

STUFF HAPPENS: PUTTING REXTON RUGGED REAL-LIFE RELIABILITY TO THE TEST

WHITE PAPER

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REXTON



Introduction

The primary purpose of hearing aids is to enable individuals with hearing loss to live their lives with minimal limitations. This ambition sets high standards for the hearing aids' audiological performance, which includes essential functions such as amplifying soft sounds, moderating loud noises, and clarifying speech. Moreover, the unique lifestyle and specific auditory needs of each user dictate additional, tailored requirements. Fortunately, advances in hearing aid technology over recent years have been significant, and now meet many of these audiological needs. As a result, user satisfaction with hearing aids is generally quite high (e.g., Bannon et al., 2023; Picou, 2022), and the percentage of hearing aid users reporting that their hearing aids regularly improve their quality of life has increased (Picou, 2022).

However, even the most advanced hearing aids will be no benefit to their users if they malfunction, and unfortunately, hearing aids are exposed to numerous hazardous factors during use. Wearing them in or behind the ear exposes them to the harshness of dust, sunlight, moisture, perspiration, and rain. If the user forgets to take them off in the shower they will be exposed to water and soaps. Hearing aids may be also accidentally dropped on the floor. As hearing aids are advanced electronic devices with a lot of delicate components, these encounters with real life may cause malfunctions, which can lead to non-functioning – and therefore useless – hearing aids.

Not surprisingly, an online consumer survey of almost 15,000 respondents (Manchaiah et al., 2021) found “reliability” to be the second most desired hearing aid attribute among users, with 85.1% of respondents reporting reliability to be “very” or “extremely” important. Only “hearing friends and family in noise” was rated to be more important, with 88.3% of respondents finding it very or extremely important. In the same survey, 45.4% of respondents found “dust resistance” to be very or extremely important, and 54.3% found water resistance to be very or extremely important. These data clearly demonstrate that reliability (the hearing aids' ability to function as required over a given period) and durability (the hearing aids' ability to withstand physical damage from normal use over a long time) are not just nice-to-haves; they are must-haves for hearing aid users.

Rexton has a special focus on these types of users and their specific requirements when developing hearing aids. A good example is Rexton Rugged hearing aids. These hearing aids were designed with one thing in mind: to provide a reliable listening experience under all possible usage conditions. In this paper, we report the results from a survey where respondents were fitted with Rexton Rugged and tried it out in their own everyday environment. They were asked to rate the performance of Rugged and compared it to the performance of their own hearing aids. We even asked them to be a little rougher than usual and submit Rugged to treatment they would not normally expose their own hearing aid to.

Before presenting the survey and the results, we will briefly introduce Rexton Rugged and explain what was done to optimize its durability and reliability.

Rexton Rugged

Rexton builds on reliable technology and durable construction at every product launch. When developing the Rexton BiCore B-Li Rugged hearing aids – referred to as Rexton Rugged (or just Rugged) in this paper – the ambition was to make it the most robust Rexton behind-the-ear (BTE)

hearing aid ever, reinforcing the Lifeproof™ pillar of the BiCore platform (Rexton, 2021) and enhancing the reliability experienced by the user – even in the toughest situations.

Rexton Rugged distinguishes itself from previous models with its superior resistance to scratches, impacts, sweat, and water exposure. These enhancements result from several design improvements, including a more robust housing, enhanced sealing and coating, an IP68-rated membrane for microphone inlets, a new airtight receiver, refined receiver suspension, and improved tactile rocker switches. Collectively, these enhancements ensure unprecedented durability and reliability. This claim is supported by extensive testing that simulates real-life and extreme use scenarios. The hearing aids were subjected to drop and scratch tests, water immersion at a depth of 2 meters, exposure to shower water, sweat, UV light, mud, sunscreen, sebum, machine oil, and perfume.

While durability was a strong focus point when optimizing the reliability of Rugged, there is obviously an audiological aspect of reliability as well. The user also needs to be able to rely on the hearing aids' ability to make them hear – no matter what situation they are in. Providing a fully reliable listening experience is therefore also a main goal for Rugged.

In addition to the Lifeproof™ pillar, the BiCore platform incorporates two other technological pillars. The second pillar, Clean Sound, focuses on the processing of input signals, even high input sounds in challenging conditions, as faithfully as possible, preventing distortion and other artifacts that degrade the sound and thereby the listening experience. This is achieved using an input stage with an advanced analog-to-digital converter that cleanly processes sounds up to 117 dB SPL.

The third BiCore pillar is Reliable Technology, focusing on the clarity of sounds in the surrounding environment, without compromising on speech understanding. The core element is Speech Preservation Technology (SPT). It uses directional analysis to separate speech from noise, allowing independent processing of both signals before they are mixed together. Speech can be optimized for better understanding, while background noise can be processed simultaneously with noise reduction and a separate set of compression characteristics. SPT is an important part of SoundPro 2.0, which analyzes and adapts to the environment based on the user's motion, the signal-to-noise ratio, ambient sound modulation, and speech origin.

In the survey presented here, we investigated how hearing aid users perceived the durability and reliability as well the audiological performance offered by Rugged when using it in their everyday life.

Survey methods

To assess the audiological performance, reliability, and durability of Rexton Rugged in real life, we carried out an international survey. This involved asking hearing care professionals (HCPs) to fit some of their experienced clients with Rexton Rugged. These hearing aid users acted as respondents. Their task was to evaluate Rugged in their own everyday life and compare their experience of it with that of their own hearing aids. The evaluation included some special tasks that tested Rugged in various challenging conditions.

Respondents

A total of 46 respondents (12 female, 34 male) completed the survey (9 in the UK, 12 in Germany, 13 in South Africa, and 12 in Taiwan/Hong Kong). The different geographical regions were chosen because they offered a range of climatic conditions, including heat and/or humidity which are particularly challenging for hearing aids.

