

SmartFocus™

An independent study

User control over adaptive features delivers real client benefit

Since the regular application of multichannel WDRC and multi-memory digital hearing instruments, most devices have become progressively more automatic, providing wearers with less and less control. Recent studies have shown that hearing instrument wearers, particularly experienced wearers, prefer to have some control at least some of the time.^{1,2} More recently, Dreschler et al.³ and Zakis et al.⁴ have shown that hearing instrument users are capable of reliably and appropriately adjusting their own hearing instruments in laboratory and real world settings. Yet, we routinely deny them the use of even a volume control in what are often very expensive devices. Therefore, we have investigated the advantages of an advanced user control – smartFocus™.



Study at a glance

There were 24 participants with an average age of 63.8 years who were seen at the University of Iowa Speech and Hearing Clinic for fitting and testing. Seven were new users of amplification, two were considered in-the-drawer users, and 15 were regular and experienced hearing instrument users with current technology. They all had mild-to-moderate sloping sensorineural hearing loss, no thresholds worse than 70 dB at 3000 Hz. Each participant was fitted with a set of Passport™ BTE instruments fitted to an NAL-NL-1 prescription – one-half with the smartFocus feature disengaged (“Gold Standard”) and the other half with the smartFocus control engaged (“smartFocus”). All other aspects of the hearing instrument settings in both conditions were identical. The participants wore the instruments for 2-4 weeks. At the end of the take-home period a series of laboratory and self-report outcomes were obtained. Then the status of the smartFocus control was reversed. If it had been disengaged it was now engaged, if it had been engaged it was now disengaged. The participants had another 2-4 week take-home trial with the new settings followed by a repeat of the laboratory and self-report inventories. The results shown in this paper included data obtained from an exit interview, Glasgow Hearing Aid Benefit Profile⁵, Client Oriented Scale of Improvement⁶, Abbreviated Profile of Hearing Aid Benefit⁷ and the Hearing in Noise Test⁸. Here are the main findings of this study.

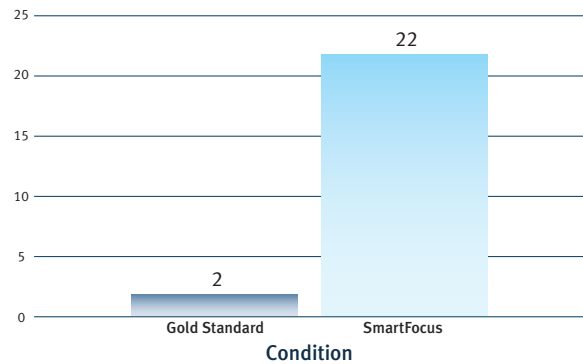
Results

Exit interview

The single most important question that the participants were asked was, “Which aid do you wish to keep at the end of the trial?” In other

words, when the trial is over you will be given whichever hearing aid you wish, do you prefer the device with the smartFocus control or the

Figure 1. User preference



“Gold Standard” instrument. Their choices are shown in Figure 1.

Table 1. Fitting preference

Choice	Sample	Reason
SmartFocus	6	Better clarity
SmartFocus	6	Comfort in noise
SmartFocus	9	Flexibility/Control
No preference	2	No difference
Gold Standard	2	Doesn't want control

The participants were then asked why they preferred one fitting over the other. Their responses are shown in Table 1.

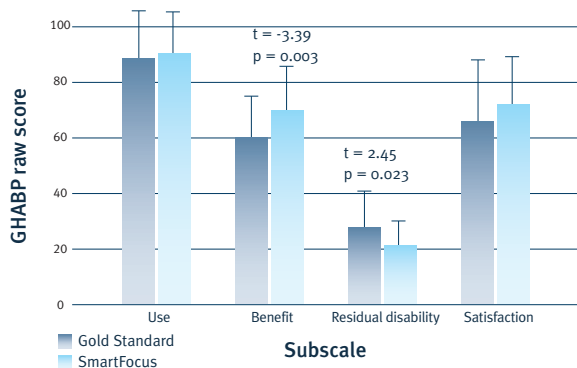
Figure 1 and Table 1 demonstrate an overwhelming preference for the smartFocus feature. Twenty-two participants indicated that they would prefer to have a hearing instrument with the smartFocus feature than to have one with out it (Figure 1). When asked to explain their choices twenty people cited benefits directly related to the stated intent of the smartFocus feature; better clarity, comfort in noise and flexibility/control (Table 1). There appears to be twenty-one respondents because one participant cited both comfort in noise and flexibility/control and is therefore counted once in each row. Two participants stated there was no

difference between the two choices and defaulted to having the control instead of not having it. The final two participants were the only ones who indicated that they did not like the ability to control the instrument. This is an interesting finding given the prevalence of fully automatic instruments.

