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What Do Owners of Hearing Aids that Stream Think of the Sound Quality?

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The ability to stream audio to hearing aids has been documented as providing additional benefit compared to using hearing aids alone.[1] This capability can overcome the reduced audibility and Signal-to-Noise Ratio (SNR) of desired sounds due to the acoustic effects of distance from the source, reverberation, and competing sounds in the listening environment. Specifically, wireless streaming from a phone, either with a streaming accessory or directly from a smartphone, is beneficial for speech understanding.[2-4] The use of remote mics that stream a conversational partner's voice to the hearing aid wearer has also been shown to benefit understanding speech at a distance or in noisy conditions.[5-7] Evidence for the subjective benefit of streaming capabilities is also strong. Results of MarkeTrak 2022 indicated a 10 percentage-point higher satisfaction rate for hearing aids that could stream, and the ability to stream was the 3rd most impactful feature on listening experience after rechargeability and volume control.[8]

The studies reporting on the benefit of audio streaming to hearing aids have quantified the benefit of speech understanding improvements. But there may also be benefit or lack thereof in terms of perception of the quality of the sound. Let's take the example of listening to the radio in a car. Years ago, the dashboard speakers typical of car radios provided a tinny, unrealistic sound quality that was not especially enjoyable – particularly the distortion when a favorite song was turned up - but it was possible to hear and understand newscasts, weather reports, and music played on the radio. Thus, there was a benefit in receiving a message, but much less so in enjoyment and appreciation of the sound. The sound systems in cars today often include high-end speakers that can faithfully reproduce sound with excellent quality at both high and low volumes. This entails benefit both in terms of the ability to receive a message and enjoyment of the sound quality.

Regarding sound quality for audio streaming to hearing aids, some investigations have been reported, but they have focused on comparing the technology across different brands of hearing aids.[9,10] These studies have examined how different sound quality dimensions affect overall preference and to what extent different products exhibit the preferred patterns. The carefully controlled methodology needed to make this comparison practical and unbiased means that the study results may not represent the real-life experience of an individual hearing aid user with a given product. One variable aspect of hearing aid fitting that could affect both benefit and sound quality is how the hearing aids are coupled to the ear. Many hearing aids today are fitted with domes that provide little ear canal occlusion. While open fittings provide many benefits, there are

also disadvantages.[11] For example, it has been shown that the benefit of wireless streaming of speech from the phone was reduced if people were fitted with open domes, which is common for those with mild-to-moderate hearing loss.[3]

It is not unusual to find posts about hearing aids and audio streaming sound quality on hearing aid user chat sites. For example: “I was a bit disappointed with the sound quality streaming into my ears and finally had to give up and return to my default iPhone audio. The calls and connection sounds were very “tinny” and difficult to understand. Has anyone else run into this issue?” Responses to this post included advising the person to change out the domes on the hearing aids with more occluding “double domes.” This suggestion could potentially prevent low-frequency content of the streamed signal from leaving the ear canal and thus provide a fuller sound quality. Apart from the inconvenience involved with this idea, double domes have also been shown to reduce low frequencies more than most expect, and there is a great deal of individual variation,[12] so this is not a guaranteed solution to improving sound quality for streaming. If the user does experience success with improved streamed audio by switching to more occluding double domes, they may create new occlusion-related annoyances with their perception of their own voice and other body-conducted sounds. This may be a poor trade-off because most hearing aid users don’t spend most of their hearing aid wear time streaming audio.

But how widespread and how important is the issue of streamed audio sound quality among hearing aid users? Despite the anecdotal reports and the fact that it makes sense from an acoustic standpoint that users may not be entirely satisfied with streaming sound quality, to our knowledge, no studies have examined this question in a larger context. Therefore, we decided to survey hearing aid users with streaming experience to systematically document their satisfaction and discover whether improvements are desired.