The age of the respondents spanned the range 23-96 years, with an average age of 61 years. All had a sensorineural hearing loss within the fitting range of Rexton Rugged, and all were experienced hearing aid users, with a median self-reported hearing-aid experience of 5.5 years. The self-reported median age of their current own hearing aids was 3 years, and they used a wide range of different models, from a wide range of manufacturers.

When recruiting respondents, the only age requirement was that they should be over 18 years old and that they should be physically active to carry out a meaningful test of Rexton Rugged. When asked about their employment status, 19 reported to be actively working, 5 were not actively working, while 22 reported to be retired. A specific requirement was that the respondents should have access to the internet and own a smartphone so they could complete the online questionnaires used in the survey.

Survey protocol

The protocol included one visit to the HCP clinic – or two visits if ear impressions were needed to produce new custom ear molds. After receiving information about the survey and signing a consent form, each respondent was fitted with Rexton Rugged using the proprietary Rexton SmartFit rationale and in accordance with the HCP's usual fitting procedure. Fine-tuning was applied when deemed necessary by the HCP.

The respondents were asked to answer some background questions (about age, gender, etc.) and some questions on their experience using their own hearing aids in an online questionnaire. The respondents were then asked to use the Rugged hearing aids for two weeks in their everyday life. After two days, the HCPs contacted the respondents to ensure that everything was going well with the new hearing aids.

Once the respondents had used the Rugged hearing aids for three weeks, they then received a link to a second questionnaire concerning their experience using Rugged (similar to the questions they had answered for their own hearing aids). Furthermore, they were asked questions about the special tasks they had been asked to perform during the test period (see a description of the tasks in a separate section below).

Once the second questionnaire was completed, the respondents were asked to switch back to their own hearing aids and wear them again for two weeks. After this period, they received a link to a third questionnaire, mirroring the survey questions they were asked about their own hearing aids. Respondents were asked to switch to the Rugged hearing aids and use them for two weeks before completing the fourth and final questionnaire. In addition to the survey questions that appeared in the previous three questionnaires and the questions on the special tasks that respondents also were asked to do in the second Rugged round, the fourth and final questionnaire also asked respondents to state a preference for Rugged or their own hearing aids across different parameters.

The second assessment of Rugged marked the end of the survey. Thus, both Rugged and the respondents' own hearing aids were assessed twice during the span of the survey period. Figure 1 summarizes the timeline for the entire survey process.

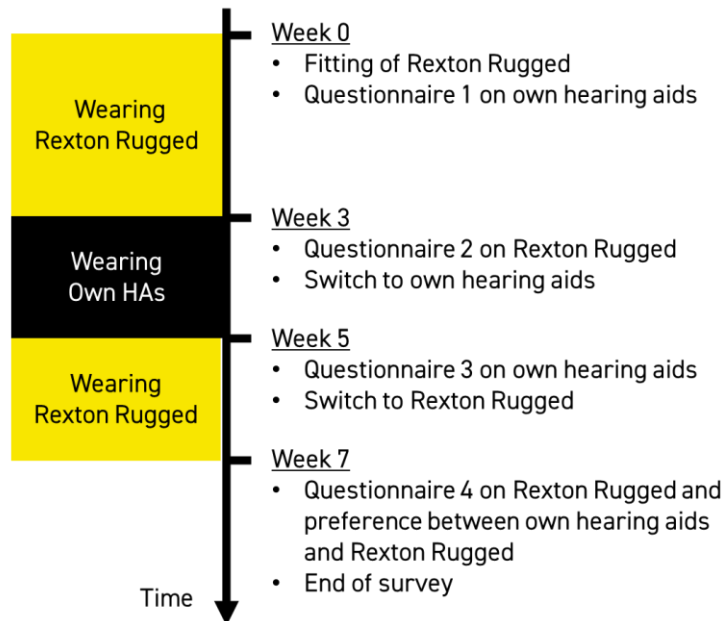


Figure 1. Timeline for each survey respondent. A total of four questionnaires were administered at different times, assessing both Rexton Rugged and the respondent's own hearing aids twice.

Special tasks

In each of the two test periods where the Rugged hearing aids were used, respondents were asked to perform four different tasks during the period. These were:

1. Take a shower with the hearing aids, using shampoo as you normally would.
2. Drop the hearing aids on a hard floor (from ear height).
3. Perform an activity involving physical exercise that makes you sweat.
4. Perform an activity for which you would normally take off your hearing aids in order to protect them.

The respondents were instructed to pay attention to how well could hear during and after performing each task, and if a malfunction appeared, they were asked to register how much time it took for the hearing aids to return to normal functionality.

In the instructions, it was made clear that the special tasks should only be performed while using Rexton Rugged, not while using their own hearing aids.

Questionnaires

All questionnaires were administered online and could be answered using a smartphone, tablet or PC. The respondents received a link via email and text message at the end of each test period, and they also received a reminder to switch hearing aids (after three and five weeks, respectively) when they had filled in the questionnaire.

The questionnaires included various questions about satisfaction in different listening situations and (in the final questionnaire) questions on the preference between Rugged and the respondents' own hearing aids. The questionnaires also asked about the perceived durability and reliability of the hearing aids and about whether the respondent would recommend the hearing aids to others. Furthermore, the two questionnaires on Rugged included a section with questions on the special tasks the respondents were asked to perform.

The specific questions asked in the questionnaires will be explained during the following presentation of the results.

Results

In the following, we present the results from the various sections of the questionnaires.

Satisfaction

In each of the four questionnaires, the respondents were asked to rate their level of satisfaction with the hearing aids they had just used. The questions were categorized as follows:

- Overall satisfaction
- Overall sound quality
- Speech understanding across all communication situations
- Sound of own voice when speaking with others
- Physical look
- Physical comfort

The ratings were made on a seven-point Likert-type rating scale going from “very dissatisfied” over “neutral (neither satisfied nor dissatisfied)” to “very satisfied”. In the analysis of the data, the seven-point categorical scale was transformed to a seven-point numeric scale from 0 (very dissatisfied) to 6 (very satisfied). Figure 2 shows the mean satisfaction ratings in the final assessments made in week 5 (own hearing aids) and week 7 (Rexton Rugged), that is, when respondents had used both sets of hearing aids and were maximally acclimatized to Rugged.