Glasgow Hearing Aid Benefit Profile (GHABP)

The Gold Standard and smartFocus fittings were compared by each participant using the GHABP. This questionnaire scores the performance of each fitting in the categories of: use, benefit, residual disability and satisfaction. Figure 2 shows the mean raw GHABP score (bars) in each category plus one standard deviation (error bars) for the Gold Standard and smartFocus fittings.

Figure 2. GHABP scores

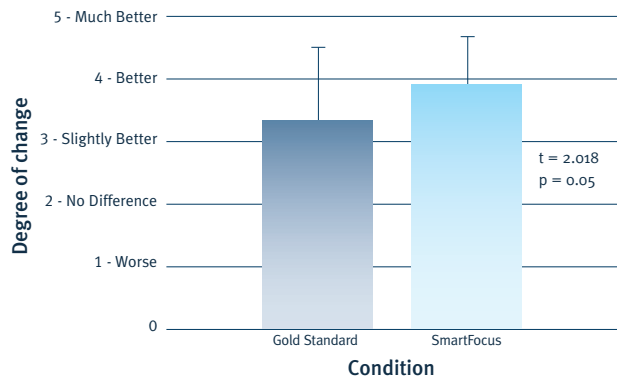


Follow-up statistical analysis (paired t-tests) showed no significant difference between Gold Standard and smartFocus in the Use ($t = -0.802$, $p = 0.431$), or Satisfaction ($t = -1.232$, $p = 0.231$) categories. However, participants experienced significantly more Benefit ($t = -3.393$, $p = 0.003$) and less Residual Disability ($t = 2.447$, $p = 0.023$) with the smartFocus device than in a traditional fitting.

Client Oriented Scale of Improvement (COSI)

The COSI allows people to rate the performance of their hearing instruments in listening situations that are relevant to them. Rather than directly compare the Gold Standard and smartFocus conditions on this questionnaire, the final benefit (for each) over unaided performance provided the basis of comparison shown in Figure 3.

Figure 3. COSI scores

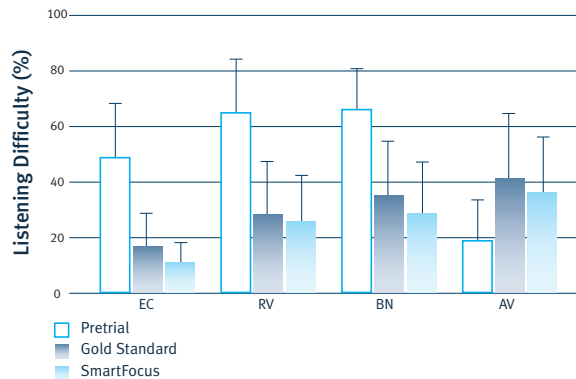


The degree of benefit provided with the smartFocus control was significantly higher than the Gold Standard condition (paired t-test, $t = 2.018$, $p = 0.05$).

Abbreviated Profile of Hearing Aid Benefit (APHAB)

The APHAB allows hearing instrument wearers to rate the percentage of problems they experience in 24 common situations. Those situations are then combined into 4 categories; Ease of Communication (EC), Reverberation (RV), Background Noise (BN) and Aversion to loud sounds (AV). Figure 4 shows the mean percentage of problems (bars) plus one standard deviation (error bars) in the pretrial condition, Gold Standard condition and smartFocus condition for all four categories.

Figure 4. APHAB scores



The pretrial condition clearly shows much more difficulty than either the Gold Standard or smartFocus condition in the EC, RV and BN categories. While there is a trend for the smartFocus condition to present with fewer problems than the Gold Standard condition in all four categories, none of these differences are statistically significant.

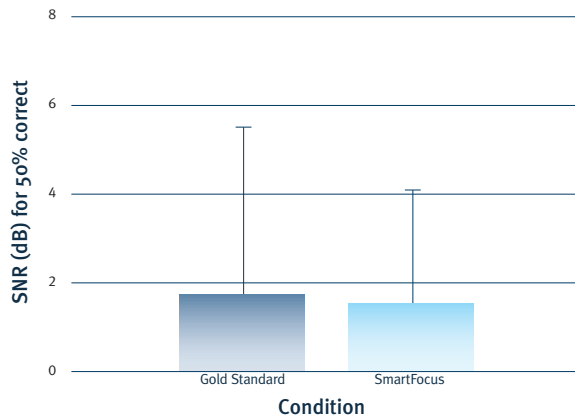
Hearing in Noise Test (HINT)

The HINT consists of a number of short sentences which are presented in speech weighted background noise. The listener is required to repeat the sentences using a 100% correct criterion. Depending on the correctness of the response, the speech level is varied to determine the 50% correct signal-to-noise ratio (SNR) level.