Methods

This study was conducted with hearing aid users in our US-based Beltone business. As a retailer, Beltone has direct interaction with its patients and maintains the ability to communicate with them about products and services. One important tool we use allows us to survey patients to gain insights into their experiences and satisfaction with their hearing aids. For the current study, a survey was emailed to a selected group of 23,526 recipients. The recipients could choose to click through the email to a web-based survey. We used screening questions to identify people who owned Receiver-in-the-Ear (RIE) hearing aids with streaming capabilities. RIE was selected as it is the most popular hearing aid style in the US today.[13] After that, people could skip any of the remaining questions and close the survey without completing it. All responses were anonymous, and no demographic or personal information about the people who responded to the survey was captured. The survey was kept open for two weeks. No compensation was offered to people who were sent the emailed invitation or those who chose to respond to the survey.

Results and discussion

Of the 23,526 recipients of the emailed invitation, 1,479 responded during the period that the survey was open. By answering the screening questions, 468 people identified themselves as owners of RIE hearing aids that they were certain had streaming capabilities. The remainder of the survey questions had varying numbers of responses because people could skip questions or stop

responding to the survey at any time. Therefore, for each question we provide the number of responses.

Coupling to the ear

The survey respondents chose a photo of the dome that matched what they wore on their hearing aids or could choose “other.” We interpreted “other” as custom earmolds. Figure 1 shows the distribution of dome types and other couplings, with 442 people responding to this question. Most (89%) reported using some type of dome with their hearing aids. The results of Coburn et al.,[12] suggest that leakage of low-frequency energy from the ear canal is likely to occur for these people – even those wearing the Power/Double style of dome - which could theoretically impact the sound quality of streaming by allowing low-frequency streamed sound to escape from the ear canal.