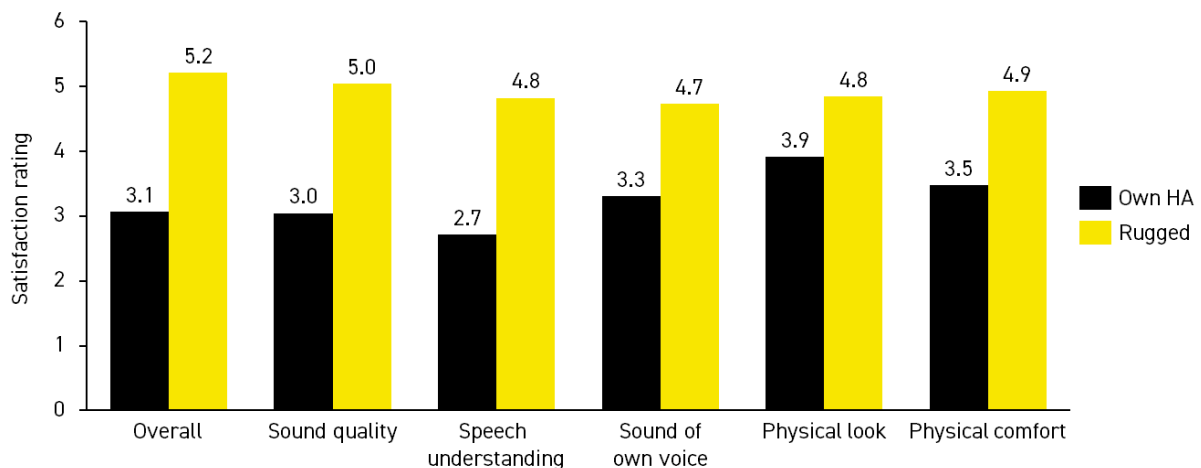


Figure 2. Mean satisfaction ratings of own hearing aids and Rexton Rugged, respectively, on a 0-6 scale, where higher ratings indicate more satisfaction.

For all six categories, substantially higher satisfaction ratings were observed for Rexton Rugged than for own hearing aids. While the mean ratings of own hearing aids were in the range 3.0-3.9 (i.e., in the middle or just above the middle of the scale), the mean ratings of Rugged were in the range 4.7-5.2 (i.e., in the upper end of the scale) – with the highest mean rating (5.2) obtained for the category of overall satisfaction.

The satisfaction ratings (from all four questionnaires) were analyzed using a mixed model ANOVA, with hearing aids (Rugged and own hearing aid), item (1-6), and assessment number (first and second) as fixed effects, and with respondent (1-46) as a random effect. The result of the analysis showed highly significant main effects of both hearing aids, item, and respondent (all $p < .0001$), whereas there was no significant effect of assessment number ($p = .86$). The latter finding indicates that there was no significant difference between the mean ratings of the hearing aids provided in first and the second assessment. A Tukey post-hoc test was applied to assess the difference between Rugged and own hearing aids across the specific categories. This analysis showed significant differences for all six items (all $p < .0001$). Thus, Rugged provided a level of satisfaction which was significantly higher than that of the respondents' own hearing aids in terms of perceptual aspects (sound quality, speech understanding and sound of own voice), design-related aspects (physical appearance and comfort), and overall general satisfaction with the hearing aids.

Another way to analyze and present the satisfaction ratings is to calculate the 'Top 3 Box' scores, which indicate the percentage of the respondents who stated some degree of satisfaction by choosing one of the three upper response categories ("somewhat satisfied", "satisfied", "very satisfied") on the 7-point scale. This calculation was done for all six satisfaction items, and the results are plotted in Figure 3, again showing the results from week 5 (own hearing aids) and week 7 (Rexton Rugged).

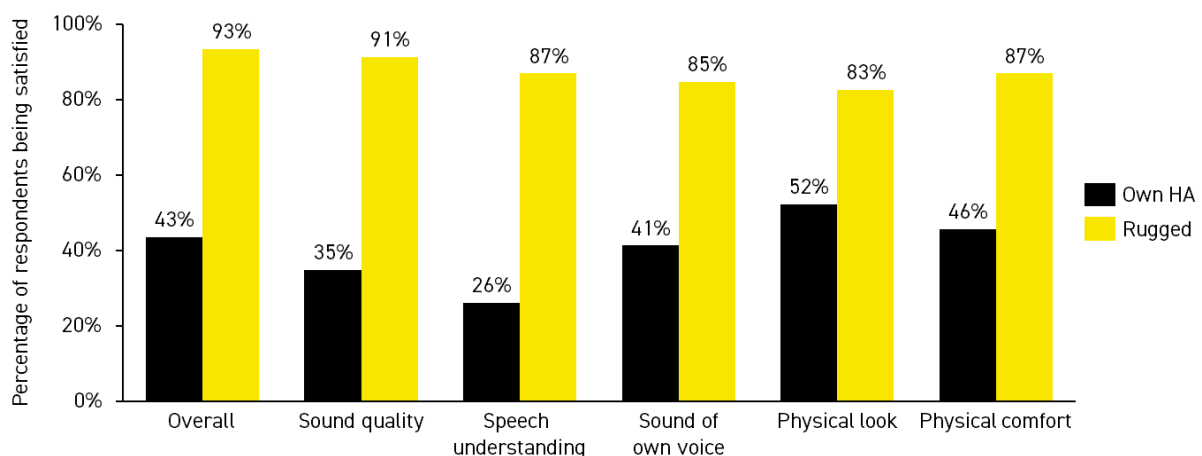


Figure 3. Percentage of respondents being satisfied (Top 3 Box) with own hearing aids and Rexton Rugged, respectively, in the six questions for which mean ratings were presented in Figure 2.

