see Figure 3).

The scenes included the sounds of a river, a TV playing in a living room, traffic noise, frying pan noise, a shopping mall, a cocktail party, a pub, a busy pedestrian mall, as well as music including classic, pop and a favourite song of the participant's choice. The noise levels of the recorded sound scenes used in our study varied from 55 to 73 dB SPL depending on the scene. Following Weisser & Buchholz's (2019) findings, recorded speech in the form of a short story was added to selected scenes (river, traffic noise, shopping centre, living room, cocktail party, pub, and pedestrian mall). The SNR in these combined scenes ranged from 3 to 5.5 dB to reflect a realistic increase in speech level in the presence of noise.

While listening to the sound scenes, participants used an interface on a screen in front of them to toggle between the two programs with the APD 3.0 and APD 2.0 fitting. They also indicated on the screen which program they preferred in terms of speech clarity, noise intrusion, comfort and overall preference.

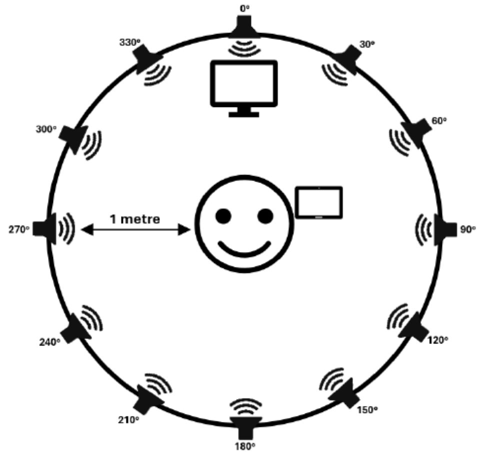

Figure 3. Setup with 12 speakers for the live sound quality preference task.

Differences in preference among the three options APD 3.0, APD 2.0 and no difference were tested for statistical significance with a Chi-squared test.

Results

Speech Intelligibility Testing

With APD 2.0, the average SRT was -5.38 dBSNR (SD = 2.15), and with APD 3.0, it was -4.7 dBSNR (SD = 2.36) . When wearing hearing aids, participants were able to understand 50% of the presented speech when it was about 5 dB softer than the noise (see Figure 4). The average threshold of the unaided baseline measurement was -0.85 dBSNR, which was significantly higher than the SRTs measured with APD 2.0 ($F(1, 36) = 14.58$, $p < .001$, $Eta^2 = 0.29$) and APD 3.0 ($F(1, 36) = 10.16$, $p = 0.003$, $Eta^2 = 0.22$).

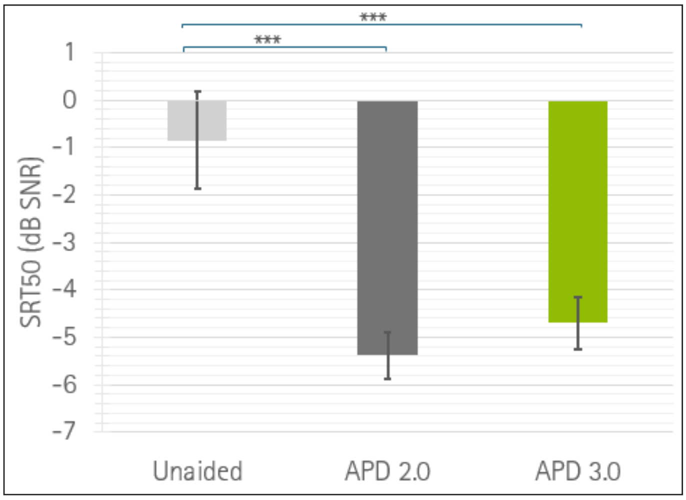

Figure 4. Average speech intelligibility results measured with the US Matrix test with hearing aids set to APD 2.0 and APD 3.0, as well as no hearing aids. The lower the SRT50, the lower the speech level at which listeners understand 50% of the presented speech (lower = better). Asterisks indicate a significant difference in results (*** p ≤ .001). Error bars: ±1 standard error.

Live Sound Quality Preference Task

Among the non-speech scenes, APD 3.0 was preferred significantly more often (63 times out of 100) than APD 2.0 (24 times) in terms of comfort ($X^2 = 17.483$, $df = 1$, $p < 0.001$). APD 3.0 was also favoured significantly more often (61 times) than APD 2.0 (28 times) for less noise intrusion ($X^2 = 12.236$, $df = 1$, $p < 0.001$). Likewise, APD 3.0 was selected significantly more often (60 times) in non-speech scenes than APD 2.0 (28 times) in terms of overall preference ($X^2 = 11.636$, $df = 1$, $p < 0.001$). Differences between the total count (100) and the preference counts for each condition represent trials in which participants indicated no difference between APD 3.0 and APD 2.0.

The indicated preference for APD 3.0 and APD 2.0 was nearly the same for scenes containing speech across all rating dimensions including speech clarity, and the small differences in counts were not significant. Notably, a higher amount of particpants indicated no preference for either program (between 23 to 38 times).

Collapsed across all sound scenes with and without speech, the preference for APD 3.0 was significantly higher than for APD 2.0 in terms of overall preference ($X^2 = 4.4118$, $df = 1$, $p = 0.035$, Cramer's $V = 0.903$), comfort ($X^2 = 5.9179$, $df = 1$, $p = 0.015$, Cramer's $V = 0.72$) and noise intrusion ($X^2 = 10.602$, $df = 1$, $p = 0.001$, Cramer's $V = 0.956$, see Figure 5).