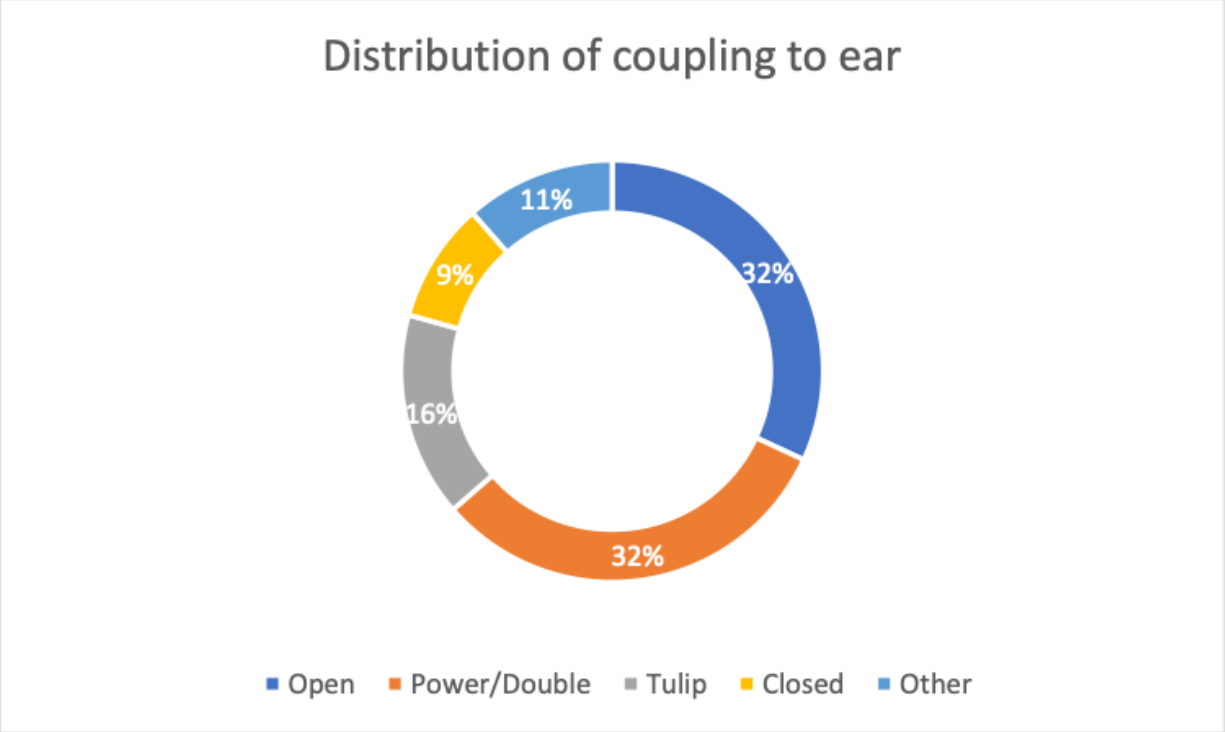


Figure 1. Survey participants indicated by clicking on a photo of the different dome types how their receivers were coupled to their ears. The “Other” category is assumed to be custom earmolds (442 responses).

Satisfaction

Participants were also asked to rate their overall satisfaction with streaming to their hearing aids on a 5-point Likert scale. There were 308 responses to this question, with a 77% majority indicating that they were “very satisfied” or “satisfied” (Figure 2).

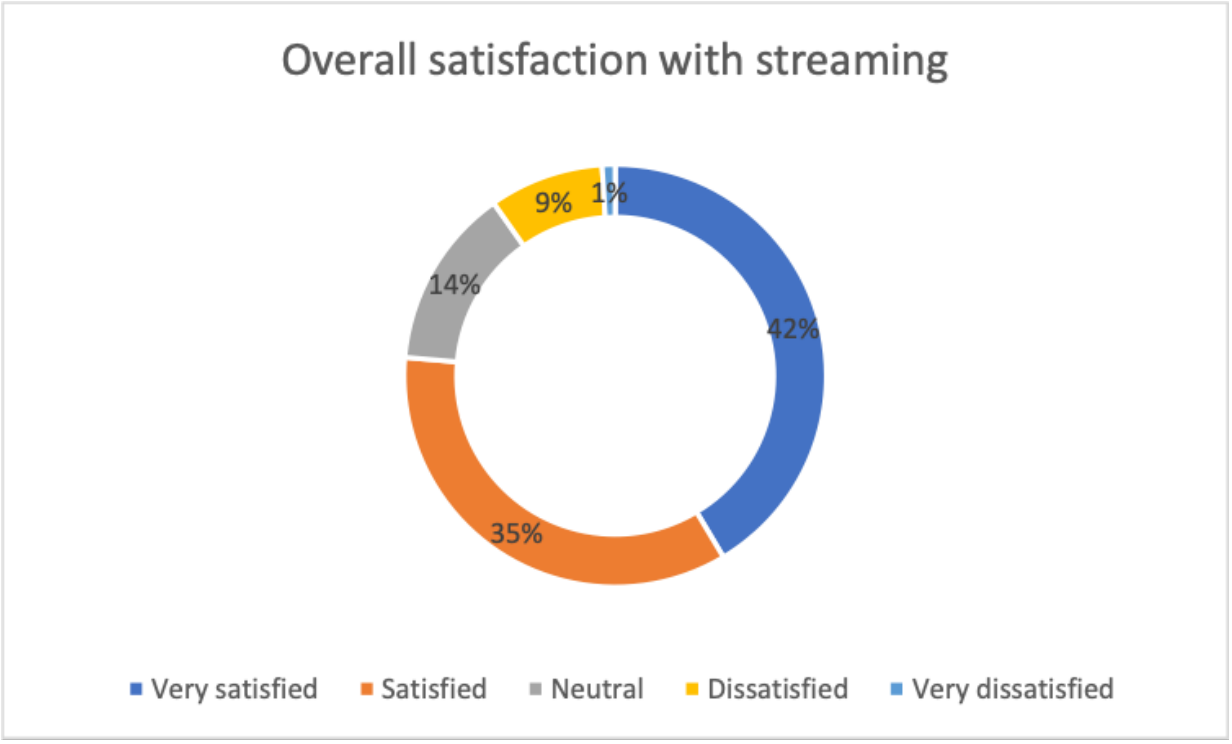


Figure 2. Participants' overall satisfaction with streaming to their hearing aids (308 responses).