Since it is based on the same underlying data, Figure 3 shows the same overall data pattern as observed in Figure 2. For all six items, the percentage of respondents satisfied with Rexton Rugged is much higher than the percentage of respondents satisfied with own hearing aids. For Rugged, all percentages are above 80%. A striking observation is that 93% expressed an overall satisfaction with Rugged, while only 43% were satisfied with own hearing aids. The biggest difference between Rugged and own hearing aids was observed for 'speech understanding' where only 26% were satisfied with their own hearing aids, whereas an impressive 87% were satisfied with Rugged. The BiCore platform's Speech Preservation Technology with its ability to process speech and noise separately is a likely main driver for both the high overall satisfaction and the high satisfaction with speech understanding.

Willingness to recommend hearing aids

Following the questions about satisfaction, respondents were asked whether they would recommend the hearing aids they had just worn to others. Figure 4 shows the percentage of respondents who stated that they would recommend their own hearing aids (when asked in week 5) and the Rexton Rugged hearing aids (when asked in week 7).

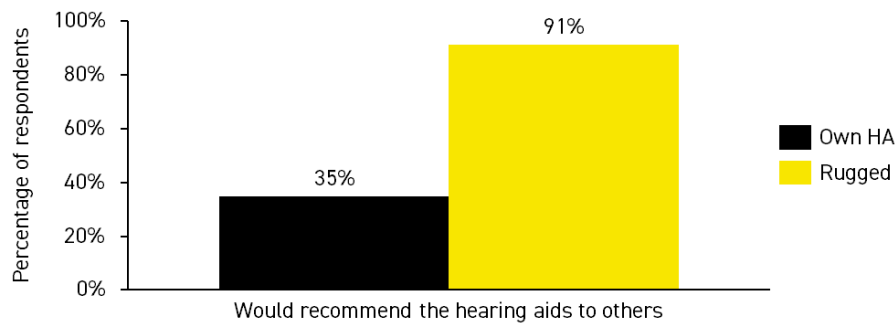


Figure 4. Percentage of respondents stating that they would recommend the hearing aids to others, when asked about own hearing aids and Rexton Rugged.

The difference between own hearing aids and Rexton Rugged is very clear on this question. While only 16 out of the 46 respondents (35%) would recommend their own hearing aids, 42 (91%) would recommend Rexton Rugged. This difference is highly significant ($p < .00001$) according to a binomial test comparing the two ratios.

Perception of reliability/durability

In each questionnaire, the respondents were asked to state their level of agreement with the following statements about the perceived reliability and durability of own hearing aids and Rexton Rugged, respectively:

- I can do the things I want to do without worrying the hearing aids will not work.
- I can always rely on the hearing aids.
- I think the hearing aids are durable.
- I think the hearing aids are reliable.

For each category, ratings were made on a 7-point Likert scale going from “strongly disagree” (0) over “neutral (neither agree nor disagree)” (3) to “strongly agree” (6). In Figure 5, the mean ratings are plotted for own hearing aids and Rugged. As above, the assessments made in week 5 and week 7 are shown.

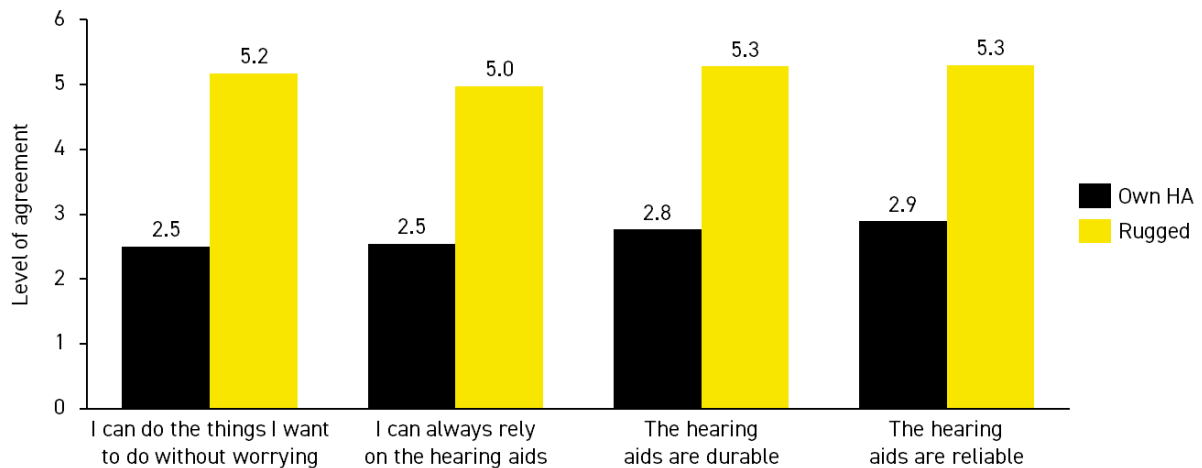


Figure 5. Mean ratings of level of agreement with the statements indicated (on a 0-6 scale), where higher ratings correspond to higher level of agreement.

The results plotted in Figure 5 show that Rugged was rated substantially higher in every category than the respondents' own hearing aids. While the own hearing aids received mean ratings just below the middle of the scale, the mean ratings of Rugged were in the upper end of the scale (in the range 5.0-5.3). When evaluating these ratings, it should of course be acknowledged that the Rugged hearing aids were new and only used for a combined period of five weeks, whereas the median age of the respondent's own hearing aids was three years. Therefore, for some aspects of reliability and durability, a direct comparison is difficult to make. However, these results still clearly indicate that the first impression of durability and reliability provided by Rugged was very positive in this group of experienced hearing aid users.