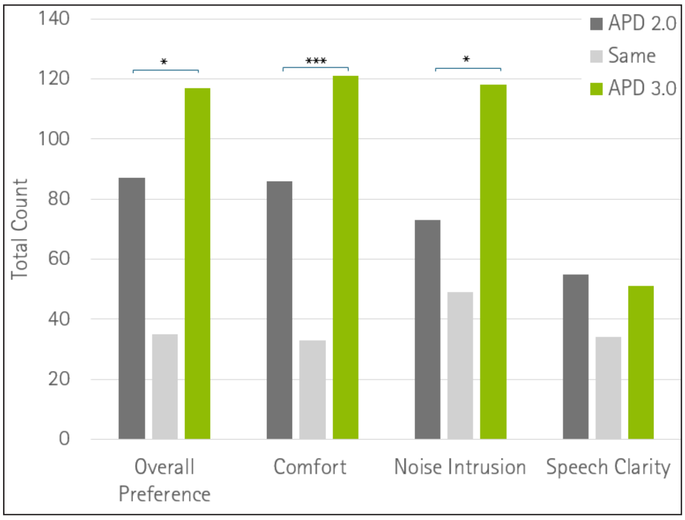

Figure 5. Results of the live sound quality preference task for all sound scenes combined in terms of overall preference, comfort, and noise intrusion. The figure shows the tally per rating condition (total number of trials = 240, one missing data point in overall preference). Speech clarity was only assessed with sound scenes containing added speech (total number of trials = 120). Asterisks indicate a significant difference in results (* p ≤ .05 and *** p ≤ .001).

Discussion

The objective of this study was to determine if a modified frequency response curve will be preferred in terms of sound quality while maintaining speech intelligiblity when compared to the current frequency response curve in APD 2.0.

In sound scenes without a speech target, most participants preferred the modified response curve of APD 3.0, whereas sound scenes with speech resulted in more indecision with more participants not indicating a preference. Preminger and Van Tasell (1995) reported that interpretation and rating of quality dimensions varied more among participants when intelligibility was held constant in sound samples containing speech. The results from the speech intelligibility test indicate no difference in intelligibility between both programs, thus the higher divergence in preference may be explained by the observations made by Preminger and Van Tasell (1995).

Consequently, the frequency response implemented in APD 3.0 provides a better starting point for good sound quality upon the first fit, and individual preferences for listening to speech can be addressed during the clinical finetuning process.

Speech intelligiblity testing showed that SRTs did not differ across fitting fomulas when listening to sentences in noise, and that both APD 3.0 and APD 2.0 result in significantly better SRTs than when not wearing hearing aids.

Conclusion

Following the overall sound quality preference of APD 3.0 compared to APD 2.0 and no significant difference in speech intelligibility, APD 3.0 has been made available in Phonak Target 10.0 and replaces APD 2.0 for all hearing aids in the Phonak Infinio generation.

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Authors and investigators

Author
Solveig Christina Voss, MSc

Solveig Christina Voss is the Senior Technical Lead at the Sonova Innovation Centre Toronto. She is a master hearing aid acoustician and holds a BSc. in Hearing Acoustics from the University of Applied Sciences in Luebeck, Germany, along with a MSc. in Hearing Sciences from Western University in London, Ontario, Canada. Since 2014, she has been working at Sonova R&D departments in Switzerland, China and Canada.

Researcher
Bilal Sheik, M.Cl.Sc.

Bilal Sheikh joined the Sonova Innovation Centre Toronto in August 2021. Before this, he worked as a clinical audiologist at Mount Sinai Hospital in Toronto. He holds a Master of Clinical Science in Audiology from Western University. At Sonova, Bilal manages in-house studies on hearing technology and collaborates with external universities and research sites to drive advancements in hearing care and technology development.

Statistician
Eric M. Cui, M.Sc.

Eric Cui completed his undergraduate research internship at the Sonova Innovation Centre Toronto in 2019 and continued to support several Sonova projects as a project statistician. He holds a master's degree in psychology and cognitive neuroscience from the University of Toronto and Baycrest Hospital, and work towards a Ph.D. degree. He is generally interested in data analysis and a multi-modal measurement approach to human behaviour in both academic and clinical research settings

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One-page summary

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Key highlights

- Adaptive Phonak Digital 3.0 (APD 3.0) features a new frequency response curve designed to enhance general sound quality in all acoustic programs.
- Study participants listened to recorded real-world sound scenes at ecologically valid signal-to-noise ratios and compared Phonak Audéo hearing aids fit to APD 3.0 with APD2.0.
- Listening comfort, noise intrusion and overall preference were rated significantly better with APD 3.0 compared to APD 2.0.
- Speech test results obtained with both APD 3.0 and APD 2.0 indicated similar speech intelligibility performance between both fitting formulas.

Considerations for practice

- APD 3.0 provides exceptional sound quality in terms of increased comfort and reduced noise intrusion with the same speech intelligibility as APD 2.0.
- Excellent sound quality can lead to better spontaneous acceptance of hearing aids.
- Frequency response modifications have been applied to all AutoSense OS 6.0 programs for seamless enhanced sound quality.