The question about overall satisfaction did not differentiate satisfaction with sound quality versus functionality. Because the coupling to the ear canal might be expected to affect sound quality, the overall satisfaction responses were broken down according to coupling type, as shown in Figure 3. The "Open," "Tulip," and "Closed" dome types are known to provide little-to-no occlusion, so the results for these dome types were combined and are marked as "Non-occluding" in Figure 3. No significant differences were observed in overall satisfaction depending on coupling type. This suggests that the ratings may have been based chiefly on functionality – or the benefit of receiving a message – rather than sound quality.

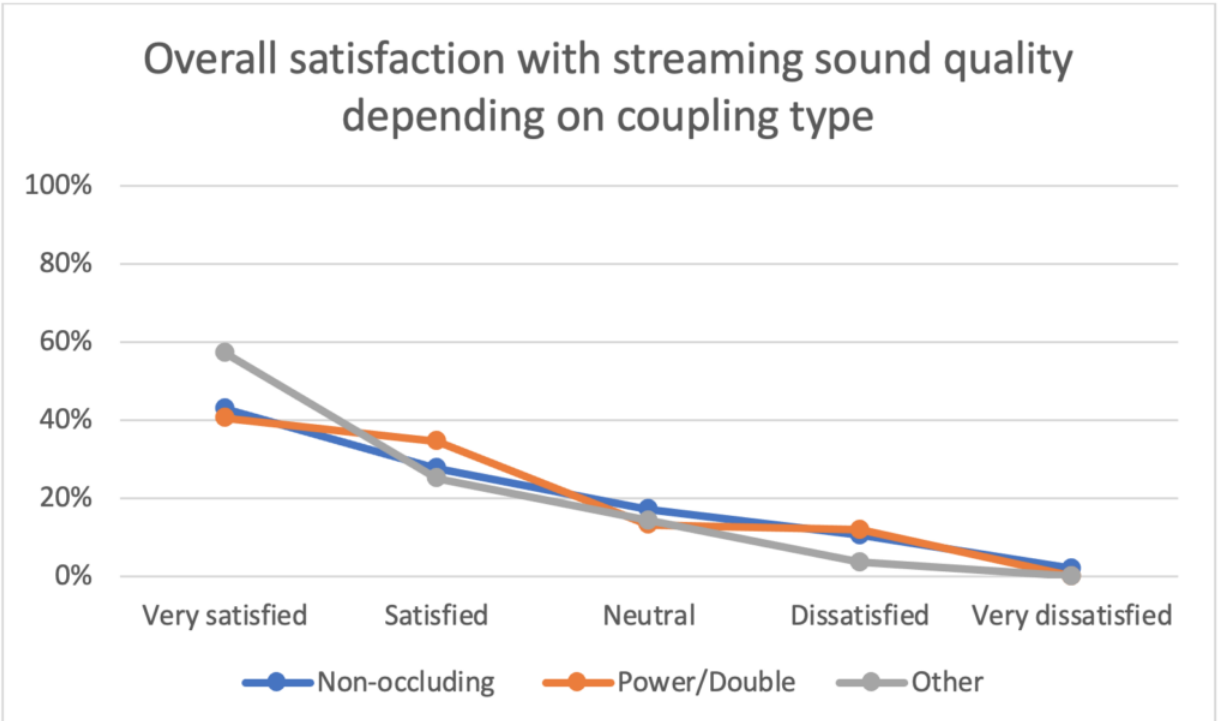


Figure 3. Percentage of each type of coupling as a function of satisfaction with streaming sound quality.