The reliability/durability ratings were analyzed in the same way as the satisfaction ratings, using a mixed model ANOVA. The result of the analysis showed highly significant main effects of both hearing aids and respondent (both $p < .00001$), but no significant effect of item ($p = .13$). The latter finding is a result of many respondents giving the same rating for all four items (for a given hearing aid), whereas the significant effect of hearing aids shows that they rated the hearing aids differently (as demonstrated quite clearly in Figure 5). As in the analysis of the satisfaction ratings, there was no significant main effect of assessment number ($p = .65$), but in this case, there was a significant interaction ($p < .01$) between hearing aids and assessment number, indicating that the difference between the two hearing aids was larger in the second assessment (shown in Figure 5) than in the first assessment. Thus, using the hearing aids for a longer time seemed to make the respondents more aware of the differences in reliability and durability.

As with the satisfaction data, the Top 3 Box scores were calculated as the percentage of the respondents who stated some level of agreement with the statements in the four categories. The results are shown in Figure 6.

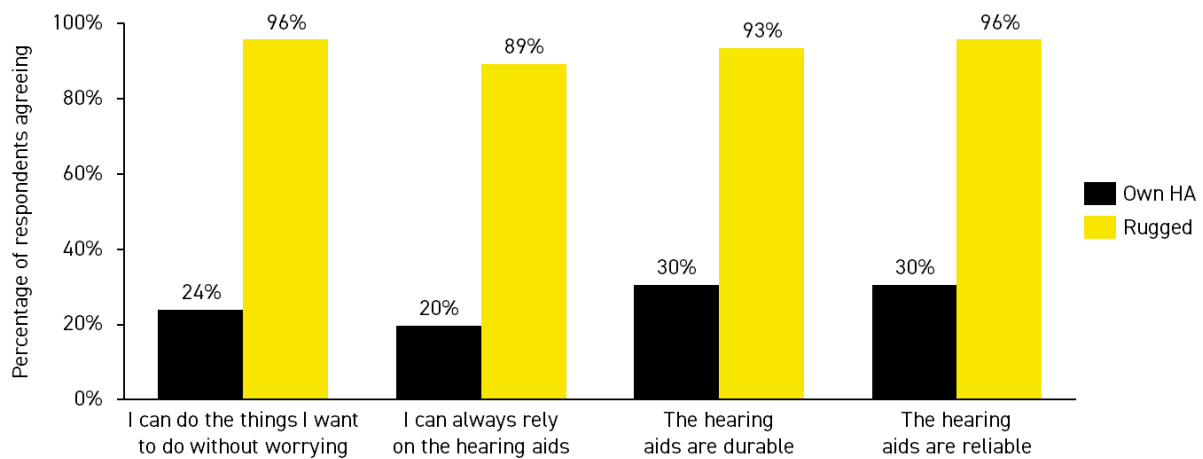


Figure 6. Percentage of respondents agreeing with the indicated statements (Top 3 Box scores) when using their own hearing aids and Rexton Rugged.

The percentage of respondents agreeing with the statements ranged from 89% to 96% for Rexton Rugged, while the range for own hearing aids was 20% to 30%. While the short assessment period of Rugged obviously still should be considered, it is quite impressive that 93% and 96% of the respondents perceived Rugged as durable and reliable, respectively.

Special durability tasks

In the two Rugged test periods, the respondents were asked to complete four different special tasks (showering, dropping the hearing aids on the floor, physical exercise, and another activity where hearing aids would normally not be used). In the questionnaires, the respondents were asked whether they had completed each task, and if so, if they had experienced any issues (malfunctions) during or just after completing the task. If an issue was reported, they were asked if the issue had disappeared spontaneously and if so, how long this took.

Figure 7 shows, for each of the four tasks completed in each of the two test periods, the number of respondents completing the task, the number of respondents who experienced an issue during or just after completing the task, and the number of these issues which disappeared spontaneously within six hours after the task was completed. For example, the upper left panel in Figure 7 shows that 40 (out of 46) respondents took a shower with Rexton Rugged in the first test period (assessed at week 3). Of these 40 respondents, 36 (90%) did not experience any sound issues with the Rugged hearing aids during or after the shower. All four subjects who reported an issue stated that the issue had disappeared spontaneously within the first six hours (allowing air drying to take place). Three of the four respondents actually reported that the issue had disappeared within two hours.

Figure 7 shows that the eight tasks (four tasks in two test periods) were completed by between 27 and 42 respondents (out of 46). In total, the respondents performed and rated 289 tasks. Not surprisingly, the task completed most frequently was the 'drop HA' task – which was very easy to perform – while the task performed the least was the 'other activity' task, which was formulated as a task very open to interpretation, and some respondents may have had trouble finding an appropriate activity. Among the respondents who did complete the 'other activity' task, the activities in this category included, for example, cooking, cleaning, gardening, cycling, and firefighting. A closer look at the data shows that the lowest number of tasks performed by one respondent was three, while 13 participants completed all eight tasks.