The HINT was initially administered on two occasions. Originally it was administered after each take home session: once for smartFocus and once for the Gold Standard condition. In each of the first two cases the HINT was obtained with the hearing instruments set to the AutoPro4 program. In the smartFocus condition the participants were tested at the learned values of the control obtained over the course of the take home trial. The fitted values were used for the Gold Standard condition as there was no learning enabled in that condition. The HINT noise was run continuously throughout each 20 item list through four

loudspeakers at 0°, 90°, 180°, and 270° around the listener’s head, and fixed at 65 dBA. The results of these HINT measurements are shown in Figure 5.

Figure 5. Initial HINT scores



Mean scores for the HINT +1 Std. for both conditions are shown here. Although the smartFocus condition was .7 dB better (lower) than the Gold Standard condition, the difference was not significant ($p = .47$). The initial inference that one might draw from Figure 5 could be that the clarity portion of the smartFocus does not yield significant improvements in SNR performance despite the participants’ subjective reports that clarity is improved in noise. However, there is an alternative explanation for Figure 5.

The HINT was used, in this case, to compare the speech perception performance in noise across both listening conditions. While it might be expected that a comfort-clarity style control should improve clarity, this result was not observed in Figure 5. This is because the control was rarely set at maximum clarity during the HINT test reported in Figure 5. Instead, participants were tested at the settings they had each chosen during the smartFocus take home trial. Thus, the control could have been set anywhere on a range from maximum comfort, through neutral, to maximum clarity. In other words, we were not evaluating the effect of the control as much as we were

evaluating the impact of the personal preferences of our participants.

To more directly evaluate the impact of the smartFocus control on speech perception in noise, 23 of the original 24 participants returned to the lab for the second set of HINT measurements. In this case the comparison was made between three settings of the smartFocus control. Those settings included:

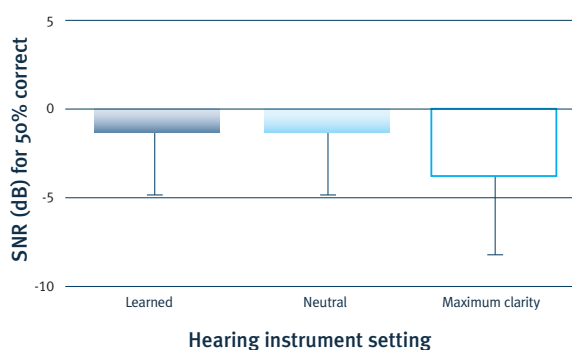
- original learned smartFocus settings used in the previous HINT tests
- neutral setting of smartFocus (omni microphones, adaptive features disabled)
- +8 clarity – 80% of maximum clarity on the control as it existed during development

The smartFocus control used in this study was an early version that extended further at the extreme ends of comfort and clarity than the final control launched with Passport and Latitude™16. A setting of 80% clarity on the control used for this study is a very close match to the existing maximum clarity setting that is now commercially available. Thus, the +8 clarity condition will be referred to as maximum clarity from this point on.

The results of the final HINT measurements are shown in Figure 6.

Mean HINT SNRs of -0.77 (Std. 4.26), -0.78 (Std. 4.25) and -3.78 (Std. 4.01) were found for Learned, Neutral, and Maximum Clarity conditions respectively. This an SNR improvement of 3 dB for the maximum clarity setting over the other two. A 3 dB SNR difference is equivalent to an improvement for speech perception in noise of as much as 27%. A one-way repeated measures ANOVA shows a significant smartFocus effect on SNR ($F(2, 42) = 41.269, p < 0.001$). Follow-up testing (Holm-Sidak method) indicated that the SNRs of the Learned and Neutral conditions were significantly higher (poorer) than that of Maximum Clarity ($t = 7.876, p < 0.001$ for Learned vs. Maximum Clarity; $t = 7.860, p < 0.001$ for Neutral vs. Maximum Clarity). The SNRs of the Learned and Neutral conditions were not different significantly ($t = 0.0155, p = 0.988$). Note that the mean Learned setting of the smartFocus on the first round of HINT scores was 0.77 dB better than the mean HINT score for the Gold Standard condition. Thus it could be inferred that the maximum clarity setting of the smartFocus control would also likely yield a significant improvement in speech intelligibility similar in magnitude to the Learned setting over the Gold Standard fitting. This assumption will be tested in the coming months.

Figure 6. Final HINT results



Summary

In this study we asked 24 hearing instrument wearers to compare the performance of Passport hearing instruments with smartFocus enabled to the same hearing instruments without the smartFocus feature. There were 4 key findings from this study:

- Given the choice of a fully automatic Passport HI and one with smartFocus enabled, 22 out of 24 subjects preferred smartFocus in a third-party study.
- The top three reasons given for these choices were:
 - better clarity
 - comfort in noise and,
 - flexibility and control.
- Hearing instruments with smartFocus were shown to provide significantly more benefit and significantly reduced disability than the same instruments without smartFocus.
- Setting the smartFocus control to maximum clarity yields a significant improvement for speech perception in noise over the neutral setting and likely over a Gold Standard fitting.

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Author

Don Hayes, Ph.D., Director, Audiology, Unitron