There were 264 people who indicated the coupling to their ears and also gave a satisfaction rating.

Benefit

To gain insight to how benefit is viewed, the respondents were also invited to write in free text asking “What is the main benefit to you of being able to stream sound to your hearing aids?” There were 160 responses to this question. However, in 57 instances, whether the person was referring to streaming wasn’t clear. For example, a “better hearing” response could refer to the overall benefit of wearing hearing aids. Therefore, only the 103 responses that clearly described benefits of streaming were included. All of these responses fell into seven themes with specific examples described below.

Convenience: 35% of responses. The most cited benefit related to how streaming was convenient. In fact, many responses quite simply stated that streaming was convenient. Most often they were specifically referring to “hands-free calls.” However, not switching to headphones or earbuds to listen to music or other audio content was also considered convenient.

Hear better on the phone: 25% of responses. The ability to hear better on the phone was often named the most significant benefit of streaming to their hearing aids. While most people functionally expressed the benefit – that they could hear better – one person described the benefit in emotional terms: “I’m not afraid to take calls anymore.”

Privacy: 15% The next most frequently named benefit of streaming is that people can listen to audio either from the TV, their phone or other devices at their preferred volume without disturbing others. Of those who mentioned this as the main benefit, half specifically used words like “Private” or “Privacy.” For example, “I can listen privately, without bothering others” was one response.

Sound quality: 8%. Fewer people mentioned sound quality as the main benefit of streaming. Those who did used the words “clarity” and “clear.”

Hear TV better: 7% A smaller percentage stated the main benefit as being able to hear the TV better than without streaming. One person mentioned that they no longer required captions to follow a TV program.

Better SNR: 6%. Although no responses expressed the benefit of streaming using technical terms, some said that by streaming, they were less bothered by noisy surroundings, could hear the sound they wanted better in noisy surroundings, or could focus better on the desired sound in background noise.

No missed calls: 4%. A few respondents most appreciated that they no longer missed phone calls because streaming meant the phone would ring in their hearing aids.

Use of streaming

Respondents were also asked to indicate what content they had streamed to their hearing aids. They were asked to select all types of audio they had tried streaming to their hearing aids. Streamed phone calls directly from a smartphone were the most common of the 306 responses at 87%. The second most commonly reported use of streaming at 38% of responses was videos on a smartphone or tablet. The very high rate of direct streaming of phone calls aligns with the high proportion of

responses naming hearing better on the phone as the main benefit of streaming.