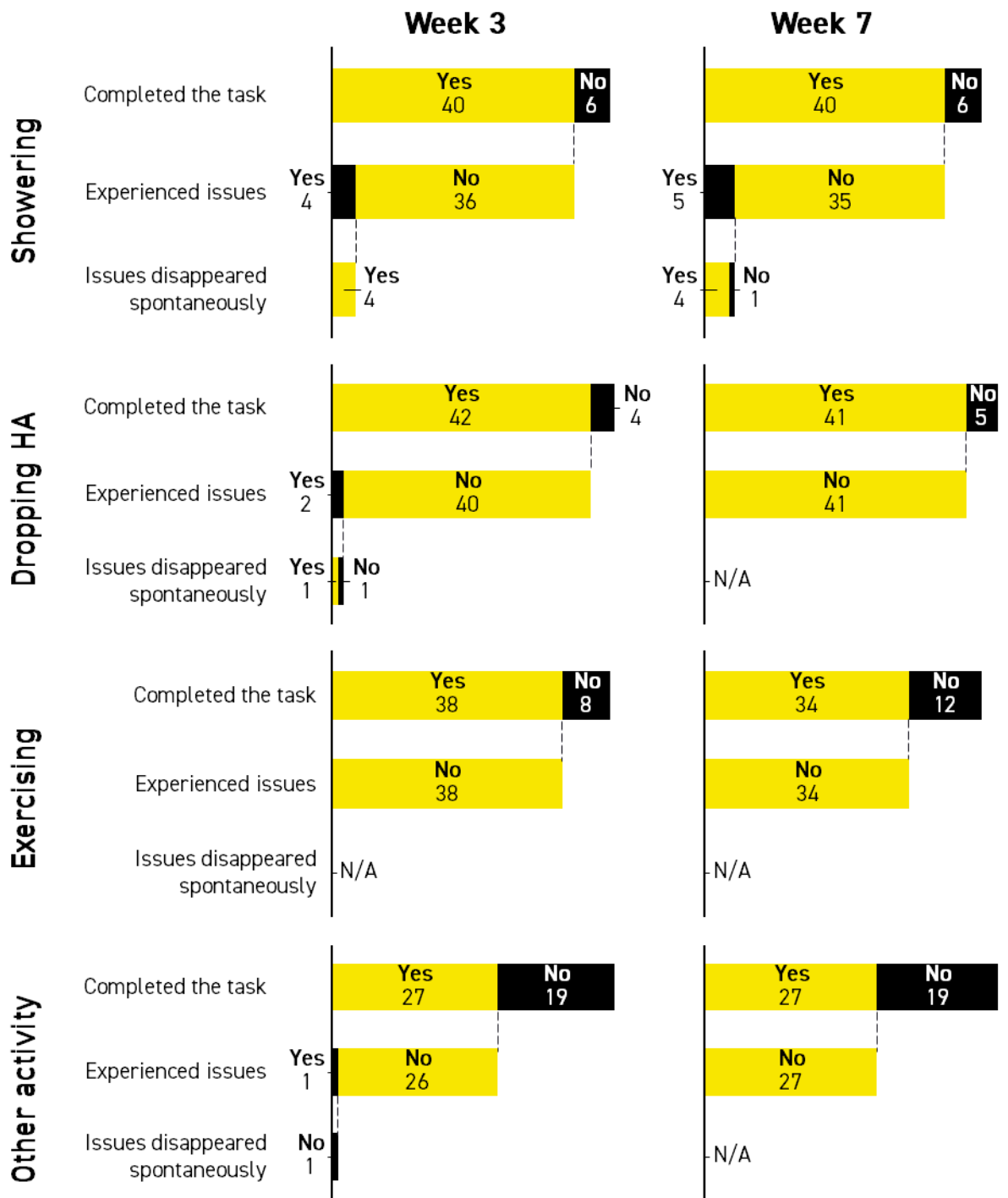


Figure 7. For each of four special tasks and each of two test periods (assessed at week 3 and 7), the panels show the number of respondents who completed the task with Rexton Rugged, the number of participants who experienced issues with the hearing aids after completing the task, and the number of issues disappearing spontaneously (within 6 hours).

The overall trend is that most respondents did not report any issues. For the 'exercising' task, no issues were reported by any of the 38 (week 3) and 34 (week 7) respondents who completed the task. For the 'other activity' task, one issue was reported (in week 3), and for the 'drop HA' task, two issues were reported (in week 3).

The task where most issues were reported was the 'showering' task, where four issues were reported in week 3 and five issues were reported in week 7. The higher frequency of issues observed for the showering task is not surprising, since such exposure to water (not least in the

microphone inlet) can have a major effect on the sound. However, in eight of the nine cases, removing the water by simply air drying the hearing aids was enough to restore them to full functionality. Six respondents reported that this happened within the first two hours, while the last two reported it happened within six hours. In the last case, where a non-disappearing issue was reported (in week 7) in connection with the showering task, we suspect the report of an issue was made by mistake when answering the questionnaire, since comments from the respondent on the showering experience indicated that no problem occurred.

In the two other cases where a non-disappearing issue was reported for the 'drop HA' task and the 'other activity' task, respectively (both in week 3), comments made by the respondents indicate that the issues reported may not be directly related to the task. In the 'drop HA' case, the respondent reported that one of the hearing aids already had a problem before the task was completed. In the 'other activity' case, the respondent's comments indicate that the issue was about noise (at a children's party) being overwhelming – and not about an issue caused by the physical working conditions. We interpret the comment as if the loudness issue didn't disappear while being in the situation.

For the three tasks where the Rugged hearing aids were worn while performing the tasks, the respondents were also asked to rate how satisfied they were with their listening abilities while performing the task, using the same 7-point scale as used in the other satisfaction ratings. For the 'showering' task the mean ratings were 4.4 (week 3) and 4.8 (week 7), for the 'exercising' task, the two mean ratings were 5.0 and 5.1, and for the 'other activity' task, they were 5.0 and 5.2. Thus, the mean ratings of satisfaction with listening abilities while performing the task were very close to the mean ratings of general satisfaction. The 'showering' ratings were a bit lower – although still in the satisfied range of the scale – but this was a rather special situation where the sound of the water was the most dominant sound source. However, a few respondents commented that they could hear a television in a neighboring room or other environmental sounds. Other respondents commented that showering with the hearing aids – something they would normally never do – was a somewhat peculiar experience for them.

All in all, the questionnaire data on the special tasks clearly indicate that Rexton Rugged could handle those tasks. In the 12 cases where issues were reported, the issues either disappeared spontaneously (nine cases) or were not likely to be caused by performing the tasks (three cases).

Preference

In the final questionnaire (in week 7), the respondents were asked to state their preference between Rexton Rugged and their own hearing aids in the following five categories:

- Overall preference.
- Easier listening in daily life.
- Better speech understanding across all listening situations.
- Appearing more reliable.
- Appearing more durable.