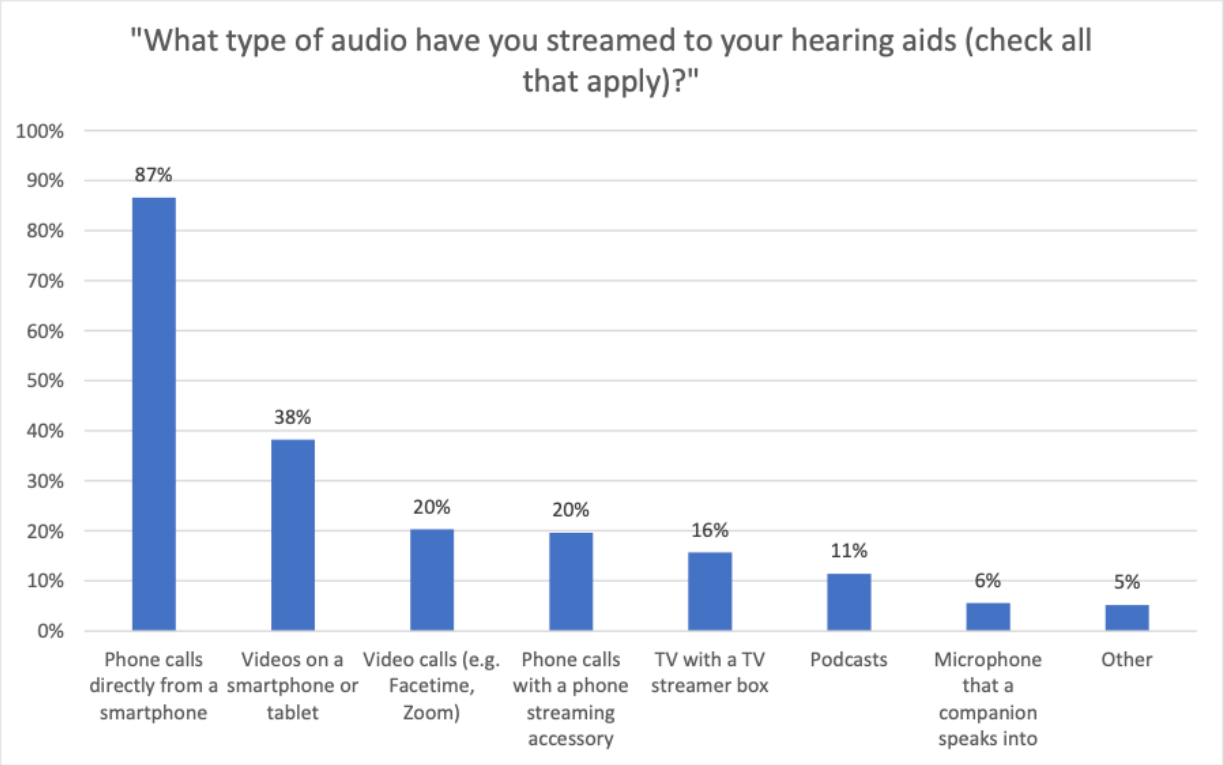


Figure 4. Types of audio streamed.

Sound quality when streaming

There were 373 responses from 288 people asking them to select descriptive words for sound quality. They could select more than one description from the list presented. Sixty-one percent of the responses positively described sound as “clear” or “full and rich.” Conversely, 34% of responses were that sound quality was “thin,” “tinny,” “too soft,” or “muffled.” A further 5% responded that the streamed sound was “too loud.”

Participants were also asked to respond “yes” or “no” to the question, “Do you wish the sound quality was better when you stream to your hearing aids?” Of 277 responses, 169 (61%) selected “no” and 108 (39%) selected “yes.” The fact that 61% of the selections from the list of sound quality descriptors (Figure 5) were positive is highly consistent with the 61% of people who indicated that they did not wish the sound quality was better when streaming.

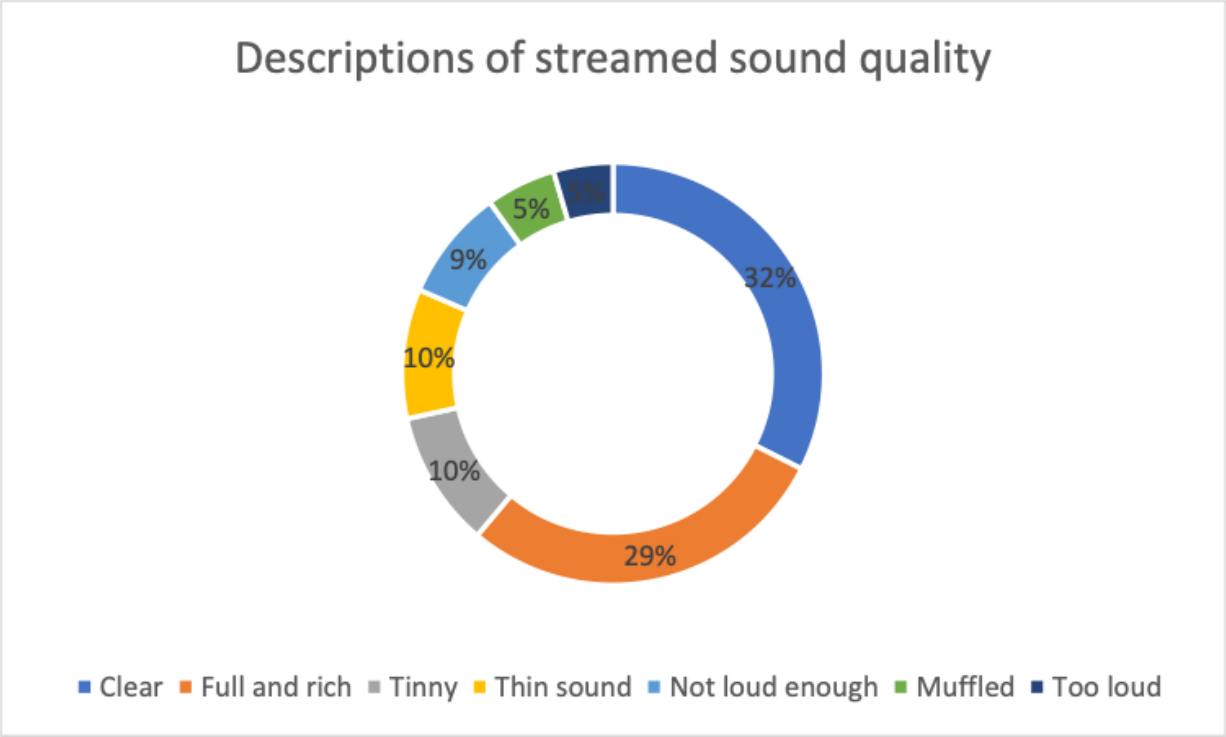


Figure 5. Description of sound quality.

To get specific feedback on what might be desirable in terms of improved sound quality, those who answered “yes” to the question asking them whether they wished for better sound quality were further asked to write in a response to “I wish the sound quality was more _____.” There were only 39 responses to this survey item, but 87% centered on more naturalness, better clarity, and more bass with an approximately equal number of responses for each (Figure 6). A few people also seemed to indirectly ask for these qualities by saying they wished that hearing aid streaming were like consumer audio. For example, “like quality speakers.” In the case of clarity and bass, these terms correspond closely to the qualities often selected to describe the streamed sound. Taken together these findings suggest that at least “clarity” and the fullness provided by a bass response are important drivers of a positive sound quality experience with streaming to hearing aids. Three responses asked for functional or technical improvements rather than sound quality, such as a wish for more robust connectivity.