The percentage of respondents preferring own hearing aids and Rexton Rugged, respectively, is shown in Figure 8 for each of the five items. An overwhelming preference for Rugged is observed for all five categories. Out of the 46 respondents, 44 (96%) stated an overall preference for Rugged. On all items, at least 44 (96%) has a Rugged preference, and on the question about which hearing aids appeared more durable, all 46 respondents (100%) picked Rugged.

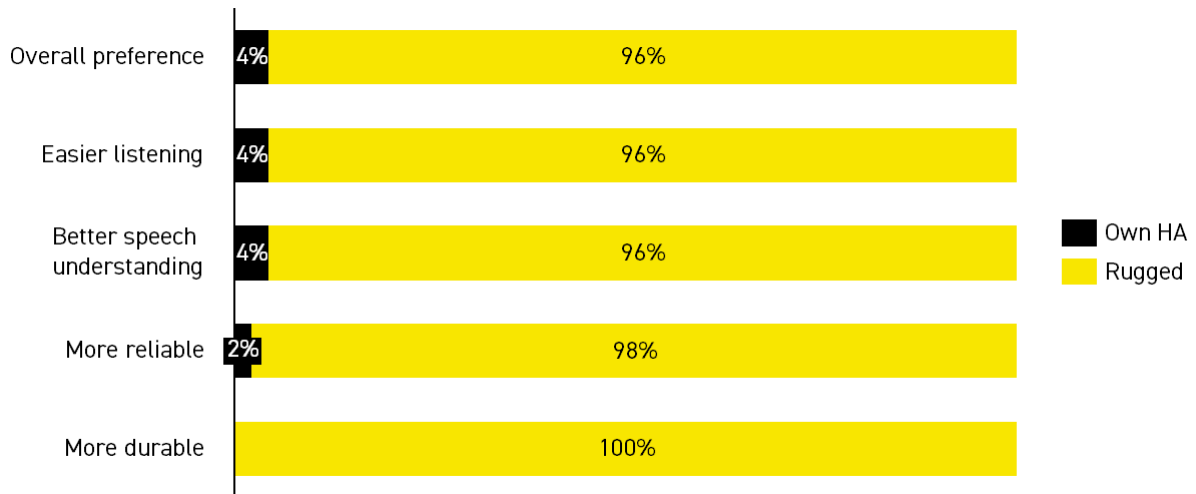


Figure 8. The percentage of respondents stating a preference for own hearing aids and Rexton Rugged in each of the five categories.

Testimonials

Besides rating their satisfaction numerically on a number of different scales, the respondents were also asked to describe, in their own words, their experience with Rexton Rugged when performing the special tasks. Furthermore, in the final questionnaire, after stating their preference between own hearing aids and Rexton Rugged, the respondents were asked to write down the reasons for their preference.

As a result, a number of testimonials were shared that provided more detailed insights in the respondents' perception of Rugged. A subset of the respondents' comments (translated to English where needed) are listed here:

Comments regarding the shower task:

- *"I was quite nervous at first, but they [the hearing aids] worked while I was showering with them and were working after I left them to dry. I have had no issues since wearing them in the shower."*
- *"I was very surprised that the hearing aids worked all the time while I showered. Could hear the water in the shower for the first time."*
- *"I was very surprised that the Rexton hearing aids did not stop working at any point, even though I could hear the water running over them. Although it felt strange as this is not something I would normally do while wearing hearing aids, I was pleasantly surprised that they worked during and after wearing them in the shower."*

Comments regarding the drop task:

- *"I dropped them from ear height and was pleased to see absolutely no damage when I picked them up, and they were working perfectly when I put them back on."*
- *"I dropped the hearing aids with a heavy heart because I couldn't believe it would still work after the fall. It was really a great relief that there was no damage and the devices still worked as before."*
- *"Was worried that it would break but to my surprise it works perfectly, very pleased and happy with the hearing aids."*

Comments regarding the exercise task:

- *"I run at least 5K every day, sweat soaked, can be used normally, very stable."*
- *"Went to the gym, sweated a lot, no noticeable issues yet."*
- *"Intensive back gymnastics. The devices didn't bother me, and I could hear the coach's announcements well."*

Comments regarding the 'other activity' task:

- *"I worked with my woodworking machines that make very loud noise. My previous hearing aids did not subdue the sound and I always had to take it out. With Rexton I was able to work comfortably with the machines."*
- *"Working on my car on the driveway in the sun. Usually get sweaty and take them out. No issues."*
- *"As before, I would usually not wear my hearing aids while cooking as my kitchen can be quite warm. With the Rexton hearing aids, I was able to leave the hearing aids in and was able to have a conversation with my partner while cooking. They were comfortable and held up well to me perspiring and the general heat in the kitchen."*

Reasons for Rugged preference:

- *"Simply put I can do the things I couldn't do with my previous hearing aids and they work, but also without them breaking down on me."*
- *"With the Rextons, I found I would leave them in longer, would have no issue leaving them in during strenuous activities, and generally happier with how I could hear and function wearing them. My previous hearing aids have served me well enough, but the Rexton Rugged have proved to be a massive improvement and I am very impressed with how well I can live with them."*
- *"I am a person who likes to be active and creative. With Rexton, I could do many more activities without problems. I could also communicate better with people."*

Taken together, these testimonials are very much in line with the questionnaire results presented above. They highlight both the benefits in durability, reliability and auditory performance, which were indicated by the respondents in the survey when testing Rugged in their everyday life, and when comparing Rugged with their own hearing aids.

Discussion

In the data presented in this paper, two clear overall trends can be observed: 1) A very high level of user satisfaction was offered by Rexton Rugged, and 2) Rexton Rugged was strongly favored when compared to the respondents' own hearing aids. The specific data suggest that the perceived high level of the durability and reliability of Rugged, and the audiological benefits offered by the BiCore sound processing, contribute to these findings.