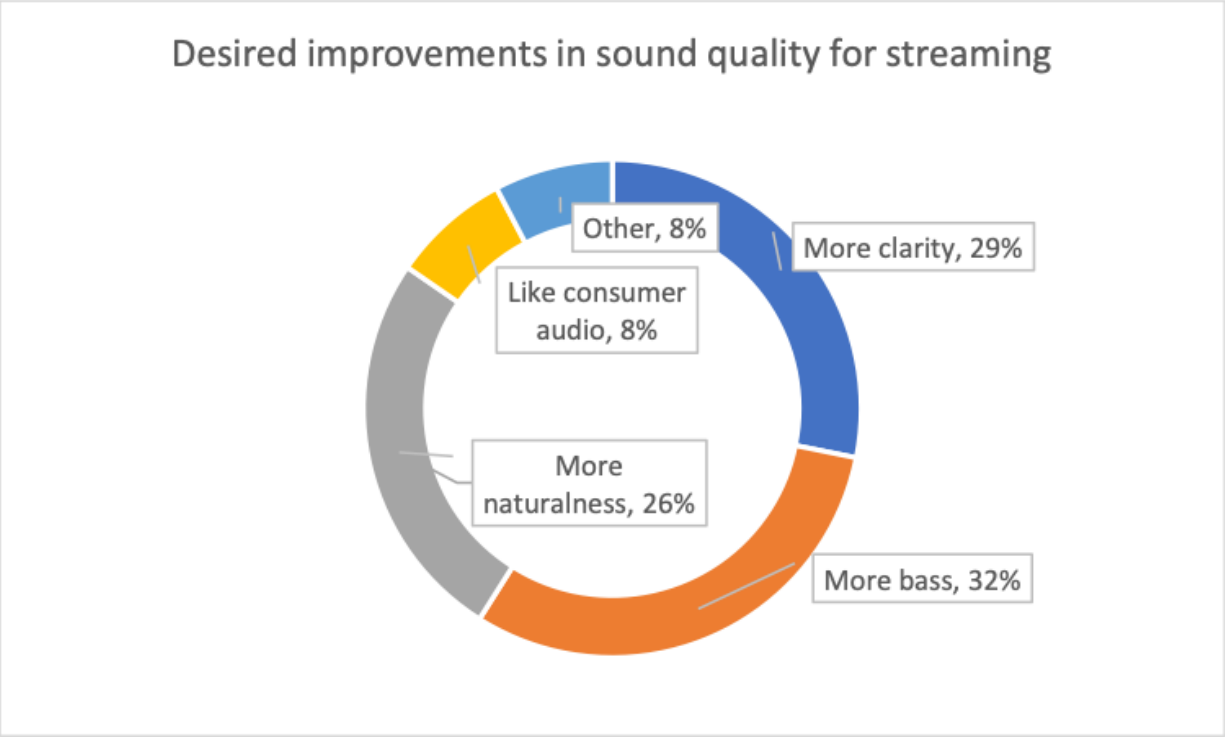


Figure 6. Desired sound quality improvements.

Participants were also asked whether they acted to change or improve sound quality when they used streaming, and 285 people responded. Presumably, some people will have interpreted this question to also mean whether they changed anything to hear better as well as or instead of improving sound quality. Most (66%) answered that they did not change anything, while 32% indicated that they changed sound settings via the push button on their hearing aids, a remote control, or a smartphone app. Only 2% responded that they changed domes on their hearing aids to improve sound quality.

Conclusions

It is both a strength and a limitation of this survey that participants were recruited from among purchasers of one brand of hearing aids and that only owners of RIE were included. On the one hand, the technology supporting the streaming, the basic signal processing in the hearing aids, and the coupling options used by the participants were the same for all. This means fewer variables might affect their streaming experience than if users of multiple brands and/or hearing aid styles were surveyed. On the other hand, not all of the 468 people who identified themselves as owners of RIE hearing aids that could stream answered all of the questions, introducing a bias that could have affected the overall results. Furthermore, any conclusions can only be confidently applied to users of Beltone hearing aids. That said, there were a large number of responses to most questions and no questions were asked that were specific to the hearing aid brand. In addition, participants were nuanced in their feedback, offering both assessments of benefit and criticisms. Therefore, it seems reasonable to make some statements that would apply to hearing aid streaming experiences in general. Based on this survey, we feel confident in concluding that:

- Hearing aid users appreciate streaming to their hearing aids, recognize benefits, and are mostly satisfied.
- Satisfaction with streaming does not seem to be a function of the type of ear canal coupling. By

extension, this may mean that sound quality is not the primary driver of satisfaction with streaming.

- Most people use streaming to take phone calls directly from their smartphones and recognize this as beneficial.
- The most frequently mentioned benefit of streaming to hearing aids is that it is convenient and that hearing on the phone is better.
- The majority of responses regarding sound quality were positive.

The fact that users are enthusiastic regarding the benefits of convenience and hearing phone calls better is great news. Hearing aid manufacturers also have opportunities to further improve satisfaction with streaming beyond these benefits so that users not only get the desired audio information easily but also delight and enjoy the experience. This may become increasingly important for users as the new Auracast™ broadcast audio (https://bluetooth/auracast) gradually becomes available in hearing aids, consumer devices and public spaces.

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