The respondents' appreciation of the durability and reliability of Rugged was clearly signified in the high mean ratings. For example, 93% of the respondents perceived the Rugged hearing aids as durable, while 96% perceived them as reliable. Furthermore, the high level of durability was indicated by the results of the special tasks and the accompanying testimonials, which revealed that the Rugged hearing aids had been used in a wide range of activities, e.g., during physical

exercise, swimming, various craft tasks, cooking, and even firefighting – without the respondents having to take them off, which some of them reported to do with their own hearing aids.

The individual respondents completed between three and eight tasks during the test period. In total, 289 tasks were completed by the 46 respondents, and in only three of these cases, respondents reported issues that did not disappear spontaneously shortly after completion of the task. However, when digging into the data and the comments made, the three cases included one case where a problem already occurred (that is, it was not caused by the task), one case where the issue most likely was a sound (loudness) issue rather than a durability issue, and the third case was most likely a response error (since the given respondent's comment indicated no problems). In conclusion, the special tasks were completed without causing any damage to the Rugged hearing aids that would stop the respondents from using them.

Interestingly, but not surprisingly, in their testimonials, several respondents commented on the fact that they were somewhat uncomfortable completing some of the tasks they were requested to do – especially the shower and drop-HA tasks – because it was something they would never dare do with their own hearing aids. They not only expressed satisfaction but also relief that they could complete the tasks without damaging the hearing aids. In the discussion of the special tasks and the respondents' reactions to them, it should be emphasized that Rexton's normal recommendation – also for Rugged – is to take off the hearing aids before showering and avoid dropping them on the floor. These particular tasks were included in the survey to illustrate that if users do forget to take off their Rugged hearing aids before a shower or accidentally drop them in the floor, chances are high that the hearing aids can handle it and be used afterwards.

The audiological performance and the benefits offered by the BiCore platform were also clearly demonstrated in the survey data. In the ratings of Rugged, 91% of respondents were satisfied with the sound quality, 87% were satisfied with the speech understanding, and 85% were satisfied with the sound of their own voice. The strong audiological performance was also demonstrated by a strong preference for Rugged, where 96% of respondents found listening easier, and the same percentage found speech understanding better with Rugged compared to their own hearing aids.

Both the durability/reliability benefits and the audiological benefits are expected to be drivers of the remarkable results showing that 93% of respondents expressed an overall satisfaction with Rugged, 96% expressed an overall preference for Rugged over their own hearing aids, and 91% were willing to recommend Rugged to others at the end of the survey period.

When discussing the results, some limitations of the survey approach need to be acknowledged. The Rexton Rugged hearing aids used for the survey were brand new, and when the end of the survey test period was reached, they had only been used for a combined period of five weeks. Therefore, corrosion (a well-known reason for hearing aid malfunction) and other issues that normally only appear after longer usage periods, were not likely to influence the survey results. Instead, the survey investigated the immediate perception of the reliability and durability of Rugged, partly based on the special tasks, which the respondents were encouraged to complete, and which subjected the Rugged hearing aids to factors that really did put them to the test.

Another factor that could affect the results – and perhaps add to the observed difference between own hearing aids and Rexton Rugged – was the brand/model and the age of the respondents' own hearing aids. No specific requirements were made regarding their hearing aids and they used a wide variety of brands and models. However, the vast majority (42 pairs) of the hearing aids were manufactured by the Top-5 manufacturers. The median age of the own hearing aids was 3 years. This means that half of the own hearing aids were three years or older and, accordingly, did not incorporate the latest levels of hearing aid technology. On the other hand, half of the own hearing aids were not older than 3 years and were therefore more likely to include new technology. Since

the respondents were fully acclimatized to their own hearing aids, this could actually provide an advantage in the comparison with the newly fitted Rugged hearing aids, as more fine-tuning could have been needed for the user to obtain the full audiological benefit from Rugged. So, even though comparing Rugged with older hearing aids could involve a bias (towards the new), the completed acclimatization to own hearing aids could pull in the opposite direction.

Summary

This paper reports the results from an international survey of 46 respondents with hearing loss who were fitted with the Rexton Rugged hearing aids and used them in their everyday life for a combined period of five weeks. In online questionnaires during and at the end of the survey, the respondents rated the performance of both Rugged and their own hearing aids. Furthermore, to test the durability of Rugged, they were requested to perform four different special tasks that exposed the hearing aids to challenging situations that are known to be common causes of hearing aid malfunctions.

The results showed a high level of satisfaction with Rexton Rugged and a clear preference for Rugged compared to the respondents' own hearing aids. The high satisfaction and strong preference were stated for the perceived durability and reliability as well as for the audiological performance, e.g., sound quality and speech understanding. The special durability tasks were completed without damaging the Rugged hearing aids and their performance.

Noteworthy main survey findings include:

- 93% of respondents were satisfied with Rugged overall.
- 91% of respondents were satisfied with the speech understanding offered by Rugged.
- 87% of respondents were satisfied with the sound quality offered by Rugged.
- 93% of respondents found the Rugged hearing aids to be durable.
- 96% of respondents found the Rugged hearing aids to be reliable.
- 96% of respondents stated that they could do the things they wanted without worrying the Rugged hearing aids would not work.
- 91% would recommend Rugged to others.
- 96% preferred Rugged over their own hearing aids

In conclusion, these findings provide strong evidence of Rexton Rugged being an extremely tough hearing aid that can withstand all the little mistakes and mishaps that happen in everyday life.

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We believe that nothing hearing related should ever be left to chance, both for the people with hearing loss, and those who depend upon them. We understand their challenges and we meet them with proven hearing technology that is made Lifeproof so it can be counted upon to perform reliably in even the harshest environments. At work, at home, during leisure time, exercise and in all weather, you can always **RELY ON REXTON.**

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